PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES NEAR SPRINGBOK, NORTHERN CAPE

WIND: DEA REF. NO.14/12/16/3/3/2/346 / NEAS REF. NO. DEA/EIA/0001222/2012
PV: DEA REF. NO.14/12/16/3/3/2/342 / NEAS REF. NO. DEAT/EIA/0001217/2012
WIND SUBSTATION & GRID CONNECTION: DEA REF. NO.14/12/16/3/3/2/386 / NEAS REF. NO. DEA/EIA/0001344/2012
PV SUBSTATION AND GRIDLINE CONNECTION: (DEA REF. NO. 14/12/16/3/3/2/447; NEA REF NO: DEA/EIA/0001597/2012)

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
Submission date: February 2013
Report No: 6428a/108495
Volume 1

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ENVIRONMENTAL IMPACT ASSESSMENT:
PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES NEAR SPRINGBOK, NORTHERN CAPE

FEBRUARY 2013

UPDATE OF DRAFT TO FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

This Update Page describes the process followed since the Draft Environmental Impact Assessment Report (EIR) was made available to Interested and Affected Parties (I&APs) for a 40-day comment period from 27 November 2012 until 14 January 2013. It also highlights the changes that have been made to the Draft EIR in response to the public participation process, and briefly reiterates the next steps in the Environmental Impact Assessment (EIA) process.

Public Participation Process regarding the lodging of the Draft EIR

The public participation process undertaken during the lodging of the Draft EIR entailed the following:

- I&APs were informed of the lodging of the Draft EIR and associated 40-day public comment period by means of letter posted and/or emailed on 23 November 2012. The letters were accompanied by an Executive Summary of the Draft EIR in English and/or Afrikaans to registered I&APs.
- The Draft EIR has been lodged at the Springbok and Pofadder Public Libraries and on Aurecon’s website (www.aurecongroup.com change “Current Location” to “South Africa” and follow the “Public Participation” link) from 27 November 2012 until 14 January 2013.
- I&APs were invited to a public meeting on 12 December 2012 to present and discuss the findings of the Draft EIR at Springbok Exhibition Hall (Skousaal) at 17h00-19h00.

Written comments received during the comment period have been noted in the Comments and Response Report (CRR4), included in Annexure C of the Final EIR.

Updating of the Draft EIR to the Final EIR

A limited number of changes were made to the Draft EIR. Information that has been added has been underlined, while removed/ deleted information is indicated by a ‘strikethrough’. To assist readers, the most significant changes are outlined below.
General changes to the Final EIR:
A number of minor changes were made to the Report that have not been highlighted in the text and include:

- The Draft EIR has been updated and is now called: “Proposed Wind and solar (photovoltaic) Energy Facilities near Springbok, Northern Cape: Final Environmental Impact Assessment Report”.
- Grammatical and typographic changes.
- Numbering for tables and figures included in the Final EIR have been updated.

Annexures have been updated and include:
- Comments on the Draft EIR have been included in Annexure C.
- Comments on the Draft EIR have been responded to in the Comments and Response Report 4 in Annexure C.
- Annexure B1, Annexure N1 and Annexure O were updated.

Way forward

This Update Page has been sent to all registered I&APs on the database. The Final EIR has been made available to the public at the same venues as the Draft EIR, as well as on Aurecon's website from 19 February 2013. The Final EIR was also submitted to the competent authority, namely the Department of Environmental Affairs (DEA) for their consideration and review on 19 February 2013.

DEA will review the Final EIR, who must, within 60 days, do one of the following:
(i) Accepting the Final EIR;
(ii) Notify the applicant that the report has been referred for specialist review;
(iii) Request amendments to the report; or
(iv) Reject the report if it does not materially comply with regulations.

If the report is accepted, DEA must within 45 days:
(a) Grant authorisation in respect of all or part of the activity applied for; or
(b) Refuse authorisation in respect of all or part of the activity.

Once DEA issues their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within 12 calendar days of the date of the decision should an Environmental Authorisation (EA) be issued. Should anyone (a member of public, registered I&AP or the Applicant) wish to appeal DEA’s decision, a Notice of Intention to Appeal in terms of Chapter 7 of the EIA Regulations (GN No. 543) in terms of NEMA must be lodged with the Minister of Water and Environmental Affairs within 20 calendar days of the decision being issued and the substantive Appeal must be lodged within 30 days of the Notice.

Aurecon would like to thank all those who have participated in this EIA process thus far.
VOLUME 1: FEIR + ANNEXURES A-D

Annexure A: DEA Acceptance of Final Scoping Report
Annexure B: Public Participation Process
Annexure C: Comments and Response Report 2
Annexure D: Assessment methodology

VOLUME 2: FEIR ANNEXURES E-Q

Annexure E: Botanical Study
Annexure F: Avifaunal study
Annexure G: Bat study
Annexure H: Heritage Impact Assessment
            Archaeology Impact Assessment
            Palaeontology Impact Assessment
Annexure I: Visual Impact Assessment
Annexure J: Freshwater Impact Assessment
Annexure K: Noise Impact Assessment
Annexure L: Socio – Economic Assessment
Annexure M: Agricultural Impact Assessment
Annexure N: Life-cycle EMP
Annexure O: Specific information required by DEA
Annexure P: Compliance with the Equator Principles
Annexure Q: Recommended mitigation measures
ENVIROMENTAL IMPACT ASSESSMENT:
PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY
FACILITIES NEAR SPRINGBOK, NORTHERN CAPE

FEBRUARY 2013

SUMMARY DOCUMENT:
FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Background
South Africa Mainstream Renewable Power Kangnas (Pty) Ltd (Mainstream) proposes to construct a 560 MW (four phases of 140 MW) wind energy facility and a 225 MW (three phases of 75 MW) solar photovoltaic energy facility, each with an associated substation, on farms near Springbok in the Northern Cape. Originally the proposed project consisted of a 750 MW and 250 MW wind and solar energy facility respectively, but this was reduced due to the incorporation of buffers recommended by specialists around sensitive environmental features. Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the requisite environmental process as required in terms of the National Environmental Management Act (No. 107 of 1998), as amended, on behalf of Mainstream.

The proposed project would take place on the farms Kangnas (Farm No. 77 Portion 3 and the Remainder), Koeris (Farm No. 78 Portion 1), Areb (Farm No. 75 Portion 0) and Smorgenschaduwe (Farm No. 127 Portion 0) in the Northern Cape (see Figure 1). These farms are located approximately 48 km east of Springbok and are accessed via the N14. The five farms cover an area of approximately 46 535 ha.

Proposed Projects
The proposed projects entail the generation of electricity from wind and solar resources. The construction period would be approximately 12 - 18 months for the proposed wind energy facility per phase and 12 - 18 months for the proposed solar photovoltaic (PV) energy facility, per 75 MW phase. The proposed wind energy facility would consist of four phases of 140 MW using turbines with a rating between 1.5 and 4 MW, thus actual turbines per 140 MW phase would range from 94 (1.5 MW) to 35 (4 MW). The size of turbines would be selected in the tender process of the Department of Energy’s (DoE) procurement programme. The final turbine selection would be subject to various considerations such as site, cost, technology and availability and would comply with dimensions and the number of turbines approved. The proposed solar energy facility (225 MW of PV and/or Concentrated PV (CPV)) may include tracking systems and would have an approximate maximum footprint of 800 hectares (ha). An onsite connection is proposed via an existing 220 kilovolt (kV) Eskom line. The existing Eskom line may in future be upgraded to 400 kV, thus the wind and solar farm may connect at 400 kV. It is proposed to construct two main substations linking each of the proposed energy facilities and the Eskom line.

Wind Component
Wind turbines can rotate about either a horizontal or a vertical axis. Turbines used in wind farms for commercial production of electricity are usually horizontal axis, three-bladed and pointed into the wind by computer-controlled motors. Horizontal axis machines have high efficiency, and low torque ripple, which contribute to good reliability. The blades are usually coloured light grey and range in length from 20 – 60 m. The tubular steel towers range from 60 - 120 m tall. The blades rotate at 10 – 22 revolutions per minute. A gear box is commonly used for stepping up the speed of the generator. Some models operate at constant speed, but more energy can be collected by variable-speed turbines. All turbines are
equipped with protective features to avoid damage at high wind speeds, by feathering (turning) the blades into the wind which ceases their rotation, supplemented by brakes. Horizontal axis wind turbines have the main rotor shaft and electrical generator at the top of a tower in a nacelle. Conventional horizontal axis turbines can be divided into three components.

- The rotor component, which includes the blades for converting wind energy to low speed rotational energy.
- The generator component, which includes the electrical generator, the control electronics, and most likely a gearbox component for converting the low speed incoming rotation to high speed rotation suitable for generating electricity.
- The structural support component, which includes the tower and rotor yaw mechanism (which turns the rotor into the wind).

The final foundation design of turbines is dependent on further geotechnical investigation, however it is likely that for the proposed project foundations would be made of reinforced concrete. The foundations would be approximately 20 m x 20 m and an average of 3 m deep. The foundation would be cast in situ and could be covered with top soil to allow vegetation growth around the approximately 6 m diameter steel tower. A flat prepared hard standing for a crane will be compacted in gravel and approximately 40 m x 40 m would be constructed adjacent to each turbine. Gravel access roads of 6 – 10 m would also be required between each turbine.

**Grid connection infrastructure (Wind):**
The proposed wind project could connect to the grid via two satellite substations (each 100 x 100 m in size) that would link phases of the facilities to the main proposed Kangnas wind energy facility substation which would connect to the double circuit overhead line. The satellite substations would consist of medium (22 – 66 kV) to high voltage transformation (132 – 400 kV) with the associated Eskom-required switchgear, telecommunications, storage, control room, access road, busbars, overhead gantries, fencing and all other generic substation infrastructure. There would be a single track gravel access road for maintenance purpose to the substation. The two satellite substations may feed energy to the main substation via overhead lines.

At the proposed main Kangnas substation the voltage would be increased and evacuated via the existing 220 kV Eskom (or future 132 – 400 kV) power line crossing the northern portion of the site. A new double circuit 132 – 400 kV line of approximately 18 km would be constructed to connect the main substation to the existing Eskom grid running across the site. It is envisaged that the new overhead line would either connect to Eskom’s grid by a loop in process, which would require the existing line to have two separate turns into the new double circuit lines. Alternatively Eskom may prefer the construction of a linking station close to the existing Eskom line. The main substation would consist of medium (22 - 66 kV) to high voltage transformation (132 – 400 kV) with the associated Eskom required switchgear, telecommunications, storage, control room, access road, bus bars, overhead gantries, fencing and all other generic substation infrastructure. There would be a single track gravel access road for maintenance purpose to the substation. The total main substation size is expected to be a maximum of 200 x 200 m or 4 ha.

**PV Component**
PV systems convert sunlight into energy. The smallest unit of a PV installation is a cell. A number of solar cells electrically connected to each other and mounted in a support structure or frame is called a PV module. A number of cells form a module, and finally a number of modules form an array. Modules are arranged in section sizes of approximately 40 x 5 m called tables and are installed on racks which are made of aluminum or steel. Modules are designed to supply electricity at a certain voltage. The current produced is directly dependent on how much light strikes the module. The arrays are arranged into rows that form the solar field. The arrays are wired to inverters that convert direct current (DC) into alternate current (AC) that can be fed into a national grid system.
The fundamental difference between PV and CPV technology is that CPV uses optics such as lenses to concentrate a large amount of sunlight onto a small area of solar PV materials to generate electricity. The basic components are similar as described above for PV although CPV technology requires tracking systems to focus the optic lens directly on the cells.

Panels can be mounted on tracking systems which follow the path of the sun to maximize the benefit of each ray of sunlight and allowing for the land underneath being utilized as well.

**Grid connection infrastructure (Solar):**

The electricity distribution infrastructure would comprise of one transmission line (132, 220 or 400 kV) traversing the site. The proposed solar project would connect to the grid via an onsite substation. The proposed route to the substation is approximately 1 km long. At the substation the voltage would be increased and evacuated via the existing 220 kV Eskom power line (or future 132 – 400 kV) crossing the northern portion of the site. The onsite Nama Aggeneys 220 kV line would be connected into the main solar substation. The substation would consist of medium (22 - 66 kV) to high (220 – 400 kV) voltage transformation with the associated Eskom required switchgear, telecommunications, storage, control room, access road, busbars, overhead gantries, fencing and all other generic substation infrastructure. There would be a single track gravel access road for maintenance purpose to the substation. The total substation size is expected to be a maximum of 200 x 200 m or 4 ha.

A summary of the two proposed facilities is as follows:

**Proposed wind energy facility:**
- Four phase of 140 MW or 560 MW in total.
- Construction of between 35 to 94-wind turbines of 1.5 and 4 MW capacity for each of the four phases of 140 MW;
- Associated infrastructure including:
  - Hard standings of 40 m x 40 m alongside turbines;
  - Access roads of 4 – 10 m wide between turbines;
  - Overhead or underground transmission lines connecting turbines;
  - One main substation connecting the proposed energy facilities to the Eskom line; and
  - Two satellite substations that would link sectors of the facility to the main substation with overhead lines.

**Proposed solar energy facility:**
- Construction of 225 MW (three phases of 75 MW) of PV (tracking or fixed) and/or CPV (tracking);
- Associated infrastructure including:
  - Access roads of 4 – 10 m wide to the PV plant; and
  - One main substation that would link the facility with overhead lines to Eskom

DoE’s current renewable energy procurement program has capped the maximum size of wind and solar energy projects at 140 MW and 75 MW respectively. While there has been no formal information about the project size cap being lifted various discussions within the industry to increase or remove the cap all together are taking place.

The Kangnas wind and solar projects have been developed at a large scale with a longer term vision that the project cap will be lifted. The wind and solar projects have been developed to allow for phases of 75 MW (solar) and 140 MW (wind) to allow the developer flexibility in the future to suit the future procurement requirements in terms of size.
Figure 1: Location of proposed wind and solar (PV) energy facilities near Springbok in the Northern Cape
EIA Process

EIA Regulations (Regulations 544, 545 and 546) promulgated in terms of NEMA, identify certain activities, which “could have a substantial detrimental effect on the environment”. These listed activities require environmental authorisation from the competent environmental authority, i.e. the Department of Environmental Affairs (DEA) in the case of energy applications, prior to commencing. The proposed projects trigger a number of listed activities in terms of NEMA and accordingly requires environmental authorisation from DEA via the EIA process outlined in Regulation 543 of NEMA. Aurecon has been appointed to undertake the required environmental authorisation and licencing processes on Mainstream’s behalf.

The EIA process consists of an Initial Application Phase, a Scoping Phase and an EIA Phase. The purpose of the Initial Application Phase is to commence the project via the submission of the relevant department’s application forms. The purpose of the Scoping Phase is to identify and describe potential positive and negative environmental impacts, (both social and biophysical), associated with the proposed project and to screen feasible alternatives to consider in further detail.

The purpose of the EIA Phase, the current phase, is to comprehensively investigate and assess those alternatives and impacts identified in the Scoping Report and propose mitigation to minimise negative impacts.

How you can get involved

Public participation is a key component of this EIA process and has taken place at various stages throughout the project. The public participation process to date has involved the following aspects:

- Distribution of the Background Information Document on 24 May 2012 to inform Interested and Affected Parties (I&APs) of the project and to invite I&APs to register on the database;
- Advertisements were placed in a local newspaper, the Plattelander, notifying the broader public of the initiation of the EIA and inviting them to register as I&APs from 25 May 2012 to 15 June 2012;
- A site notice was erected at the entrance to Smorgenschaduw Farm, Kangnas Farm and Springbok Library on 28 May 2012;
- I&APs were invited to a public meeting on 3 July 2012 and were requested to RSVP. No RSVP’s were received and subsequently this meeting was cancelled;
- Holding a Focus Group Meeting on 3 July 2012 to present and discuss the findings of the DSR at the Exhibition Hall in Springbok and was attended by 15 people, which included relevant authorities (Namakwa District Municipality, Namakhoi Municipality and the Department of Environment and Nature Conservation), landowners and neighbours of the site;
- I&APs had 40 days, until the 19 June 2012 to submit their written comments on the DSR. Cognisance was taken of all comments when compiling the final report, and the comments, together with the project team and proponent’s responses thereto, were included in final report;
- The Final Scoping Report (FSR) was made available to the public for review and comment at the same locations as the DSR until 24 August 2012. All registered I&APs were informed of the lodging of the FSR by means of a letter posted on 30 July 2012. The FSR outlined the full range of potential environmental impacts and feasible project alternatives and how these were derived. Moreover, it included a Plan of Study for EIA, which outlined the proposed approach to the current EIA Phase, including the requisite specialist investigations to be undertaken;
- The FSR and associated Plan of Study for EIA was submitted to DEA on 1 August 2012 and accepted on 8 October 2012.
- The Draft EIAR was submitted to DEA on 27 November 2012.

All written comments received on the Draft EIAR FSR were included as an annexure to the Final EIR. All issues raised via written correspondence have been summarised into a Comments and Response Report with responses (CRR4) from the project team and are included as an annexure Annexure C to the Final EIR.

The current EIA Phase aims to present the Final EIR to registered I&APs. This phase comprises:
Lodging the Final EIR at the Springbok (Namakwa Street) and the Pofadder (Main Street) Public Libraries and on Aurecon’s website (www.aurecongroup.com change “Current Location” to “South Africa” and follow the Public Participation link) from 27 February 2013 until 19 March 2013. Note that comments will not be responded to but will instead be forwarded to DEA for their consideration;

- Finalising the EIR by incorporating all public comment received into a Comments and Responses Report and making changes to the report, where relevant; and
- Submitting the Final EIR to DEA for decision-making.

Following the issuing of the Environmental Authorisations, DEA’s decision will be communicated by means of a letter to all registered I&APs and the appeal process will commence, during which any party concerned will have the opportunity to appeal the decision to the Minister of Environmental Affairs in terms of NEMA.

**Project alternatives**

The following feasible alternatives have been identified for further consideration in the Environmental Impact Assessment Report (EIR):

**Proposed wind energy facility:**

- Location alternatives:
  - One location buildable area for the proposed wind energy facility;
- Activity alternatives:
  - Wind energy generation via wind turbines; and
  - “No-go” alternative to wind energy production.
- Site layout alternatives:
  - One layout alternative per site (560 MW with 180 turbines, four phases of 35 to 93 turbines per 140 MW phase);
  - One main substation location, with two satellite substations.
- Technology alternatives:
  - A minimum and maximum tipheight of 100 – 180m A range of turbine heights.

**Proposed solar energy facility:**

- Location alternatives:
  - One location for the proposed PV/CPV plant.
- Activity alternatives:
  - Solar energy generation via a PV/CPV plant; and
  - “No-go” alternative to solar energy production.
- Site layout alternatives:
  - One layout alternative (225 MW with maximum 800793 ha footprint)
- Technology alternatives:
  - Two technology alternatives in terms of the solar panel type (PV vs CPV); and
  - Mounting system: trackers vs fixed mount.

It should be noted that the two proposed main substations and grid connections, the subject of the third and fourth EIA applications within this EIA process, forms part of both the wind and solar energy facilities respectively. No alternatives to the substations were identified as they form part of the two larger projects proposed. The separate application is simply a requirement from Eskom such that they can construct it themselves, if necessary.
Identified impacts

The EIR has provided a comprehensive assessment of the potential environmental impacts, identified by the EIA team and I&APs, associated with the proposed wind and solar energy facility.

The following specialist studies and specialists were undertaken to provide more detailed information on those environmental impacts which had been identified as potentially being of most concern, and/or where insufficient information is available, namely:

- **Botanical assessment:** Dr Dave MacDonald, Bergwind Botanical Tours and Surveys;
- **Avifauna assessment:** Mr Doug Harebottle, Private Consultant;
- **Bat assessment:** Mr Werner Marais, Animalia Zoological and Ecological Consultation;
- **Heritage Impact Assessment:** Mr Jayson Orton, ACO Associates (archaeology component) and Dr John Almond, Natura Viva cc (palaeontology component); and
- **Visual Impact Assessment:** Mr Stephen Stead, Visual Resource Management Africa
- **Socio-economic Impact Assessment:** Ms Alex Kempthorne, Urban-Econ Development Economists
- **Noise Impact Assessment:** Mr Morne de Jager, M2 Environmental Consulting
- **Agricultural Potential Assessment:** Mr Kurt Barichievy, SiVEST
- **Aquatic Ecology Impact Assessment:** Ms Antony Belcher, Private Consultant
- **Meteorite Impact Assessment:** Dr Chris Harris, University of Cape Town

The significance of the potential environmental (biophysical and socio-economic) impacts associated with the proposed project are summarised in Table 1.

Operational phase impacts

**Proposed wind energy facility**

With reference to Table 1, the most significant (medium-high (-)) operational phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed wind energy facility on avifauna and visual aesthetics. With the implementation of mitigation measures impacts on avifauna would decrease to medium (-) and visual impacts would decrease to low (-). It should be noted that three potential positive impacts on energy production on climate change, and on the local economy (employment) and social conditions would result and these would be of low-medium (+) significance, with and without mitigation measures.

There was no difference in the significance of the potential impacts resulting from the feasible alternatives, including the turbine alternatives. However, Mainstream has chosen their preferred option as per the revised layouts based on sensitivity buffers from the specialists along with technical and financial considerations. The potential impacts of the proposed wind energy facility main substation for the proposed wind energy facility were assessed within the impacts of the proposed wind energy facility and were considered to be acceptable.

**Proposed solar energy facility**

With reference to Table 1, the most significant (medium (-)) operational phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed solar energy facility on visual aesthetics. With the implementation of mitigation measures the impacts on visual aesthetics would remain medium (-). It should be noted that three potential positive impacts on energy production and local economy (employment), climate change and social conditions would result and these would be of low (+) significance, with and without mitigation measures.

There was no difference in the significance of the potential impacts resulting from the feasible alternatives, including the heights of the panels and CPV vs PV alternatives and fixed vs tracking alternatives. However Mainstream has chosen their preferred option as per the revised layouts based on sensitivity buffers from the specialists along with consideration of technical and financial considerations.
The potential impacts of the proposed main PV substation for the proposed solar energy facility were assessed within the impacts of the proposed solar energy facility and were considered to be acceptable.

**Cumulative impacts**

The potential cumulative impacts were also considered, for the proposed wind and solar energy projects together as well as for other similar project in the area as well as any other proposed renewable energy facilities, where applicable. No cumulative impacts were identified as fatal flaws, provided each project implements the mitigation measures recommended.

It should be noted that while the proposed wind and solar energy facilities are phased the assessment of each facility considers the impacts of all the phases together i.e. should less phases be constructed the impact would be equal to or lower than the facility assessment. The significance of these were considered to be of low to high (-) significance and low to medium (+), without mitigation. These potential cumulative impacts would decrease, with implementation of mitigation measures for the proposed projects as well as other proposed projects in the area, and are considered to be acceptable. However, it should be noted that it is not possible to assess these cumulative impacts in a project specific EIA, not least because not all the proposed projects in the area may be approved or constructed. As such it would be necessary for DEA, or a similar body, to undertake a strategic assessment in this regard.

**Construction phase impacts**

**Proposed wind energy facility**

With reference to Table 1, the most significant (medium - high (-) and high (-)) construction phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed wind energy facility on botany, avifauna and visual aesthetics and transport, sedimentation and erosion. With the implementation of mitigation measures the significance of these potential impacts would be low (-) for botany, visual and sedimentation and erosion, avifauna and transport would remain Medium (+). This is deemed to be acceptable based on the short duration of the construction period. The remaining negative construction phase impacts were not deemed to have a significant impact on the environment, given their duration (approximately 18-36 months) and localised extent. The remaining construction impacts were assessed to be of low (-) or lower significance, with and without mitigation measures. It should be noted that a potential positive impact on the socio-economic environment would result and would be of low (+) significance, with and without mitigation measures. No difference in significance would result from the proposed wind alternatives.

**Proposed solar energy facility**

With reference to Table 1, the most significant (medium (-) and high (-)) construction phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed solar energy facility on sedimentation and erosion, visual and transport. With the implementation of mitigation measures the significance of these potential impacts would be very low (-) for sedimentation and erosion, low (-) for visual and transport would remain high (-). This is deemed to be acceptable based on the short duration of the construction period. The remaining negative construction phase impacts were not deemed to have a significant impact on the environment, given their duration (approximately 24 months) and localised extent. The remaining construction impacts were assessed to be of low (-) or lower significance, without mitigation measures. It should be noted that a potential positive impact on the socio-economic environment would result and would be of low (+) significance, with and without mitigation measures. No difference in significance would result from the proposed solar alternatives.
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Table 1: Summary of significance of the potential impacts associated with the potential developments
Conclusions and recommendations

The impacts associated with the proposed projects would result in regional impacts (both biophysical and socio-economic) that would negatively affect the area. The significance of these impacts without mitigation is deemed to be of high or lower significance. However, with the implementation of the recommended mitigation measures the significance of the negative impacts would be minimized and would be medium or lower, for all but one impact, transport, but is deemed to be acceptable based on the short duration of the construction period. Associated with the proposed projects are positive impacts on energy production, on climate change, and on the local economy (employment) and social conditions, which are of Low (+) significance.

Based on the above, the EAP is of the opinion that both the proposed wind energy and solar energy facilities and associated infrastructure, including alternatives, being applied for be authorised as the benefits outweigh the negative environmental impacts.

The significance of negative impacts can be reduced with effective and appropriate mitigation through a Life-Cycle Environmental Management Programme (EMP), as described in the EIR. If authorised, the implementation of an EMP should be included as a condition of approval.

With regards to the alternatives considered, there is no difference in significance of impacts between technological alternatives. As such there is no preference of alternatives from an environmental perspective.

The EIA considered the potential impacts of both PV (tracking and fixed) and CPV (tracking). Both technologies were considered to have similar impacts and therefore it is requested that both technologies options are approved. The choice of technology would depend on a detailed tender process before the solar project is submitted into the DoE’s procurement process. Choice of technology would depend on: Technology available to the market at that time, cost of technology, energy yield of different technologies, local content of technology offered, warranties and guarantees offered by different technologies.
In order to limit unnecessary EA amendments, and facilitate the most affordable and fit for purpose solar energy to South Africa, it is requested that both PV (tracking and fixed) and CPV (tracking) technologies are approved.

**Way forward**

The Draft EIR was lodged at the Springbok and Pofadder Public Libraries and on Aurecon’s website (www.aurecongroup.com change “Current Location” to “South Africa” and follow the Public Participation link). All registered I&APs were notified of the availability of the Draft EIR by means of a letter which included a copy of the Executive Summary. The public had until 14 January 2013 to submit written comment on the Draft EIR to Aurecon.

I&APs have been invited to a public meeting on 12 December 2012 to present and discuss the findings of the Draft EIR at Springbok Exhibition Hall (Skousaal) at 11h00-13h00. I&APs are requested to RSVP by 7 December 2012 and informed that should the number of RSVP’s be insufficient the meeting would be cancelled and I&APs would instead be contacted telephonically/electronically to discuss any issues and concerns they may have. Three I&APs attended the public meeting. Notes of the meeting and a copy of the presentation are included in Annexure B. Notes of the meeting were sent to all I&APs that attended.

The Final EIR will been completed with the addition of any I&AP comments received and has been lodged at the same locations as the Draft EIR. The Final EIR will then be submitted to the Northern Cape DEANC and DEA for their review and decision-making, respectively. I&APs have until 19 March 2013 to submit written comment on the Final EIR to Aurecon. Any comments received on the Final EIR will not be included in a Comments and Response Report and will instead be collated and forwarded directly to DEA.

Once DEA has reviewed the Final EIR, they will need to ascertain whether the EIA process undertaken met the legal requirements and whether there is adequate information to make an informed decision. Should the above requirements be met, they will then need to decide on the environmental acceptability of the proposed project. Their decision will be documented in an Environmental Authorisation, which will detail the decision, the reasons therefore, and any related conditions. Following the issuing of the Environmental Authorisation, DEA’s decision will be communicated by means of a letter to all registered I&APs and the appeal process will commence, during which any party concerned will have the opportunity to appeal the decision to the Minister of Environmental Affairs in terms of NEMA.
List of Acronyms

DEA  Department of Environmental Affairs
DoE  Department of Energy
DSR  Draft Scoping Report
EIA  Environmental Impact Assessment
EIR  Environmental Impact Assessment Report
EMP  Environmental Management Programme
FSR  Final Scoping Report
Ha  Hectare
I&AP  Interested and Affected Party
Km  Kilometer
Kv  Kilovolt
MW  Megawatts
NEMA  National Environmental Management Act

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# PROJECT DETAILS

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- **PROJECT NO.** 108495
- **TITLE** Final Environmental Impact Assessment Report
- **AUTHORS & PREPARED BY** Cornelia Steyn, Simon Clark and Louise Corbett of Aurecon South Africa (Pty) Ltd
- **CLIENT** Mainstream Renewable Power South Africa (Pty) Ltd
- **CLIENT REPRESENTATIVE** Hendrik Reyneke
- **REPORT STATUS** Final
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GLOSSARY OF TERMS

Environment
The surroundings (biophysical, social and economic) within which humans exist and that are made up of
i. the land, water and atmosphere of the earth;
ii. micro-organisms, plant and animal life;
iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing;

Environmental Impact Assessment (EIA)
A study of the environmental consequences of a proposed course of action.

Environmental Impact Report Assessment (EIR)
A report assessing the potential significant impacts as identified during the Scoping Phase.

Environmental impact
An environmental change caused by some human act.

Environmental Management Programme (EMP)
A document that provides procedures for mitigating and monitoring environmental impacts, during the construction, operation and decommissioning phases.

Public Participation Process
A process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development.

Scoping
A procedure for determining the extent of and approach to an EIA, used to focus the EIA to ensure that only the significant issues and reasonable alternatives are examined in detail.

Scoping Report
A report describing the issues identified.

Turbine
A wind turbine is a rotary device that extracts energy from the wind.

ABBREVIATIONS

ACO Archaeology Contracts Office
CAA Civil Aviation Authority
CARs Civil Aviation Regulations
CARA Conservation of Agricultural Resources Act
CO\textsubscript{2} Carbon Dioxide
CRR Comments and Response Report
DEA Department of Environmental Affairs (previously Department of Environmental Affairs and Tourism)
DEA&DP Department of Environmental Affairs and Development Planning
DEANC Department of Environmental Affairs and Nature Conservations
DM District Municipality
DME Department of Minerals and Energy
DoE Department of Energy
DSR Draft Scoping Report
This page has been left deliberately blank.
1 INTRODUCTION AND BACKGROUND

The purpose of this Chapter is to introduce the project and describe the relevant legal framework within which the project takes place. Other applicable policies and guidelines are also discussed. The Terms of Reference (ToR), scope of and approach to the Environmental Impact Assessment are described and assumptions and limitations are stated.

1.1 INTRODUCTION

South Africa Mainstream Renewable Power Kangnas (Pty) Ltd (Mainstream) initially intended to develop a 750 MW wind energy facility and a 250 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility on the farms near Springbok in the Northern Cape. Subsequent to this initial proposal, both the turbine and solar layouts were revised in order to incorporate specialist recommendations that buffers be implemented around sensitive features and areas. The revised layouts for the wind component would now potentially consist of four phases of 140 MW wind projects with a potential total capacity of 560 MW and the solar component with three x 75 MW solar arrays with a potential capacity of 225 MW. Two separate grid connections and substations would be associated with the proposed projects.

The Department of Energy's (DoE) current renewable energy procurement program has capped the maximum size of wind and solar energy projects at 140 MW and 75 MW respectively. While there has been no formal information about the project size cap being lifted various discussions within the industry to increase or remove the cap all together are taking place. The main drivers for lifting the cap would include:

- Achieving the targets set by the Integrated Resource Plan (IRP) 2010 (11 400 MW of new build renewable energy). After the first two rounds of the DoE’s procurement process Eskom’s distribution grid is already getting congested and in locations where there is good wind and solar resource the distribution grid capacity will be limited and only smaller projects will be able to connect (< 30 MW). That will require larger projects to connect to Eskom’s transmission grid which is much more expensive and time consuming. To ensure affordable projects connecting to transmission grid, projects will need to be larger than the current caps to continue the current pricing levels as seen in Round 2;
- To achieve the local economic development goals quicker and with larger impact;
- To get more energy onto the grid at a faster pace to aid in ensuring South Africa’s energy security. South Africa will not be able to achieve the IRP targets with project sizes being limited by grid capacity and financial viability;
- To ensure South Africa’s renewable energy becomes even more affordable.

The Kangnas wind and solar projects have been developed at a large scale with a longer term vision that the project cap will be lifted. The wind and solar projects have been developed to allow for phases of 75 MW (solar) and 140 MW (wind) to allow the developer flexibility in the future to suit the future procurement requirements in terms of size.

As the only grid connection for the Kangnas site is the Nama/Aggeneys 220 kV transmission line, a 140 MW wind or 75 MW solar project will prove very difficult to be competitive or affordable.
The minimum size for a wind project at the Kangnas site, which would be competitive and affordable and hence a viable option for DoE to select, would be 280 MW, thus two of the proposed four phases. Phase A and B would be preferred by the developer due to the superior resource and limited environmental impacts of these phases.

The minimum size for a solar project at the Kangnas site, which would be competitive and affordable and hence a viable option for DoE to select, would be 225 MW, thus all three of the proposed phases.

It should be noted that Eskom’s current future planning for the Nama/Aggeneys 220 kV line is to upgrade to 400 kV. Should Eskom embark on the 400 kV upgrade in the near future all four phases (560 MW) of the proposed Kangnas wind farm would be required in order for the project to be affordable.

The proposed wind and solar energy facilities and associated substations are located approximately 48 km east of Springbok in the Northern Cape and can be accessed via the N14 as illustrated in Figure 1.1. Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the requisite environmental process as required in terms of the National Environmental Management Act (No. 107 of 1998), as amended, on behalf of Mainstream.

In terms of the National Environmental Management Act (No. 107 of 1998) (as amended) (NEMA), the proposed projects trigger a suite of activities, which require authorisation from the competent environmental authority before they can be undertaken. As these proposed projects trigger a number of listed activities in terms of NEMA, they accordingly require environmental authorisation. Since the projects are for the generation of energy, and energy projects are dealt with by the national authority, the competent authority is the national Department of Environmental Affairs (DEA). DEA’s decision will be based on the outcome of this EIA process.

This report serves to document the EIA Phase of the EIA process (the EIA process and sequence of documents produced as a result of the process are illustrated in Figure 1.2).

The EIA Phase is the last phase in the EIA process. Accordingly, this EIA Report (EIR)\(^1\) aims to collate, synthesise and analyse information from a range of sources to provide sufficient information for DEA to make an informed decision on whether or not the potential environmental impacts associated with the proposed project are acceptable from an environmental perspective (the EIA process and sequence of documents produced as a result of the process are illustrated in Figure 1.2).

\(^1\) Section 31 of EIA Regulation No. 543 of NEMA lists the content required in an EIR.
Figure 1.1: Location of the proposed wind and solar energy facilities and associated substation on five farm portions near Springbok in the Northern Cape.
This page has been left deliberately blank.
Accordingly the EIR:

- Outlines the legal and policy framework;
- Describes the Public Participation Process undertaken to date;
- Describes strategic and planning considerations;
- Describes the proposed project and its alternatives;
- Describes the assessment methodology used; and
- Assesses potential impacts and possible mitigation measures.

1.2 LEGAL REQUIREMENTS

Note that the list of Acts relevant to the project, provided below, are not exhaustive and further might be discovered. However, the Acts relevant to the project and the environment have all been included.

1.2.1 National Environmental Management Act, No. 107 of 1998

NEMA, as amended, establishes the principles for decision-making on matters affecting the environment. Section 2 sets out the National Environmental Management Principles which apply to the actions of organs of state that may significantly affect the environment. Furthermore, Section 28(1) states that “every person who causes or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring”. If such pollution or degradation cannot be prevented then appropriate measures must be taken to minimise or rectify such pollution or degradation.

Mainstream has the responsibility to ensure that the proposed activities, as well as the EIA process, conform to the principles of NEMA. In developing the EIA process, Aurecon has been cognisant of this need, and accordingly the EIA process has been undertaken in terms of NEMA and the EIA Regulations promulgated on 18 June 2010².

In terms of the EIA regulations, certain activities are identified, which require authorisation from the competent environmental authority, in this case DEA, before commencing. Listed activities in Government Notice (GN) No. 545 require Scoping and EIA whilst those in GN No. 544 and 546 require Basic Assessment (unless they are being assessed under an EIA process). The same activities are being applied for in this EIA process, for the proposed wind and solar energy facilities and associated substation and grid connection, and these are listed in The consideration of applications within one EIA process is generally acceptable to DEA (pers. comm. S Vilakazi, 13/09/2011), in order to avoid duplication of information and duplication of time and effort on DEA’s part in processing the three applications.

Since the proposed projects are based in the Northern Cape, DEA will work closely with the provincial Department of Environmental Affairs and Nature Conservation (DEANC), to ensure that the provincial environmental concerns are specifically identified and addressed.

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Further information on the EIA approach is provided in Section 1.4.4.

Table 1.1.

The consideration of applications within one EIA process is generally acceptable to DEA (pers. comm. S Vilakazi, 13/09/2011), in order to avoid duplication of information and duplication of time and effort on DEA’s part in processing the three applications.

Since the proposed projects are based in the Northern Cape, DEA will work closely with the provincial Department of Environmental Affairs and Nature Conservation (DEANC), to ensure that the provincial environmental concerns are specifically identified and addressed.

Further information on the EIA approach is provided in Section 1.4.4.

Table 1.1: Listed activities in terms of NEMA GN No. 544, 545 and 546, 18 June 2010, to be authorised for the proposed wind and solar energy facilities and associated substation and grid connection.

<table>
<thead>
<tr>
<th>NO.</th>
<th>LISTED ACTIVITY</th>
<th>WIND RELEVANCY:</th>
<th>SOLAR RELEVANCY:</th>
<th>WIND AND SOLAR SUBSTATION &amp; GRID CONNECTION RELEVANCY:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 10  | The construction of facilities or infrastructure for the transmission and distribution of electricity -  
• outside urban areas or industrial complexes with a capacity of more than 33, but less than 275 kilovolts; or  
• inside urban areas or industrial complexes with a capacity of 275 kilovolts or more. | The proposed wind facility would connect to the existing on site grid via 132, 220 or 400 kV powerlines. | The proposed solar facility would connect to the existing on site grid via 132, 220 or 400 kV powerlines. | Two substations would be constructed to evacuate the electricity from the proposed wind and solar energy facilities. |
| 11  | The construction of:  
(iii) bridges;  
(x) buildings exceeding 50 square metres in size; or  
(xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. | A few wetlands and drainage lines are scattered across the proposed site and one or more roads are likely to cross these lines. | A few wetlands and drainage lines are scattered across the proposed site and one or more roads are likely to cross these lines. | N/A |
|     |                |                |                |                                                    |
|     |                |                |                |                                                    |
| 1   | The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more. | The proposed wind energy facility would have a generation capacity of 560 MW. | The proposed solar energy facility would have a generation capacity of 225 MW. | N/A |

GN No. R544, 18 June 2010

GN No. R545, 18 June 2010

GN No. R546, 18 June 2010
<table>
<thead>
<tr>
<th>NO.</th>
<th>LISTED ACTIVITY</th>
<th>WIND RELEVANCY:</th>
<th>SOLAR RELEVANCY:</th>
<th>WIND AND SOLAR SUBSTATION &amp; GRID CONNECTION RELEVANCY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation</td>
<td>An area of approximately 346.8 ha of indigenous vegetation would be cleared for the wind facility.</td>
<td>An area of approximately 793 ha of indigenous vegetation would be cleared for the solar facility.</td>
<td>An area of approximately 4 ha of indigenous vegetation would be cleared for each of the two proposed substations.</td>
</tr>
<tr>
<td>14</td>
<td>The clearance of an area of 5 hectares or more of the vegetation cover constitutes indigenous vegetation (a) in the Northern Cape (i) All areas outside urban areas.</td>
<td>A vegetated area of approximately 346.8 ha or more would need to be cleared for the proposed projects, which is located in a rural area. The vegetation is comprised of 75% or more indigenous vegetation.</td>
<td>A vegetated area of approximately 793 ha or more would need to be cleared for the proposed projects, which is located in a rural area. The vegetation is comprised of 75% or more indigenous vegetation.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1.2.2 National Water Act, No. 36 of 1998

The National Water Act (NWA) (No. 36 of 1998) provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA. Section 21 of the NWA specifies the water uses which require authorisation from the Department of Water Affairs (DWA) in terms of the NWA before they may commence.

In terms of Section 21 (c) and (i) 3 of the NWA any activity which takes place within 500 m radius of the boundary of any wetland is excluded from General Authorisation for these water uses and as such, must be licenced. Should the proposed development occur within 500 m radius of a wetland or watercourse it may be necessary to submit a water use license application to the DWA. Numerous drainage lines and some pans were identified on the site.

Furthermore, Mainstream may source water for the proposed projects from underground sources. Should water be available and Mainstream is awarded preferred bidder status, they will apply for a water use licence (WULA). Mainstream will however apply for a non-binding letter (project and phase specific) from DWA stating water availability for the proposed projects.

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3 (c) impeding of diverting the flow of water in a watercourse; (i) altering the bed, banks, course or characteristics of a watercourse
1.2.3 National Heritage Resources Act, No. 25 of 1999

In terms of the National Heritage Resources Act (No. 25 of 1999) (NHRA), any person who intends to undertake “any development … which will change the character of a site exceeding 5000 m$^2$ in extent”, “the construction of a road…powerline, pipeline…exceeding 300 m in length” or “the rezoning of site larger than 10 000 m$^2$ in extent…” must at the very earliest stages of initiating the development notify the responsible heritage resources authority, namely the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. These agencies would in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken.

Section 38(8) of the NHRA specifically excludes the need for a separate HIA where the evaluation of the impact of a development on heritage resources is required in terms of an EIA process. Accordingly, since the impact on heritage resources would be considered as part of the EIA process outlined here, no separate HIA would be required. SAHRA or the relevant provincial heritage agency would review the EIA reports and provide comments to DEA, who would include these in their final environmental decision. However, should a permit be required for the damaging or removal of specific heritage resources, a separate application would have to be submitted to SAHRA or the relevant provincial heritage agency for the approval of such an activity, if Mainstream obtains environmental authorisation and makes the decision to pursue the proposed project further.

1.2.4 Astronomy Geographic Advantage Act (No. 21 of 2007)

The Astronomy Geographic Advantage Act (No. 21 of 2007) provides for the preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy; for intergovernmental co-operation and public consultation on matters concerning nationally significant astronomy advantage areas and for matters connected thereto.

Chapter 2 of the act allows for the declaration of astronomy advantage areas whilst Chapter 3 pertains to the management and control of astronomy advantage areas. Management and control of astronomy advantage areas include, amongst others, the following:

- Restrictions on use of radio frequency spectrum in astronomy advantage areas;
- Declared activities in core or central astronomy advantage area;
- Identified activities in coordinated astronomy advantage area; and
- Authorisation to undertake identified activities.

On 19 February 2010, the Minister of Science and Technology (the Minister) declared the whole of the territory of the Northern Cape province, excluding Sol Plaatje Municipality, as an astronomy advantage area for radio astronomy purposes in terms of Section 5 of the Act and on 20 August 2010 declared the Karoo Core Astronomy Advantage Area for the purposes of radio astronomy.

The area consists of three portions of farming land of 13 407 hectares in the Kareeberg and Karoo Hoogland Municipalities purchased by the National Research Foundation. The Karoo Core Astronomy Advantage Area will contain the MeerKAT radio telescope and the core planned Square Kilometre Array (SKA) radio telescope that will be used for the purposes of radio astronomy and related scientific endeavours. The proposed wind energy facilities fall outside of the Karoo Core Astronomy Advantage Area.
The Minister may still declare that activities prescribed in Section 23(1) of the Act may be prohibited within the area, such as the construction, expansion or operation of any fixed radio frequency interference sources and the operation, construction or expansion of facilities for the generation, transmission or distribution of electricity. It should be noted that wind energy facilities are known to cause radio frequency interference. While the Minister has not yet prohibited these activities it is important that the relevant astronomical bodies are notified of the proposed projects and provided with the opportunity to comment on the proposed projects.

1.2.5 Aviation Act, No 74 of 1962

In terms of Section 22(1) of the Aviation Act (Act No 74 of 1962) (13th amendment of the Civil Aviation Regulations (CARs) 1997) the Minister promulgated amendments pertaining to obstacle limitation and markings outside aerodromes or heliports. In terms of this act no buildings or objects higher than 45 m above the mean level of the landing area, or, in the case of a water aerodrome or heliport, the normal level of the water, shall without the approval of the Commissioner be erected within a distance of 8 kilometres measured from the nearest point of the boundary of an aerodrome or heliport. No building, structure or other object which will project above the approach, transitional or horizontal surfaces of an aerodrome or heliport shall, without the prior approval of the Commissioner, be erected or allowed to come into existence. Structures lower than 45 m, which are considered as a danger to aviation shall be marked as such when specified. Overhead wires, cables etc., crossing a river, valley or major roads shall be marked and, in addition, their supporting towers marked and lighted if an aeronautical study indicates it could constitute a hazard to aircrafts.

Section 14 relates specifically to wind energy facilities and it is stated that due to the potential of wind turbine generators to interfere with radio navigation equipment, no wind farm should be built closer than 35 km from an aerodrome. In addition, several other conditions relating specifically to wind turbines are included in Section 14. In terms of the proposed wind energy facility, Mainstream would need to obtain the necessary approvals from the Civil Aviation Authority (CAA) for erection of the proposed wind turbines. It should be noted that while no aerodromes are in close proximity to the site, the Springbok aerodrome is located 28 km south west, the Aggeneyes aerodrome is 42 km north east and the Vaalputs aerodrome is 52 km south from the proposed site.

1.2.6 Conservation of Agricultural Resources Act, No. 43 of 1983

The Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) makes provision for the conservation of the natural agricultural resources of South Africa through maintaining the production potential of land, combating and preventing erosion, preventing the weakening or destruction of the water sources, protecting vegetation, and combating weeds and invader plants. Regulation 15 of CARA lists problem plants (undesired aliens, declared weeds, and plant invaders). Plants listed in this regulation must be controlled by the landowner.

As such, as part of the EIA process, recommendations should be made to ensure that measures are implemented to maintain the agricultural production of land, prevent soil erosion, and protect any water bodies and natural vegetation on site. Mainstream together with the relevant farmers should also ensure the control of any undesired aliens, declared weeds, and
plant invaders listed in the regulations that may pose a problem as a result of the proposed projects.

1.2.7 National Road Traffic Act, No. 93 of 1996 (as amended)

The National Road Traffic Act (No. 93 of 1996) (as amended) (NRTA) makes provision for all matters pertaining to the use and management of roads within South Africa. In terms of this policy certain vehicles and loads cannot be moved on public roads without exceeding the limitations in terms of the dimensions and/or mass as prescribed in the Regulations of the NRTA. Where such a vehicle or load cannot be dismantled without disproportionate effort, expense or risk of damage, into units that can travel or be transported legally, it is classified as an abnormal load. When the movement of an abnormal load is considered to be in the economic and/or social interest of the country, a special permit may be issued to allow it to operate on a public road for a limited period. Permits are normally issued by the Provincial Road Authorities and, if necessary, input is obtained from local and metropolitan authorities. Should such a permit be required, Mainstream would need to obtain the necessary road permits from the relevant Road Authorities as it is outside of the scope of the EIA process.

1.2.8 The National Environmental Management: Biodiversity Act, No. 10 of 2004

The National Environmental Management: Biodiversity Act (No.10 of 2004) provides for the management and conservation of South African biodiversity within the framework of National Environmental Management Act. It deals, inter alia, with the protection of species and ecosystems that warrant national protection. Chapter 4 of the Act makes provision for the protection of critically endangered, endangered, vulnerable, and protected ecosystems that have undergone, or are at risk of undergoing significant degradation of ecological structure, function, or composition due to anthropogenic influences. Chapter 3 provides for Biodiversity Planning instruments, such as Bioregional Plans. No such Bioregional Plan exists for the area of concern yet, but a precursor to this, a Biodiversity Sector Plan (BSP), has been drafted by the Garden Route Initiative (GRI). A BSP provides a way forward in reconciling the conflict between development and the maintenance of natural systems. The BSP provides baseline biodiversity information needed for land-use planning and decision making and other multi-sectoral planning processes, through the identification of Critical Biodiversity Areas and Ecological Support Areas. Protecting these areas is important when considering the maintenance of Biodiversity. No BSP’s have been identified within the immediate vicinity of the site.

1.2.9 Mineral and Petroleum Resources Development Act, No. 28 of 2002

By virtue of the Minerals and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA), the State exercises sovereignty over all mineral and petroleum resources within South Africa and ensures the equitable access to such resources and the benefits derived there from. In seeking to promote economic growth and mineral and petroleum resources development, the Minister must also ensure that the natural resources are developed in a manner that is ecologically sustainable. Applications can be made for both prospecting and mining rights, as well as a mining permit to the Minister, which may be granted provided that the requisite environmental management programmes and plans have been submitted. In terms of the provisions on the MPRDA, the sourcing of material for road construction and foundation
purposes (i.e. the use of borrow pits⁴) is regarded as mining and accordingly is subject to the requirements of the Act. In terms of the current projects, one section of the Act is most relevant: If material is to be sourced on a property that would not form part of the development, and/or is not owned by the applicant, authorisation would be required from Department of Mineral Resources (DMR). In terms of Section 27 of the Act, if the proposed borrow pits would be mined in less than two years and would each be less than 1.5 ha in extent, a Mining Permit would be required. If the borrow pit exceeds 1.5 ha, a Mining Right would be required. Mainstream is not applying for any borrow pits and as such no licence or permit in terms of the MPRDA is required.

1.2.10 National Veld and Forest Fire Act, No 101 of 1998 (as amended)

The National Veld and Forest Fire Act (No. 101 of 1998) reforms the law regulating veld and forest fires, and seeks to prevent and combat veld, forest and mountain fires within South Africa by making provision for the establishment of fire protection associations who are tasked with all aspects of veld fire prevention and fire fighting and the establishment of a fire danger rating system which will prohibit the lighting of fires in open areas where the fire danger rating is high. Landowners are required to comply with the National Veld and Forest Fire Act. The Act places a duty on landowners to prevent veld fires through the preparation and maintenance of firebreaks and to acquire equipment and have personnel available to fight fires in emergency situations.

1.3 TERMS OF REFERENCE AND SCOPE OF THE EIA

In March 2012, Mainstream appointed Aurecon to undertake an EIA process, in terms of NEMA, for the proposed projects near Springbok in the Northern Cape.

This EIA process specifically excludes any upgrades of existing Eskom infrastructure (i.e. the existing grid) that may be required, however it does include connections to the grid.

1.3.1 Guidelines

This EIA process is informed by the series of national Environmental Guidelines⁵ where applicable and relevant:

- Integrated Environmental Information Management (IEIM), Information Series 5: Companion to the NEMA EIA Regulations of 2010 (DEA, 2010).
- Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft) (DEA, 2010).
- IEIM, Information Series 2: Scoping (Department of Environmental Affairs and Tourism (DEAT), 2002).
- IEIM, Information Series 4: Specialist Studies (DEAT, 2002).

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⁴ Gravel for construction purposes such as roads and foundations is obtained from a borrow pit, which consists of a shallow depression generally 1.5-2.5 m deep and 2-4 ha in area.

⁵ Note that these Guidelines have not yet been subjected to the requisite public consultation process as required by Section 74 of R385 of NEMA.

The following guidelines from the Department of Environmental Affairs and Development Planning (Western Cape) (DEA&DP) were also taken into consideration:
• Guideline for Environmental Management Plans (June 2005).
• Guideline for determining the scope of specialist involvement in EIA Processes (June 2005).
• Guideline for the review of specialist input into the EIA Process (June 2005).

1.4 APPROACH TO THE PROJECT

As outlined in Figure 1.2 on the overleaf, there are three distinct phases in the EIA process, as required in terms of NEMA, namely the Initial Application Phase, the Scoping Phase and the EIA Phase. This report covers the third phase, viz. the EIA Phase.

1.4.1 Initial Application Phase

The Initial Application Phase entailed the submission of two EIA Application Forms to notify DEA of the project, submitted on 9 May 2012. Acknowledgements of receipts of the EIA Application Forms were received from DEA on 23 May 2012. The Application Forms and DEA’s letters of acknowledgement are included in the Scoping Report.

Other tasks undertaken include:
• A Background Information Document (BID) (included in the Scoping Report), in English and Afrikaans, was sent to key Interested and Affected Parties (I&APs) to inform I&APs of the proposed projects and to invite I&APs to register on the database by 15 June 2012;
• Advertisements in English and Afrikaans were placed in a local newspaper, Die Plattelander, on 25 May 2012 notifying the broader public of the initiation of the EIA and inviting them to register as I&APs. Copies of the advertisements are included in the Scoping Report; and
• Site notices, in English and Afrikaans, were erected at the entrances to the farms and at the Springbok Public Library on 28 May 2012 (the site notices are included in the Scoping Report).

1.4.2 The Scoping Phase

Scoping is defined as a procedure for determining the extent of, and approach to, the EIA Report phase and involves the following key tasks:

• Involvement of relevant authorities and I&APs;
• Identification and selection of feasible alternatives to be taken through to the EIA Phase;
• Identification of significant issues/impacts associated with each alternative to be examined in the EIA Report; and
• Determination of specific Terms of Reference (ToR) for any specialist studies required in the EIA Report (Plan of Study for the EIA Report).

The Scoping Phase involved a desktop review of relevant literature, including a review of previous environmental studies in the area. These included, *inter alia*, the following:

• Namakwa District Municipality (DM) Integrated Environmental Management Program (IEMP) (African EPA, 2007);
• Namakwa DM Spatial Development Framework (SDF) (2007);
• Nama Khoi Local Municipality LM SDF (Macroplan, 2007);
• Vegetation Map of South Africa (Mucina and Rutherford, 2006); and
• Groundwater Resources in the Northern Cape Province (DWA, 2008).

An inception field trip of the site was undertaken on 25 November 2011 to inform a Fatal Flaw Analysis (FFA) for Mainstream. The main purpose was to familiarize the consultants with the site and to allow for a rapid survey of the site to identify potential areas of concern. Valuable information was also obtained from landowners, who have intimate knowledge of the farms and general area.

The information gathered during the site visit and subsequent report was used in refining the Plan of Study for the EIA process and ToR for the specialist studies which were undertaken during the EIA Phase.

1.4.3 The EIA Phase

The Scoping Phase is followed by the EIA Phase, during which the specialist investigations occur, and culminates in a comprehensive EIR documenting the outcome of the impact assessments.

This report covers the third and final phase of the EIA process, namely the EIA Phase. The purpose of the EIR is to describe and assess the range of feasible alternatives identified during the Scoping process in terms of the potential environmental impacts identified. The ultimate purpose is to provide a basis for informed decision making, firstly by the applicant with respect to the option(s) they wish to pursue, and secondly by the environmental authority regarding the environmental acceptability of the applicant’s preferred option.
Figure 1.2: The EIA process in terms of NEMA
The approach to the EIA Phase entailed undertaking further review of relevant literature and specialist studies. The results of this review have been used to describe and assess the significance of the identified potential impacts associated with the proposed project. This EIR also includes the key issues arising out of the public participation to date.

1.4.4 The public participation process

Consultation with the public forms an integral component of this investigation and enables I&APs (e.g. directly affected landowners, national, provincial and local authorities, civic associations and communities), to identify their issues and concerns, relating to the proposed activities, which they feel should be addressed in the EIA process. To create a transparent process and to ensure that I&APs are well informed about the project, as much information as is available has been included upfront to afford I&APs numerous opportunities to review and comment on the proposed project. A summary of the public participation process is provided in Annexure B.

1.4.5 Authority involvement

The EIA Application Forms were submitted to DEA to notify them of the proposed projects. DEA acknowledged receipt of the EIA Application Forms and issued reference numbers for the proposed projects.

Where the need arises, Focus Group meetings will be arranged with representatives from the relevant national and provincial departments and local authorities. The purpose of these meetings will be to ensure that the authorities have a thorough understanding of the need for the project and that Aurecon has a clear understanding of the authority requirements. It is anticipated that beyond providing key inputs into the EIA, this authority scoping process will ultimately expedite the process by ensuring that the final documentation satisfies the authority requirements and that the authorities are fully informed with respect to the nature and scope of the proposed projects.

There are other authorities who have a commenting role to play in the EIA process. Their comments on the EIA Report will help to inform DEA’s decision making. These authorities include:

- Department of Environmental Affairs;
- Nama Khoi LM;
- Namakwa DM;
- Northern Cape DEANC;
- South African Heritage Resources Agency;
- Department of Agriculture, Forestry and Fisheries;
- Department of Agriculture, Land Reform and Rural Development (Northern Cape);
- Department of Water Affairs; and
- Eskom.

A total of five comments were received from authorities and the respondents and key issues raised are listed below:

Issues included in CRR3 for comments received on the FSR:
• Department of Environment and Nature Conservation (DENC) relating to concern over the curtailment of possible expansion of target areas of the Goegap nature reserve and the adjacent Ratelkraal property owned by World Wildlife Fund (WWF) and the recommendation of a protected areas buffer for renewable developments;
• Department of Agriculture, Forestry and Fisheries requesting the total development footprints (ha) for both the solar and wind energy facilities;
• SAHRA recommended a 50 m buffer around the Kalkom crater and that no construction should take place within that buffer zone;
• DENC Research and Development Support Section Goegap Nature Reserve requests that their internal botanist must provide comment on the EIA applications.
• Department of Land Reform and Rural Development (Northern Cape) requests that the developer must comply with the Conservation of Agricultural Resources Act (No. 43 of 1983) especially the protection of vleis, marshes, water sponges and water courses. The department indicated that a rezoning application is required.

Issues included in CRR4 for comments received on the Draft EIR:
• The Department of Water Affairs (DWA) has stated that water users are expected to assess the potential water uses (associated with the development) as defined under section 21 of the National Water Act (36 of 1998). All identified water uses will need to be authorised in terms of section 40 of the National Water Act unless such a water use is permissible under section 22 of the Act. DWA will only process applications for water use authorisations received from developers who have attained preferred bidder status.
• WWF-SA has assessed the application and do not have any concerns at this stage.
• BirdLife South Africa is of the opinion that there is insufficient information on which to base an informed decision and therefore does not support this application. Should the proposed developments be approved then recommendations to mitigate potential impacts on avifauna have been provided in the BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.
• Eskom confirmed that the development does not seem to have a direct impact on existing transmission infrastructure and provided requirements for works at or near Eskom infrastructure.
• If the recommendations are adhered to, the SAHRA Archaeology, Palaeontology and Meteorites Unit has no objection to the development (in terms of the archaeological and palaeontological components of the heritage resources).

Comments have been included in and responded to in CRR3 and CRR4 in Annexure B.C

1.4.6 Decision making

The Final EIR, together with all I&AP comments on the Draft EIR, will be submitted to DEA for their review and decision-making. DEA must, within 60 days, do one of the following:
• Accept the report;
• Notify the applicant that the report has been referred for specialist review;
• Request amendments to the report; or
• Reject the report if it does not materially comply with regulations.
If the report is accepted, DEA must within 45 days:
- Grant authorisation in respect of all or part of the activity applied for; or
- Refuse authorisation in respect of all or part of the activity.

Once DEA issues their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within 12 calendar days of the Environmental Authorisation having been issued. Should anyone (a member of public, registered I&AP or the Applicant) wish to appeal DEA’s decision, a Notice of Intention to Appeal in terms of Chapter 7 of the EIA Regulations (GN No. 543) in terms of NEMAct must be lodged with the Minister of Water and Environmental Affairs within 20 calendar days of the decision being issued and the substantive Appeal must be lodged within 30 days of the Notice.

1.5 ASSUMPTIONS AND LIMITATIONS

1.5.1 Assumptions

In undertaking this investigation and compiling the EIR, the following has been assumed:
- The strategic level investigations undertaken by the Department of Energy regarding South Africa’s proposed energy mix prior to the commencement of the EIA process are technologically acceptable and robust;
- The information provided by the applicant is accurate and unbiased; and
- The scope of this investigation is limited to assessing the environmental impacts associated with the proposed wind and solar energy facilities and connections to the grid. The EIA does not include any infrastructure upgrades which may be required from Eskom to allow capacity in the local grid for the proposed projects.

1.5.2 Gaps in knowledge

This EIA Report has identified the potential environmental impacts associated with the proposed activities. However, Mainstream is undertaking further work on the proposed project and investigations in parallel with this EIA process from a technical feasibility perspective. As such the nature and significance of the impacts presented in this report could change, should new information become available, or as the project description is refined. The purpose of this section is therefore to highlight gaps in knowledge when the EIA Phase of the project was undertaken, namely that the planning for the proposed projects is at a feasibility level and therefore some of the specific details are not available to the EIA process. This EIA process forms a part of the suite of feasibility studies, and as these studies progress, more information will become available. This will require the various authorities, and especially DEA, to issue their comments and ultimately their environmental decision to allow for the type of refinements that typically occur during these feasibility studies and detailed design phase of projects. Undertaking the EIA process in parallel with the feasibility study does however have a number of benefits, such as integrating environmental aspects into the layout and design and therefore ultimately encouraging a more environmentally sensitive and sustainable project.
1.6 INDEPENDENCE

Aurecon nor any of its sub-consultants are subsidiaries of Mainstream, nor is Mainstream a subsidiary to Aurecon. Furthermore, all these parties do not have any interests in secondary or downstream developments that may arise out of the authorisation of the proposed project.

1.7 DETAILS AND EXPERTISE OF THE EAPS WHO COMPILED THE EIA REPORT

The Project Director, Mr Andries van der Merwe, Project Manager, Miss Louise Corbett, and the Project Staff, Mrs Cornelia Steyn and Mr Simon Clark, are appropriately qualified and registered with the relevant professional bodies. Mr van der Merwe is a certified Environmental Assessment Practitioner of South Africa (EAPSA), and Miss Corbett is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNSP). Aurecon is bound by the codes of conduct for EAPSA and SACNASP. The CV summaries of the key Aurecon staff are included in the Plan of Study for EIA contained in the FSR.

1.8 STRUCTURE OF THE EIA REPORT

As outlined above, the EIA process undertaken to date has culminated in the production of a comprehensive EIR, which provided detailed information relevant to the project. However, for the sake of being succinct, information contained within the Scoping Report is not repeated within this EIA Report unless it has direct bearing on the issues under discussion. Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the EIA process, it is critical that this EIA Report is read in conjunction with the FSR (Aurecon, 2012).

Table 1.2 presents the structure of the EIA report as well as the applicable sections that address the required information in terms of NEMA. Specifically, Section 31 of the EIA Regulations requires that the following information is provided:

Table 1.2: NEMA requirements for EIA Reports and location in this EIR

<table>
<thead>
<tr>
<th>Section 31(2) of Regulation 543</th>
<th>CHAPTER OR SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Details of:</td>
<td></td>
</tr>
<tr>
<td>(i) the EAP who prepared the report; and</td>
<td>1.6, page 74</td>
</tr>
<tr>
<td>(ii) the expertise of the EAP to carry out an EIA;</td>
<td>(summaries of EAP CVs provided in Chapter 6 of FSR)</td>
</tr>
<tr>
<td>(b) a detailed description of the proposed activity;</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>(c) a description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is:</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>(i) a linear activity, a description of the route of the activity; or</td>
<td></td>
</tr>
<tr>
<td>(ii) an ocean-based activity, the coordinates where the activity is to be</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 31 OF REGULATION 543

undertaken;

(d) a description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;

(e) details of the public participation process conducted in terms of subregulation (1), including-

(i) steps undertaken in accordance with the plan of study;
(ii) a list of persons, organisations and organs of state that were registered as interested and affected parties;
(iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and
(iv) copies of any representations and comments received from registered interested and affected parties;

(f) a description of the need and desirability of the proposed activity;

(g) a description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;

(h) an indication of the methodology used in determining the significance of potential environmental impacts;

(i) a description and comparative assessment of all alternatives identified during the environmental impact assessment process;

(j) a summary of the findings and recommendations of any specialist report or report on a specialised process;

(k) a description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;

(l) an assessment of each identified potentially significant impact, including-

(i) cumulative impacts;
(ii) the nature of the impact;
(iii) the extent and duration of the impact;
(iv) the probability of the impact occurring;
(v) the degree to which the impact can be reversed;
(vi) the degree to which the impact may cause irreplaceable loss of resources; and
(vii) the degree to which the impact can be mitigated;

(m) a description of any assumptions, uncertainties and gaps in knowledge;

(n) a reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;

(o) an environmental impact statement which contains-
### SECTION 31 OF REGULATION 543

<table>
<thead>
<tr>
<th></th>
<th>CHAPTER OR SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>a summary of the key findings of the environmental impact assessment; and</td>
</tr>
<tr>
<td>(ii)</td>
<td>a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;</td>
</tr>
<tr>
<td>(p)</td>
<td>a draft environmental management programme containing the aspects contemplated in regulation 33;</td>
</tr>
<tr>
<td>(q)</td>
<td>copies of any specialist reports and reports on specialized processes complying with regulation 32;</td>
</tr>
<tr>
<td>(r)</td>
<td>any specific information that may be required by the competent authority; and</td>
</tr>
<tr>
<td>(s)</td>
<td>any other matters required in terms of sections 24(4)(a) and (b) of the Act.</td>
</tr>
</tbody>
</table>

#### Section 31(3) of Regulation 543

The EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by Section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in subregulation 31(2)(g), exist.

Chapter 3 and 4
2  FORWARD PLANNING OF ENERGY IN SOUTH AFRICA

This chapter provides an overview of the policy and legislative context in which the development of renewable energy projects takes place in South Africa. The following policies and legislative context are described:

- Policies regarding greenhouse gas and carbon emissions;
- White Paper on Renewable Energy (2003);
- National Energy Act (No. 34 of 2008) and Electricity Regulation Act (ERA) (No. 4 of 2006);
- Integrated Energy Plan for the Republic of South Africa (2003);
- Integrated Resource Plan (2010); and
- Regional Methodology for Wind Energy Site Selection (Department of Environmental Affairs and Development Planning (DEA&DP), 2006 Guideline document).

2.1.1 Policies regarding greenhouse gas and carbon emissions

Gases that contribute to the greenhouse effect are known to include carbon dioxide (CO₂), methane, water vapour, nitrous oxide, chlorofluorocarbons, halons and peroxyacynitrate. All of these gases are transparent to shortwave radiation reaching the earth’s surface, but trap long-wave radiation leaving the earth’s surface. This action leads to a warming of the earth’s lower atmosphere, resulting in changes in the global and regional climates, rising sea levels and extended desertification. This in turn is expected to have severe ecological consequences and a suite of implications for mankind.

Electricity generation using carbon based fuels is responsible for a large proportion of CO₂ emissions worldwide. In Africa, the CO₂ emissions are primarily the result of fossil fuel burning and industrial processes, such coal fired power stations. South Africa accounts for some 38 % of Africa’s CO₂ emissions. The global per capita CO₂ average emission level is 1.23 metric tonnes. In South Africa however, the average emission rate is 2.68 metric tonnes per person per annum. The International Energy Agency (IEA) (2008) “Renewables in global energy supply: An IEA facts sheet” estimates that nearly 50% of global electricity supplies will need to come from renewable energy sources in order to halve carbon dioxide emissions by 2050 and minimise significant, irreversible climate change impacts.

The United Nations Framework Convention on Climate Change (UNFCCC) has initiated a process to develop a more specific and binding agreement on the reduction of greenhouse gas (GHG) emissions. This led to negotiations with a particular focus on the commitments of developed countries, and culminated in the adoption of the Kyoto Protocol in 1997, which came into effect in February 2005. Using the above framework to inform their approach, the Kyoto Protocol has placed specific legal obligations in the form of GHG reduction targets on developed countries and countries with ‘Economies in Transition’. The developed countries listed in Annex 1 of the UNFCCC are required to reduce their overall emissions of six GHGs by at least 5 % below the 1990 levels between 2008 and 2012. While South Africa, as a developing country, is not obliged to make such reductions, the increase in greenhouse gas emissions must be viewed in light of global trends to reduce these emissions significantly. More recently under the Copenhagen Accord 2010, countries representing over 80 % of global emissions have submitted pledges on emission reductions. South Africa commitment is to reduce GHG emissions totalling 34 % by 2020 and 42 % by 2025.
The Kyoto Protocol, to which South Africa is a signatory, was informed by the principles of sustainable development which resulted in related policies and measures being identified to promote energy efficiency while protecting and enhancing the ‘sinks and reservoirs’ of greenhouse gases (forests, ocean, etc.). Other methods/approaches included encouraging more sustainable forms of agriculture, in addition to increasing the use of new and renewable energy and the adoption/implementation of advanced and innovative environmentally sound technologies. South African policies are being informed by the Kyoto Protocol (which is valid until 2012) and its partial successor the Copenhagen Accord 2010 and associated sustainable development principles whereby emphasis is being placed on industries for ‘cleaner’ technology and production.


As required by the Constitution of the Republic of South Africa (Act No. 108 of 1996), the White Paper on the Energy Policy of the Republic of South Africa (1998) was published by the Department of Minerals and Energy in response to the changing political climate and socio-economic outlook. Key objectives are identified in terms of energy supply and demand, as well as co-ordinated with other social sectors and between energy sub-sectors.

The White Paper commits to government’s focused support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications. With the aim of drawing on international best practice, specific emphasis is given to solar and wind energy sources, particularly for rural, and often off-grid areas.

While considering the larger environmental implications of energy production and supply, the White Paper looks into the future to adopting an integrated resource planning approach, integrating the environmental costs into economic analysis. It is with this outlook that the renewable energy, including solar energy, is seen as a viable, attractive and sustainable option to be promoted as part of South Africa’s energy policy towards energy diversification.


Published by the Department of Minerals and Energy (DME) in 2003, the White Paper on renewable Energy supplements the above-mentioned Energy Policy which identified the medium- and long-term potential for renewable energy as significant. The White Paper sets out the vision, policy principles, strategic goals, and objectives in terms of renewable energy. At the outset the policy refers to the long term target of “10 000 GigaWatt hours (GWh) (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013.” The aim of this 10-year plan is to meet this goal via the production of mainly biomass, wind, solar, and small-scale hydro sources. It is estimated that this would constitute approximately 4 % of projected energy demand for 2013.

The White Paper presents South Africa’s options in terms of renewable energy as extensive and a viable and sustainable alternative to fossil fuel options. A strategic programme of action to develop South Africa’s renewable energy resources is proposed, particularly for power generation and reducing the need for coal-based power generation. The starting point will be a number of initial investments spread across both relatively low cost technologies, such as
biomass-based cogeneration, as well as technologies with larger-scale application, such as solar water heating, wind and small-scale hydro.

Addressing environmental impacts and the overarching threats and commitments to climate change, the White Paper provides the platform for further policy and strategy development in terms of renewable energy in the South African energy environment.

2.1.4 National Energy Act (No. 34 of 2008) and Electricity Regulation Act (No. 4 of 2006)

South Africa has two acts that direct the planning and development of the country’s electricity sector:

i. The National Energy Act (No. 34 of 2008); and

ii. The Electricity Regulation Act (ERA) (No. 4 of 2006).

In May 2011, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy.

In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) (see Section 2.1.7) has been developed by the DoE and sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be undertaken in accordance with the specified capacities and technologies listed in the IRP.

2.1.5 IPP Procurement Process

South Africa aims to procure 3 725 MW capacity of renewable energy by 2016 (the first round of procurement). This 3 725 MW is broadly in accordance with the capacity allocated to renewable energy generation in IRP2010.

On 3 August 2011, DoE formally invited interested parties with relevant experience to submit proposals for the finance, operation and maintenance of renewable energy generation facilities adopting any of onshore wind, solar thermal, solar photovoltaic, biomass, biogas, landfill gas or small hydro technologies for the purpose of entering, inter alia, an Implementation Agreement with DoE and a Power Purchase Agreement with a buyer (Eskom) in terms of the ERA. This Request for Qualification and Proposals (RFP) for new generation capacity was issued under the IPP Procurement Programme. The IPP Procurement Programme has been designed to

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6 http://www.eskom.co.za/c/73/ipp-processes/ (accessed 29/10/11)
7 http://www.eskom.co.za/c/73/ipp-processes/ (accessed 29/10/11)
contribute towards the target of 3 725 MW and towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa.

In terms of this IPP Procurement Programme, Bidders will be required to bid on tariff and the identified socio-economic development objectives of DoE. The tariff will be payable by the Buyer should the project be selected. Although earlier information was that the 2009 Renewable Energy Feed In Tariff would act as an upper limit on price, the actual caps are set out in Table 2.1. A bid will be ‘non-compliant’ and automatically rejected during the qualification phase if the price cap is exceeded. Bid Responses which are submitted must be accompanied by a Bid Guarantee in the form of a bank guarantee for an amount equal to R 100 000 per MW of the proposed installed capacity.

The generation capacity allocated to each technology is set out in Table 2.1.

Table 2.1: Generation capacity and price cap per each technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>MW</th>
<th>Price cap (per MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore wind</td>
<td>1 850</td>
<td>R 1 150</td>
</tr>
<tr>
<td>Concentrated solar thermal</td>
<td>200</td>
<td>R 2 850</td>
</tr>
<tr>
<td>Solar photovoltaic</td>
<td>1 450</td>
<td>R 2 850</td>
</tr>
<tr>
<td>Biomass solid</td>
<td>12.5</td>
<td>R 1 070</td>
</tr>
<tr>
<td>Biogas</td>
<td>12.5</td>
<td>R 800</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>25</td>
<td>R 600</td>
</tr>
<tr>
<td>Small hydro</td>
<td>75</td>
<td>R 1 030</td>
</tr>
<tr>
<td>Small projects(^{12})</td>
<td>100</td>
<td>As above</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3 725</td>
<td></td>
</tr>
</tbody>
</table>

Each project procured in terms of this IPP Procurement Programme will be required to achieve commercial operation by not later than end 2016.

The submission and selection dates for projects for the RFP are given in Table 2.2.

Table 2.2: Bid submission dates, selection of preferred bidders and signing of agreements\(^{13}\)

<table>
<thead>
<tr>
<th>Submission no.</th>
<th>Submission date</th>
<th>Preferred selection date</th>
<th>bidder</th>
<th>Signing agreements date of agreements date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5 March 2012</td>
<td>21 May 2012</td>
<td></td>
<td>11 - 22 February 2013</td>
</tr>
<tr>
<td>Third</td>
<td>7 May 2013 - 19 August 2013</td>
<td>Dates to be announced by DOE</td>
<td>Dates to be announced by DOE</td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>Dates to be announced by DOE</td>
<td>Dates to be announced by DOE</td>
<td>Dates to be announced by DOE</td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>Dates to be announced</td>
<td>Dates to be announced by DOE</td>
<td>Dates to be announced by DOE</td>
<td></td>
</tr>
</tbody>
</table>

\(^{9}\) http://www.ipp-renewables.co.za/ (accessed 30/10/11)
\(^{10}\) http://www.nortonrose.com/knowledge/publications/54959/south-africa-renewable-energy-ipp-request-for-proposals (accessed 30/10/11)
\(^{12}\) Small projects are less than 5 MW.
\(^{13}\) http://www.ipp-renewables.co.za/?page_id=524 (accessed 30/10/11)
The selection process to determine the preferred bidders will be based on both price and other economic development criteria in a 70% / 30% ratio respectively (Creamer, T. 2011). If the maximum MW allowance for any particular technology has been allocated during any particular window, then the subsequent bidding opportunities will not be opened for that technology.

IPPs that wish to connect to Eskom’s network will be required to apply for a connection, pay a connection charge and sign a connection and use-of-system agreement\textsuperscript{14}. All IPPs will be provided non-discriminatory access to Eskom’s network, subject to the IPP’s obtaining its required approvals such as EIA’s and a generating and trading licence from NERSA.

2.1.6 Integrated Energy Plan for the Republic of South Africa

Commissioned by DME in 2003, the Integrated Energy Plan (IEP) aims to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance in providing low cost electricity for social and economic developments, ensuring security of supply, and minimising the associated environmental impacts.

The IEP projected that the additional demand in electricity would necessitate an increase in electricity generation capacity in South Africa by 2007. Furthermore, the IEP concluded that, based on energy resources available in South Africa, coal would be the primary fuel source in the 20 year planning horizon, which was specified as the years 2000 to 2020, although other cleaner technologies continue to be investigated as alternatives in electricity generation options. Therefore, though the next two decades of energy generation are anticipated to remain coal-based, alternative technologies and approaches are available and need to be contextually considered.

2.1.7 Integrated Resource Plan

The Integrated Resource Plan (IRP) is a National Electricity Plan, which is a subset of the Integrated Energy Plan. The IRP is also not a short or medium-term operational plan but a plan that directs the expansion of the electricity supply over the given period.

The IRP, indicating the schedule for energy generation programmes, was first gazetted on 31 December 2009. A revised schedule was gazetted on 29 January 2010 and the schedule has once again been revised and the final IRP (IRP2010-2030) was gazetted on 6 May 2011.

Developed for the period of 2010 to 2030, the primary objective of the IRP2010, as with its predecessors, is to determine the long-term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing, and cost. While promoting increased economic development through energy security, the IRP2010 aims to achieve a "balance between an affordable electricity price to support a globally competitive economy, a

\textsuperscript{14} \texttt{http://www.eskom.co.za/c/article/150/independent-power-producers-ipp/} (accessed 30/10/11)
more sustainable and efficient economy, the creation of local jobs, the demand on scarce resources such as water and the need to meet nationally appropriate emission targets in line with global commitments”.

As can be seen by Table 2.3 below the current final IRP provides for an additional 20 409 MW (shaded in grey) of renewable energy in the electricity mix in South Africa by 2030.

Table 2.3: Policy adjusted scenario of the IRP2010 as gazetted on 6 May 2011

<table>
<thead>
<tr>
<th>Technology</th>
<th>Total generating capacity in 2030</th>
<th>Capacity added (including committed) from 2010-2030</th>
<th>New (uncommitted) capacity options from 2010-2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MW</td>
<td>%</td>
<td>MW</td>
</tr>
<tr>
<td>Coal</td>
<td>41 074</td>
<td>45.9</td>
<td>16 383</td>
</tr>
<tr>
<td>OCGT</td>
<td>7 330</td>
<td>8.2</td>
<td>4 930</td>
</tr>
<tr>
<td>CCGT</td>
<td>2 370</td>
<td>2.6</td>
<td>2 370</td>
</tr>
<tr>
<td>Pumped Storage</td>
<td>2 912</td>
<td>3.3</td>
<td>1 332</td>
</tr>
<tr>
<td>Nuclear</td>
<td>11 400</td>
<td>12.7</td>
<td>9 600</td>
</tr>
<tr>
<td>Hydro</td>
<td>4 759</td>
<td>5.3</td>
<td>2 659</td>
</tr>
<tr>
<td>Wind</td>
<td>9 200</td>
<td>10.3</td>
<td>9 200</td>
</tr>
<tr>
<td>CSP</td>
<td>1 200</td>
<td>1.3</td>
<td>1 200</td>
</tr>
<tr>
<td>PV</td>
<td>8 400</td>
<td>9.4</td>
<td>8 400</td>
</tr>
<tr>
<td>Other</td>
<td>890</td>
<td>1.0</td>
<td>465</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>89 532</strong></td>
<td><strong>100</strong></td>
<td><strong>56 539</strong></td>
</tr>
</tbody>
</table>

The final IRP2010 reflects both the consultation process on the draft IRP2010 currently being undertaken with stakeholders and the further technical work undertaken in this period. It is noted that “given the rapid changes in generation technologies and pricing, especially for “clean” energy sources, the IRP will have to be reviewed on a regular basis, for instance every two years, in order to ensure that South Africa takes advantage of emerging technologies. This may result in adjustments in the energy mix set out in the balanced revised scenario within the target for total system capacity.”

2.1.8 Regional Methodology for Wind Energy Site Selection- a DEA&DP Guideline document (2006)

In May 2006 DEA&DP published the Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape: Towards a Regional Methodology for Wind Energy Site Selection. With the aim of paving the way for wind energy as a viable, clean, renewable energy development in the Western Cape the following vision was developed: “The vision for the Western Cape is to establish a policy on the implementation of regional criteria for the identification of areas suitable for the establishment of wind energy projects. This will promote the implementation of wind energy projects while balancing national interests of promoting alternative energy generation with local strategic environmental objectives. This will also avoid conflict between local and national interests through a proactive environmental planning process.”

Further to the above the Guideline aims to facilitate:
• Policy on the implementation of a methodology to be used for the identification of areas suitable for the establishment of wind energy projects;
• Alignment with the White Paper on Energy Policy for the Republic of South Africa;
• Coordinated implementation;
• Responsible and rational wind energy developments to benefit both developers as well as affected communities;
• Avoidance of unsuitable sites;
• Public awareness; and
• Guidance in terms of environmental assessments processes.

In a total of seven volumes two alternative assessment methodologies, a criteria based/quantitative method, and a landscape based/qualitative method are presented. The comparative assessment pointed towards restricted, negotiable, preferred areas as well as cumulative impacts. The methodology delineates areas appropriate for wind energy development including negative and positive thresholds (buffers), cumulative impacts as well as landscape character, value, sensitivity and capacity. The methodology stops short of addressing local level issues and indicates the need to address these on a site-specific level. The methodologies were tested on a large study area on the Cape West Coast.

The document is designed to guide planners and decision-makers to appropriate areas for wind farm development based on planning, infrastructure, environmental and landscape criteria. As many of these criteria are also applicable to other areas, outside the Cape West Coast, reference has been made to this guideline here. Note that it this document is still in draft format and is not necessarily in line with best practice. As such certain key requirements have been omitted from the Applicant’s approach.
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3 THE PROPOSED ACTIVITY

This chapter considers the need for the proposed projects, describes the components of the proposed projects that could have an impact on the environment, then summarises the suite of alternatives that were proposed for further consideration in the Scoping Report.

3.1 THE NEED FOR THE PROPOSED ACTIVITY

As can be seen by the numerous policies and legislation described in Chapter 2 the need for renewable energy is well documented. Reasons for the desirability of renewable energy include:

- Creating a more sustainable economy;
- Reducing the demand on scarce resources such as water;
- Meeting nationally appropriate emission targets in line with global climate change commitments;
- Reducing and where possible eliminating pollution;
- Alleviating energy poverty by providing energy in rural areas;
- Local economic development;
- Local skills development;
- Enhancing energy security by diversifying generation; and
- Local and national job creation.

Furthermore, the IRP allows for an additional 20 409 MW of renewable energy in the electricity blend in South Africa by 2030. While there are a number of renewable energy options (including, inter alia, wind, solar and hydropower) being pursued in South Africa, many more renewable energy projects are required to meet the targets set by the IRP. Consequently, based on this requirement for renewable energy, Mainstream has identified a number of projects for both wind and solar energy generation and these proposed projects form one of many that require the necessary environmental studies. Table 3.1 shows specific questions as detailed in the Need and Desirability Guideline.

Table 3.1: Specific questions as detailed in the Need and Desirability Guideline

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved SDF agreed to by the relevant environmental authority i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP?</td>
<td>The area proposed is currently zoned as Agricultural land. However the farmers have signed an option for a long term lease agreement with Mainstream for portions of their farms. The portions leased have a relatively low agricultural potential and grazing would continue below the turbines as such it would not affect the economic viability of the farm. Grazing would be excluded from the footprint of the solar energy facilities. However the additional income would safeguard the economic sustainability of the farms. The location of the proposed projects falls outside of the IDP and SDF areas, however the proposed facilities would create job opportunities for a wide skill level. In addition, commitment will be formalised when the project is tendered to the Department of Energy to</td>
</tr>
<tr>
<td>QUESTION</td>
<td>RESPONSE</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>2. Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur at this point in time?</td>
<td>Yes. The activities fall outside of SDF area, but are in line with the Nama Khoi LM SDF which recognises the need for economic development to create a sustainable economy which creates employment opportunities for local people.</td>
</tr>
<tr>
<td>3. Does the community/area need the activity and the associated land use concerned (is it a societal priority)?</td>
<td>Yes. The closing of mines in the municipality has also contributed to the high unemployment rate which has increased from 22.41% in 1996 to 28.49% in 2001 in the Namakwa District Municipality area (Namakwa District Municipality IDP, 2006 - 2011). The proposed wind and solar energy facilities in Springbok would not only be a source of income to the landowners, but it would create job opportunities for the local community as the construction and operation of the facilities require a wide range of skill levels which Springbok can, to a degree, supply. Secondary economic impacts may include an increase in service amenities through an increase in contractors and associated demand for accommodation, etc.</td>
</tr>
<tr>
<td>4. Are there necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?</td>
<td>The proposed project would feed into the national Eskom grid through an onsite connection, which forms part of the EIA process.</td>
</tr>
<tr>
<td>5. Is this development provided for in the infrastructure planning of the municipality, and if not, what will the implication be on the infrastructure planning of the municipality (priority and placements of services)?</td>
<td>No. It should be noted that once the proposed projects are operational, there would be a very limited requirement for municipal services.</td>
</tr>
<tr>
<td>6. Is this project part of a national programme to address an issue of national concern or importance?</td>
<td>Yes. The establishment of the proposed facilities would strengthen the existing electricity grid for the area. Moreover, the projects would contribute towards meeting the national energy target as set by the Department of Energy (DoE), of a 30% share of all new power generation being derived from independent power producers (IPPs).</td>
</tr>
</tbody>
</table>

**DESIRABILITY (PLACING)**

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the development the best practicable environmental option (BPEO) for this land/site?</td>
<td>Yes. Springbok is a very arid region of the Northern Cape where agricultural potential is low and cattle, sheep and goat farming forms the predominant land use. The area, being proposed for the facilities has a low agricultural potential which is why the proposed facilities are well suited and the best practicable environmental option for this site.</td>
</tr>
</tbody>
</table>
| 2. Would the approval of this application compromise the integrity of the existing approved Municipal IDP and SDF as agreed to by the relevant authorities. | No. The projects fall outside of IDP area, but are in line with the Nama Khoi IDP which recognizes the need for economic development to strengthen and improve the local economy to create a sustainable economy which...
<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>creates employment opportunities for local people. The Namakwa District IDP pursues economic development through large programmes to build economic infrastructure.</td>
<td>No. Neither the Emthanjeni LM or the Nama Khoi LM have an EMF in place. Furthermore, the EIA process would ensure that the proposed facilities would be environmentally sustainable. The site falls within the Namakwa District Biodiversity Sector Plan (Desmet and Marsh, 2008). A field survey was undertaken by the botanical specialist and the subsequent findings conclude that the lowland areas mapped by Desmet &amp; Marsh (2008) as part of the ‘higher biodiversity areas’ both within the ‘wind focus area’ and the ‘solar focus area’ (see Figure 4.6) do not have a high biodiversity status as indicated by the mapping. Therefore, contrary to what is indicated by the maps, the latter areas are, in the opinion of the specialist, acceptable for consideration for development of wind and solar renewable energy facilities.</td>
</tr>
<tr>
<td>3. Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in Environmental Management Frameworks (EMFs)), and if so, can it be justified from in terms of sustainability considerations?</td>
<td>No. Neither the Emthanjeni LM or the Nama Khoi LM have an EMF in place. Furthermore, the EIA process would ensure that the proposed facilities would be environmentally sustainable. The site falls within the Namakwa District Biodiversity Sector Plan (Desmet and Marsh, 2008). A field survey was undertaken by the botanical specialist and the subsequent findings conclude that the lowland areas mapped by Desmet &amp; Marsh (2008) as part of the ‘higher biodiversity areas’ both within the ‘wind focus area’ and the ‘solar focus area’ (see Figure 4.6) do not have a high biodiversity status as indicated by the mapping. Therefore, contrary to what is indicated by the maps, the latter areas are, in the opinion of the specialist, acceptable for consideration for development of wind and solar renewable energy facilities.</td>
</tr>
<tr>
<td>4. Do location factors favour this land use (associated with the activity applied for) at this place?</td>
<td>Yes. The site was selected based on the following criteria: Wind resource based on historic data from the Springbok South African Weather Service Station (SAWS) and used to provide a comprehensive macro wind model of the area; Solar resource; Grid connectivity and close proximity to strong grid access; and Unpopulated and non-arable or low arable potential land. Desktop studies furthermore assessed potential sensitivities of fauna, flora and heritage.</td>
</tr>
<tr>
<td>5. How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?</td>
<td>Potential impacts associated with the proposed activities have been assessed in detail in Chapter 4.</td>
</tr>
<tr>
<td>6. How will the development impact on people’s health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc.)?</td>
<td>Potential impacts associated with the proposed activities have been assessed in detail in Chapter 4.</td>
</tr>
<tr>
<td>7. Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?</td>
<td>No. The socio-economic impacts have been assessed in Chapter 4 and are considered to be acceptable.</td>
</tr>
<tr>
<td>8. Will the proposed land use result in unacceptable cumulative impacts?</td>
<td>No. Potential cumulative impacts associated with the proposed activities have been assessed in detail in Chapter 4 and are considered to be acceptable.</td>
</tr>
</tbody>
</table>
3.2 DESCRIPTION OF THE PROPOSED ACTIVITIES

3.2.1 Wind Energy Facility project

The proposed wind energy facility would consist out of four phases of 140 MW each, the turbine sizes would range between 1.5 – 4 MW which means each 140 MW phase may consist of between 94 (using 1.5 MW machines) to 35 turbines using 4 MW machines). The combined four phases would have a maximum total installed capacity of 560 MW. The size of the turbines would be selected by the developer in a tender process nearing the point when this project is nearing the DoE’s procurement programme, the final turbine would be selected based on fit for site technology, cost of technology available within required timelines, local content achieved by respective turbine suppliers, turbine dimensions and numbers approved within this environmental study, etc.

A wind turbine is a rotary device that extracts energy from the wind. If the mechanical energy is used directly by machinery, such as for pumping water, cutting lumber or grinding stones, the machine is called a windmill. If the mechanical energy is instead converted to electricity, the machine is called a wind turbine. Figure 3.1 shows a wind energy facility in Texas, United States of America.

3.2.2 Components of a wind turbine

Wind turbines can rotate about either a horizontal or a vertical axis. Turbines used in wind farms (see Figure 3.1) for commercial production of electricity are usually horizontal axis, three-bladed and pointed into the wind by computer-controlled motors, as is proposed for this project. These have high tip speeds of over 320 km/hour, high efficiency, and low torque ripple, which contribute to good reliability.

The main components a wind turbine is made up are listed and described below (see Figure 3.2):

- Rotor and blades;
- Nacelle;
- Generator;
- Tower; and
- Foundation.

3.2.2.1 Rotor and blades

The rotor has three blades that rotate at a constant speed, approximately 6-15 revolutions per minute (rpm) in the case of the turbines being considered at Springbok. The blades are usually coloured light grey and, in the case of the proposed project, would be approximately 40 – 60 m long (80 – 120 m rotor diameter).
Figure 3.1: Brazos Wind Ranch located in Texas, USA

http://en.wikipedia.org/wiki/Wind_power_in_Texas (accessed 14/06/12)
Figure 3.2: Typical components of a horizontal axis wind turbine

3.2.2.2 Nacelle

Larger wind turbines are typically actively controlled to face the wind direction measured by a wind vane situated on the back of the nacelle. By reducing the misalignment between wind and turbine pointing direction (yaw angle), the power output is maximised and non-symmetrical loads minimised. The nacelle can turn the blades to face into the wind (‘yaw control’).

All turbines are equipped with protective features to avoid damage at high wind speeds. By turning the blades into the wind (‘furling’) the turbine ceases its rotation, accompanied by both electromagnetic and mechanical brakes. This would typically occur at very high wind speeds, typically over 72 km/h (20 m/s). The wind speed at which shut down occurs is called the cut-out speed. The cut-out speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level. The turbine controls the angle of the blades (‘pitch control’) to make optimal use of the available wind and avoid damage at high wind speeds.

The nacelle also contains the generator, control equipment, gearbox and wind speed measure (anemometer) in order to monitor the wind speed and direction.

3.2.2.3 Generator

The generator converts the turning motion of the blades into electricity. A gear box is commonly used for stepping up the speed of the generator. Inside the generator, wire coils rotate in a magnetic field to produce electricity. Each turbine has a transformer that steps up the voltage to match the transmission line frequency and voltage for electricity evacuation/distribution.

3.2.2.4 Tower

The tower is constructed from tubular steel or reinforced concrete and supports the rotor and nacelle. For the proposed project the tower would be between 60 m and 120 m tall, depending on the selected turbine. Wind has greater velocity at higher altitudes, therefore increasing the height of a turbine increases the expected wind speeds.

3.2.2.5 Foundation

Foundations are designed to factor in both weight (vertical load) and lateral wind pressure (horizontal load). Considerable attention is given when designing the footings to ensure that the turbines are adequately grounded to operate safely and efficiently. The final foundation design of the proposed turbines is dependent on a geotechnical investigation; however it is likely that the proposed turbine foundations would be made of reinforced concrete. The foundations would be approximately 20 m x 20 m and an average of 3 m deep. The foundation would be cast in situ and could be covered with top soil to allow vegetation growth around the 6 m diameter steel tower.

3.2.3 Construction and operation of the proposed wind energy facility

The turbine tower comprises sections, the first is bolted to the concrete foundation and subsequent sections are lifted on site by a crane, manoeuvred into position and bolted together (see Figure 3.3). A permanent hard standing made of compacted gravel of approximately 4020 m x 50 m would be constructed adjacent to each turbine location for the crane.

The preliminary area considered for turbines, and assessed by the various specialists, is shown in Figure 3.4 and the revised layout in Figure 3.5. Details of the proposed wind project are summarised in Table 3.4.

Gravel surface access roads of approximately 6-10 m wide would also be required between each turbine. Cables connecting each turbine would interconnect and ultimately become a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible.

Figure 3.3: A wind turbine in the process of being erected

Figure 3.4: Preliminary area within which turbines of the proposed wind energy facility would be located on farms near Springbok in the Northern Cape
Figure 3.5 Revised area within which turbines of the proposed wind energy facility would be located on farms near Springbok in the Northern Cape
Each turbine would have a transformer that steps up the voltage from 690 Volt to a medium voltage +/- 33 kilovolt (kV). This transformer is housed within each turbine tower or immediately outside the turbine.

The electricity distribution infrastructure would comprise of a double circuit transmission line between the wind farm main substation (Kangnas) and existing the Eskom Nama Aggeneys 220 kV grid line.

The existing Eskom 220 kV line will be turned into and out of (looping in and looping out of the proposed Kangnas Substation) with two separate overhead 220 kV lines for a maximum of 1 km before the two lines will become a single double circuit transmission line to the proposed Kangnas substation. There will be a single track gravel access road for maintenance purpose to the two lines and double circuit transmission line to Kangnas Substation. The proposed route to the Eskom grid is approximately 20 km long. The transmission lines would be routed within a 200m corridor (i.e. 100 m on either side) which will allow for minor servitude alignment deviations should sensitive features be identified during the construction phase.

The total Kangnas main substation size is expected to be a maximum of 200 m x 200 m or 4 ha.

The transmission line between the proposed Kangnas sub and Eskom’s grid will be (132 – 400 kV) (the existing Eskom grid onsite to be connected to is 220 kV, through discussions with Eskom it has been noted that Eskom is doing away with all 220 kV line’s across the national network over time. At the time of submitting this report no clarity had been received from Eskom if the line would be upgraded or downgraded to 400 or 132 kV, or at what point in time this will happen).

The proposed project could connect to the grid via two satellite substations (100 x 100 m) that would link sectors of the facilities to the main proposed Kangnas wind energy facility substation which would connect to the double circuit overhead line. The satellite substations would consist of medium (22 - 66 kV) to high voltage transformation (132 – 400 kV) with the associated Eskom required switchgear, telecommunications, storage, control room, access road, bus bars, overhead gantries, fencing and all other generic substation infrastructure. There would be a single track gravel access road for maintenance purpose to the substation. At the proposed Kangnas substation the voltage would be increased and evacuated via the existing 220 kV Eskom (or future 132 – 400 kV) power line crossing the northern portion of the site (see Figure 3.8). The main substation would consist of medium (22 - 66 kV) to high voltage transformation (132 – 400 kV) with the associated Eskom required switchgear, telecommunications, storage, control room, access road, bus bars, overhead gantries, fencing and all other generic substation infrastructure. There will be a single track gravel access road for maintenance purpose to the substation. The total main substation size is expected to be a maximum of 200 x 200 m or 4 ha.

The proposed wind energy facility would be constructed in four 140 MW phases. Table 3.2 provides details of the construction and operation requirements for the four phases. The timing of phases would depend on the developer's success in the respective renewable energy IPP bidding rounds. The timing and format of the bidding rounds as decided by DOE, and the available grid capacity as determined by Eskom on the grid.
Table 3.2 Construction and operation requirements of the four phases of the proposed wind energy facility

<table>
<thead>
<tr>
<th>PHASE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Turbines</td>
<td>±65</td>
<td>±65</td>
<td>±65</td>
<td>±65</td>
<td>±2 60</td>
</tr>
<tr>
<td>MW Produced</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>5 60</td>
</tr>
<tr>
<td>New Roads (km)</td>
<td>58.5</td>
<td>34</td>
<td>34</td>
<td>33</td>
<td>159.5</td>
</tr>
<tr>
<td>Existing roads to be upgraded (km)</td>
<td>25.2</td>
<td>30.5</td>
<td>55.5</td>
<td>33.5</td>
<td>144.7</td>
</tr>
<tr>
<td>Cables (km)</td>
<td>83.7</td>
<td>64.5</td>
<td>89.5</td>
<td>66.5</td>
<td>304.2</td>
</tr>
<tr>
<td>Footprint (ha)</td>
<td>94.6</td>
<td>74.9</td>
<td>100.4</td>
<td>76.9</td>
<td>346.8</td>
</tr>
<tr>
<td>Water (construction) (m$^3$)</td>
<td>64 948</td>
<td>60 809</td>
<td>66 200</td>
<td>61 240</td>
<td>253 197</td>
</tr>
<tr>
<td>Water (operation) (m$^3$/day)</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>13.6</td>
</tr>
</tbody>
</table>

Approximately 253 197 cubic meters (m$^3$) (or an average of 87.9 m$^3$ per day) of water is required for the construction phase of the proposed wind energy facility is. During the operational phase it is anticipated to be 13.6 m$^3$/day during peak maintenance periods. Mainstream has indicated that water could be sourced from underground sources (if available) and, if required, Mainstream will apply for a WUL once it has been confirmed that they are a preferred bidder. Mainstream will however apply to DWA and or other relevant water control authorities for a non-binding letter (project and phase specific) confirming the water availability for the proposed projects.

Turbines are designed to operate continuously, unattended and with low maintenance for more than 20 years or greater than 120 000 hours of operation. Once operating, the proposed wind energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. There would be basic operation and maintenance including storage facilities on site.

A number of jobs during the construction phases and operational phases of the proposed wind facility would be created. The proposed project would make use of local labour as far as possible. As many of the jobs as possible would be filled by people local to the wind farm area. Records would be kept of local jobs produced and the process used to procure man hours from the local market. Table 3.3 provides a breakdown of the employment opportunities for the proposed wind energy facility.

Table 3.3: Employment opportunities, and breakdown per skill set, per phase of the proposed wind energy facility for a total of 750 MW windfarm development

<table>
<thead>
<tr>
<th>Phase</th>
<th>Permanent</th>
<th>Highly Skilled</th>
<th>Skilled</th>
<th>Unskilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>285</td>
<td>71</td>
<td>403</td>
<td>686</td>
</tr>
<tr>
<td>Operation</td>
<td>130</td>
<td>0</td>
<td>14</td>
<td>55</td>
</tr>
</tbody>
</table>

Training would be provided for technicians to operate the facilities by the suppliers of the turbines.

As per Section 2.1.5, Mainstream is planning to apply for an IPP contract in the third bidding round in August 2013. The construction period is anticipated to last 12 – 18 months for each

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18 Note that the number of turbines is based on a 2.3 MW machine – the number of turbines would change if smaller or larger capacity turbines are to be used.
140 MW phase. Only security and key staff would be housed on site. The number and location of onsite key staff during construction and operation would be determined in consultation with the relevant land owners, but would be less than 15 staff. Non local employees would be accommodated in nearby towns. Electricity for construction would be obtained from temporary diesel generators and possibly small scale mobile PV units, until the project is connected to the national grid. Drinking water would be provided from authorised ground water resources on site, where possible otherwise water would be trucked in from an appropriate source. Basic sanitation would be provided where all sewage would be either treated and held in septic tanks, compostable toilets or similar on site and would be removed as necessary to a licensed waste treatment facility, where necessary.

A summary of the land requirements of various components of the proposed wind energy facility is provided in Table 3.4.

Table 3.4: Summary of proposed wind energy facility infrastructure components, size, footprints and land requirements

<table>
<thead>
<tr>
<th>Component</th>
<th>Approximate Size (m)</th>
<th>Footprint (m²)</th>
<th>Land Requirement (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>wind turbines</td>
<td>Hub height: max120</td>
<td>Per turbine: 25</td>
<td>0.4625 – 1.25</td>
</tr>
<tr>
<td></td>
<td>Rotor diameter 120m</td>
<td>Total: 4 625 – 12 500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>max tip height 180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation</td>
<td>20 x 20</td>
<td>Per foundation: 400</td>
<td>7.4 – 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 74000 - 200000</td>
<td></td>
</tr>
<tr>
<td>Hard Stand</td>
<td>20 x 50</td>
<td>Per turbine: 1 000</td>
<td>18.5 - 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 185 000 – 500 000</td>
<td></td>
</tr>
<tr>
<td>Existing roads to be upgraded</td>
<td>Width: 6 – 10</td>
<td>~868 200 – 1 447 000</td>
<td>86.82 – 144.7 ha</td>
</tr>
<tr>
<td></td>
<td>Length: ~144.7 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Roads</td>
<td>Width: 6 – 10</td>
<td>~957 000 – 1 595 000</td>
<td>95.7 – 159.5 ha</td>
</tr>
<tr>
<td></td>
<td>Length: ~159.5 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>200 x 200</td>
<td>40 000</td>
<td>4</td>
</tr>
<tr>
<td>Satellite substation (2)</td>
<td>Per substation: 100 x 100</td>
<td>Per substation: 10 000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 20 000</td>
<td></td>
</tr>
<tr>
<td>Cable trenches**</td>
<td>Width: 0.5</td>
<td>~152 100</td>
<td>15.2 ha</td>
</tr>
<tr>
<td></td>
<td>Length: 304.2 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction camp and storage area</td>
<td>2 500</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Excavated material per turbine</td>
<td>20 x 20 x 3.5 (1 400 m³)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

3.2.4 Decommissioning of the proposed wind energy facility

The turbine infrastructure which would be utilised for the proposed project is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Generally a power purchase agreement (PPA) of 20 years is signed with the energy buyer. After the PPA comes to an end the PPA may be renegotiated at terms that are financially viable at that point in time. The PPA may be based on a shorter term agreement using the existing turbines (if the existing turbines are still suitable) or a longer term PPA may be negotiated based on repowering (refurbishment) of the proposed wind energy facility. It is most likely that refurbishment of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time. New turbine technology may also reduce potential environmental impacts.
Where no new PPA can be negotiated it is likely that the wind farm would be decommissioned according to requirements in the EMP and as required by any other legislation/regulations at that time.

The following decommissioning and/or repowering activities have been considered to form part of the project scope of the proposed wind energy facility:

a) Site preparation

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

b) Disassemble and replace existing turbines

A large crane would be brought on site. It would be used to disassemble the turbine and tower sections. These components would be reused, recycled or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades. The land-use would revert back agriculture/ grazing.

3.3 SOLAR ENERGY FACILITY PROJECT

PV systems convert sunlight into energy. The smallest unit of a PV installation is a cell. The PV cells are made of silicone which acts as a semi-conductor. The cells absorb light energy which energizes the electrons to produce electricity. A number of solar cells electrically connected to each other and mounted in a support structure or frame, behind a glass sheet to protect the cells from the environment, is called a PV module. A number of cells form a module and a number of modules form an array (see Figure 3.6). Modules are arranged in section sizes of approximately 40 x 5 m called tables and are installed on racks which are made of aluminum or steel. Modules are designed to supply electricity at a certain voltage. The current produced is directly dependent on how much light strikes the module. The arrays are arranged into rows that form the solar field.
Figure 3.6: Components of PV technology: (i) Solar cell, (ii) module and (iii) array\textsuperscript{19}

The proposed solar energy facility (225 MW of PV and/or CPV) would have an approximate maximum footprint of $800 \, \text{ha}$ ($793 \, \text{ha}$). (refer to Figure 3.8).

The arrays and racks are founded into the ground through either concrete, screw or pile foundations (see Figure 3.10). The arrays are wired to inverters that convert direct current (DC) into alternate current (AC) that can be fed into a national grid system.

Figure 3.7: below illustrates the components of the process of generating electricity from solar energy (sun) and fed into the grid.

\footnotesize{\textsuperscript{19} (Source: http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/)
Figure 3.8: Preliminary focus area of the proposed solar energy facility on farms near Springbok in the Northern Cape
Figure 3.9 Revised focus area of the proposed solar energy facility on farms near Springbok in the Northern Cape
Figure 3.10: PV ground mounted system\textsuperscript{20}

PV Panels can also be mounted on tracking systems which follow the path of the sun to maximize the benefit of each ray of sunlight and allowing for the land underneath to be utilized as well (see Error! Reference source not found.). Tracking systems do increase the capital cost and operation and maintenance cost of the project.

Figure 3.11: CPV energy facilities in the southern area of Spain\textsuperscript{21}

The fundamental difference between PV and CPV technology is that CPV uses optics such as lenses to concentrate a large amount of sunlight onto a small area of solar PV materials to generate electricity. It is argued that CPV technology can reduce overall cost by using more advanced technologies with higher efficiencies. Using CPV technology does require tracking systems to ensure the sunlight is focused on the small cell.

\textsuperscript{20} (Source: http://en.wikipedia.org/wiki/Photovoltaicsystem)

\textsuperscript{21} (Source: http://www.ecofriend.com/entry/concentrated-photovoltaics/)
3.3.1 Construction and operation of the proposed solar energy facility

The preliminary focus area of the proposed solar energy facility, as was assessed by the specialists, is given in Figure 3.8 and the revised layout in Figure 3.4. Details of the proposed project are summarised in Table 3.5.

**Table 3.5: Summary of proposed solar infrastructure components, size, footprints and land requirements**

<table>
<thead>
<tr>
<th>Component</th>
<th>Size (m)</th>
<th>Footprint (m²)</th>
<th>Land Requirement (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 072 000 x 280 W Panels (estimated) 225 MW</td>
<td>Panel height: 10 or 16</td>
<td>±3-4 hectares per MW</td>
<td>675 – 900</td>
</tr>
<tr>
<td>Access Roads</td>
<td>Width: 6-10</td>
<td>Included in above</td>
<td>Included in above</td>
</tr>
<tr>
<td>Substation</td>
<td>200 x 200</td>
<td>40 000</td>
<td>4</td>
</tr>
<tr>
<td>Operation and maintenance building</td>
<td>50 x 504</td>
<td>2500</td>
<td>0.25</td>
</tr>
<tr>
<td>Construction camp and storage area</td>
<td>100 x 100</td>
<td>10 000</td>
<td>1</td>
</tr>
</tbody>
</table>

A gravel surface access road of approximately 6-10 m wide would also be required to reach the array. Cables connecting the arrays would interconnect with overhead transmission lines that would follow the route of the access roads.

The array would each have an inverter to change the voltage from direct to alternating current. The electricity distribution infrastructure would comprise of one transmission line (132, 220 or 400 kV) traversing the site. The proposed project would connect to the grid via an onsite substation. The proposed route to the substation is approximately 1 km long. At the substation the voltage would be increased and evacuated via the 220 kV Eskom power line (or future 132 – 400 kV) crossing the northern portion of the site (see Figure 3.5).

The onsite Nama Aggeneys 220 kV line would be turned into the main solar PV substation (Areb). The substation will consist of medium (22-66 kV) to high voltage transformation (220 – 400 kV) with the associated Eskom required switchgear, telecommunications, storage, control room, access road, bus bars, overhead gantries, fencing and all other generic substation infrastructure. There would be a single track gravel access road for maintenance purpose to the substation.

The existing line would be turned into and out of (looping in and loop out of the proposed Areb Substation) with two separate overhead 220 kV lines of approximately maximum length of 1 km. There will be a single track gravel access road for maintenance purpose to the two lines. The transmission lines would be routed within a 200m corridor (i.e. 100 m on either side) which will allow for minor servitude alignment deviations should sensitive features be identified during the construction phase.

The total substation size is expected to be a maximum of 200 x 200 m or 4 ha.

The proposed solar energy facility would be constructed in three 75 MW phases. The timing of phases would depend on the developer’s success in the respective renewable energy IPP bidding rounds. The timing and format of the bidding rounds as decided by DOE, and the available grid capacity as determined by Eskom on the grid.
Mainstream has indicated that water could be obtained from underground water sources if available, and Mainstream would apply for a WUL once it has been confirmed that they are a preferred bidder. Mainstream will however apply to DWA for a non-binding letter (project and phase specific) confirming water availability for the proposed projects.

The area’s low rainfall figure suggests minimal need for stormwater management. The clearance of vegetation for bulk earthworks would increase the total volume of stormwater run-off emanating from the cleared area and may result in soil erosion. Gravel access roads may also be vulnerable to erosion by stormwater run-off.

The volume of stormwater runoff from the site would be increased due to the large area covered by the impermeable surface area of the solar panels. Local scouring or erosion could occur beneath the solar panels where water falls directly from the solar panels on soil (without plant cover).

As such, a comprehensive stormwater management plan would be compiled for the solar array, should the project be approved. This would indicate how water velocities would be reduced before stormwater is allowed to enter natural channels and how natural processes for water infiltration of the affected landscape would be accommodated. Mitigation measures would also be recommended, for example gutter-like rainwater collection channels below the panels could be constructed, in order to transport runoff water from panels to underground water tanks or nearby holding ponds. Initial flood calculations for pre- and post-development suggest that an area of approximately 1.5 ha may be required for retention ponds. This would be incorporated within the footprint of the proposed solar energy facility.

Approximately 285 jobs during the pre-construction and construction phases and 130 jobs during the operational phase for the proposed solar facility would be created. The proposed projects would make use of local labour as far as possible, and a minimum of 50% of the jobs would be filled by people local to the surrounding area. A breakdown of the employment opportunities per skill set and per phase of the proposed solar projects is provided in Table 3.6 below.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Permanent</th>
<th>Highly Skilled</th>
<th>Skilled</th>
<th>Unskilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>285</td>
<td>16</td>
<td>101</td>
<td>168</td>
</tr>
<tr>
<td>Operation</td>
<td>130</td>
<td>0</td>
<td>15</td>
<td>115</td>
</tr>
</tbody>
</table>

Training would be provided for technicians to operate the facilities by the suppliers of the PV panels.

The facility would be designed to operate continuously, unattended and with low maintenance for more than 20 years. Once operating, the proposed solar energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. Only security and key staff would be housed on site. The number and location of onsite key staff during construction and operation would be determined in consultation with the relevant land owners, but would be less than 15 staff. Non local employees would be accommodated in nearby towns. Electricity for construction would be obtained from temporary diesel generators.
and possibly small scale mobile PV units, until the project is connected to the national grid. Drinking water would be provided from authorised ground water resources on site, where possible otherwise water would be trucked in from an appropriate source. Basic sanitation would be provided where all sewage would be either treated and held in septic tanks, compostable toilets or similar on site and would be removed as necessary to a licensed waste treatment facility, where necessary.

As per Section 2.1.5, Mainstream is applying for an IPP contract in March 2013 and should this be awarded the proposed project would need to be constructed by June 2016. The construction period is anticipated to last 24 months for the solar energy facility.

The project will last the full period of the PPA which is currently 20 years. Regular cleaning of the panels to remove dust, dirt, pollen, and bird excretions would be required to ensure that the maximum quantity of sunrays can be captured by the PV panels (Ibrahim, 2010). The frequency of panel cleaning would depend on the site conditions. Panels would be washed with water and a mild, organic, and non-abrasive detergent.

### 3.3.2 Decommissioning phase of the proposed solar energy facility

The PV site has a project lifespan of approximately 20 years, based on the photo sensitivity life cycle of the panels. The loss in efficiency occurs due to various climatic conditions that contribute to their affectivity. However, as all the infrastructure, such as roads, transmission, substations and foundations would already be established, and the energy source (solar) is a renewable one the proposed project would continue to be operated after 20 years. The solar panels would be upgraded to make use of the latest technology available. All redundant equipment that would need to be replaced would be removed from site and would be sold off or recycled.

### 3.4 CONSIDERATION OF ALTERNATIVES

#### 3.4.1 Introduction

NEMA requires that alternatives are considered during the EIA process. An important function of the Scoping Phase is to screen alternatives to derive a list of feasible alternatives that need to be assessed in further detail in the EIA Phase. An alternative can be defined as a possible course of action, in place of another, that would meet the same purpose and need (DEAT, 2004).

“alternatives”, in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity.

The alternatives most pertinent to the proposed project include the following:
• Location alternatives - alternative locations for the entire project proposal or for components of the project proposal;
• Activity (type) alternatives - also referred to as project alternatives. Requires a change in the nature of the proposed activity. This category of alternatives is most appropriate at a strategic decision-making level;
• Layout alternatives - site layout alternatives permit consideration of different spatial configurations of an activity on a particular site; and
• Technology alternatives – technology alternatives permit consideration of different types of technology used in the project.

The above categories of alternatives are the ones most pertinent to this EIA process, and were be explored in detail in the Scoping Phase and are summarised below. The purpose of this section of the report is to summarise the potential alternatives assessed in the EIA Phase.

3.4.2 Location alternatives

South Africa is on the verge of increasing the percentage contribution made by renewable energy power generation to the existing energy mix. In response to this potential for the implementation of a large scale renewable energy production, and in particular the 1 850 MW and 1 450 MW which is required from wind and PV energy respectively, Mainstream has identified many potential sites across the country and is currently pursuing the best suited locations for wind and PV energy production.

Mainstream undertook a fatal flaw analysis of four sites in the Northern and Western Cape, of which the current site was one. These sites were identified by considering the following technical aspects:

The fatal flaw analysis considered the following environmental aspects:
• Surrounding land uses;
• Existing services infrastructure;
• Climate;
• Topography, geology and soils;
• Botany;
• Fauna;
• Avifauna;
• Freshwater ecology;
• Archaeology and palaeontology;
• Visual landscape;
• Socio-economic aspects;
• Agricultural production and potential; and
• Planning consistency.

The sites were visited and desktop studies were undertaken to identify potential issues and fatal flaws from an EIA perspective. Input was provided by the following specialists:
• Dr Dave McDonald, Bergwind Botanical Tours & Surveys (botany);
• Mr Doug Harebottle, Private Consultant (avifauna);
• Mr Kurt Barichiev, SiVEST (agriculture);
• Dr Tim Hart, ACO & Associates (heritage); and
• Mr Werner Marais, Animalia Zoological and Ecological Consultation (bats).

Based on the Fatal Flaw Analysis, Mainstream decided to pursue two of the four sites, namely the Kangnas site and a site closer to Pofadder (currently the subject of a separate EIA process DEA ref. 14/12/16/3/3/2/348 (wind) & DEA ref. 14/12/16/3/3/2/347 (solar)).

Given the favourable technical characteristics of the site and the ready market for renewable energy it was decided to pursue wind and solar energy facilities on the site. Based on the selection process undertaken by Mainstream in selecting the site, no other site location alternatives are assessed in this EIR.

### 3.4.3 Activity alternatives

As can be seen by the numerous policies and legislation described in Chapter 2 the need for additional energy generation in South Africa is well documented. Furthermore, numerous policies and legislation have been promulgated indicating the mixture of renewable and non-renewable energy which South Africa wishes to pursue. These strategic documents provide the road map for the activity alternatives available to South Africa. The IRP2010 allows for an additional 20 409 MW of renewable energy in the electricity mix in South Africa by 2030 and based on this requirement for renewable energy Mainstream has identified a number of projects for wind and solar energy generation.

The sites are suitable for solar and wind power given the high level of solar radiation experienced and favourable wind regime at Springbok. As such only solar energy generation will be considered for the proposed solar energy facility and only wind energy generation will be considered for the proposed wind energy facility.

The no-go alternative is the baseline against which all alternatives are assessed. It consists of the status quo, and as such will not be explicitly assessed.

### 3.4.4 Site layout alternatives

One site layout per project has been compiled based on inter alia the following criteria:

- Technical constraints
  - Spatial orientation requirements of turbines and solar panels and associated infrastructure (e.g. roads); and
  - Layout relative to other existing infrastructure, such as power lines.

- Environmental constraints
  - Wind resource profile;
  - Solar irradiation;
  - Topographical constraints, including surface and groundwater;
  - Botanical and avifaunal constraints (presence of sensitive or protected plant communities or avifauna); and
  - Aesthetics.

Originally focus areas were put forward (see Figure 3.4 and Figure 3.8) and this was assessed by the specialists. Based on the specialist studies, buffers were allowed around sensitive points or areas and the layout was revised to avoid these (see Figure 3.5 and Figure 3.9). The two
main substations were sited to avoid sensitive areas hence only one location for each has been proposed. Although other locations were considered these were considered to be environmentally fatally flawed and hence not feasible.\textsuperscript{22} Originally four satellite substations were considered for the proposed wind energy facility but this was reduced to two, based on environmental as well as technical considerations. The access roads in the revised layout were aligned along existing roads where possible. They were located to avoid any perceived geotechnical and drainage issues.

To indicate how environmental considerations have been incorporated into the proposed projects see Table 3.7. This table indicates how the buildable area (the area within which the proposed footprints can be located) has decreased due to considerations such as buffers on drainage lines, sensitive receptors, steep slopes etc. The revised layouts have been located within these buildable areas, i.e. they have been located within the best possible areas.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|}
\hline
 & Initiation Phase (site) & Scoping Phase & EIA Phase & \% reduction in land from start to finish \\
\hline
Buildable area & 46 535 & 35 288 & 20 571 & 53 \\
MW & 1 000 (wind: 750; solar: 250) & 1 000 (wind: 750; solar: 250) & 785 (wind: 560; solar: 225) & 22 (wind: 25; solar: 10) \\
\hline
\end{tabular}
\caption{Change in buildable areas due to incorporation of environmental considerations}
\end{table}

This report assesses the final layout i.e. the layout incorporating relevant buffers and recommendations of the specialists, whilst the specialist reports assessed the original focus areas.

\subsection*{3.4.5 Technology alternatives}

\subsubsection*{3.4.5.1 Wind turbines}

The most important factors apart from commercial considerations, that need consideration when selecting a turbine for any site is the annual average wind speed, reference wind speed, the return period for extreme wind conditions and wind direction (i.e. wind resource profile). Other determining factors when selecting the preferred turbine are efficiency, full load hours and the capacity factor. Based on these characteristics Mainstream would ultimately select a turbine which is best suited to the sites. Mainstream has indicated that the turbines ultimately selected are likely to range between 60 – 120 m in tower height and 80 – 120 m rotor diameter. In order to assess the potential impacts of the turbines a minimum and maximum tipheight of 100 – 180 m will be considered. It should however be borne in mind throughout the EIA process that the turbine dimensions could be anything between this range.

\subsubsection*{3.4.5.2 Solar technology}

\textsuperscript{22} Although the two main substations are separate EIA applications they form part of the larger energy facilities projects, hence no other alternatives were considered.
Various technology alternatives were considered in terms of the following:

- Solar panel type: PV vs CPV; and
- Mounting system: trackers vs fixed mount

### 3.4.5.3 Solar panel type

Two solar panel types, i.e., PV solar cells and CPV, were considered for the proposed solar plant. The CPV technology uses mirrors or lenses to concentrate sunlight onto a small area to generate electricity directly onto the collector PV cells. Both PV and CPV have been considered in the EIA phase.

### 3.4.5.4 Mounting system

Solar panels can be mounted in various ways to ensure maximum exposure of the PV panels to sunlight. In a fixed axis system, the PV panels are installed at a set tilt and cannot move, whereas in a one or two (dual) axes tracking system, the panels follow the sun to ensure maximum exposure to sunlight. These systems are illustrated in Figure 3.12.

![Figure 3.12: Solar panels can be mounted via (a) fixed axis photovoltaic systems, (b) single axis tracking PV systems and (c) dual axis tracking systems](http://en.wikipedia.org/wiki/Solar_tracker#Tracker_type_selection) (Accessed on: 24 October 2011)

Mainstream will investigate all three these alternative mounting options for the PV panels.

### 3.4.5.5 Foundation options

There are various methods for anchoring PV panels. However, the preferred foundation option would be dependent on the soil characteristics of the area, as these anchoring structures would need to withstand climatic conditions, as well as the response of the soil to these changes, to prolong the lifespan of the panels. A geotechnical assessment would however be required to determine the soil conditions and the type of anchoring required.

### 3.4.6 Summary of alternatives

To summarise, the feasible alternatives which are assessed in the EIR include the following:


Proposed wind energy facility:
   Location alternatives:
   • One location buildable area for the proposed wind energy facility;
   Activity alternatives:
   • Wind energy generation via wind turbines; and
   • “No-go” alternative to wind energy production.
   Site layout alternatives:
   • One layout alternative per site (560 MW with 180 turbines four phases of 35 to 93 turbines per 140 MW phase);
   • One main substation location, with two satellite substations.
   Technology alternatives:
   • A minimum and maximum tipheight of 100—180 m A range of turbine heights.

Proposed solar energy facility:
   Location alternatives:
   • One location for the proposed PV/CPV plant.
   Activity alternatives:
   • Solar energy generation via a PV/CPV plant; and
   • “No-go” alternative to solar energy production.
   Site layout alternatives:
   • One layout alternative (225 MW with a maximum 800793 ha footprint)
   Technology alternatives:
   • Two technology alternatives in terms of the solar panel type (PV vs CPV); and
   • Mounting system: trackers vs fixed mount.
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4 ASSESSMENT OF POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

This Chapter forms the focus of the EIR. It contains a detailed assessment of the operational (or long-term) impacts as well as the construction phase impacts on the biophysical and socio-economic environments using the methodology described in Annexure D. A summary table of the assessment of all the potential impacts is also provided.

A brief assessment to determine the extent to which the proposed projects comply with the Equator Principles has also been undertaken and a summary of this information has been provided in this chapter.

4.1 INTRODUCTION

This Chapter describes the potential impacts on the biophysical and socio-economic environments, which may occur due to the proposed activities described in Chapter 3. These include potential impacts, which may arise during the operation of the proposed development (i.e. long-term impacts) as well as the potential construction related impacts (i.e. short to medium term). The assessment of potential impacts will help to inform and confirm the selection of the preferred alternatives to be submitted to DEA for consideration. Note that each of the proposed main substations and grid connection are assessed within as the wind and solar energy facilities, as they are considered to be an essential component of these projects. In turn, DEA’s decision on the environmental acceptability of the proposed project and the setting of conditions of authorisation (should the projects be authorised) will be informed by this chapter, amongst other information, contained in this EIR.

The potential impacts identified during the Scoping Phase of this project, and updated where necessary, are as follows:

- Operational phase impacts on the biophysical environment:
  - Impact on flora;
  - Impact on avifauna;
  - Impact on bats;
  - Impacts fauna; and
  - Impact on climate change
- Operational phase impacts on the social environment:
  - Visual impacts;
  - Impact on energy production;
  - Impact on local economy (employment) and social conditions;
  - Impact on agricultural land;
  - Impact on surrounding land uses; and
  - Impact of noise.
- Construction phase impacts on the biophysical and social environments:
  - Disturbance of flora, avifauna, bats and fauna;
  - Sedimentation and erosion of water ways;
  - Impact on heritage resources (including palaeontology);
o Visual impacts;
  o Impact on local economy (employment) and social conditions;
  o Impact on transport;
  o Noise pollution;
  o Storage of hazardous substances on site; and
  o Dust impact.

Each of these impacts is assessed in detail in a section below. The baseline and potential impacts that could result from the proposed developments are described and assessed. It should be noted that this assessment considers the impacts of the revised final layouts (dated November 2012), whilst the specialist assessment considered the focus areas shown in Figure 3.4 and Figure 3.8. The proposed layouts (dated November 2012) (Figure 3.5 and Figure 3.9) take into account all of the buffers recommended by the specialists. Specialists confirmed that the revised layouts do not impact on any sensitive areas or features and align with their reporting and recommendations. Comments from the specialists on the layout revisions are included in the specialist annexures, namely Annexures E to M.

Mitigation measures are also recommended below. Finally, comment is provided on the potential cumulative impacts\(^{25}\) which could result should these developments, and others like it in the area, be approved.

The methodology used to assess the potential impacts is detailed in Annexure D. The (+) or (-) after the significance of an impact indicates whether the impact is positive or negative, respectively.

A brief assessment to determine the extent to which the proposed projects comply with the Equator Principles has also been undertaken and a summary of this information has been provided at the end of this chapter.

### 4.2 OPERATIONAL PHASE IMPACTS ON BIOPHYSICAL ENVIRONMENT

#### 4.2.1 Impact on Flora

The dominant vegetation type found in the vicinity of the site is Bushmanland Arid Grassland, a widespread vegetation type in the Bushmanland Bioregion and as such is listed as least threatened. The proposed projects could have impacts on flora through the footprint of infrastructure, particularly that of the solar facility, turbines and access roads. A specialist botanical assessment was undertaken by Dr Dave MacDonald of Bergwind Botanical Surveys and Tours cc. Dr MacDonald undertook a verification site visit on 23 & 24 July 2012 in order to better inform the botanical assessment. The botanical study is included in Annexure E. The findings and recommendations of the botanical study are summarised below.

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\(^{25}\) EIA's are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.
a) Description of the environment

The Bushmanland Bioregion falls within the summer rainfall zone of the Northern Cape Province. The site is approximately on the boundary between the winter and summer rainfall zones tending more to summer rainfall. The rainfall is, however, highly unpredictable and occurs mostly in the summer to autumn months. It can vary between 50 to 200 mm per annum.

The site is located in the Bushmanland Bioregion at the western limit of its extent, close to the Succulent Karoo Biome. This vegetation type is characteristically dominated by ‘white grasses’ in the genus *Stipagrostis* but has a complement of low shrubs with *Salsola sp.* important in some places. The second vegetation type found in the study area is Bushmanland Inselberg\(^\text{26}\) Shrubland. It is found on the low but prominent granite-gneiss hills which stand out of the extensive plains on the farms Kangnas (No. 77 Portion 3), Smorgen Schaduwe (No.127, Remainder) and Areb (No. 75, Remainder). This vegetation is botanically important with many succulent species and notably *Aloe dichotoma* (quer tree or kokerboom) and *Aloe gariepensis* (Orange River aloe). A small area of Platbakkies Succulent Shrubland was mapped by Mucina *et al.* (2005) as occurring in the southern corner of Smorgen Schaduwe (No. 127, Remainder). This vegetation type falls within the Succulent Karoo Biome but spreads eastwards into the Bushmanland Arid Grassland on gravel patches, many of which are too small to map as separate units. Bushmanland Inselberg Shrubland is considered to be Least Threatened.

Vegetation of the ‘Wind Focus Area’

The vegetation of the ‘Wind Focus Area’ (see Figure 3.4 is mostly Bushmanland Arid Grassland on deep red sandy soil (Figure 4.5 and Figure 4.2). The dominant species are *Stipagrostis* sp. and *Centropodia glauca*. No other grass species and no other shrub or herbaceous species were recorded due to the extremely dry conditions. The discernible areas of Platbakkies Succulent Shrubland (Figure 4.1) in the study area were mapped and are shown in Figure 4.5 as pink areas. These areas are considered botanically sensitive due to higher species richness and the increased likelihood of finding endemic plants species than in the extensive areas of Bushmanland Arid Grassland which are not botanically sensitive.

\(^{26}\) Inselbergs are isolated hills.
Vegetation of the ‘Solar Focus Area’

The vegetation of the ‘Solar Focus Area’ is Bushmanland Arid Grassland (Figure 4.3). No gravel patches are found in the ‘Solar Focus Area’. However, in this area there is a significant shallow seasonal drainage system (Figure 4.5). The vegetation is generally low shrubland with sparse grass cover, due mainly to the drought conditions. In this area are numerous tall shrubs of Parkinsonia africana (wild green hair tree) (Figure 4.4). This is not an uncommon shrub species in the arid areas of South Africa and Namibia.

Figure 4.1 Platbakkies Succulent Shrubland with dwarf succulent shrubs amongst small boulders (McDonald, 2012)

Figure 4.2 Dwarf shrubland on shallow calcrete. Such areas although within the Bushmanland Arid Grassland show affinities to the Platbakkies Succulent Shrubland (McDonald, 2012)
Figure 4.3 Part of the ‘Solar Focus Area’ at Areb (No. 75, Remainder) within the site. The track runs lengthwise through the seasonal drainage line (McDonald, 2012)

Figure 4.4 Parkinsonia africana (wild green hair tree) in the ‘Solar Focus Area’. (McDonald, 2012)
Figure 4.5: Vegetation of the Kangnas study area
Figure 4.6: Vegetation types of the area
c) Impact assessment

Wind Energy Facility potential impacts
Only a small number of wind turbines would be located within an area marked as ecologically sensitive by Desmet & Marsh (2008), indicated by the yellow area in Figure 4.5 and Figure 4.6, however the field survey revealed that this area is open Bushmanland Arid Grassland and is not botanically or ecologically sensitive. However, a small number of turbines are located within the botanically sensitive Platbakkies Succulent Shrubland gravel patches. This would have a high magnitude impact.

The potential impacts on botany are considered to be site specific or local, of low to high magnitude and long term and therefore of low to high (-) significance, without mitigation. With mitigation measures implemented, the impacts would be of low (-) significance. Note that the greatest impact on botany high (-) within the greater Kangnas area is as a result of fragmentation by access roads and it is not possible to mitigate this impact. However, the impact is considered to be acceptable based on the low sensitivity of the vegetation and its widespread distribution. No difference in significance would result from the proposed wind alternatives.

Solar Energy Facility potential impacts
Comment from DEANC, dated 6 July 2012 and included in Annexure C, indicates that they are concerned that the proposed solar energy facility would limit the conservation of Bushmanland Arid Bushveld through the possible expansion of the Goegap Nature Reserve (18 km to the east of the site) and the WWF owned Ratelkraal (2 km east of the site).

It is noted that there is a large area of Bushmanland Arid Bushveld vegetation to the north of the site, which could be considered for expansion of the protected areas network (see Figure 4.6). Additionally, the proposed projects would not cover the entire site hence it is possible that portions of the site could be considered for conservation. DEANC would need to discuss this with the landowners. It should be noted that during land negotiations in 2011, landowners were specifically asked if they had been approached by WWF/DEANC to discuss future expansion of the Goegap Nature Reserve and all of them indicated that this was not the case.

It should furthermore be noted that Mainstream has been in contact with Ms Natasha Wilson of WWF, on more than one occasion, specifically with regards to WWF’s expansion plans and the proposed projects. No objection has been received from WWF to date. Furthermore WWF confirmed that they did not have any further concerns regarding the proposed projects (refer to Annexure B for comments received).

More detail on the expansion plans and legal status thereof was requested but this was not provided. Based on the information provided here the proposed facilities would not limit the possible expansion of the Goegap Nature Reserve or adjacent Ratelkraal.

The revised solar PV array would cover an array of approximately 705 800ha. The majority of potential impacts are considered to be site specific or local, of low to high magnitude and long term and therefore of low (-) significance, without mitigation. With mitigation measures implemented, the impacts would be of low (-) significance. No difference in significance would
result from the proposed solar alternatives, including PV (tracking and fixed) and CPV (tracking).

b) Mitigation measures

The following mitigation measures are recommended:

Wind Energy Facility
- Wherever possible, restrict construction activities to designated turbine sites and laydown areas.
- Avoid Platbakkies Succulent Shrubland gravel patches. Specifically locate turbines and associated infrastructure such as roads beyond a 30 m buffer around the patches.
- Micro-site turbines with the aid of a botanist, to avoid sensitive sites.
- Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.

Solar Energy Facility
- Avoid drainage lines and maintain a buffer of at least 30 m from drainage lines.
- Collect seeds from Parkinsonia africana (wild green hair trees) to be cultivated offsite. The cultivated shrubs could be planted on the site and effectively used for visual screening of the PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

c) Cumulative impacts

Numerous wind energy and solar energy projects are proposed for the Northern Cape Province and many are targeted on the wide open spaces of Bushmanland and more specifically in Bushmanland Arid Grassland (refer to 4.2.2 (c) cumulative impacts for a list of projects proposed for the area). Owing to the vast expanse of this vegetation type and the relatively low botanical sensitivity, with only a limited number of endemic and Red List species the cumulative impacts in the foreseeable future would be Low (-) significance. This may change with time as more renewable energy projects are proposed.

Impacts on fauna

Any animals found on site could be impacted by the maintenance and operation of the proposed project, through a disturbance or reduction of habitat.

d) Description of the environment

According to the landowner, Mr Weich van Niekerk (pers. comm. 2011), the following fauna species have been seen on the farm: springbok, aardvark, bat-eared fox, caracal, ground squirrel, klipspringer, hyraxes and baboons. Reptiles include the puff adder, Cape cobra and the Many-horned adder. Various other mammals, reptiles, amphibians and invertebrates are also likely to occur.
e) Impact assessment

Wind Energy Facility potential impacts
The proposed wind energy facility would have a footprint of less than 1% of the site (or approximately 465.5 ha). The density of the proposed project would also be very low, with project components, and in particular turbines, spaced far apart. Operation and maintenance of the proposed project would entail very few on site activities and as such disturbance of animals or habitat are likely to be very limited. Existing human activities in the area are likely to have habituated most animals to the presence of humans and as such it is anticipated that any disturbance would result in animals leaving an area for a short period, if at all, and returning once the disturbance has passed. As such the potential impact of the proposed project on fauna is considered to be of low magnitude, local extent and short term (due to the infrequent disturbances and short nature of disturbances) and therefore of very low (-) significance, with or without mitigation. No difference in significance would result from the proposed wind alternatives.

Solar Energy Facility potential impacts
The proposed solar energy facility would have a footprint of approximately 705800ha of the site. The density of the proposed project would be relatively high as the panels would be in close proximity to one another. However, operation and maintenance of the proposed project would entail very few or rare on site activities and as such disturbance of animals or habitat are likely to be very limited. Existing human activities in the area are likely to have habituated most animals to the presence of humans and as such it is anticipated that any disturbance would result in animals leaving an area for a short period, if at all, and returning once the disturbance has passed. As such the potential impact of the proposed project on fauna is considered to be of low magnitude, local extent and short term (due to the infrequent disturbances and short nature of disturbances) and therefore of low (-) significance, with or without mitigation. No difference in significance would result from the proposed solar alternatives.

f) Mitigation measures

No mitigation measures are recommended.

g) Cumulative impacts

Although a number of energy projects are proposed for the area, these are widely spaced apart and are unlikely to result in cumulative impacts on animals.

4.2.2 Impact on avifauna (birds)

The avifauna comprises a Nama-Karoo assemblage which reflects the major habitat types within the Springbok-Pofadder region. Based on atlas data from the first South African Bird Atlas (SABAP1) and second (SABAP2) bird atlas projects, up to 115 species can be recorded
within a 25 km radius of the development zones. Of the 115 species, 12 are red data species, 60 are endemics and four red-listed endemics occur in the broader area. Potential avifaunal impacts could arise from disturbance caused by vehicular and people traffic during construction, displacement caused from habitat loss, risk of collision with wind turbine blades and power lines and behavioural displacement (alteration of flight paths). As such Mr Doug Harebottle was appointed to undertake an avifaunal specialist study. A field survey was undertaken from 24 – 28 June 2012 to inform the Avifauna Impact Assessment. The Avifauna Impact Assessment is included in Annexure F and the findings and recommendations are summarised below.

a) Description of the environment

The landscape is dominated by low-lying flat country (plains) and granite inselbergs (particularly towards the north-west). The proposed development areas and general surroundings are all located on privately owned farmland. The Goegap Nature Reserve lies approximately 20 km west of the study area and comprises a similar avifauna to that of the site. The inselbergs consist of ridges and rocky cliffs faces and are likely to be important sources of lift for soaring species, notably raptors and possibly bustards. The ridge slopes are well vegetated and provide habitat for species with montane affinities and the boulder-koppies provide additional habitat for cliff-nesting and foraging species. Two wetland areas have been identified within the study area namely Granite Pan and Steenbok Pan which would provide seasonal habitat for wetland associated species in the area. Eskom powerlines and pylons along the N14 and south western section of the proposed wind energy facility would provide suitable perches and nesting sites for certain species such as raptors and corvids. A total of 115 species have been recorded from SABAP1 and SABAP2 of which 12 species were seen for the first time in the area. Of the 115 species, seven are red-list species, 59 endemics or near endemics and three red-listed endemics (Ludwig’s Bustard, Red Lark and Sclater’s Lark). All of the red-listed endemics are likely to breed within the study area.

Although intensive searches during the site survey by Mr Harebottle no active raptor nests were found. It was however strongly suspected that a Verreaux’s Eagle (previously Black Eagle) nest on the ridge where a pair of Verreaux’s Eagle was observed in the solar focus area during the site survey. Cliff lines could possibly also hold resident breeding pairs of other raptors including Booted Eagle, Jackal Buzzard, Lanner Falcon and Rock Kestrel.

A variety of raptors and large terrestrial species, particularly Ludwig’s Bustard and Karoo Korhaan, frequent the wind focus area. Southern Pale-chanting Goshawk and Jackal Buzzard were also noted using areas in and around the solar focus area. Pied Crows and Cape Crows were observed on a daily basis flying around the proposed wind focus area, usually in small groups, most likely to search for sheep carcasses.

The South African Shelduck was the only waterbird that was observed. Namaqua Sandgrouse, a species restricted to the arid western parts of South Africa, was observed flying in a south-easterly direction to the Granite Pan. The birds would be using the pan as a drinking area. Sociable Weavers were observed flying short distances (<200 m) from their colonies to feedlots where they were seen foraging in the wind focus areas. The location and status of a Secretarybird nest provides evidence that the breeding pair utilise the wind focus area as a foraging zone, but actual movements of the birds would need to be tracked/monitored when the birds are actively breeding (September–December).
Eagle and Ludwig’s Bustard in the solar focus areas. The birds of greatest potential relevance and importance in terms of possible impacts relative to the proposed wind energy facility are likely to be (a) resident and breeding raptors, notably Martial Eagle Polemaetus bellicosus, Verreaux’s Eagle Aquila verreauxii, Cape Eagle-Owl Bubo capensis and possibly Jackal Buzzard Buteo rufofuscus; (b) large terrestrial birds and raptors nesting, foraging on, or moving over, the lowland/plateau interface, including Booted Eagle Aquila pennatus, Southern Pale-chanting Goshawk Melierax canorus, Black-chested Snake-Eagle Circaetus pectoralis, Ludwig’s Bustard Neotis ludwigii, Blue Crane Anthropoides paradiseus and possibly Black Harrier Circus maurus (c) endemic passerines that utilise the ridge lines (Fairy Flycatcher Stenostira scita and most likely African Rock Pipit Anthus crenatus and (d) flocks of waterbirds moving between the wetlands (farm dams and pans) in and around the development sites, notably Greater Flamingo Phoenicopterus ruber and various duck species.

b) Potential Impacts

Wind Energy Facility Potential Impacts

The potential impacts on the avifauna of the site includes displacement and disturbance of resident or breeding Karoo species, large terrestrial birds, resident or migrant raptor species, aerial species and/or mortality of these species caused by collision with the wind turbine blades or power lines, habitat loss, electrocution on new power infrastructure as well as behavioural displacement (alteration of flight paths).

Overall the most important species include (i) Resident and breeding raptors, especially Verreaux’s Eagle (at least one pair was seen and possibly breeding in the footprint area of the solar focus area) Secretarybird (a known nest site just north of the footprint area of the revised wind turbine layout), Martial Eagle, Rock Kestrel and Southern Pale-chanting Goshawk (ii) large terrestrial bird species, especially Ludwig’s Bustard, Kori Bustard and Karoo Korhaan (iii) Populations of localised/range-restricted or biome-restricted species particularly Red Lark, Stark’s Lark, Karoo Lark and Sickle-winged Chat.

Collisions with turbines and power lines

The number of collisions of birds with turbines and power lines ranges from low to high across countries and the world. Although collision rates may appear relatively low in many cases, cumulative effects over time, especially when considered for large, long lived, slow reproducing and/or threatened species (many of which are collision-prone), may be of considerable significance.

Many factors influence the number of birds killed at wind energy facilities. These can be classified into three broad groupings: (i) avian variables, (ii) location variables, and (iii) facility-related variables. It is logical to assume that the more birds there are flying through a site, the higher the chances of a collision occurring. The types of birds present in the area are also very important as some species are more vulnerable to collision with turbines and power lines than others. Species-specific variation in behaviour, from general levels of activity to particular foraging or commuting strategies, also affect susceptibility to collision. There may also be seasonal and temporal differences in behaviour, for example breeding males displaying may be particularly at risk.
Landscape features can potentially channel birds towards a certain area, and in the case of raptors, influence their flight and foraging behaviour. Birds fly lower during strong headwinds due to poor visibility so when the turbines are functioning at their maximum speed, birds are likely to be flying at their lowest height, increasing collision risk.

Larger wind energy facilities, with more turbines, are more likely to result in significant numbers of bird casualties, because they are a greater group risk. Turbine size may also be proportional to collision risk, with taller turbines associated with higher mortality rates in some instances. Illumination of turbines and other infrastructure at night is often associated with increased collision risk, either because birds moving long distances at night do so by celestial navigation, and may confuse lights for stars or because lights attract insects, which in turn attract night birds. However, the turbines under consideration would not be lit at night, except with regulation aviation safety lighting (small, flashing red lights).

Some literature suggests that spacing between turbines can change the number of collisions (i.e. wider spacing results in less collisions), but other literature suggests that all attempts by birds to fly between turbines, rather than over or around them, should be discouraged to minimise collision risk.

Collision prone birds are generally either (i) large species and/or species with high ratios of body weight to wing surface area (wing loading), which confers low manoeuvrability (cranes, bustards, vultures, gamebirds, waterfowl, falcons), (ii) species which fly at high speeds (gamebirds, pigeons and sandgrouse, swifts, falcons), (iii) species which are distracted in flight - predators or species with aerial displays (many raptors, aerial insectivores, some open country passerines\(^\text{27}\)), (iv) species which habitually fly in low light conditions, and (v) species with narrow fields of forward binocular vision. Exposure is greatest in (i) very aerial species, (ii) species inclined to make regular and/or long distance movements (migrants, any species with widely separated resource areas - food, water, roost and nest sites), (iii) species that regularly fly in flocks (increasing the chances of incurring multiple fatalities in a single collision incident).

Soaring species may be particularly prone to colliding with turbines where the turbines are placed along ridges to exploit the same updrafts favoured by such birds for cross-country flying. Large soaring birds such as many raptors and storks depend heavily on external sources of energy for sustainable flight. In terrestrial situations, this generally requires that they locate and exploit pockets or waves of rising air, either in the form of bubbles of vertically rising, differentially heated air (thermal soaring) or in the form of wind forced up over rises in the landscape, creating waves of rising turbulence (slope soaring).

*Habitat loss – destruction, disturbance and displacement*

Birds in the study area are likely to be disturbed, especially shy and/or ground-nesting species. Some studies have shown that specific bird species avoid wind energy facilities due to noise or movement of the turbines or avoidance of the collision impact zone. Power line service roads or servitudes would need to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, and to prevent vegetation from intruding into the legally prescribed clearance gaps between the ground and the conductors, although this is unlikely to
be an issue on site due to the generally low lying vegetation. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retaining cleared servitudes can alter the bird community structure at the site.

**Electrocution on power infrastructure**

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components. Electrocution risk is strongly influenced by the voltage and design of the hardware installed (generally occurring on lower voltage infrastructure where air gaps are relatively small), and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energised components.

*Figure 4.7* and *Figure 4.8* show the locations of a few of the species of concern, and flight paths noted, on the site.

Based on the above, the potential impacts most likely to be experienced at the proposed site include:

- Disturbance and displacement of resident or breeding Karoo species (notably Red Lark, Stark’s Lark, Karoo Lark) from foraging/breeding areas by operation of the facilities;
- Disturbance and displacement of large terrestrial birds (notably Ludwig’s Bustard, Kori Bustard and Northern Black Korhaan) from nesting or foraging areas by operation of the facilities and/or mortality of these species in collisions with new powerlines.
- Disturbance and displacement of resident/migrant raptor species (notably Verreaux’s Eagle, Secretarybird, Martial Eagle, Rock Kestrel and Jackal Buzzard) from foraging/breeding areas by operation of the facilities, and/or mortality of these species in collisions with new power lines, or electrocution when perched on power lines.

The extent of the potential impacts on avifauna would be regional if Jackal Buzzards or Booted Eagles are killed or displaced, or local should only other priority species be affected, such as Ludwig’s Bustard. The duration would be long-term as the ecology of the area would remain affected for as long as the proposed wind energy facilities are operational. Some priority species may be displaced for the duration of the project.

Based on the above the potential impact on birds due to disturbance, displacement and mortality is considered to be of medium-high magnitude, regional extent and long term therefore of medium to high (-) significance for the proposed wind energy facility, without mitigation. With the implementation of mitigation measures this is anticipated to reduce to medium (-) significance. No difference in significance would result from the proposed wind alternatives.

**Solar Energy Facility Potential Impacts**

The potential impacts on the avifauna includes the disturbance and displacement of aerial species (notably raptors, swifts, swallows) from foraging areas by glare and glint from PV cells.. The extent of possible mortality would be local should only priority species such as the Ludwig’s Bustard and Karoo Korhaan be affected. The potential impact on birds due to disturbance, displacement and mortality is considered to be of low-medium magnitude, local extent and long
term and therefore of low to medium (-) significance for the proposed solar energy facility, without mitigation. With the implementation of mitigation measures and revised design layout this is anticipated to reduce to low (-) significance. No difference in significance would result from the proposed wind alternatives.

c) Mitigation measures

The following mitigation measures are recommended:

**Mitigation measures for the wind energy facility**

- Monitor the local avifauna pre- and post-construction for a one year (12 month) period with monitoring in each of the four seasons which will help to establish how birds use the site on an annual basis. Implement appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in the Avifaunal Impact Assessment, or when collision or electrocution mortalities are recorded for any of the priority species listed in the assessment. It should be noted that avifaunal monitoring is currently underway and interim reports will be submitted to DEA as they become available.

- Minimize the disturbance associated with the operation of the facilities, by scheduling maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times. This will primarily be informed by the monitoring and any other additional information that comes to light. Most of it will be related to breeding activities and sites particularly of priority species. Disturbance caused by maintenance activities will need to be kept to a minimum where specific turbines fall within sensitive areas.

**Mitigation measures for the solar energy facility**

The same mitigation measures as proposed for the proposed wind energy facility should be implemented. Post-construction Monitoring of the local avifauna for a one year (12 month) period in accordance with Birdlife South Africa’s guidelines for solar energy facilities.

**d) Cumulative impacts**

Various wind and solar energy applications are proposed for the Northern Cape Province. The nearest renewable energy developments to the Kangnas developments include (a) Springbok wind energy facility (about 50-60 MW, 40 turbines, 8 000 ha, just east of Okiep, approximately 38 km away) and (b) Pofadder wind and solar energy facility (Wind 750 MW, > 500 turbines, and solar 225 MW with a total project area of 17 500 ha, 80 km east of the proposed Kangnas. The Springbok development has not progressed past the EIA phase while the Pofadder wind energy facility is currently in the EIA process. An additional development is the Kannikwvlakte wind energy facility (110 MW, 55 turbines, 1 560 ha) located approximately 90 km west-northwest of Springbok) which has been approved and the pre-construction bird monitoring programme has been finalised.

Viewed in isolation these projects may pose a limited threat to the avifauna of the area. However, in combination with the development of a number of renewable energy facilities in the

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28 Email communication between Doug Harebottle (avifaunal specialist) and Simon Clark (Aurecon) dated 21/02/13.
region the formation of significant barriers to birds either in the form of displacement from foraging areas or reducing energy-efficient travel between resource areas will result as a cumulative impact. Migrant raptors, swallows and swifts and long-distance flyers such as ducks, might be at risk from collisions should their flight paths traverse the locations of the wind energy facilities. Cumulative impacts from the proposed Springbok and Pofadder wind energy facilities would be greatest considering the distances (less than 80 km) between the three development areas and all sites having similar topography and vegetation. Impacts from the Kannikwavlakte wind energy facility would probably be negligible based on distance (140 km) from the proposed Kangnas wind energy facility site.
Figure 4.7: Locations of important bird species at the proposed wind and solar energy facility sites. (Source: D Harebottle, 2012)
Figure 4.8: Observed flight paths of eight priority bird species at the proposed wind and solar energy facilities as observed during a field survey from 24-28 June 2012. (Source: D Harebottle, 2012)
4.2.3 Impact on bats

Many bat species roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas can adversely impact individuals of different communities within the same population concurrently. Urban development and agricultural practices have contributed to a decline in bat numbers globally, as well as in South Africa. Wind energy facilities are known to impact on bats and as such the proposed projects could have an impact on any bats found on the sites. As such Werner Marais of Animalia Zoological & Ecological Consultation was appointed to undertake a bat specialist study. A field survey was undertaken from 18-22 July 2012. Bat activity was observed at dusk and at night. Bat echolocation calls were recorded on a continuous basis, during night and day time, while traversing the study area with a vehicle. The Bat Impact Assessment is included in Annexure G and the findings and recommendations are summarised below.

a) Description of the environment

The inselbergs found on site can prove useful as roosting sites for bats. The two small caves found in the study area can offer roosting space as well as the farm buildings. Precipitation in the area is very low, and channels or streams are temporary, such that surface water on this site is very limited. This reduces the likelihood of the use of the site for foraging. Drainage lines and open water sources are generally used for foraging.

The following bat species could possibly occur in the study area: Geoffroy’s horseshoe bat (Rhinolophus clivosus), Darling’s horseshoe bat (Rhinolophus darling), Egyptian slit-faced bat (Nycteris thebaica), Roberts’s flat-headed bat (Sauromys petrophilus), Egyptian free-tailed bat (Tadarida aegyptiaca), Natal long-fingered bat (Miniopterus natalensis), Angolan wing-gland bat (Cistugo seabrae), Long-tailed serotine (Eptesicus hottentotus), Temmink’s myotis (Myotis tricolor) and Cape serotine (Neoromicia capensis).

The main method of bat detection involved the use of a bat detector which is a device that is capable of recording ultrasonic bat calls that is not always audible to the human ear for computer analysis afterwards. One species was identified and confirmed in the study area, using this method, during the site survey, namely the Egyptian free-tailed bat (Tadarida aegyptiaca). The Egyptian free-tailed bat is a very common bat and can typically be found roosting in crevices and roofs of houses. Their conservation status is of “Least Concern”. Figure 4.9 shows the bat sensitivity of various areas of the site.

b) Potential Impacts

Wind Energy Facility Potential Impacts

Many bat species roost in large aggregations and concentrate in small areas. Furthermore, the reproductive rates of bats are also much lower than those of most other small mammals- usually only 1-2 pups per female annually. Therefore any major disturbance to a small area within which a bat population resides would impact on the whole population and the recovery of the population would be very slow. Since bats have highly sophisticated navigation by echolocation, it is not understood why they are hit by rotating turbine blades. A number of theories exist, one theorizing that under natural circumstances bats’ echolocation is designed to track down and pursue smaller insect prey or avoid stationary objects, not focus on unnatural objects moving...
sideways across the flight path. Another is that bats may be attracted to the large turbine structure as roosting space or that swarms of insects get trapped in low air pockets around turbines and subsequently attracts bats. Whatever the reasons, it has been found internationally that wind turbines can have a negative impact on bats either through physical injury or through barotrauma, the leading cause of bat mortality. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal haemorrhage.

These potential impacts are particularly relevant to migrating bats. However, the migration paths of South African bats in the Northern Cape Province are not well studied and are virtually unknown. Cave dwelling species like Miniopterus natalensis and Myotis tricolor undertake annual migrations and the caves on the site could possibly provide roosting space.

Considering the number of bat species which may be found on site, as well as the potential impacts described above, the majority the potential impact of the proposed projects on bats during the operational phase is considered to be of a low magnitude, regional extent and long term, and thus of a low (-) significance, without mitigation. No difference in significance would result from the proposed wind alternatives.

**Solar Energy Facility Potential Impacts**

No impacts were identified.

c) Mitigation measures

**Mitigation measures for the wind energy facility**

The following mitigation measures are recommended:

- No turbines may be placed in the area indicated as having a High Bat Sensitivity (Figure 4.9) Areas of Moderate Bat Sensitivity must receive special attention and be prioritised in post construction monitoring and implementation of mitigation measures;
- Undertake affordable long term monitoring of bats and the potential impacts of turbines on them to effectively fine tune mitigation.
- Post-construction monitoring of possible bat fatalities is recommended for at least four seasons at the proposed wind energy facility, focusing efforts on turbines in the Moderate bat sensitivity areas and at the two small caves on site. **Pre-construction monitoring is optional for this site.** However Mainstream is currently undertaking pre-construction monitoring. Monitoring should inform and recommend what mitigation measures are required.
- Consider implementing an ultrasonic deterrent device so as to repel bats from wind turbines if any turbines are placed in moderate sensitivity areas. Should this measure prove effective it may be implemented in place of curtailment, should this be agreed to by a bat specialist, based on long term monitoring;
- Research from long term monitoring should be shared with academic institutions to aid in research of the potential impacts of wind energy facilities on bats; and
• Where recommended by long-term bat monitoring, curtailment selected turbines to lessen bat mortalities. Curtailment should be informed by long term bat monitoring which will indicate at which turbines, seasons, time of night and in which weather curtailment is required.

  d) Cumulative impacts

The migration of bats travelling several hundred kilometres in South Africa has been recorded, hence the cumulative impact of several wind energy facilities along migration routes operating without mitigation would be catastrophic to the population sizes of these migrating bats. It would be beneficial to collaborate with academic institutions to research any bat migration routes in relation to location of the site and determine the season of the year migration take place.

Bat populations are slow to recover to equilibrium numbers once major mortalities take place due to low reproductive rates. If any mortality due to blade collisions is allowed to continue without mitigation for a long period of time across the proposed wind energy facility as well as any other wind energy facility proposed in the area, the mortality rate is highly likely to exceed the reproductive rates of local bat populations, causing a high cumulative impact.

29 Curtailment is where the turbine cut-in speed is raised to a higher wind speed based on the principle that bats will be less active in strong winds due to the fact that their insect food cannot fly in strong wind speeds, and the small insectivorous bat species need to use more energy to fly in strong winds.
Figure 4.9: Bat sensitivity map
4.3 OPERATIONAL PHASE IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

4.3.1 Visual impacts

The landscape of the site comprises open, flat plains which are characteristic of the Nama Karoo. Man-made additions to this are largely restricted to farm-related structures such as fences and isolated farmsteads. Such landscapes are dominated by horizontal features and earthy colours, and are hence susceptible to visual intrusion resulting from the construction of industrial infrastructure such as PV facilities and wind energy facilities.

Due to the potential visual impacts of the proposed projects, an independent consultant, Mr Steven Stead of Visual Resource Management Africa CC, was appointed to conduct a Visual Impact assessment (VIA) of the project. This involved a field visit from 25 - 27 June 2012, the preparation of visual montages illustrating the envisaged visual impact, and the generation of viewsheds. The report is included in full in Annexure I and summarised below.

a) Description of the environment

The site consists largely of a vast, open and flat plain which is typical of the Nama Karoo. This landscape is relatively iconic of the Karoo landscape and is strongly associated with South African cultural heritage. Land use in this area consists mostly of large-scale sheep farming. The elevation of the area ranges from 1 000 to 1 100 meters above mean sea level (mamsl), and topographically prominent features include the Koperberg mountain range to the east of the site (elevation 1 016 to 1 205 mamsl) and hills approximately 20 km to the west. Visibility is generally high across the plains and may exceed 24 km.

The scenery present at these sites is common in the area, and as such the overall scarcity of this landscape is rated as low. Modifications to the landscape are dominated by fences and farm tracks, which are minor in nature. The overall scenic quality of the site is moderate to low.

a) Impact assessment

Wind Energy Facility Potential Impacts

The degree to which the proposed project would be visible is determined largely by the height of the turbines and rotors. Visibility is moderated by the distance over which this would be seen, the weather and season conditions and some back-grounding effect from the environment. Factors affecting visibility are the open quality of the site and the surrounding land uses and land cover, which promote high visibility.
Turbines with a height of 120-180 m would generally have a high visibility and a large viewshed, however this is limited by the Klein Koperberg Mountains and to the north by low hills located between the site and the N14. The proposed wind energy facility would fall within the foreground / middle-ground view (<6 km) for a short 3 km section of the N14, but would otherwise be located in the background and hence have a moderate to low visual exposure. The 6 km and 24 km viewsheds of the proposed wind energy facility are illustrated in Figure 4.10.

Key observation points from which the visual impact of the wind farm was assessed are the N14 foreground, N14 west background, N14 east background and the R355 road (see Figure 4.12). The contrast in form, line, colour and texture that would be created by the proposed wind facility against the natural background are largely weak to moderate, with strong contrasts (in line, colour and texture) being limited to the R1 observation point (the N14 foreground). Photomontages illustrating the proposed project for various viewpoints are provided in Figure 4.12 and Figure 4.13.

Tourist areas which receive a greater number of visitors are more sensitive visual receptors. Such a receptor is the Geogap Nature Reserve, located 11 to 18 km west of the site. The terrain within this reserve and to the west is rugged and undulating and hence the proposed wind facility would only be visible from high-lying sections in the east where the Blou-myn 4x4 route is located. Most activities in the reserve take place in valleys in the west, from which the wind farm would not be visible. It is highly unlikely that the sense of place at this reserve would be affected.

The R355 road to the southwest of the site (key observation point R4) has a rural/infrastructure land-use and is hence more susceptible to changes in the sense of place than major roads such as the N14 (key observation points R1 and R2). The R355 is located 17 km southwest of the site and, while the turbines would be poorly visible from it, they would not significantly affect the sense of place. The installation of lights on the turbines would have a greater impact on the night-time sense of place, however these can be contained. The site of the proposed wind farm is remote and contains very few receptors, the most prominent being a short section of the N14. As such the proposed wind energy facility would be in the background for most receptors.
Figure 4.10: Viewshed of proposed wind turbines with offset of 180 m (tallest alternative) above ground.
Figure 4.11: The location of key observation points and their distance from the proposed site of the proposed wind turbines.
Figure 4.12: Photomontage of proposed wind turbines as viewed from the N14 eastbound foreground (R1 in Figure 4.11; for illustrative purposes only).

Figure 4.13: Photomontage of proposed wind turbines as viewed from the N14 westbound (R2 in Figure 4.11; for illustrative purposes only).
The scenic resources of the Goegap Nature Reserve would not be impacted. The majority of the potential visual impacts are considered to be of low intensity, regional extent and long term and therefore of medium to high (-) significance, without mitigation. The preliminary layouts were revised and with the implementation of mitigation measures the intensity would be reduced to very low and as a result reduce the significance of the visual impact to low (-) for all alternatives. No difference in significance would result from the proposed wind alternatives although there is a preference for the taller (180 m) turbines as this would reduce clustering.

**Solar Energy Facility Potential Impacts**

Three key observation points were identified for the proposed PV facility: the Varsputs farmstead, the N14 eastbound and the N14 westbound, located 2.52 km east, 1.1 km south and 0.98 km southeast of the site respectively.

The visual absorption capacity of the area around the proposed PV site is low as the terrain is flat and the vegetation short. The overall sensitivity of the receiving environments, which is based on an assessment of the type and number of users, the public interest and the presence of special areas, is generally moderate to high.

The proposed PV array would be visible as a wide, flat horizontal form and hence would have a low form contrast and impact. The contrast in the texture (smooth PV panels versus rough background) and colour (grey-black PV panels against grey-brown background), contribute to a moderate overall visual impact from the Varsputs farmstead.

PV panels with a height of 10 to 16 m have identical viewsheds, extending largely to the northeast and northwest (Figure 4.14). This is away from Springbok and the Goegap Nature Reserve, which are located to the southwest and largely shielded from the PV focus area by the mountains.

The overall visual impact that the proposed PV facility would have is determined to be of moderate significance as the site is remote and installations are not high. Hills to the west would shield the site from the Goegap Nature Reserve, and the 750 m buffer around the nature reserve and existing 220kV power line to the south would shield the site from the N14.

The visual impacts of the proposed PV facility are consider to be medium magnitude, regional extent and long term and therefore of medium (-) significance without or with mitigation. No difference in significance would result from the proposed solar alternatives although there is a preference for the 10 m height.
Figure 4.14: Viewshed of proposed PV panels with offset of 16m above ground level.
Mitigation measures for the wind energy facility

- LED lighting should be used.
- Lighting should be kept to an efficient minimum while still keeping within the safety norms. See Annexure 3 of the Visual Impact Assessment for an explanation, and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility, a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corporation has been included (see Annexure 3).
- Rehabilitation of previously modified areas should be continually undertaken.
- No branding on the turbines.
- No lights on the blade tips (within safety limits).

Mitigation measures for the solar energy facility

- LED directional lighting, with no overhead lighting, should be used to prevent light spillage.
- Lighting should be kept to an efficient minimum while still keeping within the safety norms. See Annexure 3 of the Visual Impact Assessment for an explanation, and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility, a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corporation has been included (see Annexure 3).
- Rehabilitation of previously modified areas should be continually undertaken.

Cumulative impacts

The construction of infrastructure to harness solar and wind energy and feed this into the national grid would likely attract additional PV and solar facilities, and associated transmission infrastructure, to the area. This may result in the transformation of a significantly larger area...
from agricultural to energy generation than what is proposed as part of this project. Such a transformation may limit the area available for farming, and place limitations on eco-tourism possibilities. However, it is not possible to estimate the significance of this cumulative impacts as not all facilities receiving environmental approval would be constructed. Furthermore, no nearby approved facilities have been identified. Only one proposed wind and solar facility near to Pofadder is currently undergoing an EIA process and hence could have cumulative impacts.

4.3.2 Impact on climate change

The establishment of renewable energy facilities would reduce South Africa’s future reliance on energy from coal-fired power stations which could in turn reduce the future volume of greenhouse gases emitted to the atmosphere, reducing the greenhouse effect on a regional, national and international scale.

a) Description of the environment

Gases which contribute to the greenhouse effect are known to include carbon dioxide (CO$_2$), methane (CH$_4$), water vapour, nitrous oxide, chlorofluorocarbons (CFCs), halons and peroxyacylnitrate (PAN). All of these gases are transparent to shortwave radiation reaching the earth’s surface, but trap long-wave radiation leaving the earth’s surface, acting like a greenhouse. This action leads to a warming of the earth’s lower atmosphere, with changes in the global and regional climates, rising sea levels and extended desertification. This is turn is expected to have severe ecological consequences and a suite of implications for humans. Total greenhouse gas emissions reported to be emitted within South Africa for the 2008 year was approximately 435 million metric tons of CO$_2$ equivalent (UN Statistical division, 2011).

b) Impact assessment

Greenhouse gases released from a new coal-fired power station are primarily CO$_2$ with minor amounts of nitrous oxide (N$_2$O). The Medupi Power Station (4 788 MW), currently under construction near Lephalale in Limpopo, is expected to produce 29.9 million metric tons of CO$_2$ per annum. The emissions from Medupi Power Station would increase South Africa’s CO$_2$ equivalent emissions (2008) by some 7 %. This is a significant increase in greenhouse gas emissions, given the aims of the Kyoto Protocol, which are to reduce overall emission levels of the six major greenhouse gases to 5 % below the 1990 levels, between 2008 and 2012 in developed countries. While South Africa, as a developing country, is not obliged to make such reductions, the increase in greenhouse gas emissions must be viewed in light of global trends to reduce these emissions significantly.

No greenhouse gases are produced by wind or solar energy facilities during operation, as wind drives the turbines that generate the electricity and the rays of the sun are converted to electrical energy. Although wind and solar energy facilities would not completely replace coal-fired power stations within South Africa, since these would still be required to provide base-load, they would reduce South Africa’s reliance on them. This would assist in reducing future volumes of greenhouse gas emissions.
A life-cycle analysis looks at the entire chain of activities needed for electricity production and distribution, such as fuel extraction and transport, processing and transformation, construction and installation of the plant and equipment, waste disposal, as well as the eventual decommissioning. Every energy technology (wind, hydro, coal, gas, etc) has its own very distinct fuel cycle. A comparative life-cycle analysis for the current energy technologies used in Europe was conducted by AUMA (2000). The study focused mainly on emissions from the various energy technologies. Although the results of the analysis are not necessarily entirely accurate in the South African context, they offer a good proxy for a comparative assessment of coal-fired and wind and solar energy facilities in South Africa. The results of the analysis are illustrated graphically in Figure 4.16 below.

It is evident from Figure 4.16 above that small to almost negligible environmental impacts are associated with renewables, particularly wind, relative to fossil fuels such as coal, over the entire life-cycle.

**Figure 4.16: Matrix of environmental impacts by categories (AUMA, 2000)**

While the proposed wind and solar energy facilities would not provide an equivalent amount of energy as a typical new coal-fired power station (560 and 225 MW, respectively compared to...
When considered with regards to climate change and given the spirit of the Kyoto Protocol, the impact is deemed to be of regional extent, very low magnitude and long term and therefore of low (+) significance for both the proposed wind and solar energy facilities, without mitigation.

c) Mitigation measures

No mitigation measures are recommended.

d) Cumulative impacts

Many wind and solar energy facilities are proposed throughout the Northern Cape and South Africa. Although not all those proposed will be constructed, a large number will be operating in the next few years. Given the number of wind and solar energy facilities proposed across the country, the potential cumulative impacts of the proposed projects on the potential reduction in future greenhouse gas emissions is considered to be of regional extent, low magnitude and long term, and therefore of medium (+) significance.

4.3.3 Impact on local and regional economy

The Northern Cape region of Southern Africa has been identified as producing levels of sunlight which is ideal for solar energy plants as well as sufficient wind for wind farms. In light of the current energy crisis and the pressure on the country to increase its share of renewable energy the opportunities for private renewable energy producers to supply Eskom power grid with energy is becoming more financially feasible. In light of the proposed wind and solar energy facilities a Socio-Economic Impact Assessment was undertaken by Urban-Econ (included in Annexure L). Background information was gathered through a literature review. A site visit was conducted from 27-29 June 2012. Modelling was undertaken to determine the economic impacts of the proposed development using Input-Output modelling. The economic findings and recommendations of the Socio-Economic Impact Assessment are discussed below.

a) Description of the environment

The Nama Khoi Local Municipality (LM) covers a geographical area of 14 921 km² which is approximately 12 % of Namakwa District Municipality. The municipality has a population density of 3.9 people per km² and a household density of 1.1 households per km² in 2012. This indicates that the communities are very dispersed. The total population equates to approximately 1.1 million and a total of 277 551 households within the Nama Khoi municipal area. The town of Springbok has the largest population. The majority of households are housed in a permanent house or brick structure. This is a positive indicator in terms of the development levels and quality of life in the area.

The majority of the adult population in Nama Khoi LM have some education but did not obtain their Grade 12. This means that the majority of the adult population have a low skill level and would either need job employment in low-skill sectors, or better education opportunities in order to improve the skills level of the area, and therefore their income levels. The majority (48.6 %) of
the population is semi- and unskilled. This will not change or improve unless education levels are improved. The more skilled people become the more income they will earn.

The employment profile of the study area is an important indicator of human development, but also of the level of disposable income and therefore the expenditure capacity of the residing population. Nama Khoi LM is largely populated by potentially economically active and young people. During 2009, 38.6% were employed. This implies that there is a large amount of human capital available for any kind of work, but also that there is space for training and developing young and economically active people in highly qualified occupations in the relevant fields needed. Furthermore, development projects need to take into consideration the mode of transport utilized by the labour force. New industrial developments should not be situated far away from the pick-up or drop-off points of various means of transportation. The level of employment and the type of occupations taken up by the population of the LM directly affects the income levels of its people. 57.7% of households fall within the poverty level. The high poverty level has social consequences.

b) Impact assessment

Note that construction phase impacts on the local and regional economy are assessed under Section 4.3.

The main economic effects that were measured were employment numbers, Gross Geographic Product (GGP) and new business sales in order to determine the impact of the proposed projects on the local residents. These impacts were quantified in terms of direct, indirect and induced impacts. Descriptions of these measures are as follows:

- Impact on employment numbers: The number of additional jobs created or jobs lost as a result of the change in the economic growth of the local economy. This is the most popular measure of economic impact because it is easier to comprehend than large, abstract Rand figures.
- GGP: This measures the broader impact of the full income effect and essentially reflects the sum of wage income and corporate profit generated in the region.
- New Business Sales: This measures the impact on Business Output (also referred to as revenue or sales volume) and is the broadest measure of economic activity as it generates the largest numbers. It includes the gross level of business revenue, which pays for cost of materials and cost of labour, as well as generating net business income profits.

- Additional New Business Sales:

The cost implications for the proposed projects for the annual operations are less than that of the construction phase and as a result the impacts on new business sales will be less than the impacts analysed in the construction phase. However, the impacts from the construction phase are a one-off and the impacts during the operational phase would accrue each year during operation therefore the total impacts from the operational phase would in time surpass those of the construction phase, provided the projects operate for a number of years. The total impact that the proposed wind farm should have on new business sales during the operational phase is R185,500,000 (summation of direct, indirect and induced impacts). These new business sales should accrue to businesses that are directly involved in the maintenance, security and other...
operational activities required for the proposed facilities. The total impact for the proposed solar energy facility during the operational phase is R158 260 000 (Table 4.1).

Table 4.1: New business sales during operational phase, for a 250 MW solar and a 750 MW wind energy facility

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<th>Indirect Impact</th>
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<td>R930,000</td>
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**Photovoltaic Plant**

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<td>R0</td>
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</tbody>
</table>

- **Additional Gross Domestic Product (GDP):**

The total impact that the proposed wind farm would have on additional GDP during the operational phase is R39 730 000, while the total impacts of the proposed solar energy facility should amount to R45 470 000 during the operations of the proposed development (Table 4.2). The direct stimulation for the increase in production is the increase in new business sales. Thus these two economic indicators are mutually related.
### Table 4.2: Additional GDP during the operational phase, for a 250 MW solar and a 750 MW wind energy facility

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<tr>
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<td>R1,430,000</td>
<td>R3,260,000</td>
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<tr>
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<td><strong>Total</strong></td>
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**Photovoltaic Plant**

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**No-Go Alternative**

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- **Impact on employment**

With the sustainable nature of operational activities, the employment opportunities which would be generated during this phase of the development, are purported to be full time or long term employment opportunities and if they are occupied by local residents and provided by local ventures, the development would benefit the local economies and ease unemployment and income hindrances, which in turn would stimulate further expenditure and sales within the economies. The total impact during the operational phase of the proposed wind and solar energy facilities should have on employment is 226 new permanent employment opportunities during the operations of the wind energy facility, and 309 new permanent employment opportunities during the operations of the solar facility (Table 4.3).
Table 4.3: Impact on employment during operational phase, for a 250 MW solar and a 750 MW wind energy facility

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<td>Services</td>
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<td><strong>Total</strong></td>
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<td><strong>126</strong></td>
<td><strong>53</strong></td>
<td><strong>309</strong></td>
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<tr>
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<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
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<tr>
<td>Mining</td>
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<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Manufacturing</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Utilities</td>
<td>0</td>
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<td>0</td>
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<td>Construction</td>
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<td>Trade and accommodation</td>
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<tr>
<td>Transport</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Financing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Business services</td>
<td>0</td>
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<td>Services</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

Impact on tourism industry

The operational phase of the proposed wind and solar energy facilities should have a neutral impact on the tourism industry. Although the operations and presence of a wind and solar energy facilities could serve as tourist attraction and increase the diversity of tourism operations in the region (to include green tourism) it would not necessarily contribute to an increase in tourist. It is not anticipated that the proposed facilities would have any impact on the numbers of tourists at the Goegap Nature Reserve.

The potential impact from both the proposed wind and solar energy facility on new business sales, GDP and employment would be of regional extent, very low to low magnitude and
medium term and therefore of very low to low (+) significance. With the implementation of the mitigation measures as recommended below the impact for both the wind and solar energy facilities would be of very low to medium (+) significance. There would be no difference in significance for any of the alternatives for the proposed wind or solar energy facility.

c) Mitigation measures

Mitigation measures for the wind energy facility

- Source local labour, businesses and resources for supply, where possible.
- Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and the methods and procedures that are to be used to communicate with pertinent suppliers. These standards need to be carefully defined and analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.

Mitigation measures for the solar energy facility

The same measures as recommended for the proposed wind energy facility should be implemented.

d) Cumulative impacts

A number of other wind and solar energy developments are planned for the Northern Cape in addition to the Kangnas Wind and Solar project. A number of other wind and solar developments are to be located in the vicinity of the Kangnas development (Springbok wind energy facility, the Pofadder wind energy facility and the Kannikwakakte wind energy facility). None of these developments have progressed past the EIA process. The cumulative impacts of the Kangnas wind and solar facility (independently and collectively with the other proposed developments) will be positive to both local and regional societies and economies. Cumulatively the impacts of the Kangnas development and the other proposed developments will be greatest on employment, and regional development in the form of new business sales and regional GGP (if mitigation measures and recommendations are implemented to stimulate manufacturing activities in the region to support the green industry, and spin off investments and activities).

4.3.4 Operational phase impacts on social environment

a) Description of the environment

The majority of households in the Nama Khoi LM are housed in a permanent house or brick structure. This is a positive indicator in terms of the development levels and quality of life in the area. The majority of households within the Nama Khoi LM have access to services (i.e. water, electricity, sanitation, and refuse removal) but these services are not always proved in a constant way. Many rural areas still lack basic infrastructure such as roads, water and electricity
supply. This lack of infrastructure entrenches the problems of chronic poverty and limits the potential of communities to sustain economic growth, rural livelihoods and social development.

b) Impact assessment

In order to facilitate the operation of the proposed wind and energy facilities a need would arise for the upgrade of various infrastructures such as roads. This impact is not limited to the construction phase only as it would promote the local economy and business development in the Springbok area. The local communities would also benefit as the area currently is in need of various infrastructure upgrades, especially with regards to electricity infrastructure. With the operations of the wind and solar energy facilities in the local municipal area, it may serve as a catalyst for additional investment resulting from and relating to the generation and manufacture of green energy which might lead to additional investment through the continued operations. An important social benefit of the operations of the development would be skills development. With the some 500+ individuals that are forecast to be generated by the development (Table 4.4), a number of these have been designated for FET (further education training). This will enable local individuals to stimulate their own local economies, should the skills and training obtained effectively be reintegrated into the local and regional economies.

Table 4.4: Employment during operation phase, for a 250 MW solar and a 750 MW wind energy facility

<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Layout 1: Wind Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>69</td>
<td>107</td>
<td>46</td>
<td>222</td>
</tr>
<tr>
<td>Alternative 1: Photovoltaic Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>130</td>
<td>126</td>
<td>53</td>
<td>309</td>
</tr>
<tr>
<td>No-Go Alternative:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Sales</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Additional GGP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Employment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Impact on infrastructure and resources

As the proposed site for the development is located outside the town of Springbok, it will not contribute significantly to improvement of the infrastructure of Springbok or other towns in the area. The proposed development would contribute to more effective electricity infrastructure in the region, mainly through the efficient and effective supply of electricity to local communities. The operations of the development may also result in the improvement of road and water infrastructure in the area.

- Impact on social lives of local communities

Due to possible new business sales and additional production in the local and regional economies (see operating expenditure in Table 4.5) improved incomes and business development would be created that would benefit the standard and quality of living for the Springbok community. In addition, the employment that would be provided and the recommended skills development that would result from the construction and operations would...
also improve the social dynamics of the local and regional area, by not only providing these households with a source of income, but also providing them with the means to generate their own income and create additional employment for local communities.

- **Impact on employment and income**

Employment opportunities generated during the operational phase is assumed to be more permanent in nature, as this employment created pertains to each year that the proposed facilities would be in operation. Although the employment will be distributed locally, regionally and nationally the creation of over 500 permanent employment opportunities by one developing sector is a significant positive for South Africa and the local and regional economies.

**Table 4.5: Operating expenditure, for a 250 MW solar and a 750 MW wind energy facility**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Entire Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm</strong></td>
<td></td>
</tr>
<tr>
<td>Project Size</td>
<td>750 MW</td>
</tr>
<tr>
<td>Project Operating Expenditure</td>
<td>R124,900,000</td>
</tr>
<tr>
<td>Local Expenditure</td>
<td>R67,500,000</td>
</tr>
<tr>
<td>% of local expenditure in Total Project cost</td>
<td>54%</td>
</tr>
<tr>
<td><strong>Photovoltaic Plant</strong></td>
<td></td>
</tr>
<tr>
<td>Project Size</td>
<td>250 MW&lt;sup&gt;30&lt;/sup&gt;</td>
</tr>
<tr>
<td>Project operating expenditure</td>
<td>R86,000,000</td>
</tr>
<tr>
<td>Local Expenditure</td>
<td>R60,200,000</td>
</tr>
<tr>
<td>% of local expenditure in total project costs</td>
<td>70%</td>
</tr>
</tbody>
</table>

The potential impact on infrastructure and resources, social lives and income of communities for both the proposed wind and solar energy facilities is of local to regional extent, very low to low magnitude and medium term and therefore of very low to low (+) significance. With the implementation of the mitigation measures for both the wind and solar energy facilities as recommended below this impact would be of low to medium (+) significance. There would be no difference in significance for any of the alternatives for the proposed wind or solar energy facility.

**c) Mitigation measures**

**Mitigation measures for the wind and solar energy facility**

- Establish an educational notice board in order to provide an ideal practical learning environment for local and district schools.
- Source supplies from local labour, businesses and resources, where possible.
- It is recommended that the local government and stakeholders undertake the necessary studies to ascertain as to whether establishing manufacturing activities in the area related to the proposed activities and the green energy industry is feasible.

<sup>30</sup> This has since reduced to 225 MW but this reduction would not affect this assessment significantly.
d) Cumulative impacts

The cumulative impacts of the Kangnas wind and solar facility (independently and collectively with the other proposed developments) would be positive to the social wellbeing of the local community. Cumulative impacts from the proposed developments will also have significant cumulative impacts on energy provision in the area. Although the energy generated from the sites would be sold to Eskom and feed into the main grid, the provision and upgrading of energy infrastructure in the immediate local municipalities will have positive cumulative impacts on energy provision which would also benefit local economies, which rely heavily on effective provision of electricity in order to function efficiently.

4.3.5 Impact on agricultural land

The proposed site is used for agricultural purposes, consisting of sheep, cattle, goats and game grazing and as such Mr Kurt Barichiev of SIVEST (Pty) Ltd was appointed to undertake an Agricultural Impact Assessment. Both a desktop review and a field verification was undertaken from 24 – 30 June 2012 in order to inform the Agricultural Impact Assessment. The study considered climate, soils, terrain, land capability, geology, current agricultural practices and agricultural potential. The Agricultural Impact Assessment is included in Annexure M. The findings and recommendations of the study are summarised below.

e) Description of the environment

Agricultural potential is described as an area’s suitability and capacity to sustainably accommodate an agricultural land use.

Climate

The study area has a semi-arid to arid continental climate with a winter rainfall regime i.e. most of the rainfall is confined to winter and early autumn. Mean Annual Precipitation (MAP) is approximately 195 mm per year. An MAP of 195 mm is deemed extremely low as 500 mm is considered to be the minimum amount of rain required for sustainable dry land farming. Without some form of supplementary irrigation natural rainfall for the study area is insufficient to produce sustainable harvests. This is reflected in the lack of dry land crop production within the site.

The region typically experiences hot days with an average midday temperature of 28°C in summer, with average night time temperatures dropping to around 4°C during winter (http://www.saexplorer.co.za). Evaporation for the region is estimated at between 2 000 and 2 200 mm per annum. In summary the climate for the study area is severely restrictive to arable agriculture which is primarily due to the lack of rainfall and severe moisture availability restrictions.

Geology

The study area is underlain by a variety of geologic materials including, Sedimentary, Gneiss, Quartzite and Tillite. Non-descript sedimentary geologic materials dominate much of the Kangnas site, and this material is found on all five farm portions. Tillite, consisting of
consolidated masses of unweathered blocks and unsorted glacial till, is found in non-contiguous zones throughout the site and particularly on the remainder of Farm Kangnas (No.77).

Gneiss, a coarse grained metamorphic rock which is characterised by alternating light and dark bands, differing in mineral composition, is found along the western boundary of Farm Smorgen Schaduwe and Farm Areb. A ring of Quartzite, a medium grained metamorphic rock, underlies the north eastern portion of the study area and is formed from recrystallised sandstone with the fusion of sedimentary quartz grains.

**Slope**

Slope or terrain is used to describe the lie of the land. Terrain influences climate and soil characteristics and thus plays a dominant role in determining whether land is suitable for agriculture. In most cases sloping land is more difficult to cultivate and is usually less productive than flatland, and is subject to higher rates of water runoff and soil erosion.

The majority of the site is characterised by flat plains and gently sloping topography with an average gradient of less than 5%. These plains are ideal areas for intensive agriculture, with a high potential for large scale mechanisation. From a developmental perspective, the flat topography would also allow for minimal earthworks and site preparation. The site does, however, contain sporadic steep rocky outcroppings and ridges particularly on Farm Arab, Farm Smorgen Schaduwe and the northern areas of Portion 3 of the Farm Kangnas (No.77). These outcrops and ridges are limiting to arable agriculture.

**Land use**

According to the Environmental Potential Atlas for South Africa (ENPAT) Database and 2010 land cover data the site consists of a mix of natural veld and unimproved shrubland which is used as grazing land for sheep, goats and cattle. According to the spatial databases there are no cultivated fields or irrigated lands on site.

**Soils**

The ENPAT for the Northern Cape Province shows the majority of the study area is dominated by shallow Red Aapedal (structureless) soils with a high base status. The southern and eastern portions of the site are classified as having an effective soil depth (depth to which roots can penetrate the soil) of less than 0.45 m deep, which is a limiting factor in terms of sustainable crop production. Marginally deeper soils are found on the northern portions of the site and particularly on Farm Areb.

**Agricultural potential**

Highly restrictive climate characteristics dramatically reduce the agricultural potential of the site. The combination of low, unpredictable rainfall and a severe moisture deficit means that sustainable arable agriculture cannot take place without some form of irrigation. The sites do not contain, nor are they bounded by a reliable surface water irrigation resource, and the use of borehole water for this purpose does not seem agriculturally and economically feasible. This is due to the high cost of borehole installation, the sheer volume of water required for irrigation purposes and the brackish nature of the local groundwater.

According to the ENPAT agricultural dataset the south eastern portion of the site is dominated by soils which have a poor suitability for arable agriculture but which can still be used as grazing
land. The ridges and high spots are not suitable for agriculture, grazing or forestry due to rocky soils and rough topography. These areas are confined and are not suitable for arable agriculture, but still remain suitable for grazing.

By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderately low for grazing. This poor agricultural potential rating is primarily due to highly restrictive climatic characteristics and soil related limitations. The site is not classified as high potential nor is it a unique dry land agricultural resource (see Figure 4.17 for Agricultural potential map for the site).

h) Impact assessment

The proposed projects primary impacts on agricultural activities would involve the footprints of a wind energy facility, a solar energy facility, a main substation and associated infrastructure. Only a portion (less than 1 %) of the site would be affected.

Wind Energy Facility potential impacts

The entire site is dominated by grazing land and is considered non-sensitive when assessed within the context of the activities associated with the proposed wind energy facilities. Consequently, the impact of the proposed development on the study area’s agricultural potential would be extremely low. The hardstandings, turbines and associated infrastructure such as roads and substations footprint of typical wind energy facility generally covers approximately 1% of the impacted area, which is considered to be insignificant. The remaining land would continue to be used for grazing.

There are no centre pivots, irrigation schemes or active agricultural fields which would be influenced by the proposed wind turbine layout. Consequently the overall impact of the wind energy facility on soil resources would be of local extent, very low magnitude and long term and therefore of very low (-) significance, and no mitigation measures are recommended for the revised final layout. No difference in significance would result from the proposed wind alternatives.

Solar Energy Facility potential impacts

The proposed PV/CPV solar energy facility’s primary impact on agricultural activities would involve the construction of the solar fields and associated infrastructure.

Unless grazing is permitted within the solar site, the proposed solar project would effectively eliminate the lands agricultural potential, for as long as the development persists (worst case scenario). However, the proposed solar project and associated infrastructure would only influence a small portion of the total farm area (approximately 800 ha). The remaining land would continue to function as it did prior to the development (approximately 7 647 ha or 87 % of the Farm Areb). Farm Areb has low agricultural value and is replaceable. Consequently, the overall impact of the proposed solar energy facility on the site’s agricultural potential and production would be low, due to the site’s low inherent agricultural potential and value. Thus the potential impact on soil resources would be of local extent, very low magnitude and long term and therefore of very low (-) significance, without mitigation. No difference in significance would result from the proposed solar alternatives.
Figure 4.17: Agricultural potential map (source: SIVEST, 2012)
c) Mitigation measures

Mitigation measures for the wind energy facility

The following mitigation is recommended for the proposed wind energy facility:

- Avoid homesteads and interact with land owners with regards to the final turbine positioning.

Mitigation measures for the solar energy facility

The following mitigation is recommended for the proposed solar energy facility:

- Allow periodic grazing of sheep within the PV site in order to minimise the loss of grazing land and allow agricultural production to remain virtually unaffected. However, it has been noted by Mainstream that this would not be possible due to power purchase agreement (PPA) guarantees and security concerns.

d) Cumulative impacts

The proposed projects are not expected to have any cumulative impact due to the minor loss of agricultural land.

4.3.6 Impact on freshwater

The topography of the study area is relatively flat, although a few ridges and granite inselbergs are present in the landscape. The site is situated on a watershed between the Orange River and the Buffels River and its main freshwater features consisting of small ephemeral streams that drain the onsite inselbergs for a short period following rainfall events. The potential exists for the proposed wind and solar energy facilities to impact on freshwater features, modify water quality, cause erosion and/or invasive plant growth. As such a freshwater study was undertaken by Mrs Antonia Belcher. A desktop review was undertaken as well as a more detailed assessment of the freshwater features at the sites. A site visit was conducted on 14 July 2012 in order to inform the Freshwater Impact Assessment. During this study, the characterisation, mapping and integrity assessments of the freshwater features were undertaken. The Freshwater Impact Assessment is included in Annexure J. The findings and recommendations of the study are summarised below.

a) Description of the environment

The site is largely spread over the watershed between minor, northward flowing tributaries of the Orange River and the south and westward flowing tributaries of the Buffels River. The main freshwater features within the study area consist of a number of small ephemeral streams (Figure 4.18, Figure 4.19 and Figure 4.20) that drain the inselbergs for a short period following rainfall events.

These small drainage channels are discernible only as slightly shallow depressions with no clear associated vegetation and slightly clayey soils. The presence of larger drainage channels is a result of the confluence of a number of the small drainage channels and is more defined
and significant in terms of ecosystem functionality. There are also two small springs and ephemeral pans at farms Kangnas and Koeris.

The geology of the study area can be described as being underlain by bedrock of the Namaqua-Natal Metamorphic Province. Shallow rock occurs on the higher lying areas of the plateau which are water recharge areas. Tertiary to recent sand deposits and tillite covers the area and overlying soils on the plains are freely drained structure-less soils with excessive drainage, high erodibility and low fertility. The ephemeral streams have no visible aquatic vegetation.

The rivers in the western half of the study area have been identified as having conservation importance according to Freshwater Ecosystem Protected Areas (FEPA) map (Figure 4.20). FEPA s are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity. There were no aquatic features identified as part of the Critical Biodiversity Areas mapping. The surrounding terrestrial landscape is seen as an ecological support area with limited loss of ecological functioning.

![An ephemeral tributary of the Orange River (source: Belcher, 2012)](image)

**Figure 4.18: An ephemeral tributary of the Orange River (source: Belcher, 2012)**

**b) Potential Impacts**

**Wind Energy Facility Potential Impacts**

The potential impacts on the freshwater systems on the sites would include limited loss of natural vegetation associated with the ephemeral systems, altered surface runoff, water quality modification, erosion and invasive plant growth. The turbines are designed to operate continuously, unattended and with low maintenance. Major impacts associated with the access roads during the operation phase relate to disturbance to the instream and riparian habitat of the freshwater ecosystems along the designated routes. There would be basic operation and maintenance including storage facilities on site. Septic tanks or similar would be installed for operational staff. Erosion and sedimentation from the project activities, together with the potential for invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats.

The proposed wind energy facility would not have an impact on the runoff from the 1:100 year flood as the infrastructure is widely spaced and the impervious surfaces constitute a small percentage of the total area. However, the proposed facility would be subject to overland or sheet flow and design of any roads within the development site would have to implement measures to accommodate this.
Figure 4.19: Water features in the study area
Figure 4.20: Freshwater Ecosystem Priority Areas for the study area (SANBI, 2012), general site area encircled (source: Belcher, 2012)
The potential impact on freshwater is considered to be of local extent, low magnitude and long term, and therefore of very low (-) significance, with and without mitigation. No difference in significance would result from the proposed wind alternatives.

**Solar Energy Facility Potential Impacts**

During the operation phase the proposed solar energy facility would be monitored and controlled remotely. When required, a mobile team would conduct maintenance of the panels. Regular cleaning of the panels to remove dust, dirt, pollen, and bird excretions would be required to ensure that the maximum quantity of sun rays can be captured by the PV panels. The frequency of panel cleaning would depend on the site conditions. Panels would be washed with water and a mild, organic, and non-abrasive detergent. Potential impacts associated with the access roads during the operation phase relate to disturbance to freshwater related habitats at river crossings for transmission lines and access routes to the solar panels and increased runoff.

According to a hydrology study undertaken for the proposed project, the PV facility would increase runoff from the site, however this runoff would not coincide with the flood peak of the upstream catchment. This means that the larger flood peak from the combined catchment would not be increased by the increased runoff from the PV area and the impact of the 1:100 year flood is therefore limited.

A localized long term impact of moderate to low intensity and local extent and therefore very low (-) significance, without and with mitigation, would result on the aquatic resources. No difference in significance would result from the proposed solar alternatives.

c) Mitigation measures

The following mitigation measures are recommended:

**Mitigation measures for the wind energy facility**

- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Monitor invasive alien plant growth on an ongoing basis to ensure that disturbed areas do not become infested with invasive alien plants.
- Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/wellpoints.
- Compile a stormwater management plan and maintain storm water run-off infrastructure to mitigate both the flow and water quality impacts of any storm water leaving the site.
- Stabilise any erosion areas soon as possible should they develop.

**Mitigation measures for the solar energy facility**

The same mitigation measures as those recommended for the proposed wind energy facility should be implemented, as well as:

- The stormwater management plan should address the discharge of runoff into the watercourses flowing across the site to ensure that erosion of the river channels does not occur.
d) Cumulative impacts

Current land and water use impacts on the ephemeral streams are low. Due to the ephemeral character of these surface water systems, they are also slow to recover from any impacts. The nature of the proposed projects means that they have minimal impact on the surface water features, with the correct mitigation measures. Most of the proposed activities are outside of the identified freshwater features therefore the overall cumulative impact should be limited and of low (-) significance.

4.3.7 Impact of noise

The study area falls in the Nama Karoo Biome and has a rural character in terms of the background sound levels. The potential exists for noise from the proposed wind turbines to affect surrounding landowners and the ambient noise environment. As such Mr Morné de Jager of M² Environmental Connections was appointed to undertake a specialist study and a site visit was undertaken between 27 to 29 May 2012 to inform the Noise Impact Assessment (NIA). The study considered the current ambient sound character and undertook noise propagation modelling for both the construction and operational phases. Potentially sensitive receptors were initially identified using Google Earth®, supported by the site visit to confirm the status of the identified dwellings. The area studied in terms of the noise impact of the proposed projects was approximately 466 km² and included an area up to a radius of 2 000 m beyond the proposed wind turbines. The Noise Impact Assessment is included in Annexure K. The findings and recommendations of this study are summarised below.

a) Description of the environment

The N14 transects the site in the north and there are no residential communities close to the proposed development. The area can be considered rural in nature and the surface area is generally flat with low growing and sparse vegetation. Gravel roads traverse the study area and are mainly used by the farmers in the area. There are a number of notable hills (inselbergs) present, yet the area where the wind focus area is relatively flat, sloping into a southern direction. The study area has a rural character in terms of the ambient sound levels and a number of dwellings and structures are present.

Wind Energy Facility Potential Impacts

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are: intensity, loudness, annoyance and offensiveness.

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources that are associated with components within the turbine, such as the gearbox and generator. Mechanical noise from wind turbines is generally perceived as audible tones that are associated with components of the power train within the turbine. In addition there are other
lesser noise sources, such as the substations themselves, traffic (maintenance) as well as transmission line noise emitted from the proposed wind energy facility.

The exact make and model of wind turbine to be used at this facility is not yet known. It was indicated by the developer that the proposed wind energy facility would likely use 1.5 – 4.0 MW wind turbines. For the purpose of the modelling the sound emission levels of a worst-case conceptual noise source was considered. Typical day time activities would include the operation of the various wind turbines and maintenance activities (relative insignificant noise source). However, the day time period (working day) was not considered for this EIA because noise generated during the day by a wind energy facility is generally masked by other noises from a variety of sources surrounding potentially noise-sensitive developments.

Times when a quiet environment is desired (at night for sleeping, weekends etc.) ambient sound levels are more critical. The time period investigated therefore would be a quieter period, normally associated with the 22:00 – 06:00 timeslot. Maintenance activities were also not considered for the night time period. Ambient sound levels created due to the operation of the various Wind Turbine Generators (WTGs) at night were considered. Because of little vegetation, ground attenuation is minimal, and due to the very quiet ambient sound levels measured, the extent of the area where the ambient sound levels can be changed is quite extensive. As wind speeds increase, wind induced noise levels also increase, and the associated ambient sound levels due to this were also considered at all times together with acoustic energy in the low frequency range due to wind speed. The magnitude of the sound will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions.

Figure 4.21 illustrates the projected change in ambient sound levels (as modelled with the ISO model) with a wind blowing at 5 m/s. It considers the likely ambient sound levels (in $L_{A90}$ statistical sound level descriptor) as well as the projected total noise levels, and calculates how the operational phase may influence the ambient sound levels at night in similar conditions. The Noise Control Regulations refers to the 35 dBA level as the acceptable rating for rural areas. As can be seen the total noise levels however are far below the 35 dBA level and there are few nearby receptors. As such the possibility of complaints are highly unlikely.

Based on the above considerations, the significance of the noise impact for the revised layout is considered to be of low intensity, local extent and long term and therefore of low (-) significance for the proposed wind energy facility. No additional mitigation measures are required and recommended for the wind energy facility. No operational noise impacts would result from the proposed solar facility. No difference in significance would result from the proposed wind alternatives.

c) Mitigation measures

Wind Energy Facility Potential Impacts

- Educate surrounding receptors with respect to the sound generated by the wind energy facility. Community involvement must continue throughout the lifespan of the proposed facility.
Figure 4.21: Projected change in ambient sound levels (ISO model) showing contours of constant sound levels for a 5 m/s wind
• Provide a contact number for the operator of the wind farm in the case of sudden and sharp increases in sound levels result from mechanical malfunctions or perforations or slits in the blades.

d) Cumulative impacts

As no other wind energy facilities are proposed in the near vicinity it is not anticipated that any further cumulative noise impacts would result.

4.4 CONSTRUCTION PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENTS

The construction phase is likely to result in a number of negative impacts on the biophysical and the socio-economic environment. The following potential impacts have been identified as relevant to the construction of the proposed projects:

• Impact on botany;
• Impact on avifauna;
• Impact on bats;
• Impact on fauna;
• Sedimentation and erosion of water ways;
• Impact on heritage resources including palaeontology;
• Visual impacts;
• Impact on local economy (employment) and social conditions;
• Impact on transport;
• Noise pollution;
• Storage of hazardous substances on site; and
• Dust impact.

The significance of construction phase impacts is likely to be limited by their relatively short duration, since the construction phase should last approximately 18 months for the wind energy facility per phase and 24 months for the solar facility. Many of the construction phase impacts could be mitigated through the implementation of an appropriate EMP. A life-cycle Environmental Management Program (EMP) is contained in Annexure N of this report, which specifies the mitigation measures that could be implemented to mitigate construction phase impacts, amongst others.

4.4.1 Impact on botany

The potential impacts on botany would be as a result of the construction of (a) wind turbines and crane hard-standing areas as well as sub-station sites (b) internal access roads and underground cabling, and (c) overhead transmission lines. The vegetation of site is mostly Bushmanland Arid Grassland with Low botanical sensitivity. However, a small number of turbines are located within the botanically sensitive Platbakkies Succulent Shrubland gravel patches. Therefore construction of the proposed wind energy facility would result in high
magnitude, local and long term and therefore of high (-) significance without mitigation. With mitigation measures implemented, the impacts would be of low (-) significance. The potential construction phase impact on botany of the proposed solar facility would be of low magnitude, local extent and long term and therefore of low (-) significance, with or without mitigation.

a) Mitigation measures

Mitigation measures for the wind energy facility

The following mitigation measures are recommended for the wind energy facility:

- Wherever possible, restrict construction activities to designated turbine sites and lay-down areas.
- Avoid Platbakkies Succulent Shrubland gravel patches. Specifically locate turbines and associated infrastructure such as roads beyond a 30 m buffer around the patches;
- Micro-site turbines with the aid of a botanist, to avoid sensitive sites.
- Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.

Mitigation measures for the solar energy facility

The following mitigation measures are recommended for the solar energy facility:

- Where possible, collect seeds from Parkinsonia africana (wild green hair trees) and cultivate off site. The cultivated shrubs could be planted on the site and effectively used for visual screening of the solar PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

4.4.2 Disturbance of avifauna

The primary potential avifaunal impacts would arise from (a) disturbance caused by vehicular and people traffic during construction, (b) displacement caused from habitat loss, disturbance during the construction phase and from maintenance activities for both the wind and solar wind energy facilities respectively. This could have a lasting impact in cases where the site coincides with critical areas for restricted range, endemic and/or threatened species. Furthermore, construction activities could disturb breeding, foraging or migrating birds. Bird species of particular concern, which may be affected, include the Red Lark, Stark’s Lark, Karoo Lark, Ludwig’s Bustard, Kori Bustard, Northern Black Korhaan, Verreaux’s Eagle, Secretarybird, Martial Eagle, Rock Kestrel and Jackal Buzzard.

The potential impact on avifauna during the construction phase of the proposed wind energy facility is considered to be of local extent resulting in a medium (-) significance, with and without mitigation. No difference in significance would result from the proposed wind alternatives.

The potential impact on avifauna for the proposed solar energy facility is considered to be of local extent resulting in a low-medium (-) significance, without mitigation. With the implementation of mitigation measures the significance would reduce to low (-) significance. No difference in significance would result from the proposed wind alternatives.

The following mitigation measures are recommended for the wind energy facility:

- Restricting the construction footprint to a bare minimum.
- Demarcation of ‘no-go’ areas identified during the pre-construction monitoring phase to minimise disturbance impacts associated with the construction of the facility.
- Reducing and maintaining noise disturbance to a minimum particularly with regards to blasting on the ridge-top associated with excavations for foundations for wind turbines. Blasting should not take place during the breeding seasons (mostly spring) of the resident avifaunal community (the avifaunal monitoring programme should recommend the season) and in particular for priority species. Blasting should be kept to a minimum and, where possible, synchronized with neighbouring blasts.
- Excluding development or disturbance from sensitive areas. Currently these include the Secretarybird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan). These currently fall outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
- Minimising the length of any new powerlines installed, and ensuring that all new lines are marked with bird flight diverters along their entire length. It is imperative that all new powerline infrastructure is adequately insulated and bird friendly when configured.
- Distribution lines connecting each turbine to the installation network should be buried underground to mitigate the considerable risk of avian collision that would be posed by overhead lines.
- Additional mitigation arising from the results of pre-construction monitoring might include re-scheduling construction or maintenance activities on site, adjusting the siting of turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
- The project should consider marking the turbine blades as a way to reduce collisions.

The following mitigation measures are recommended for the solar energy facility:
The same measures as recommended for the proposed wind energy facility should be implemented. In addition, an exclusion zone of at least 1 km must be adopted from the known Verreaux’s Eagle pair nest site.

4.4.3 Disturbance of bats

During the construction phase of the projects, turbine and infrastructure construction activities may result in loss of foraging and roosting habitat, although the proposed area does not display a high potential to support an abundance of bats. Roosting space are moderately available but the lack of open water sources and low insect food abundance results in limited bat colonies

The extent of the impact for both the proposed wind and solar energy facility is site specific, resulting in a significance rating of low (-) with or without mitigation.

The following mitigation measures are recommended for the wind energy facility:
- The placement of associated infrastructure (substation, gridline, roads) in areas designated as having a High Bat Sensitivity should be avoided. If possible, underground cabling should not be laid in these areas. If cabling is located within these areas, vegetation rehabilitation can be carried out to rectify this impact.
The same measures as recommended for the proposed wind energy facility should be implemented.

### 4.4.4 Sedimentation and erosion of watercourses

The site is situated on a watershed between the Orange River and the Buffels River with the main freshwater features being a number of small ephemeral streams that drain the inselbergs for a short period following rainfall events, two small springs/well points and some ephemeral pans at Kangnas and Koeris farms. The ephemeral tributaries of the Buffels and Orange rivers within the site are considered to be in a largely natural to moderately modified ecological state.

The sediment loads of any drainage depressions or pans may increase due to the excavations on the site, the laying of linear infrastructure such as roads or power lines across drainage lines and other construction related activities.

The potential impact of sedimentation and erosion from the construction of the proposed wind energy facility is considered to be of medium to high magnitude, site specific and short term and therefore of **low (-)** significance, without mitigation. The potential of this impact would reduce to **very low (-)** significance, after mitigation.

The potential impact of disturbance of freshwater related habitats in the actual solar development zone is considered to be of moderate magnitude, site specific and short term and therefore of **very low (-)** significance, with and without mitigation.

The following mitigation measures are recommended for the wind energy facility:

- Wind turbines should be located outside of any of the identified drainage channels, as is currently the case.
- Construction activities should as far as possible be limited to the identified sites for the proposed wind energy facility and the identified access routes.
- Where transmission lines need to be constructed over/through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete.
- Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed projects. Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited.
- All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded.
- Road infrastructure and power transmission lines should coincide as much as possible to minimize the impact.
- Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.
- All crossings over drainage channels or stream beds after the construction phase should be rehabilitated such that the flow within the drainage channel is not impeded.
- A buffer of 30 m (measured from top of bank) should be maintained adjacent to the identified ephemeral streams and 500m from the springs.
- All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100 m away from any drainage areas/ephemeral streams and regularly serviced. These measures
should be addressed, implemented and monitored in terms of the EMP for the construction phase.

- Any septic tanks constructed for the project should be located at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/wellpoints.
- Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

The same measures as recommended for the proposed wind energy facility should be implemented.

### 4.4.5 Impact on heritage resources

Heritage resources include archaeological material (e.g. rock paintings, stone tools), palaeontological material (e.g. fossilised materials) and cultural heritage material (e.g. old graveyards, fences or ruins of buildings). Since some potential heritage material is buried, it is often only found during the construction phase of a project. A large scale development such as the proposed projects could have a negative impact on the archaeological and cultural heritage resources (including visual, landscape and sense of place impacts) by damaging or destroying such material or by requiring the material to be removed and stored in situ. As such a heritage impact study was undertaken by Mr Jayson Orton. A site survey was conducted from 23-28 July 2012. The Heritage Impact Assessment is included in Annexure H. The findings and recommendations of the study are summarised below.

#### a) Description of the environment

The landscape on and around the study area is dominated by two strongly contrasting components namely low rocky inselbergs and ranges of hills with flat grassland in between. During the site survey a large number of heritage occurrences were recorded.

*Pre-colonial archaeology*

The best pre-colonial sites are often found in caves. These are very rare in the Bushmanland landscape however four are located on the site. Two of these caves contain rock art, the third cave had only two quartz artefacts and the fourth cave was located in a small rocky valley and seemed to contain only light traces of occupation. These traces consisted of fragments of burnt bone, some fragments of ostrich eggshell and pottery and a few quartz flaked stone artefacts. The majority of archaeological sites recorded contained scatters of stone artefacts, predominantly in quartz (milky and clear) and cryptocrystalline silica (CCS) with silcrete, quartzite and other rocks more rarely represented ([Figure 4.22: Stone artefacts that occurred near the base of hill on the western side of the site (J Orton, 2012)](image))
More than 70 individual archaeological finds of varying nature were located near “Gobeesvlei” on farm Kangnas, including a large horizontally pierced and internally reinforced lug (Figure 4.23). It was thought that the proximity to water, particularly after rains, served as the main attraction and resulted in the good artefact collection (Figure 4.23).

Other finds on site contained pottery, some with fibre temper. The significance of the temper lies in the fact that fibre (grass) tempered sherds have been directly associated with Bushmen groups while the other no fibrous sherds are associated with the Khoenhoen. Grindstones were also found that may have functioned as weights for the ropes that were used to hold down a matjieshuis.

**Pre-colonial rock art**

Rock art in the study area took two forms. The first form was located at a site which is locally known as Kromneus (Figure 4.25). The rock art sites contain paintings thought by their style and imagery to have been made by Khoekhoen herders rather than Bushmen hunter-gatherers. The imagery includes shapes listed as typical of ‘herder art’ such as circles, and grids. Two gemsbok and a third unidentifiable animal are also present but importantly, all paintings are finger-painted. One new painted site was discovered. It was found in a small crevice between two boulders on the farm Areb.
The second form of rock art takes the form of small hollows or ‘cupules’ pecked and ground into the surface of the rock face. Eight cupule sites were found, all on the farm Smorgen Schaduwe. This form of art is very rare outside of the Iron Age and most of the examples were on vertical rock faces (Figure 4.26).

Historical archaeology (Anglo-Boer war)

Several examples of informal type structures pertaining to the Anglo-Boer war were identified on site. Most of the structures were perched on the northern edge of a hill with a commanding view across the plains to the north (Figure 4.27). A number of old tin cans and other similar metal items were also identified. Such items are frequently found on known Anglo-Boer War sites.

Figure 4.25: Panoramic view of the entire painted rock face at Kromneus (J, Orton 2012)

Figure 4.26: View and close-up view of the ‘cupule’ site (J Orton, 2012)

Figure 4.27: Stone enclosure (J Orton, 2012)

Figure 4.28: Tin cans found at Anglo-Boer War sites (J Orton, 2012)
Historical archaeology (Other)

Several other informally built, piled stone structures were also present on site. These included small circular features and kraals with walls up to one metre high and single stone high alignments of rocks possibly dating back to the very late 19th century or early 20th century. A large kraal may have been in use until fairly recently and many historical artefacts typical of the late 19th and early 20th centuries and even a probable grave were associated with this site (Figure 4.29). Artefacts of glass, ceramic and metal were found, and a number of bones were also present.

Figure 4.29: Large historical kraal built against the side of a rocky ridge (J Orton, 2012)

The last type of historical archaeological resource noted were ‘putse’ excavated by hand during the late 19th and early 20th centuries. These are essentially wells but with only the uppermost parts lined with stones. They can be very deep. Three dry ‘putse’, 20 m to 25 m deep and only about 2.5 m to 3.0 m in diameter, were identified on farm Areb. Another two were identified on farm Kangnas (in Gobeesvlei) and on farm Koeris (in Springbokvlei) respectively (Figure 4.30).

Figure 4.30: The “putse” located at Gobeesvlei (Kangnas) and Springbokvlei (Koeris) (J Orton, 2012)
General built environment

Most of the farm buildings in the study area appear to date from the 1930s to 1960s. Some buildings on farm Smorgen Schaduwe appear to be older. They are vernacular Karoo-style buildings, now serving as farm outbuildings. The walls of these structures are very thick and they are flat-roofed. The oldest ‘modern’ house is likely the house at farm Areb. An interesting item at farm Koeris is an old water pump that may have predated the windmills and is regarded as a heritage object.

Cemeteries and graves

Family cemeteries on site are located in close proximity to the farm buildings. Isolated graves might occur away from the houses. A few potential examples were encountered, including two small neighbouring mounds of stones that seemed like possible graves on farm Smorgen Schaduwe. Another possible grave was located alongside a stockpost on farm Areb (see Figure 4.31). It was a stone mound with one stone that is probably a headstone. The possible grave also had a small blue bottle on top of it, perhaps left in memory of the deceased (Figure 4.31).

![Image of a grave with a blue bottle](image)

Figure 4.31: Grave alongside the stockpost and bottle found on the grave (J Orton, 2012)

Cultural landscapes

The site was first used for farming relatively recently when compared to, for example, the south-western Cape. As a result the cultural landscape has few layers. The landscape is dominated by vast undeveloped spaces with occasional livestock enclosures, watering points, cement dams and windmills and trees were very rare. Otherwise the only other elements of cultural landscape pertain to the farm werfs which are generally 20th century. Five sites were identified to be of heritage importance, namely (i) Orange Hill, (ii) SMS Hill, (iii) Gobeesvlei, (iv) Springbokvlei and (v) Site KNG2012/007 (see Figure 4.34 to Figure 4.36).

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31 Pre-colonial refers to the time before colonization of a region or territory (http://www.thefreedictionary.com/pre-colonial). Prehistoric refers to historical terms of or relating to man’s development before the appearance of the written word (http://www.thefreedictionary.com/prehistorically). Before 1488 (Orton, 2012).
Figure 4.32: (i) ‘Orange Hill’ on farm Smorgenschaduwe appears to be geologically different to the surrounding landscape and has a clearly orange hue. There are a large number of archaeological sites on and around this hill, including six of the eight ground ‘cupule’ sites described above. There are many scatters of stone artefacts, including one with a preserved hearth that may be a recent Khoekhoen stockpost.

Figure 4.33: (ii) A large number of archaeological occurrences are present on ‘SMS Hill’ on farm Smorgenschaduwe and, although none are of very high significance, the sheer number of finds shows the importance ascribed to this hill in both pre-colonial and historical times.
Figure 4.34: (iii) ‘Gobeesvlei’ with extensive granite bedrock outcrops is home to a large number of archaeological sites and more may be preserved beneath the surface of the ground.

Figure 4.35: (iv) ‘Springbokvlei’ is a large pan located on farm Koeris. Some of the bedrock is exposed and water frequently collects within this pan. Many archaeological sites were located on the surface. There is a possibility that further sites may be fully preserved beneath the ground.
b) Impact assessment

Wind Energy Facility Potential Impacts

Direct impacts to heritage resources present on farm Kangnas, Koeris, Areb and Smorgen Schaduwe are primarily expected to occur during the construction phase of the wind energy facility. Most of the important heritage resources have already been protected through institution of buffers around farm werfs, pans and mountains. There are, however, five areas of primary heritage concern that require action before development and during operation of the proposed facilities. These areas are (i) Orange Hill, (ii) SMS Hill, (iii) Gobeesvlei, (iv) Springbokvlei and (v) Site KNG2012/007. No conventional archaeological mitigation work (i.e. excavation, recording) is required so long as the suggested buffers and no-go areas are implemented. Impacts to graves and built environment resources will not occur in the actual wind turbine layout zone.

The majority of potential heritage impacts are considered to be of regional extent, low-medium magnitude and long term and therefore of low to medium (-) significance, with or without mitigation. No difference in significance would result from the proposed wind energy facility alternatives.

Solar Energy Facility Potential Impacts

Direct impacts to heritage resources are primarily expected to occur during the construction phase of the solar energy facility, although indirect visual impacts would continue for the life of the project. Impacts to graves and built environment resources would not occur in the actual solar layout zone. Based on the above, the potential impact on heritage resources is considered
to be site specific, very low to medium magnitude and long term and therefore of very low to medium (-) significance, with or without mitigation. No difference in significance would result from the proposed solar alternatives.

c) Mitigation measures

Mitigation measures for the wind energy facility

- ‘Orange Hill’ and its surrounds should be considered a no-go area and a buffer as shown in Figure 4.32 should be implemented. The buffer is approximately 700 m diameter.
- ‘SMS Hill’ and its surrounds should be considered a no-go area and a buffer as shown in Figure 4.33 should be implemented. The buffer is approximately east/west and 1.9 km north/south (approximately 450 m from all recorded heritage sources).
- ‘Gobees se Pan’ and its immediate surroundings should be considered a no-go area and a buffer as shown in Figure 4.34 should be implemented. The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage sources).
- ‘Springbokvlei’ and its immediate surroundings should be considered a no-go area and a buffer as shown in Figure 4.35 should be implemented. The buffer is approximately 900 m east/west and 1000 m north/south (approximately 200 m from all recorded heritage sources).

4.4.6 Impact on palaeontology

The study area is largely underlain by ancient Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province that crop out as low, rocky inselbergs. In the intervening flatter, low-lying areas where the wind and solar energy facilities are likely to be constructed older basement rocks are extensively mantled with geologically young superficial deposits (Quaternary to Recent sandy alluvium, colluvium, soils, wind-blown sand, calcrite hardpans etc) that are generally of low to very low palaeontological sensitivity. However, small but significant areas of older fossiliferous sediments have been recorded in the subsurface within the general area and have yielded scientifically important vertebrate and plant fossil material. A large scale development such as the proposed project could have a negative impact on the palaeontological resources by damaging or destroying such material or by requiring the material to be removed and stored in situ. As such a Palaeontology Impact Assessment (PIA) was therefore undertaken by Dr John Almond. The assessment was based on a desktop review of the paleontological aspects in the project. The PIA is included in Annexure H. The findings and recommendations of the study is summarised below.

Furthermore two areas were pointed out by a landowner, Mr van Niekerk, that he believes are meteorite impact sites / craters. Meteorite impact sites are considered to be rare geological features and as such are protected under the National Heritage Resources Act (No. 25 of 1999) (NHRA) (ACO, 2012). Professor Chris Harris of the University of Cape Town’s (UCT) Department Of Geological Sciences undertook a site visit to investigate the two sites on 2 April 2012 (the site visit report is included in Annexure H).
b) Description of the environment

Geological environment
The study area is situated within the arid Bushmanland region between Springbok and Pofadder. The region is of special geological and palaeontological interest in that the study area is mantled by unconsolidated Quaternary to Recent superficial sediments. These include a range of quartz-rich alluvial sands and gravels, skeletal soils, colluvial deposits such as bouldery or blocky scree, sandy, arkosic (feldspar-rich) and gravelly sheet wash and slope deposits derived from weathering of the surrounding granite-gneiss terrain and wind-blown (aeolian) sands. These last may probably be equated with the Quaternary Gordonia Formation of the Kalahari Group.

The geological map of the region approximately 50 km east of Springbok, Northern Cape, indicates the following outcrop areas of the main rock units represented within the site (Figure 4.37).

- Mid Proterozoic (Mokolian / Kheisian) metamorphic rocks of the Bushmanland Group and Gladkop Metamorphic Suite
- Early to Mid Proterozoic (Mokolian / Namaquan) metamorphic and intrusive igneous rocks of the Little Namaqualand Suite, Korridor Suite
- Tertiary / Quaternary calcrete (pedogenic limestone)
- Quaternary aeolian (wind-blown) sands, probably equivalent to the Gordonia Formation (Kalahari Group)
- Quaternary sand, scree, rubble, sandy soils of alluvial and colluvial origin
- Kimberlite volcanic pipe
- Olivine melilitite volcanic pipe
- Permo-carboniferous Mbizane Formation (Dwyka Group, Pmb)

Pans and water courses are often associated with thick developments of calcrete (pedogenic limestone). Calcrete hardpans that date back to Late Tertiary (Neogene) to Quaternary or Recent age also occur subsurface and extensive surface exposures are mapped at the south-eastern and south-western edges of the study area.

Several kimberlite and olivine melilitite volcanic pipes of Cretaceous age are mapped just to the east of the site. Some of these pipes are still associated with fossiliferous crater lake deposits whose preservation reflects the low levels of landscape denudation since Late Cretaceous times in the Bushmanland region. Of particular interest is the buried double feeder pipe olivine-melilitite system with a footprint of some one to two hectares that has been deduced on geophysical as well as geological grounds at Goebeesvllei in the north-eastern portion of the site. It is quite possible that other potentially-fossiliferous crater lake deposits are hidden beneath the Late Caenozoic superficial sediments elsewhere within the site (e.g. calcrete-capped pans).

The site is almost entirely underlain by Mid Proterozoic (Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province. The basement rocks build the numerous isolated inselbergs and ridges scattered across the Bushmanland landscape. Small Dwyka Group inliers (Mbizane Formation, Pmb) are mapped just to the southeast of the site with none recorded within the site itself.
Palaeontological heritage

Sediments and fossils of probable Late Cretaceous age have been recorded in the Kangnas area of Bushmanland, representing some of the oldest remnants of post-Gondwana rocks and fossils from South Africa. The fossil material largely comprises the teeth and disarticulated post-cranial skeletal elements (leg bones, vertebrae, ribs) of the ornithischian dinosaur *Kangnasaurus*. Associated fossils include calcified and silicified wood, lignite, leaf fragments and aquatic ostracods (microscopic seed shrimps). The dinosaur remains were first recorded from quartzofeldspathic grits, breccias and laminated calcareous mudrocks in a well and associated spoil heap at Goebbees farmstead (Farm Kangnas 77) at a depth of some 34 m by Rogers (1915). The dinosaur material was subsequently revised by Cooper (1985), who considers the remains to belong to a single individual. Nevertheless, the taxonomic validity, age and systematic position of *Kangnasaurus* remain uncertain, with some workers regarding the genus as of dubious status. According to the most recent review, it was probably a basal bipedal, herbivorius iguanodontian related to *Dryosaurus* (Figure 4.38). There is a significant possibility that other small patches of fossiliferous crater lake sediments lie buried beneath the superficial sediment cover (sands, calcrete etc) within the site.
Late Tertiary to Recent superficial deposits

The predominantly porous, sandy superficial deposits in the site, including the Quaternary alluvial and aeolian sands and gravels, are unlikely to contain substantial fossil remains. Among the limited range of other fossils that might be encountered within Late Cenozoic surface sediments in the study area are calcified rhizoliths (root casts), termitaria and other burrows, freshwater molluscs, ostrich egg shells, sparse bones, teeth and horn cores of mammals, and tortoise remains. Finer-grained river and pan sediments may contain fossils of fish, frogs, molluscs, crustaceans (crabs, ostracods, phyllopods such as conchostracans) as well as microfossils such as diatoms, palynomorphs and macroplant remains (e.g. wood, peats). Skeletal remains of a Pliocene three-toed horse, *Hipparion*, have been recorded from a well at Areb, 65 km east of Springbok and within the northern part of the site, close to the proposed solar energy facility (Figure 4.39).

Figure 4.38: Reconstruction of a bipedal iguanodontian dinosaur similar to *Kangnasaurus* from the Late Cretaceous Bushmanland (source: Natura Viva).

Figure 4.39: Reconstruction of an extinct Miocene three-toed horse, *Hipparion*. Fossil remains or related fossil horses are recorded from Areb in Bushmanland (Northern Cape) as well as Langebaanweg (West Coast Fossil Park, W. Cape) (Source: Natura Viva).
Kalkkom

The two possible meteorite impact craters are located near the farm Kangnas (Figure 4.40). The smaller potential crater showed little evidence of being a crater and is probably a depression where a thicker than normal sequence of calcrete developed. By contrast, the large crater (Kalkkom) consisted of a distinct depression about 1 km in diameter and it is therefore possible that it is a crater. Desktop research indicated that it was likely that the Kalkkom ‘crater’ was formed by the eruption of an olivine melilitite pipe about 55 million years ago (Ma). This is the opinion of de Wit (1993) and is consistent with the presence of numerous olivine melilitite pipes in Namaqualand. A series of such pipes is found about 10 – 30 km to the east of Kalkkom. It is much less likely that the crater was the result of a kimberlite pipe. These are found north of the Orange River and Kalkkom is situated over 50 km from the area where kimberlites are found. However, there is no physical evidence to prove that the Kalkkom Crater is an olivine melilitite pipe. Neither the geological map nor de Wit et al (1993) mention the presence of olivine melilitite in the immediate vicinity. There are numerous other explanations for the presence of a pan, for example related to structures in the underlying gneiss. The geological map (see Figure 4.40) indicates that Kalkkom is situated at or near a synform whose axis trends east-west.

Figure 4.40: Geological map indicating the “crater” Kalkkom

32 A structure formed by the downward bending of rock strata onto earlier and steeper folds of smaller size (http://encyclopedia2.thefreedictionary.com/Synform, accessed on: 06/06/12)
The ‘crater’ might therefore represent a pan developed at a depression where surface water was unable to drain away as a result of the underlying structure. One other possible explanation is the depression was caused by a meteorite impact. The Kalkkom Crater bears a superficial resemblance to the Kalkkop Crater in the Easter Cape which was shown to be the result of a meteorite impact about 250 000 years ago (Reimold et al., 1998). Although the crater shape at Kalkkop is more obvious than at Kalkkom, this may be due to a difference in age or rate of erosion. The meteorite origin of Kalkkop was only proved as a result of drilling, which intersected shocked brecciated material below the base of the calcrite in the centre of the crater (at > 90 m depth).

It was not possible to examine the bedrock that would have been the ‘target’ were this a meteorite impact crater due to the lack of bedrock exposures as a result of a 10 m of calcrite covering. According to Mr van Niekerk, the calcrite is typically about 10 m thick in the area, but is at least 80 m thick in the large crater.

The only way to distinguish between these possible origins would be to undertake drilling (preferable core drilling) in the centre of the crater through the calcrite into the underlying bedrock.

b) Impact assessment

The construction phase of the wind and solar energy facilities would entail numerous, excavations into the superficial sediment cover and in some areas into the underlying bedrock as well. These include, for example, excavations for the proposed wind turbines and solar panel foundations, underground cables, new electricity transmission line pylons and substations, as well as new gravel access roads and any control / administrative buildings. In addition, substantial areas of bedrock would be sealed-in or sterilized by infrastructure such as lay-down and standing areas for the proposed wind turbines as well as new access roads. All these developments may adversely affect fossil heritage within the projects’ footprint by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good.

Most surface rocks within study area are unfossiliferous but highly significant fossil material (e.g. dinosaur and mammal remains) occurs at small, localized sites (buried crater lake and alluvial deposits) within the site. Given the uncertainties concerning the patchy distribution of buried fossil heritage, predicted impacts for the proposed wind and solar energy facilities are not significantly different, and are considered unsure. However, these deposits are unlikely to be directly affected except by deeper excavations (> 3 m³) that penetrate the generally unfossiliferous superficial deposits overlying them. The potential impacts on palaeontology from both the proposed wind energy facility and solar energy facility developments are considered to be of low intensity, local extent and long term and therefore of low (-) significance, with or without mitigation. No difference in significance would result from the proposed wind or solar alternatives.

33 It is possible that a number of the turbine foundations would be greater than 3 m deep. The palaeontologist has indicated that this would not change the significance rating.
c) Mitigation measures

The following mitigation measures are recommended:

- The environmental control officer “ECO” responsible for these developments should be alerted to the two known fossil sites within the site as well as possibility of fossil remains being found either on the surface or exposed by fresh excavations during construction.
- Should fossil remains (e.g. vertebrae bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) be discovered during construction, these should be safeguarded (preferably in situ) and the ECO should alert the South African Heritage Resource Agency (SAHRA) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist. The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved repository (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

4.6.7 Visual impact

The construction of the proposed facilities would typically include land clearing for site preparation and access routes; excavation, possible blasting if founded on rock, and filling; transportation of supply materials and fuels; construction of foundations involving excavations and placement of concrete; operating cranes for unloading and installation of equipment; and commissioning of new equipment. The potential visual impact of the proposed facilities are considered to be of low magnitude, regional extent and long term and therefore of medium (-) significance without mitigation. With the implementation of mitigation measures and the revised layout, the significance would be reduced to low (-).

Mitigation measures for the wind energy facility

The following mitigation measures are recommended for the wind farm during construction:

- Implement dust control measures.
- Litter needs to be strictly controlled.
- All topsoil (if any) needs to be stockpiled in a suitable location and re-utilised for landscaping / rehabilitation.
- Excess material from earthworks of infrastructure and roads should be disposed of offsite or through natural landscaping of areas. No dumping or piling should be allowed.
- Fencing should be a grey chain link fence, or similar, that will blend with the agricultural landscape context and should not extend up to the N14.
- Rehabilitation of foundation area must be commenced once construction phase has been completed.
- Signage (if any) should be constrained.

Mitigation measures for the solar energy facility

The same measures as recommended for the proposed wind energy facility should be implemented.
4.4.7 Impact on socio-economic environment

As noted in Section 4.3.3 a Socio-Economic Impact Assessment was undertaken. The findings of this study as it relates to construction phase impacts are given below.

d) Current status

As noted in Section 4.3.3 the Nama Khoi LM population is mostly semi-and unskilled with an unemployment rate of 16.5%. Many rural areas lack basic infrastructure such as roads, water and electricity. This lack of infrastructure entrenches the problems of chronic poverty and limits the potential of communities to sustain economic growth, rural livelihoods and social development. The leading sectors within the Nama Khoi LM boundaries are mining, wholesale and retail trade, government and community services, finance, transport and tourism.

e) Description and significance of potential impact

According to the socio-economic assessment (refer to Annexure L), the proposed wind energy facility would have a total impact (direct, indirect and induced impact) on new business sales in the local, regional and national economies to the amount of approximately R13.3 million during the construction phase of the development. The proposed solar energy facility would have a total impact on new business sales to the amount of R7.9 million. These impacts would be distributed across the local, regional and national economies and would be for the entire duration of the construction phase. This would result in a total value of R4.1 million that would be generated in the form of new production activities or GDP during the development of the proposed wind energy facility and a total of R24 million for the development of the proposed solar energy facility. The increase in new business sales is the catalyst for the stimulation of additional GDP as an increase in sales has to be accompanied by an increase in production to satisfy the increase in demand generated by increased new business sales.

During the construction phase of the proposed wind energy facility a total of 20 065 new employment opportunities should be created. In turn, the total number of new employment opportunities that would be created as a result of construction of the proposed solar facilities amounts to 14 688 which would be distributed nationally. The capital expenditure of the proposed development is given in Table 4.6.

Table 4.6: Cost and investment for the construction phase of both a 750 MW wind and 250 MW solar energy facilities.

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Entire Project</th>
<th>Each Phase of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Farm</td>
<td>750 MW</td>
<td>140 MW</td>
</tr>
<tr>
<td>Project Cost (R’s millions) in 2012</td>
<td>R11, 131, 000, 000</td>
<td>R2, 078, 000, 000</td>
</tr>
<tr>
<td>Local Expenditure</td>
<td>R4, 783, 000, 000</td>
<td>R893, 000, 000</td>
</tr>
<tr>
<td>District Expenditure</td>
<td>R901, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td>Rest of Country Expenditure</td>
<td>R3, 881, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td>% of local expenditure in Total project cost</td>
<td>43%</td>
<td>43%</td>
</tr>
<tr>
<td>Average Duration</td>
<td>8 years</td>
<td>1.5 years</td>
</tr>
<tr>
<td>Project Size</td>
<td>250 MW(^{34})</td>
<td>N/A</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>-----</td>
</tr>
<tr>
<td>Project Turnover</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Project operating expenditure</td>
<td>R4, 700, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td>Local Expenditure</td>
<td>R2, 115, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td>% of local expenditure in total project costs</td>
<td>45%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Overall, the potential construction phase impacts on the socio-economic environment for both the proposed wind and solar energy facilities would be regional, medium magnitude and short term and would therefore be of medium (+) significance, with and without mitigation. No difference in significance would result from the proposed wind or solar alternatives.

**f) Recommended mitigation measures for construction impacts on socio-economic environment**

**Wind Energy Facility Potential Impacts**
- Source supplies of services, labour and products from the local and regional economies. It is recommended that local labour, resources and businesses be sourced during the construction stage.
- Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour.
- Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner.
- Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
- Implement an educational initiative during the construction phase of the proposed wind and solar facilities as it provides an ideal practical learning environment for local and district schools.

**Solar Energy Facility Potential Impacts**
The same measures as recommended for the proposed wind energy facility should be implemented.

**4.4.8 Impact on Agriculture**
The construction entails the clearing of vegetation around the footprint of the proposed turbines and the crane hardstand, as well as creating service roads.

The proposed construction of a solar energy facility would entail the initial clearing of vegetation and levelling of the site. During construction large areas of soil would be exposed, which could be eroded through rain or wind action. Erosion or sedimentation could extend into the surrounding agricultural land.

\(^{34}\) This has since reduced to 225 MW but this reduction would not affect this assessment significantly.
The construction of the proposed projects are envisaged to have a potential impact on agricultural resources of low magnitude, local extent and short term and therefore of very low (-) significance for both proposed projects, without and with mitigation. No difference in significance would result from the proposed alternatives.

The following mitigation measures are recommended for both the proposed solar and wind energy facilities:

- Clearing activities should be kept to a minimum (panel/turbine and road footprint).
- In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion.
- If earth works are required then storm water control and wind screening should be undertaken to prevent soil loss from the site.
- Clearing activities should be kept to a minimum (turbine and road footprint).
- Where earthworks are required, any steep or large embankments that are expected to be exposed during the ‘rainy’ months should either be armoured with fascine like structures. A fascine structure usually consists of a natural wood material and is used for the strengthening an earthen structures or embankments.

4.4.9 Impact on transport

Construction vehicles are likely to make use of the existing roads, including the N14, to transport equipment and material to the construction site. For each wind turbine approximately 72 - 83 construction vehicles would be required to bring in construction materials and components (based on the N100 (2.5 MW) turbine transport requirements in Nordex Energy GmbH (Nordex), 2009). The proposed projects consist of 180 turbines hence approximately a maximum of 12 960 – 14 940 construction vehicles trips would be required. The construction period would be divided into four phases with each phase construction period spread over 12 - 18 months. This equates to an approximate maximum of 13.5-15.6 construction vehicles trips per day, assuming an even spread over the minimum 12 months construction period for each phase.

Due to the large size of many of the facility’s components (e.g. tower and blades) and the need for them to be transported via “abnormal loads” from Port Elizabeth, Cape Town or Saldanha harbour, construction related transport could impact negatively on the traffic flow in the vicinity and on the integrity of the affected roads. This may exacerbate the risk of vehicular accidents. The necessary clearances from the respective Roads Authorities would need to be in place prior to the transporting of these loads.

Cumulatively, it is estimated by The GreenCape Initiative (2011) that some 13 abnormal loads would be on roads daily in the Western Cape until 2015. Most of these loads would use on the N1 or the N7 and many would extend to the Northern Cape.

As with the proposed wind energy facility, construction vehicles are likely to make use of the existing roads, including the N14, to transport equipment and material to the construction site.
Construction of the solar facility would require approximately 3,286 vehicle trips per 75 MW phase, and consisting of three phases, making up a total of approximately 9,858 vehicle trips for all three phases. This equates to some 6.8 vehicle trips per day over each phases 24 month construction period.

The potential impact of the projects on transport is considered to be of medium magnitude, regional extent and short term and therefore of medium (-) significance, with or without mitigation for both proposed projects. The cumulative potential impact of wind and solar energy projects on transport is considered to be of high magnitude, regional extent and short term and therefore of high (-) significance, with or without mitigation. No difference in impact significance would result from the proposed alternatives.

**Wind Energy Facility Potential Impacts**
The following mitigation measures are recommended:

- Ensure that road junctions have good sightlines;
- Implement traffic control measures where necessary;
- Transport components overnight as far as possible; and
- Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

**Solar Energy Facility Potential Impacts**
The same measures as recommended for the proposed wind energy facility should be implemented.

### 4.4.10 Noise pollution

Projected noise levels for the construction of the proposed wind energy facilities were modelled using the methods as proposed by SANS 10357:2004. The worst case scenario was considered with the noisiest activity (laying of turbine foundations) taking place at each proposed wind turbine location during wind-still conditions, in good sound propagation conditions. The resulting noise projections indicated that the construction activities, as modelled for the worst case scenario, would comply with the Noise Control Regulations (GN No. R154) as well as the acceptable day rating levels as per the SANS 10103:2008 guidelines. The noise levels for the construction of the solar facility are anticipated to be similarly acceptable.

Various construction activities would be taking place during the development of the facilities and may pose a noise risk to them. While the noise impact study investigated likely and significant noisy activities, it did not evaluate all potential activities that could result in a noise impact. These activities could include temporary or short-term activities where small equipment is used (such as the digging of trenches to lay underground power-lines).

Based on the above the significance of the construction noise impact was considered to be of high magnitude, local extent and short term and therefore of low (-) significance, with and without mitigation measures. No difference in significance would result from the proposed wind alternatives.
Mitigation measures for the wind energy facility

The following mitigation measures are recommended:

- Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see Figure 4.41 for sensitive receptors);
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
- Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200 m away from any house;
- Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
- Ensuring compliance with the Noise Control Regulations;
- Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them (within 500 m). Information that should be provided to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  - Proposed working times;
  - how long the activity is anticipated to take place;
  - what is being done, or why the activity is taking place;
  - contact details of a responsible person where any complaints can be lodged should there be an issue of concern.
- Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
- If any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured.
- The construction crew must abide by the local by-laws regarding noise; and
- Where possible construction work should be undertaken during normal working hours (06h00 – 22h00; adopted from SANS 10103:2008), from Monday to Saturday; If agreements can be reached (in writing) with the all the surrounding (within a 1 km) potentially sensitive receptors, these working hours can be extended.

4.4.11 Storage of hazardous substances on site

As at any construction site, various hazardous substances are likely to be used and stored on site. These substances may include amongst other things, diesel, curing compounds, shutter oil and cement. Utilisation of such substances in close proximity to the aquatic environment such as pans is of greater concern than when used in a terrestrial environment.

This potential impact is considered to be of high magnitude, local extent and short to medium term and therefore of low to medium (-) significance, with and without mitigation for both the proposed wind and solar facilities. With the implementation of mitigation the likelihood of this impact occurring would reduce. No difference in impact significance would result from the proposed alternatives.

The following mitigation measures are recommended:

- Implement measures as provided in the EMP, which inter alia specify the storage details of hazardous compounds and the emergency procedures to follow in the event of a spillage; and
Figure 4.41: Identified and confirmed Noise-sensitive Developments in the vicinity of the proposed wind energy facility
• Comply with the various pieces of legislation controlling the use of hazardous substances at a construction site.

4.4.12 Dust impacts

Construction vehicles are likely to make use of the existing farm roads to transport equipment and material to the construction site. Earthworks would also be undertaken. These activities would exacerbate dust especially in the dry winter months.

This potential impact is considered to be of medium magnitude, local extent and short term and therefore of low (-) significance, without mitigation and very low (-) significance with mitigation for both proposed wind and solar energy facilities. No difference in significance would result from the proposed wind alternatives.

The following mitigation measures are recommended:
• Implement measures as provided in the EMP, which includes procedures for dealing with dust pollution events including watering of roads, etc.

4.5 SUMMARY OF POTENTIAL IMPACTS

A summary of all the potential impacts from the proposed projects assessed above is included in Table 4.7 and
Table 4.8. While some difference in magnitude of the potential impacts would result from the proposed alternatives this difference was not considered to be significant for any of the potential impacts. As such, the tables below applies to all proposed alternatives.
### Table 4.7: Summary of potential impacts of the proposed wind, substation and grid connection projects

<table>
<thead>
<tr>
<th>Potential impact</th>
<th>No/mit/Mit&lt;sup&gt;35&lt;/sup&gt;</th>
<th>Extent</th>
<th>Magnitude</th>
<th>Duration</th>
<th>SIGNIFICANCE</th>
<th>Probability</th>
<th>Conf.&lt;sup&gt;36&lt;/sup&gt;</th>
<th>Reversibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPERATIONAL PHASE</strong></td>
<td></td>
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</tr>
<tr>
<td>Impact on Botany, Preferred layout</td>
<td>No mit</td>
<td>Local</td>
<td>Low - High</td>
<td>Long term</td>
<td>Low - High (-)</td>
<td>Definite</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
<tr>
<td>No-go alternative</td>
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<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Impact on fauna</td>
<td>No mit</td>
<td>Local</td>
<td>Low</td>
<td>Short term</td>
<td>Very Low (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Mit</td>
<td>Local</td>
<td>Low</td>
<td>Short term</td>
<td>Very Low (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
<td></td>
</tr>
<tr>
<td>Impact on birds</td>
<td>No mit</td>
<td>Regional</td>
<td>Medium-High</td>
<td>Long term</td>
<td>Medium - High (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Mit</td>
<td>Local</td>
<td>Medium</td>
<td>Long term</td>
<td>Medium (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Irreversible</td>
<td></td>
</tr>
<tr>
<td>Impact on bats</td>
<td>No mit</td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Probable</td>
<td>Low</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Mit</td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
<td></td>
</tr>
<tr>
<td>Impact on freshwater</td>
<td>No mit</td>
<td>Local</td>
<td>Low</td>
<td>Long term</td>
<td>Very Low (-)</td>
<td>Probable</td>
<td>Low</td>
<td>Reversible</td>
</tr>
<tr>
<td>Mit</td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Very Low (-)</td>
<td>Probable</td>
<td>Low</td>
<td>Reversible</td>
<td></td>
</tr>
<tr>
<td>Impact on climate change</td>
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<td>Very Low</td>
<td>Long Term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Mit</td>
<td>Regional</td>
<td>Very Low</td>
<td>Long Term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
<td></td>
</tr>
<tr>
<td>Visual aesthetics</td>
<td>No mit</td>
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<td>Long term</td>
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<td>Reversible</td>
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<tr>
<td>Mit</td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
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<td>Sure</td>
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<td>Impact on energy production</td>
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<td>Long term</td>
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<td>Reversible</td>
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<tr>
<td>Mit</td>
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<td>Low</td>
<td>Long term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
<td></td>
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<td>Impact on local economy (employment)</td>
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<td>Medium term</td>
<td>Very Low - Low (+)</td>
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<td>Reversible</td>
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<tr>
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<td>Medium term</td>
<td>Very Low - Medium (+)</td>
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<td>Sure</td>
<td>Reversible</td>
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<td>Very Low - Low (+)</td>
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<td>Very Low - Medium (+)</td>
<td>Probable</td>
<td>Sure</td>
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</tr>
<tr>
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<td>Very Low</td>
<td>Long term</td>
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<tr>
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<td>Long term</td>
<td>Low-High (-)</td>
<td>Definite</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
</tbody>
</table>

<sup>35</sup> Note that this refers to No mitigation and Mitigation.
<sup>36</sup> Conf.=Confidence in the assessment of the potential impact.
<table>
<thead>
<tr>
<th>Potential impact</th>
<th>No mit/Mit</th>
<th>Extent</th>
<th>Magnitude</th>
<th>Duration</th>
<th>SIGNIFICANCE</th>
<th>Probability</th>
<th>Conf.</th>
<th>Reversibility</th>
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</thead>
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<tr>
<td>Impacts on avifauna</td>
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</tr>
<tr>
<td></td>
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<td>Medium</td>
<td>Medium</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Impacts on bats</td>
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<td>Short</td>
<td>Very Low (-)</td>
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</tr>
<tr>
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<td></td>
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</tr>
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<td>Archaeology</td>
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</tr>
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</tr>
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<td>Storage of hazardous substances on site</td>
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<td>Impact of dust</td>
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### Table 4.8: Summary of potential impacts of the proposed solar project

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<td>Impact on Botany, Preferred layout</td>
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<td>Low-High</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Definite</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
<tr>
<td></td>
<td>Mit</td>
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<td>Long term</td>
<td>Low(-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td></td>
<td>No mit</td>
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<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Definite</td>
<td>Sure</td>
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<td>Low (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Irreversible</td>
</tr>
<tr>
<td>Impact on fauna</td>
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<td></td>
<td>Local</td>
<td>Low</td>
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<tr>
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<tr>
<td>Impact on bats</td>
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<td></td>
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<td>Impact on freshwater</td>
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<td>Very Low (-)</td>
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<td>Low</td>
<td>Reversible</td>
</tr>
<tr>
<td>Impact on climate change</td>
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<td>Very Low</td>
<td>Long Term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
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</tr>
<tr>
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<td>Low (+)</td>
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<td>Reversible</td>
</tr>
<tr>
<td>Visual aesthetics</td>
<td>No mit</td>
<td></td>
<td>Regional</td>
<td>Medium</td>
<td>Long term</td>
<td>Medium (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td></td>
<td>Mit</td>
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<td>Medium</td>
<td>Long term</td>
<td>Medium(-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Impact on energy production</td>
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<td></td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td></td>
<td>Mit</td>
<td></td>
<td>Regional</td>
<td>Low</td>
<td>Long term</td>
<td>Low (+)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Impact on local economy (employment)</td>
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<td>Very Low-Low (+)</td>
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<td>Very Low-Low (+)</td>
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<td>Very Low-Low (+)</td>
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<td>Sure</td>
<td>Reversible</td>
</tr>
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<td>Long term</td>
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</tr>
<tr>
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<td>Long term</td>
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<td>Impacts on flora</td>
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<td>Low</td>
<td>Long term</td>
<td>Low (-)</td>
<td>Probable</td>
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<td>Low</td>
<td>Long term</td>
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<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
<tr>
<td>Impacts on avifauna</td>
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<td>Local</td>
<td>Low - Medium</td>
<td>-</td>
<td>Low - Medium (-)</td>
<td>Probable</td>
<td>Sure</td>
<td>Reversible</td>
</tr>
</tbody>
</table>

37 Note that this refers to No mitigation and Mitigation.
38 Conf. = Confidence in the assessment of the potential impact.
Potential impact | No mit/Mit | Extent | Magnitude | Duration | SIGNIFICANCE | Probability | Conf. | Reversibility
--- | --- | --- | --- | --- | --- | --- | --- | ---
Impacts on bats | No mit | Local | Low (-) | Low (-) | Probable | Sure | Reversible
Sedimentation and erosion | No mit | Local | Moderate | Short term | Very Low (-) | Probable | Sure | Reversible
Impact on heritage resources: Archaeology | No mit | Local | Low - Medium | Long term | Low - Medium (-) | Definite | Low | Irreversible
Impact on heritage resources: Cultural heritage | No mit | - | - | - | - | - | - | -
Palaentology | No mit | Local | Low | Long term | Low (-) | Unlikely | Low | Reversible
Visual aesthetics | No mit | Regional | Low | Long term | Medium (-) | Probable | Sure | Reversible
Impact on local economy (employment) and social conditions | No mit | Regional | Medium | Short term | Medium (+) | Probable | Sure | Reversible
Impact on agriculture | No mit | Local | Low | Short term | Very Low (-) | Definite | Sure | Reversible
Impact on transport | No mit | Regional | High | Short term | Medium (-) | Probable | Sure | Reversible
Noise pollution | No mit | Local | High | Short term | Low (-) | Probable | Sure | Reversible
Storage of hazardous substances on site | No mit | Local | High | Short - Medium term | Low - Medium(-) | Probable | Sure | Irreversible
Impact of dust | No mit | Local | Medium | Short term | Low (-) | Probable | Sure | Reversible

4.6 COMPLIANCE WITH EQUATOR PRINCIPLES

A brief assessment (see Annexure P) has been undertaken to determine the extent to which the proposed wind and solar energy facilities comply with the Equator Principles (EP). Also taken into consideration were the requirements noted in the draft EP III document published on 13 August 2012. Based on the information contained in this report the proposed facilities are most likely Category B projects according to the International Finance Corporation and comply with the principles (although some aspects to be confirmed fall outside the scope of the EIA/EMP itself).
5 CONCLUSIONS AND WAY FORWARD

The purpose of this Chapter is to briefly summarise and conclude the EIR and describe the way forward.

5.1 CONCLUSIONS

As per the requirements of NEMA, this EIR investigation has reviewed a range of project alternatives and contemplated the array of potential environmental impacts associated with the following proposed activities in Springbok:

Proposed wind energy facility:
- Construction of 180 four phases of 140 MW capacity with wind turbines ranging in size from 1.5-4 MW capacity;
- Associated infrastructure including:
  - Hard standings of 20 40 m x 40 m alongside turbines;
  - Access roads of 4 – 10 m wide between turbines;
  - Overhead or underground transmission lines connecting turbines;
  - One main substation connecting the proposed energy facilities to the Eskom line; and
  - Two satellite substations that would link sectors of the facility to a main substation with overhead lines.

Proposed solar energy facility:
- Construction of 225 MW (three phases of 75 MW) of PV (tracking or fixed) and/or CPV (tracking);
- Associated infrastructure including:
  - Access roads of 4 – 10 m wide to the PV plant; and
  - One main substation with overhead lines.

The following feasible alternatives were considered in the EIR:

Proposed wind energy facility:
- Location alternatives:
  - One location for the proposed wind energy facility;
- Activity alternatives:
  - Wind energy generation via wind turbines; and
  - “No-go” alternative to wind energy production.
- Site layout alternatives:
  - One layout alternative per site;
  - One main substation location, with two satellite substations.
- Technology alternatives:
  - A minimum and maximum tipheight of 100 – 180 m.
  - A range of turbine heights.

Proposed solar energy facility:
- Location alternatives:
One location for the proposed PV/CPV plant.

- Activity alternatives:
  - Solar energy generation via a PV/CPV plant; and
  - “No-go” alternative to solar energy production.

- Site layout alternatives:
  - One layout alternative (225 MW with 800793 ha footprint).

- Technology alternatives:
  - Two technology alternatives in terms of the solar panel type (PV vs CPV); and
  - Mounting system: trackers vs fixed mount.

Aurecon submits that this EIR provides a comprehensive assessment of the environmental issues associated with each of the feasible alternatives of the proposed projects outlined in the FSR and the associated Plan of Study for EIA. These impacts and alternatives were derived in response to inputs from consultation with I&APs, provincial and local authorities, and the EIA project team.

Table 5.1 provides a summary of the significance of the environmental impacts associated with the proposed developments.
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<tr>
<th>IMPACT</th>
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<th>Preferred Layout</th>
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<td>9 Impact on local economy (employment)</td>
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<td>10 Impact on social conditions</td>
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<td>12 Impact on agricultural land</td>
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<td><strong>CONSTRUCTION PHASE IMPACTS</strong></td>
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<td>13 Impacts on flora</td>
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<td>14 Impacts on avifauna</td>
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<td>L</td>
</tr>
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<td>15 Impacts on bats</td>
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<td>16 Sedimentation and erosion</td>
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<td>17.3 Impact on heritage resources: Cultural heritage</td>
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<td>M+</td>
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<td>20 Impact on agriculture</td>
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<td>L-M</td>
</tr>
<tr>
<td>24 Impact of dust</td>
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<td>VL</td>
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</tbody>
</table>

Table 5.1: Summary of the significance of the environmental impacts associated with the proposed developments
5.2 LEVEL OF CONFIDENCE IN ASSESSMENT

With reference to the information available at the feasibility stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as being acceptable for the decision-making, specifically in terms of the environmental impacts and risks. The EAP believes that the information contained within the FSR and this EIR is adequate to inform Mainstream’s decision making regarding which alternatives to pursue and will allow DEA to be able to determine the environmental acceptability of the proposed alternatives.

It is acknowledged that the projects details will evolve during the detailed design and construction phases to a limited extent. However, these are unlikely to change the overall environmental acceptability of the proposed projects and any significant deviation from what was assessed in this EIR should be subject to further assessment. If this was to occur, an amendment to the Environmental Authorisation may be required in which case the prescribed process would need to be followed.

5.3 OPERATIONAL PHASE IMPACTS

Wind energy facility
Table 5.1, the most significant (medium-high (-)) operational phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed wind energy facility on avifauna and visual aesthetics. With the implementation of mitigation measures impacts on avifauna would decrease to medium (-) and visual impacts would decrease to low (-).
It should be noted that three potential positive impacts on energy production and local economy (employment), climate change and social conditions would result and these would be of low-medium (+) significance, with and without mitigation measures.

There was no difference in the significance of the potential impacts resulting from the feasible alternatives, including the turbine alternatives. However Mainstream has chosen their preferred option as per the revised layouts based on sensitivity buffers from the specialists along with technical and financial considerations. The potential impacts of the proposed wind energy facility main substation for the proposed wind energy facility were assessed within the impacts of the proposed wind energy facility and were considered to be acceptable.

**Solar energy facility**

Table 5.1, the most significant (medium (-)) operational phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed solar energy facility on visual aesthetics. With the implementation of mitigation measures the impacts on visual aesthetics would remain medium (-).

It should be noted that three potential positive impacts on energy production and local economy (employment), climate change and social conditions would result and these would be of low (+) significance, with and without mitigation measures.

There was no difference in the significance of the potential impacts resulting from the feasible alternatives, including the heights of the panels and CPV vs PV alternatives. However Mainstream has chosen their preferred option as per the revised layouts based on sensitivity buffers from the specialists along with consideration of technical and financial considerations. Mainstream has also chosen the PV technology alternative as their preferred alternative. However both PV (tracking and fixed) and CPV (tracking) are considered to have similar impacts and therefore it is requested that both technologies options are approved as the choice of technology will depend on a detailed tender process before the solar project is submitted into the DoE’s procurement process. The potential impacts of the proposed main PV substation for the proposed solar energy facility were assessed within the impacts of the proposed solar energy facility and were considered to be acceptable.

### 5.4 CUMULATIVE IMPACTS

Section 31(2)(l)(i) of the EIA regulations (GN No. 543 of 2010) required that “An environmental impact assessment report must contain all information that is necessary for the competent authority to consider the application and to reach a decision contemplated in regulation 35, and must include …an assessment of each identified potentially significant impact, including…cumulative impacts.” A guideline on cumulative impacts exists (DEAT, 2004) which notes the difficulties in assessing cumulative impacts within project specific EIA’s.

The potential cumulative impacts were considered within each impact section, where these could be understood and quantified, for the proposed wind and solar energy projects together as well as for other similar project in the area as well as any other proposed renewable energy facilities, where applicable. The significance of these were considered to be of low to high (-) significance and low to medium (+), without mitigation. These potential cumulative impacts
would decrease, with implementation of mitigation measures for the proposed projects as well as other proposed projects in the area, and are considered to be acceptable. However, it should be noted that it is not possible to assess these cumulative impacts in a project specific EIA, not least because not all the proposed renewable energy projects in the area may be approved or constructed. In many cases the potential cumulative impacts are not well understood due to lack of information (e.g. the cumulative impacts on bats cannot be quantified as it is not certain the degree to which bat migration takes place in South Africa) and it is therefore impossible to ascribe an intensity, extent, timeframe and/or likelihood to the potential impact. In such instances mitigation measures have been recommended which would assist in the gathering of knowledge e.g. bird and bat monitoring. This could result in new mitigation measures being recommended or at least assisting in the understanding of impacts for future renewable energy projects. It was also recommended that DEA, or a similar body, undertake a strategic assessment of cumulative impacts resulting from renewable energy facilities in South Africa. As such it would be necessary for DEA, or a similar body, to undertake a strategic assessment in this regard.

The assessment of cumulative impacts within this report takes into consideration the cumulative impacts of the four applications (the proposed wind energy facility, solar energy facility and the two proposed substations and grid connections) together with other proposed renewable energy projects in the area. No cumulative impacts were identified as fatal flaws, provided each project implements the mitigation measures recommended.

It should be noted that while the proposed wind and solar energy facilities are phased the assessment of each facility considers the impacts of all the phases together i.e. should less phases be constructed the impact would be equal to or lower than the facility assessment.

5.5 CONSTRUCTION PHASE IMPACTS

Wind energy facility
With reference to Table 5.1, the most significant (medium - high (-) and high (-)) construction phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed wind energy facility on botany, avifauna and visual aesthetics and transport sedimentation and erosion. With the implementation of mitigation measures the significance of these potential impacts would be low (-) for botany, visual and sedimentation and erosion avifauna and transport would remain Medium (-). This is deemed to be acceptable based on the short duration of the construction period. The remaining negative construction phase impacts were not deemed to have a significant impact on the environment, given their duration (approximately 18-36 months) and localised extent. The remaining construction impacts were assessed to be of low (-) or lower significance, with and without mitigation measures. It should be noted that a potential positive impact on the socio-economic environment would result and would be of low (+) significance, with and without mitigation measures. No difference in significance would result from the proposed wind alternatives.

Solar energy facility
The most significant (medium (-) and high (-)) construction phase impacts on the biophysical and socio-economic environment, without mitigation was for the potential impacts of the proposed solar energy facility on sedimentation and erosion, visual and transport. With the
implementation of mitigation measures the significance of these potential impacts would be very low (-) for sedimentation and erosion, low (-) for visual and transport would remain high (-). This is deemed to be acceptable based on the short duration of the construction period. The remaining negative construction phase impacts were not deemed to have a significant impact on the environment, given their duration (approximately 24 months) and localised extent. The remaining construction impacts were assessed to be of low (-) or lower significance, without mitigation measures. It should be noted that a potential positive impact on the socio-economic environment would result and would be of low (+) significance, with and without mitigation measures. No difference in significance would result from the proposed solar alternatives.

5.6  RECOMMENDATIONS

Chapter 4 has outlined mitigation measures which, if implemented, could significantly reduce the negative impacts associated with the projects. Where appropriate, these and any others identified by DEA could be enforced as Conditions of Approval in the Environmental Authorisation, should DEA issue a positive Environmental Authorisation. The mitigation measures for each EIA application are included in Annexure Q.

5.6.1  Considerations in identification of preferred alternative

Mainstream has identified their preferred alternatives as follows:
Proposed wind energy facility:
- Revised layout as per Figure 3.5; and
- Technology alternatives can only be chosen after an EA is received.
Proposed solar energy facility:
- Revised layout as per Figure 3.9; and
- Technology alternatives can only be chosen after an EA is received.

Mainstream selected these alternatives as preferred based on specialist input to minimise potential environmental impacts, as well as technical and financial considerations to inform their decision.

Wind energy facility
The proposed wind energy facility results in low to medium (+) significance impacts and very low to high (-) significance impacts on the environment. This assessment has considered the revision of the layouts in response to the impacts assessed by the various specialists and the mitigation measures put forward. The potential for the proposed wind energy facility is considered to be environmentally acceptable, considering the positive impacts.

With regards to the alternatives considered, including the turbine alternatives, there is no difference in significance of impacts between alternatives. Based on specialist recommendations, buffers have already been incorporated into the layout revisions to avoid sensitive features and areas and as such the revised layout is considered to be the preferred alternative from an environmental perspective.
No alternatives were identified for the proposed main substation.

**Solar energy facility**

The proposed solar energy facility results in *low to medium* (+) significance impacts and *very low to high* (-) significance impacts on the environment. This assessment has considered the revision of the layouts in response to the impacts assessed by the various specialists and the mitigation measures put forward. The potential for the proposed solar energy facility is considered to be environmentally acceptable, considering the positive impacts.

With regards to the alternatives considered, including the height differences and CPV and PV, there is no difference in significance of impacts between alternatives. Based on specialist recommendations, buffers have already been incorporated into the layout revisions to avoid sensitive features and areas and as such the revised layout is considered to be the preferred alternative from an environmental perspective.

The EIA considered the potential impacts of both PV (tracking and fixed) and CPV (tracking). Both technologies were considered to have similar impacts and therefore it is requested that both technologies options are approved. The choice of technology would depend on a detailed tender process before the solar project is submitted into the DoE’s procurement process. Choice of technology would depend on: Technology available to the market at that time, cost of technology, energy yield of different technologies, local content of technology offered, warranties and guarantees offered by different technologies.

In order to limit unnecessary EA amendments, and facilitate most affordable and fit for purpose solar energy to South Africa, it is requested that both PV (tracking and fixed) and CPV (tracking) technologies are approved.

No alternatives were identified for the proposed main substation.

**5.6.2 Compliance with Equator Principles**

A brief assessment was undertaken to determine the extent to which the proposed wind and solar energy facilities comply with the EP. Also taken into consideration were the requirements noted in the draft EP III document published on 13 August 2012. Based on the information contained in this report the proposed facilities are most likely Category B projects according to the International Finance Corporation and comply with the principles (although some aspects to be confirmed fall outside the scope of the EIA/EMP itself).

**5.6.3 Opinion with respect to environmental authorisation**

Regulation 32(2) (m) of the EIA Regulations requires that the EAP include an opinion as to whether the activity should be authorised or not.

The impacts associated with the proposed projects would result in regional impacts (both biophysical and socio-economic) that would negatively affect the area.
Based on the significance of the potential impacts, summarised in Section 5.3 and 5.5, the EAP is of the opinion that the proposed wind and solar energy facilities and associated substations, including alternatives, being applied for be authorised as the benefits outweigh the negative environmental impacts. The significance of negative impacts can be reduced with effective and appropriate mitigation through a Life-Cycle EMP, as described in this report. If authorised, the implementation of an EMP should be included as a condition of approval.

It should be noted that the Department of Energy’s (DoE) current renewable energy procurement program has capped the maximum size of wind and solar energy projects at 140 MW and 75 MW respectively. While there has been no formal information about the project size cap being lifted various discussions within the industry to increase or remove the cap all together are taking place. The main drivers for lifting the cap would include:

- Achieving the targets set by the Integrated Resource Plan (IRP) 2010 (11 400 MW of new build renewable energy). After the first two rounds of the DoE’s procurement process Eskom’s distribution grid is already getting congested and in locations where there is good wind and solar resource the distribution grid capacity will be limited and only smaller projects will be able to connect (< 30 MW). That will require larger projects to connect to Eskom’s transmission grid which is much more expensive and time consuming. To ensure affordable projects connecting to transmission grid, projects will need to be larger than the current caps to continue the current pricing levels as seen in Round 2;
- To achieve the local economic development goals quicker and with larger impact;
- To get more energy onto the grid at a faster pace to aid in ensuring South Africa’s energy security. South Africa will not be able to achieve the IRP targets with project sizes being limited by grid capacity and financial viability;
- To ensure South Africa’s renewable energy becomes even more affordable.

The Kangnas wind and solar projects have been developed at a large scale with a longer term vision that the project cap will be lifted. The wind and solar projects have been developed to allow for phases of 75 MW (solar) and 140 MW (wind) to allow the developer flexibility in the future to suit the future procurement requirements in terms of size.

As the only grid connection for the Kangnas site is the Nama/Aggeneys 220 kV transmission line, a 140 MW wind or 75 MW solar project will not be competitive nor affordable.

The minimum size for a wind project at the Kangnas site, which would be competitive and affordable and hence a viable option for DoE to select, would be 280 MW, thus two of the proposed four phases. Phase A and B would be preferred by the developer due to the superior resource and limited environmental impacts of these phases.

The minimum size for a solar project at the Kangnas site, which would be competitive and affordable and hence a viable option for DoE to select, would be 225 MW, thus all three of the proposed phases.

It should be noted that Eskom’s current future planning for the Nama/Aggeneys 220 kV line is to upgrade to 400 kV. Should Eskom embark on the 400 kV upgrade in the near future all four
phases (560 MW) of the proposed Kangnas wind farm would be required in order for the project to be affordable.

5.7 WAY FORWARD

The Draft EIR was lodged at the Springbok and Pofadder Libraries and on the Aurecon website (www.aurecongroup.com/) (change “Current Location” to South Africa and follow the public participation link). All registered I&APs were notified of the availability of the Draft EIR by means of a letter, which included a copy of the Draft EIR Executive Summary. I&APs had until 14 January 2013 to submit written comment on the Draft EIR to Aurecon.

I&APs were invited to a public meeting on 12 December 2012 to present and discuss the findings of the Draft EIR at Springbok Exhibition Hall (Skousaal) at 11h00-13h00. I&APs are requested to RSVP by 7 December 2012 and should the number of RSVP’s be insufficient the meeting would be cancelled and I&APs would instead be contacted telephonically/electronically to discuss any issues and concerns they may have.

The Final EIR has been completed with the addition of any I&AP comments received. The Final EIR will then be submitted to the Northern Cape DEANC and DEA for their review and decision-making, respectively.

The Final EIR has been made available for review at the same locations as the Draft EIR. Any comments received on the Final EIR will not be included in a Comments and Response Report and will instead be collated and forwarded directly to DEA.

Once DEA has reviewed the Final EIR, they will need to ascertain whether the EIA process undertaken met the legal requirements and whether there is adequate information to make an informed decision. Should the above requirements be met, they will then need to decide on the environmental acceptability of the proposed projects. Their decision will be documented in an Environmental Authorisation, which will detail the decision, the reasons therefore, and any related conditions. Following the issuing of the Environmental Authorisations, DEA’s decision will be communicated by means of a letter to all registered I&APs and the appeal process will commence, during which any party concerned will have the opportunity to appeal the decision to the Minister of Environmental Affairs in terms of NEMA.
6 REFERENCES

6.1 REPORTS


DEA. 2010. Integrated Environmental Information Management (IEIM), Information Series 5: Companion to the NEMA EIA Regulations of 2010

DEA. 2010. Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft)


DWA. 2008. Groundwater Resources in the Northern Cape Province

Emthanjeni LM. 2010. Integrated Development Plan 2010

Macroplan Town and Regional Planners. 2007. Emthanjeni LM Spatial Development Framework


6.2 GUIDELINES

Guideline for Environmental Management Plans (June 2005).

Guideline for determining the scope of specialist involvement in EIA Processes (June 2005).

Guideline for the review of specialist input into the EIA Process (June 2005).


6.3 ELECTRONIC RESOURCES


The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corp ‘Good Neighbour – Outdoor Lighting’ www.nelpag.org (accessed 06/12/12)


http://www.orangesengurak.org/river/subbasins/lowerorange.aspx (accessed 02/01/11)

http://196.33.85.14/cgs_inter/content/GSSA/GSSASpecialPubsA.htm (accessed 12/11/10)


6.4 PERSONAL COMMUNICATION

Personal communication between Louise Corbett of Aurecon and Sandile Vilakazi of DEA on 13/09/2011 via e-mail

Personal communication between Simon Clark of Aurecon and John Almond of Natura Viva on 04/10/11 via e-mail

Personal communication between Simon Clark of Aurecon and Doug Harebottle of Avifaunal specialist on 21/02/13 via e-mail
Annexure A
Attention: Ms Louise Corbett
Aurecon South Africa (Pty) Ltd
P.O. Box 494
CAPE TOWN
8000

Fax: (086) 667 3532

PER FACSIMILE / MAIL

Dear Ms Corbett

APPLICATION FOR ENVIRONMENTAL AUTHORISATION: CONSTRUCTION OF WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES, SUBSTATION AND GRIDLINE, AND ASSOCIATED INFRASTRUCTURE NEAR SPRINGBOK, WITHIN THE NAMA-KHOI LOCAL MUNICIPALITY OF THE NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE

The Final Scoping Report (FSR) and Plan of Study for Environmental Impact Assessment dated July 2012 and received by the Department on 02 August 2012 refers.

The Department has evaluated the submitted FSR and the Plan of Study for Environmental Impact Assessment dated July 2012 and is satisfied that the documents comply with the minimum requirements of the Environmental Impact Assessment (EIA) Regulations, 2010. The FSR is hereby accepted by the Department in terms of regulation 30(1)(a) of the EIA Regulations, 2010.

You may proceed with the environmental impact assessment process in accordance with the tasks contemplated in the Plan of Study for Environmental Impact Assessment as required in terms of the EIA Regulations, 2010.

Please ensure that comments from all relevant stakeholders are submitted to the Department with the Final Environmental Impact Report (EIR). This includes but is not limited to: Department of Water Affairs, Department of Agriculture, Forestry and Fisheries, Eskom, Namakwa District Municipality, Nama-Khoi Local Municipality, Northern Cape Department of Environment and Nature Conservation, Endangered Wildlife Trust and WESSA. Proof of correspondence with the various stakeholders must be included in the Final EIR. Should you be unable to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments.

Proof of correspondence with the various stakeholders must be included in the Final EIR. Should you be unable to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments.
Please ensure that confirmation (in writing) is sought from WWF with regards to any future plans to expand the protected areas network. This must be submitted with the Draft EIR.

The discussion on Alternatives must clearly come out in the Draft EIR as stated in your letter dated 05 September 2012. Please also provide the department with the route on the gridline and weather it will be underground or overhead (if overhead please provide the department with alternative alignments that were considered for the routing of the line and also the distance from the facility to the substation it will be connecting to).

There must be a clear distinction in the assessment of impacts for both the PV or and/or CSP and the Wind Energy Facility.

Please ensure that the Draft and Final EIR includes at least one A3 regional map of the area and the site layout plan to illustrate the Wind Turbines position, PV positions, Substation site, Gridline route (including alternatives to routes) and associated infrastructure. The maps must be of acceptable quality and as a minimum, have the following attributes:
- Maps are relatable to one another;
- Cardinal points;
- Co-ordinates;
- Legible legends;
- Indicate alternatives;
- Latest land cover;
- Vegetation types of the study area; and
- A3 size locality map.

You are required to submit the final site layout plan together with the Draft and Final EIR to the Department. All available biodiversity information must be used in the finalisation of the layout.

Positions of solar facilities:
- Foundation footprint;
- Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible);
- Wetlands, drainage lines, rivers, stream and water crossing of roads and cables indicating the type of bridging structures that will be used;
- The location of Heritage sites;
- Sub-station(s) and/or transformer(s) sites including their entire footprint;
- Connection routes (including pylon positions) to the distribution/transmission network;
- All existing infrastructure on the site, especially roads;
- Buildings including accommodation;
- All “no-go” areas; and
- A map combining the final layout plan must be superimposed on the environmental sensitivity map.

The Environmental Management Programme (EMP) submitted as part of the application for environmental authorisation must include the following:
a. All recommendations and mitigation measures to be recorded in the Draft and Final EIR.
b. The final site layout plan.
c. Measures as dictated by the final site lay-out plan and micro-siting.
d. An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.

e. A map combining the final layout plan superimposed (overlaid) on the environmental sensitivity map.

f. An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.

g. A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site in consultation with the ECO and be implemented prior to commencement of the construction phase.

h. An open space management plan to be implemented during the construction and operation of the facility.

i. A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility including timeframes for restoration which must indicate rehabilitation within the shortest possible time after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

j. A storm water management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water run-off.

k. An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.

l. An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.

m. A traffic management plan for the site access roads to ensure that no hazards would results from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.

n. A transportation plan for the transport of PV components, main assembly cranes and other large pieces of equipment.

o. Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants.

The applicant is hereby reminded to comply with the requirements of regulation 67 with regard to the time period allowed for complying with the requirements of the Regulations, and regulations 56 and 57 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the competent authority for decision-making. The reports referred to are listed in regulation 56(3a-3h).

Further, it must be reiterated that, should an application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then
this Department will not be able to make nor issue a decision in terms of your application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999.

You are requested to submit one electronic copy (CD/DVD) and two (2) hard copies of both the Draft and Final EIR to the Department as per regulation 34(1)(b) of the EIA Regulations, 2010.

Please also find attached information that should be used in the preparation of the Environmental Impact Report. This will enable the Department to speedily review the EIAR and make a decision on the application.

You are hereby reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, that no activity may commence prior to an environmental authorisation being granted by the Department.

Mr Mark Gordon  
Chief Director: Integrated Environmental Authorisations  
Department of Environmental Affairs  
Letter signed by: Ms Fatima Rawjee  
Designation: Director: Integrated Environmental Authorisations  
Date: 08/10/2012

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<td>Mr J. Bonil</td>
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<td>SAMRPPD</td>
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<td>Mr C. Geldenhuys</td>
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<td>Northern Cape: DENC</td>
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<td>Municipal Manager</td>
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EIA INFORMATION REQUIRED FOR SOLAR ENERGY FACILITIES

1. General site information

The following general site information is required:

- Descriptions of all affected farm portions
- 21 digit Surveyor General codes of all affected farm portions
- Copies of deeds of all affected farm portions
- Photos of areas that give a visual perspective of all parts of the site
- Photographs from sensitive visual receptors (tourism routes, tourism facilities, etc.)
- Solar plant design specifications including:
  ▶ Type of technology
  ▶ Structure height
  ▶ Surface area to be covered (including associated infrastructure such as roads)
  ▶ Structure orientation
  ▶ Laydown area dimensions (construction period and thereafter)
  ▶ Generation capacity
- Generation capacity of the facility as a whole at delivery points

This information must be indicated on the first page of any Scoping or EIA document. It is also advised that it be double checked as there are too many mistakes in the applications that have been received that take too much time from authorities to correct.

2. Site maps and GIS information

Site maps and GIS information should include at least the following:

- All maps/information layers must also be provided in ESRI Shapefile format
- All affected farm portions must be indicated
- The exact site of the application must be indicated (the areas that will be occupied by the application)
- A status quo map/layer must be provided that includes the following:
  ▶ Current use of land on the site including:
    ▶ Buildings and other structures
    ▶ Agricultural fields
    ▶ Grazing areas.
    ▶ Natural vegetation areas (natural veld not cultivated for the preceding 10 years) with an indication of the vegetation quality as well as fine scale mapping in respect of Critical Biodiversity Areas and Ecological Support Areas
    ▶ Critically endangered and endangered vegetation areas that occur on the site
    ▶ Bare areas which may be susceptible to soil erosion
    ▶ Cultural historical sites and elements
  ▶ Rivers, streams and water courses
  ▶ Ridgelines and 20m continuous contours with height references in the GIS database
  ▶ Fountains, boreholes, dams (in-stream as well as off-stream) and reservoirs
High potential agricultural areas as defined by the Department of Agriculture, Forestry and Fisheries

Buffer zones (also where it is dictated by elements outside the site):
- 500m from any irrigated agricultural land
- 1km from residential areas

Indicate isolated residential, tourism facilities on or within 1km of the site

- A slope analysis map/layer that include the following slope ranges:
  - Less than 8% slope
  - Between 8% and 12% slope
  - Between 12% and 14% slope
  - Steeper than 18% slope

- A map/layer indicating locations of birds and bats including roosting and foraging areas (specialist input required)

- A site development proposal map(s)/layer(s) that indicate:
  - Positions of solar facilities
  - Foundation footprint
  - Permanent laydown area footprint
  - Construction period laydown footprint
  - Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible)
  - River, stream and water crossing of roads and cables indicating the type of bridging structures that will be used
  - Substation(s) and/or transformer(s) sites including their entire footprint.
  - Cable routes and trench dimensions (where they are not along internal roads)
  - Connection routes to the distribution/transmission network (the connection must form part of the EIA even if the construction and maintenance thereof will be done by another entity such as ESKOM)
  - Cut and fill areas along roads and at substation/transformer sites indicating the expected volume of each cut and fill
  - Borrow pits
  - Spoil heaps (temporary for topsoil and subsoil and permanently for excess material)
  - Buildings including accommodation

With the above information authorities will be able to assess the strategic and site impacts of applications.

3. Regional map and GIS information

The regional map and GIS information should include at least the following:

- All maps/information layers must also be provided in ESRI Shapefile format
- The map/layer must cover an area of 20km around the site
- Indicate the following:
  - Roads including their types (tarred or gravel) and category (national, provincial, local or private)
  - Railway lines and stations
  - Industrial areas
  - Harbours and airports
  - Electricity transmission and distribution lines and substations
  - Pipelines
4. Important stakeholders

Amongst other important stakeholders, comments from the National Department of Agriculture, Forestry and Fisheries must be obtained and submitted to the Department. Any application, documentation, notification etc. should be forwarded to the following officials:

Ms Mashudu Marubini  
Delegate of the Minister (Act 70 of 1970)  
E-mail: MashuduMa@daff.gov.za  
Tel 012-319 7619

Ms Thoko Buthelezi  
AgriLand Liaison office  
E-mail: ThokoB@daff.gov.za  
Tel 012-319 7634

All hardcopy applications / documentation should be forwarded to the following address:

**Physical address:**
Delpen Building  
Cnr Annie Botha and Union Street  
Office 270  
Attention: Delegate of the Minister Act 70 of 1970

**Postal Address:**
Department of Agriculture, Forestry and Fisheries  
Private Bag X120  
Pretoria  
0001  
Attention: Delegate of the Minister Act 70 of 1970

In addition, comments must be requested from Eskom regarding grid connectivity and capacity. Request for comment must be submitted to:

Mr John Goeringh  
Eskom Transmission  
Megawatt Park D1Y38  
PO Box 1091  
JOHANNESBURG  
2000
B. AGRICULTURE STUDY REQUIREMENTS

- Detailed soil assessment of the site in question, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include the following:
  - Identification of the soil forms present on site
  - The size of the area where a particular soil form is found
  - GPS readings of soil survey points
  - The depth of the soil at each survey point
  - Soil colour
  - Limiting factors
  - Clay content
  - Slope of the site
  - A detailed map indicating the locality of the soil forms within the specified area,
  - Size of the site
- Exact locality of the site
- Current activities on the site, developments, buildings
- Surrounding developments / land uses and activities in a radius of 500 m of the site
- Access routes and the condition thereof
- Current status of the land (including erosion, vegetation and a degradation assessment)
- Possible land use options for the site
- Water availability, source and quality (if available)
- Detailed descriptions of why agriculture should or should not be the land use of choice
- Impact of the change of land use on the surrounding area

A shape file containing the soil forms and relevant attribute data as depicted on the maps
EIA INFORMATION REQUIRED FOR WIND FARM APPLICATIONS

1. General site information

The following general site information is required:
- Descriptions of all affected farm portions
- 21 digit Surveyor General codes of all affected farm portions
- Copies of deeds of all affected farm portions
- Photos of areas that give a visual perspective of all parts of the site
- Photographs from sensitive visual receptors (tourism routes, tourism facilities, etc.)
- Turbine design specifications including:
  - Nacelle height
  - Blade length
  - Turbine shaft dimensions
  - Foundation dimensions
  - Laydown area dimensions (construction period and thereafter)
  - Blade rotation direction
  - Generation capacity
- Onsite measured wind parameters (speed, variability, etc.)
- Generation capacity of the facility as a whole at delivery points

This information must be indicated on the first page of any Scoping or EIA document. It is also advised that it be double checked as there are too many mistakes in the applications that have been received that take too much time from authorities to correct.

2. Site maps and GIS information

Site maps and GIS information should include at least the following:
- All maps/information layers must also be provided in ESRI Shapefile format
- All affected farm portions must be indicated
- The exact site of the application must be indicated (the areas that will be occupied by the application)
- A status quo map/layer must be provided that includes the following:
  - Current use of land on the site including:
    - Buildings and other structures
    - Agricultural fields
    - Grazing areas
    - Natural vegetation areas (natural veld not cultivated for the preceding 10 years) with an indication of the vegetation quality as well as fine scale mapping in respect of Critical Biodiversity Areas and Ecological Support Areas
    - Critically endangered and endangered vegetation areas that occur on the site
    - Bare areas which may be susceptible to soil erosion
    - Cultural historical sites and elements
  - Rivers, streams and water courses
  - Ridgelines and 20m continuous contours with height references in the GIS database
  - Fountains, boreholes, dams (in-stream as well as off-stream) and reservoirs
  - High potential agricultural areas as defined by the Department of Agriculture, Forestry and Fisheries
Buffer zones (also where it is dictated by elements outside the site):
- 500m from any irrigated agricultural land
- 1km from residential areas
- Indicate isolated residential, tourism facilities on or within 1km of the site

- A slope analysis map/layer that include the following slope ranges:
  - Less than 8% slope (preferred areas for turbines and infrastructure)
  - Between 8% and 12% slope (potentially sensitive to turbines and infrastructure)
  - Between 12% and 14% slope (highly sensitive to turbines and infrastructure)
  - Steeper than 18% slope (unsuitable for turbines and infrastructure)

- A map/layer that indicate locations of birds and bats including roosting and foraging areas (specialist input required)

- A site development proposal map(s)/layer(s) that indicate:
  - Turbine positions
  - Foundation footprint
  - Permanent laydown area footprint
  - Construction period laydown footprint
  - Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible)
  - River, stream and water crossing of roads and cables indicating the type of bridging structures that will be used
  - Substation(s) and/or transformer(s) sites including their entire footprint.
  - Cable routes and trench dimensions (where they are not along internal roads)
  - Connection routes to the distribution/transmission network (the connection must form part of the EIA even if the construction and maintenance thereof will be done by another entity such as ESKOM)
  - Cut and fill areas at turbine sites along roads and at substation/transformer sites indicating the expected volume of each cut and fill
  - Borrow pits
  - Spoil heaps (temporary for topsoil and subsoil and permanently for excess material)
  - Buildings including accommodation

With the above information authorities will be able to assess the strategic and site impacts of the application.

3. Regional map and GIS information

The regional map and GIS information should include at least the following:
- All maps/information layers must also be provided in ESRI Shapefile format
- The map/layer must cover an area of 20km around the site
- Indicate the following:
  - Roads including their types (tarred or gravel) and category (national, provincial, local or private)
  - Railway lines and stations
  - Industrial areas
  - Harbours and airports
  - Electricity transmission and distribution lines and substations
  - Pipelines
  - A visibility assessment of the areas from where the facility will be visible
  - Critical Biodiversity Areas and Ecological Support Areas
  - Critically Endangered and Endangered vegetation areas
> Agricultural fields
> Irrigated areas
> An indication of new road or changes and upgrades that must be done to existing roads in order to get equipment onto the site including cut and fill areas and crossings of rivers and streams.

4. **Important stakeholders**

Amongst other important stakeholders, comments from the National Department of Agriculture, Forestry and Fisheries must be obtained and submitted to the Department. Request for comment must be submitted to:

Mrs. Anneliza Collett
Directorate: Land Use & Soil Management
Department of Agriculture, Forestry & Fisheries
Tel: 012 - 319 7508
Fax: 012 - 329 5538
e-mail: AnnelizaC@nda.agric.za
www.agis.agric.za

In addition, comments must be requested from Eskom (Mr Kevin Leask or Mr Ronald Marais (011) 8008111) regarding grid connectivity and capacity.

**Agricultural study**

- Detailed soil assessment of the site in question, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include the following:
  - Identification of the soil forms present on site
  - The size of the area where a particular soil form is found
  - GPS readings of soil survey points
  - The depth of the soil at each survey point
  - Soil colour
  - Limiting factors
  - Clay content
  - Slope of the site
  - A detailed map indicating the locality of the soil forms within the specified area.
  - Size of the site
- Exact locality of the site
- Current activities on the site, developments, buildings
- Surrounding developments / land use and activities in a radius of 500 m of the site
- Access routes and the condition thereof
- Current status of the land (including erosion, vegetation and a degradation assessment)
- Possible land use options for the site
- Water availability, source and quality (if available)
- Detailed descriptions of why agriculture should or should not be the land use of choice
- Impact of the change of land use on the surrounding area
- A shape file containing the soil forms and relevant attribute data as depicted on the map.
Annexure B1
1 THE PUBLIC PARTICIPATION PROCESS

The purpose of this Annexure is to provide an outline of the Public Participation Process, a summary of the process undertaken to date, and the way forward with respect to public participation as part of the EIA Phase of this project. This Annexure also provides a summary of the key issues that have been raised to date.

1.1 INTRODUCTION

Consultation with I&APs forms an integral component of an EIA process and enables inter alia directly affected landowners, neighbouring landowners, stakeholders, communities and interested parties to identify the issues and concerns relating to the proposed activity, which they feel should be addressed in the process. The approach to this public participation process, summarised in the Plan of Study for EIA in the Scoping Report, has taken cognisance of the DEAT Guideline on Stakeholder Engagement (2002).

Public participation, as required in terms of the EIA Regulations can, in general, be separated into the following phases:

Initiation of Public Participation Process
During this phase, I&APs are notified of the initiation of the environmental investigation, to enable them to register as I&APs, and raise issues and concerns at the outset of the investigation.

Comment on Draft and Final Reports
During the Scoping and EIA Phases, registered I&APs are provided with an opportunity to comment on draft and final versions of the reports. This is enabled by the lodging of the reports at suitable locations and invitations to public meetings/open houses to discuss the content of the relevant report.

Decision and Appeal period
This is the final phase of the public participation process. Once the competent authority has made their decision and issued an Environmental Decision, the applicant and I&APs are notified of the decision and have the opportunity to appeal to the national Minister of Water and Environmental Affairs, within the stipulated timeframes.

Progress with respect to these various stages for the current project is discussed in more detail below. It should be noted that the public participation process developed for this investigation meets and exceeds the minimum requirements of NEMA.
1.2 SUMMARY OF THE PUBLIC PARTICIPATION PROCESS TO DATE

1.2.1 Initiation of the public participation process

The approach adopted for the current investigation was to identify as many I&APs as possible initially, through a suite of activities, as follows:

- Placing advertisements in local newspapers (Die Plattelander);
- Placing notice boards at the site, next to the N14 and the Springbok Library;
- Providing written notice and a Background Information Document (BID) to potential I&APs including surrounding landowners, organs of state, ward councillors and relevant authorities; and
- Requesting potential I&APs to recommend other potential I&APs to include on the database (chain referral process).

Thereafter, the remainder of the communications were focused on registered I&APs.

1.2.2 Compilation of I&AP database

The initial database of I&APs was compiled through identification of neighbours from the landowners and through liaison with the local municipality and other organisations in the area. The initial database included the landowner, neighbouring landowners, relevant district and local municipal officials, relevant national and provincial government officials, and organisations in the area. This database is augmented via chain referral, and is continually updated as new I&APs are identified throughout the project lifecycle. The current list of I&APs, comprising approximately 58 individuals and organisations, is included in Section 2 below. The sectors of society represented by I&APs on the database are listed below.

(i) Provincial government (Northern Cape);
(ii) Local government (Nama Khoi LM and Namakwa District Municipality);
(iii) Organised agriculture;
(iv) Business/Commerce;
(v) Industry;
(vi) Scientific and research based organisations
(vii) Local landowners;
(viii) Local communities and other community based organisations in the project area; and
(ix) Media.

1.2.3 Advertising in regional and local newspapers

Advertisements for the EIA process appeared in the local newspaper, Die Plattelander, on 25 May 2012 (a copy of the advertisement is included in Section 3).
1.2.4 Site notices

Site notices were placed at the entrances to the proposed sites, next to the N14 and the Springbok library. The notices provided a description of the proposed activities and EIA process, and invited members of the public to register as I&APs, and raise any initial issues or concerns. The content of the site notice is included Section 3.

A Background Information Document (BID) which served to notify I&AP’s of the commencement of the Environmental Impact Assessment (EIA) process for the proposed wind and solar (photovoltaic) energy facilities near Springbok in the Northern Cape was posted to I&AP’s on 24 May 2012. The BID invited I&AP’s to register and/or provide comment on the EIA process before 15 June 2012. I&AP’s were also sent the BID via e-mail.

1.3 ISSUES AND CONCERNS RAISED DURING INITIATION PHASE

Issues were submitted via telephone, mail, fax and e-mail during the comment period from 24 May 2012 until 15 June 2012. Comments and concerns raised by I&APs have been incorporated into a CRR included in Annexure C of the Scoping Report.

Key issues raised by the public during the Initiation Phase were recorded in a Comments and Response Report (CRR) which was included in Annexure E of the Scoping Report. Only two comments were received, from SAHRA with regards to the requirement to undertake the necessary heritage studies in terms of the NHRA and from WESSA commenting on the process that WESSA will follow.

1.4 ISSUES AND CONCERNS RAISED DURING THE SCOPING PHASE

Five comments were received during the comment period on the Draft Scoping Report (DSR) from 21 June 2012 until 30 July 2012. These comments were included in CRR 2 and related to:

- Requirements to undertake the necessary heritage studies;
- Eskom requirements within their servitudes;
- Change in AgriLand Liaison officer;
- CAA’s requirements for approval;
- WESSA’s limited capacity to comment; and
- Status of Namakwa District Municipality EIA commenting process.

I&APs were invited to a public meeting on 3 July 2012 and were requested to RSVP. No RSVP’s were received and subsequently this meeting was cancelled. A Focus Group Meeting, was however held on 3 July 2012 at the Exhibition Hall in Springbok and was attended by 15 people, which included relevant authorities (Namakwa District Municipality, Namakhoi Municipality and the Department of Environment and Nature Conservation), landowners and neighbours of the site. Notes of the meeting are included in Annexure B of the Final Scoping Report (FSR).
Six comments were received on the FSR and have been responded to in CRR 3 in Annexure C of the EIA Report (EIR). The issues raised were as follows:
- Buffers on heritage resources;
- World Wildlife Fund of South Africa internal guideline on commenting on renewable energy applications;
- Potentially impacts on Goegap Nature Reserve; and
- Requirements of the Conservation of Agriculture Resources Development Act (No. 43 of 1983).

1.5 COMMENT ON DRAFT EIAR

The second last stage of the Public Participation Process involves the public review of, and comment on, the Draft EIR. Letters of notification and Summaries of the Draft EIR were sent to all registered I&APs (refer to Annexure D for the current database and this annexure for copies of the letters) informing them of the availability of the report for their review and comment.

Copies of the Draft EIR were lodged at the Springbok (Namakwa Street) and the Pofadder (Main Street) Public Libraries and on Aurecon’s website (www.aurecongroup.com/ - change “Current Location” to South Africa and follow the public participation links). The public will have had until 14 January 2013 to submit written comment on the Draft EIR. Cognisance will be was taken of all comments when in compiling the final report, and these comments, together with the study team and Applicant’s responses thereto, will be were included as an annexure in the final report. Where appropriate, the report will be was updated.

I&APs are were invited to a public meeting on 12 December 2012 at the Exhibition Hall in Springbok from 17h00 to 19h00 and are were requested to RSVP. Three I&APs attended the public meeting. Notes of the meeting and a copy of the presentation are included in this annexure. Notes of the meeting were sent to all I&APs that attended.

1.6 COMMENT ON THE FINAL EIAR

As is required by the NEMA EIA Regulations, I&APs must be given the opportunity to comment on all draft and final reports. Consequently, once the EIR has been finalised, and has been it will made available for a 21 day comment period. The report will be made is available in the same locations in which the Draft EIR was made available, and I&APs will be were notified of the availability of the Final EIR in writing.

Should you wish to comment on the EIR, comments should be directed to:

<table>
<thead>
<tr>
<th>Aurecon</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Corlie Steyn</td>
<td>or</td>
</tr>
<tr>
<td>P O Box 509, George, 6530</td>
<td>PO Box 494, Cape Town, 8000</td>
</tr>
<tr>
<td>Tel: 044 805 5421</td>
<td>Tel: 021 526 6027</td>
</tr>
<tr>
<td>Fax: 044 805 5454</td>
<td>Fax: 021 526 9500</td>
</tr>
<tr>
<td>Email:</td>
<td>Email:</td>
</tr>
<tr>
<td><a href="mailto:cornelia.steyn@aurecongroup.com">cornelia.steyn@aurecongroup.com</a></td>
<td><a href="mailto:louise.corbett@aurecongroup.com">louise.corbett@aurecongroup.com</a></td>
</tr>
</tbody>
</table>
Comments received will not be responded to but will be forwarded to DEA.

1.7 REVIEW AND DECISION PERIOD

The Final EIR, together with all I&AP comments on the Draft EIR, will be submitted to DEA for their review and decision-making. DEA must, within 60 days, do one of the following:

- Accept the report;
- Notify the applicant that the report has been referred for specialist review;
- Request amendments to the report; or
- Reject the report if it does not materially comply with regulations.

If the report is accepted, DEA must within 45 days:

- Grant authorisation in respect of all or part of the activity applied for; or
- Refuse authorisation in respect of all or part of the activity.

Once DEA issues their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within 12 calendar days of the Environmental Authorisation having been issued. Should anyone (a member of public, registered I&AP or the Applicant) wish to appeal DEA’s decision, a Notice of Intention to Appeal in terms of Chapter 7 of the EIA Regulations (GN No. 543) in terms of NEMA must be lodged with the Minister of Water and Environmental Affairs within 20 calendar days of the decision being issued and the substantive Appeal must be lodged within 30 days of the Notice.
Annexure B2
Good day

Your application is awaiting to be presented to the committee, please be patient due to the fact that there are application that came before this one therefore it is only fair to other applicant to follow the right channels.

A letter will be sent to you as soon as you application is processed. I hope you will bare with us.

Hope you find this in order

Serah
Sent from my BlackBerry® wireless device

From: "Cornelia Steyn" <Cornelia.Steyn@aurecongroup.com>
Date: Tue, 11 Sep 2012 08:18:06 +0000
To: SerahMu<SerahMu@nda.agric.za>
Subject: RE: 2012-06-0029 Koeris 78

Dear Serah

We have not received any formal comment from you, can you please assist me and tell me when we can expect your comment?

Kind regards

Corlie

Cornelia Steyn | BA (Hons) Geography
Environmental Practitioner | Aurecon
T +27 44 805 5421 | M +27 82 575 7415
E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George | South Africa
aurecongroup.com

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⚠️ Please consider your environment before printing this e-mail

DISCLAIMER

From: SerahMu [mailto:SerahMu@nda.agric.za]
Sent: 30 August 2012 12:34 PM
To: Cornelia Steyn
Subject: RE: 2012-06-0029 Koeris 78

Good Day
Can you please be specific on the footprint were the wind and solar is going to be erected.

I need you to tell me that out of 46 535 (ha) how many hectares will be used.

Thanks for the table and I cant really say i understand it.

Serah Masala Muobeleni  
Department of Agriculture, Forestry and Fisheries  
Directorate: Land Use and Soil Management  
Tel: 012 319 7480  
Cell: 083 779 6631  
Fax: 012 319 5938/ 086 266 5262  
Email Address: SerahMu@nda.agric.za

---

From: Cornelia Steyn [mailto:Cornelia.Steyn@aurecongroup.com]  
Sent: 30 August 2012 10:49 AM  
To: SerahMu  
Subject: RE: 2012-06-0029 Koeris 78

Dear Serah

Sorry I was out of office until today.

The first table is for the wind farm and the second for the solar panels.

Hope this is what you need?

Kind regards  
Corlie

<table>
<thead>
<tr>
<th>Project</th>
<th>No. of turbines (approximate)</th>
<th>Turbine size (MW)</th>
<th>Project size (MW)</th>
<th>Size (ha)</th>
<th>Footprint (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>185 to 500</td>
<td>1.5-4 MW</td>
<td>750</td>
<td></td>
<td>&lt; 1 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project</th>
<th>Maximum height</th>
<th>Project size (MW)</th>
<th>Size (ha)</th>
<th>Footprint (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>16.4-m</td>
<td>250</td>
<td>1000</td>
<td>&lt; 2.15 % (1 000 ha)</td>
</tr>
</tbody>
</table>
Good Day

Can you please give me the footprint of the area where the proposed wind and solar energy.

The total hectares that is going to be used for the project.

Urgently please

Serah Masala Muobeleni
Department of Agriculture, Forestry and Fisheries
Directorate: Land Use and Soil Management
Tel. 012 319 7480
Cell. 083 779 6631
Fax. 012 319 5938/086 266 5262
Email Address: SerahMu@nda.agric.za
Good Day

Can you please give me the footprint of the area were the proposed wind and solar energy.

The total hectares that is going to be used for the project.

Urgently please

_Serah Masala Muobeleni_

*Department of Agriculture, Forestry and Fisheries*

_Directorate: Land Use and Soil Management_

_Tel._ 012 319 7480

_Cell._ 083 779 6631

_Fax._ 012 319 5938/ 086 266 5262

_Email Address:_ SerahMu@nda.agric.za
Our Reference:

DEA Reference: 14/12/16/3/3/2/346
NEAS REF No. DEAT/EIA0001222/2012
DEA Reference: 14/12/16/3/3/2/342
NEAS REF No. DEAT/EIA0001217/2012

CORLIE STEYN
PO Box 494
CAPE TOWN
8000

Attention: CORLIE STEYN

Enquiries: N.J. Toerien

Date: 11/09/2012

TO

E Lonw

INITIAL

NS CT 2012 -09- 18

ILE No.

ACTION

The proposed project involves the establishment of wind and solar (photovoltaic) energy on farms Kangas (Farm no. 77 Portion 3 and the Remainder), Koeris (Farm no. 78 Portion 1), Areb (Farm no. 75 Portion 0) and Smorgenshauwe (Farm no. 127 Portion 0).

The Department of Agriculture, Land Reform and Rural Development is guided by Act 43 of 1983. With the development of the abovementioned activities the developer must comply with Act 43 of 1983 and also take care of the following:

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

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

7.(1) "...no land user shall utilize the vegetation in a vlei, marsh or water sponge or within the flood area of a water course or within 10 meters horizontally outside such flood area in a manner that causes or may cause the deterioration of or damage to the natural agriculture resources."

(3)(b) "cultivate any land on his farm unit within the flood area of a water course or within 10 meters horizontally outside the flood area of a water course"

Take also care of the following: who is the current landowner, will it be a subdivision of land or a lease contract between the developer and the landowner?
Rezoning will also be applicable because the land use will change from the current agricultural status.
The Department of Agriculture, Land Reform and Rural Development foreseen no problems in the development as mentioned above as long as the developer adheres to the articles of Act 43 of 1983.
Please contact the undersigned if any additional information is required.
Thank you

N.J. Toerien
SRM CONTROL TECHNICIAN
DEPT. OF AGRICULTURE, LANDREFORM AND RURAL DEVELOPMENT
Ms L Corbett  
Aurecon South Africa (Pty) Ltd  
P.O. Box 494  
CAPE TOWN  
8000  
Fax: (066) 667 3532

PER FACSIMILE / MAIL

Dear Ms Corbett

FINAL SCOPING REPORT FOR THE PROPOSED SPRINGBOK WIND AND SOLAR ENERGY FACILITIES, SUBSTATION AND GRIDLINE IN THE NORTHERN CAPE PROVINCE

The above mentioned refers.

The Department received a letter dated 06 July 2012 from the Northern Cape Department of Environment and Nature Conservation (DEN) expressing their concerns regarding the proximity of the proposed facilities to the Goegap Nature Reserve and the adjacent property of Ratekraal, which is the property of WWF. The said letter is attached for your ease of reference.

The Department requests you to respond to the issues raised in the attached letter and submit all responses to this Department using the following contact details:

Ms Fatima Rawjee  
Acting Director: Integrated Environmental Authorisations  
Department of Environmental Affairs  
Private Bag x 447  
PRETORIA  
0001

Please also ensure that the DEN have received a copy of both the Draft and Final Scoping report.
You are hereby reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, that no activity may commence prior to an environmental authorisation being granted by the Department.

Yours sincerely

[Signature]

Mr Mark Gordon
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Date: 10 SEPTEMBER 2012

<table>
<thead>
<tr>
<th>CC:</th>
<th>Mainstream Renewables Power Development (Pty) Ltd</th>
<th>Tel: 021 850 4050</th>
<th>Fax: 021 671 5065</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr C Geldenhuys</td>
<td>DENC</td>
<td>Tel: 053 807 7300</td>
<td>Fax: 053 807 7328</td>
</tr>
<tr>
<td>Mr Sehego</td>
<td>Nama-khol Local Municipality</td>
<td>Tel: 027 718 8101</td>
<td>Fax: 021 712 1636</td>
</tr>
</tbody>
</table>
Dear Ms Dlomo

EIA PROCESS FOR THE PROPOSED WIND ENERGY FACILITY ON KANGNAS FARM NEAR SPRINGBOK, NORTHERN CAPE (DEA REF. NO: 14/12/16/3/32/346, NEA REF NO: DEA/EIA/0001222/2012)

AND

PROPOSED SOLAR PHOTOVOLTAIC ENERGY FACILITY ON KANGNAS FARM NEAR SPRINGBOK, NORTHERN CAPE (DEA REF. NO: 14/12/16/3/32/342, NEA REF NO: DEA/EIA/0001217/2012)

AND

PROPOSED SUBSTATION ON KANGNAS FARM NEAR SPRINGBOK, NORTHERN CAPE (DEA REF. NO: 14/12/16/3/32/386, NEA REF NO: DEA/EIA/0001344/2012)

RESPONSE TO THE DEPARTMENT ENVIRONMENT AND NATURE CONSERVATION COMMENT

Our telephonic discussion on 30 August 2012 and a comment forwarded by the Department of Environmental Affairs (DEA) on the same day have reference.

We would like to acknowledge receipt of the comment from the Department of Environment and Nature Conservation (DENC), dated 6 July 2012, received by DEA on 7 August 2012 and by Aurecon South Africa (Pty) Ltd (Aurecon) on 30 August 2012 on the above-mentioned applications. It should be noted that DENC did not send Aurecon a copy of these comments however, Aurecon will request DENC to do so in accordance with the Environmental Impact Assessment (EIA) Regulations (Government Notice No. 543 of 2010) in future. Please note that we received this comment via DEA on 30 August 2012.

In the comment DENC provides some background to the proposed applications, as provided in the Environmental Impact Assessment (EIA) process, before noting their concerns and recommendations with reference to the EIA applications. It was noted in the Final Scoping Report (FSR) for the applications that any comments received after submission of the FSR would be forwarded to DEA and responded to in the Draft Environmental Impact Assessment Report (DEIR). However DEA has indicated that a response is required in order to proceed with the processing of the FSR, hence a brief response is provided below. Please note that DENC’s concerns and recommendations will be addressed in more detail in the DEIR once all specialist studies have been completed, assuming DEA approves the FSR.

<table>
<thead>
<tr>
<th>No.</th>
<th>DENC Concern &amp; Recommendation</th>
<th>Project Team Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The map of the proposed development shows the proximity of the facility to Goegap Nature Reserve</td>
<td>The site is approximately 18 km away from Goegap Nature Reserve and approximately 2.5...</td>
</tr>
</tbody>
</table>
and the adjacent property of Ratelkraal which is the property of the WWF. The possible expansion of the protected area network into Bushmanland (which has almost no protection status) is curtailed by this proposed development.

km away from Ratelkraal. It is noted that there is a large area of Bushmanland Arid Bushveld vegetation to the north of the site, which could be considered for expansion of the protected areas network (see attached figure). Additionally, the proposed projects would not cover the entire site hence it is possible that portions of the site could be considered for conservation. This would need to be explored in the DEIR. During land negotiations in 2011, landowners were specifically asked if they had been approached by WWF/DENC to discuss future expansion of the Goegap nature reserve and all of them indicated that this was not the case.

It should furthermore be noted that Mainstream Renewable Power South Africa (Pty) Ltd has been in contact with Ms Natasha Wilson of WWF, on more than one occasion, specifically with regards to WWF’s expansion plans and the proposed projects. No objection has been received from WWF to date.

Please provide the shapefiles for the possible protected areas network expansion so that the potential impacts, if any, of the proposed projects can be assessed by the various specialists and included in the DEIR. Please also indicate the legal status of these possible expansion areas.

2 Other similar developments are proposed around the Springbok area with some developments directly adjacent to Goegap Nature Reserve. The renewable energy targets presume an even more concerted effort in the near future to expand the renewable energy network which will impact on biodiversity around and on current protected areas (e.g. birds and bats), other wilderness areas away from protected areas, sensitive habitats, water resources etc.

The cumulative impacts of the proposed projects will be considered in the DEIR. However, it should be noted that not all renewable energy projects proposed will be constructed as there are many requirements to be met.

3 It is highly recommended that the locality of the Renewable Energy facilities be reconsidered and not placed within the Protected Area expansion.

See response to 1 above.

Mainstream undertook a fatal flaw analysis of four sites in the Northern and Western Cape, of which the current site was one. These sites were identified by considering various technical aspects, including surrounding land uses and existing services infrastructure as well as environmental aspects such as botany, avifauna, bats and more. Site visits and desktop studies were undertaken, and input was received from
One of the sites considered in the fatal flaw analysis was located immediately adjacent to Goegap Nature Reserve and it was decided not to pursue this site in order to limit potential impacts on the reserve as well as the WWF site. Based on the Fatal Flaw Analysis, Mainstream decided to pursue two of the four sites, namely the Kangnas site and a site closer to Pofadder (currently the subject of a separate EIA process). Based on the selection process undertaken by Mainstream in selecting the site, no other site location alternatives are assessed in the EIA.

<table>
<thead>
<tr>
<th>It is highly recommended that the Renewable Energy facilities are not placed within visible and/or ecological impact zones around the Protected Areas. This means not within a minimum buffer zone surrounding Protected Areas.</th>
<th>See response to 1 above. We are not aware of any legally applicable buffer zones around protected areas and would appreciate if these could be provided. Various specialist studies will be undertaken for the proposed projects, including a visual, botanical, aquatic ecology, avifaunal and bat studies. These studies will determine the potential visual and ecological impacts of the proposed projects on the surrounds. This information will be included in the DEIR.</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that climate change migration corridors be considered and not be impacted on by Renewable Energy facilities.</td>
<td>It is not certain if climate change migration corridors have been designated or if it is suggested that they are compiled. If they have been designated it is requested that these are please made available so that the potential impacts on these corridors can be considered. If this recommendation is a suggestion that corridors be compiled then it is suggested that a body such as DEA complete this task as this would need to be addressed at a strategic, not project specific, level.</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>It is recommended that a more strategic planning of placement of Renewable Energy facilities be implemented as the current ad hoc and random method is causing negative impacts on the Northern Cape’s biodiversity, eco-tourism and planning processes.</td>
<td>As this comment is addressed to DEA no response is required.</td>
</tr>
</tbody>
</table>

We trust that the above responses are sufficient to allow DEA to continue with the processing of the FSR and we look forward to your correspondence in this regard.
Yours sincerely
Aurecon

LOUISE CORBETT (Pr. Sci. Nat).
Associate: Environment & Advisory Services
cc:
Mr D van Heerden, Department of Environment and Nature Conservation, Northern Cape  (dvvanheerden@ncpg.gov.za, tel: 053 807 7437 / 7300, fax: 053 807 7328)
Aurecon Cape Town Office Electronic File Reference: C:\Users\Louise.corbett\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\FPOSJUIWLetter to DEA 300812_LC.doc
Ms Nosipho Ngcaba  
Director-General  
Department of Environmental Affairs  
Private Bag X447  
Pretoria  
0001  
Att: Ms Dee Fischer; Chief Director: Environmental Impact Management

RE: PROPOSED SPRINGBOK WIND AND SOLAR ENERGY FACILITY FOCUS GROUP MEETING.

1. BACKGROUND

As per standard EIA related public participation meetings interested and affected parties are allowed the opportunity to provide comment on proposed developments. In the presentation at the proposed Springbok wind and solar energy facility Focus Group Meeting 3/7/2012 it was explained that the intention was to erect a 750 MW wind energy facility and a 250 MW solar energy facility on the farms Kangnas, Koeris, Smorgenschaduwe and Areb approximately 40 km west of Springbok (Figure 1). This would also include four substations, one primary station, power cables and road infrastructure.

The five properties together are 46 535 hectares in total. The development proposal is for 185-500 wind turbines depending on technology type. Each turbine’s foundation is expected to be 400m² with a crane hoist foundation of 800m² adjacent to each turbine (total footprint = 22-60 hectares). A 6-10m wide road will be constructed (or current roads upgraded) to each turbine (total footprint unknown). The PV facility is expected to cover 1 000 hectares. A wider disturbance footprint can be expected during the construction phase.
Figure 1 Farms targeted for the proposed renewable energy facility are Areb (RE75), Kangnas (77/3 & RE77), Koeris (78/1) and Smorgenschaduwe(127RE) and are located approximately 40km east of Springbok. The farms in this diagram lie in a possible expansion path of the protected area network from Goegap Nature Reserve eastwards. The farm Ratelkraals is the property of the World Wildlife Fund for Nature (WWF) and is currently managed by DENC.

The developer indicated that government’s Integrated Resource Plan of 2010 made allowance for the generation 20 409 MW of renewable energy of which 8 400 MW would be Solar (PV) and 9 200 MW Wind, but that this target is constantly reviewed. The energy use in South Africa is currently 38 000 MW. This indicates the extent of the Renewable Energy push in South Africa. Interestingly for Renewable Energy tenders developers are required to conduct 12 months of wind data to support a proposed development in an area, but for solar there is no such requirement.

- On a question of the construction time frame the developer indicated that a 150-200 MW project takes 18-22 months to complete. The developer indicated that projects tendered for during the first phase of government’s Renewable Energy initiative have to be operational by 2014 and those tendered during the most recent fifth phase have to be operational by 2016.
- It was estimated that 30-40 people would be permanently active/employed at the facilities during the operational phase and 300-500 people would be on site during the construction phase.
- The development will occupy approximately 50% - 75% of the land area of the farms but it is expected by the developer that 1% - 3% of grazing would be lost.
- Comments must be received before 23 July 2012.
• It is unclear what the nature of the contractual agreements with land owners are, i.e., if continued use of the land would be possible for livestock farming.

2. CONCERNS & RECOMMENDATIONS

The map of the proposed development shows the proximity of the facility to Goegap Nature Reserve and the adjacent property of Ratelkraal which is the property of the WWF. The possible expansion of the protected area network into Bushmanland, which has almost no protection status, is curtailed by this proposed development.

Other similar developments are proposed around the Springbok area with some developments directly adjacent to Goegap Nature Reserve. The Renewable Energy targets presume an even more concerted effort in the near future to expand the Renewable Energy network which will impact biodiversity around and on current protected areas (e.g., birds and bats), other wilderness area away from protected area, sensitive habitats, water resources etc.

It is highly recommended that the locality of these Renewable Energy facilities be reconsidered and not placed within the Protected Area expansion targeted areas.

It is highly recommended that Renewable Energy facilities are not placed within visible and/or ecological impact zones around Protected Areas. This means not within a minimum buffer zone surrounding Protected Areas.

It is recommended that climate change migration corridors be considered and not be impacted on by Renewable Energy facilities.

3. RECOMMENDATION

It is recommended that a more strategic planning of placement of Renewable Energy facilities be implemented as the current ad hoc and random method is causing negative impacts on the Northern Cape's biodiversity, ecotourism and planning processes.

Regards

[Handwritten signature]

D VAN HEERDEN
HEAD OF DEPARTMENT
Hi Corlie

Sorry for the delay in the comments but the Upington server for e-mail is off for the past 2 days. I ask one of the official in the office to made some comments but due to the technical problem they are not able to access their mails.

I will be in the office on 21 Sept 2012 and will try my best to provide you with comments.

Thank You.
Shaun Cloete

-----Original Message-----
From: Cornelia Steyn [mailto:Cornelia.Steyn@aurecongroup.com]
Sent: 19 September 2012 02:45 PM
To: Cloete Shaun; Cebekhulu Mdudu Christopher (UPN); Julies Anasta
Subject: RE: Proposed wind and solar energy facilities near Springbok

Dear Shaun

Please let us know if we can assist with anything to help you to provide comment to us.

Kind regards
Corlie

Cornelia Steyn I BA (Hons) Geography
Environmental Practitioner  I Aurecon
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E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloehof Building, 65 York St, George I South Africa aurecongroup.com

-----Original Message-----
From: Cloete Shaun [mailto:CloeteS@dwa.gov.za]
Sent: 18 September 2012 12:23 PM
To: Cebekhulu Mduduze Christopher (UPN); Julies Anasta
Cc: Cornelia Steyn
Subject: FW: Proposed wind and solar energy facilities near Springbok

Christopher,

Can u please follow up with Anasta for the document mentioned below
(Proposed wind and solar energy facilities near Springbok) can u please get the document and provide the standard comments for Solar / Wind Applications.

Anasta can u please locate the document or is it still with you?

Thank You.
Shaun Cloete

-----Original Message-----
From: Cornelia Steyn [mailto: Cornelia.Steyn@aurecongroup.com]
Sent: 14 September 2012 09:39 AM
To: Cloete Shaun
Subject: Proposed wind and solar energy facilities near Springbok

Dear Shaun

I refer to our telephonic conversation this morning.

Please find the final scoping report attached.

A hard copy was also posted to you on 2nd August and we also emailed it to you.

Can you please acknowledge this email and provide a date when you would be able to provide us with your official comment?

Thank you for your assistance in this regard.

Kind regards

Corlie

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Beste Corlie,

my besonderhede is hieronder. Let asseblief daarop dat prosedures binne ons departement vereis dat kommentaar van my as plantkundige oor EIA aansoeke net gelewer kan word as dit via ons Omgewing afdeling (wat EIA aansoeke ontvang en hanteer) aangevra word.

Groete
Conrad

Conrad Geldenhuys
Production Scientist Grade A: Botanist
Research and Development Support Section
Northern Cape Department of Environment and Nature Conservation
Goegap Nature Reserve
1 Airport road
Private Bag X1
Springbok
South Africa
8240
EMAIL: c.geldenhuys@hotmail.com
Tel: (+27) 027 718 9906
Fax: (+27) 027 718 9907
Cell: (+27) 079 524 0970

Beste Conrad

Kan jy asb jou posadres, faks nommer en selfoon nommer (indien moonltik) vir ons aanstuur.

Groete
Corlie

Cornelia Steyn | BA (Hons) Geography
Environmental Practitioner | Aurecon
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E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George | South Africa
aurecongroup.com
Dear Sindiswa,

In reference to the attached letter dated 10 September 2012 and our telephonic discussion earlier today, we would like to confirm that we have already responded officially in an email on 5 September 2012, and we have posted a hard copy on that day. We attach this letter again for your convenience.

Thank you for your kind assistance in this matter.

Kind regards

Corlie

Cornelia Steyn  
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Environmental Practitioner  
Aurecon  
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M +27 82 575 7415  
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DISCLAIMER
Dear Serah,

Currently there are two focus areas: one for the wind one for solar (please refer to the two attachments).

The total area for both are 46 535 (ha), but the footprint area for the wind facility will be <1% which means 465,53 ha if you take it at 1,

and for the solar facility approximately 1000ha of the 46 545ha will be the footprint area for the development.

So in total 1465,53 ha will be used as the footprint development area for both the solar and the wind facilities.

Please email me again if this is still unclear.

Kind regards
Corlie

Cornelia Steyn  BA (Hons) Geography
Environmental Practitioner  I Aurecon
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E  Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George  I South Africa
aurecongroup.com
From: Cornelia Steyn [mailto:Cornelia.Steyn@aurecongroup.com]
Sent: 30 August 2012 10:49 AM
To: SerahMu
Subject: RE: 2012-06-0029 Koeris 78

Dear Serah

Sorry I was out of office until today.

The first table is for the wind farm and the second for the solar panels.

Hope this is what you need?

Kind regards

Corlie

<table>
<thead>
<tr>
<th>Project</th>
<th>No. of turbines (approximate)</th>
<th>Turbine size (MW)</th>
<th>Project size (MW)</th>
<th>Size (ha)</th>
<th>Footprint (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>185 to 500</td>
<td>1.5-4 MW</td>
<td>750</td>
<td></td>
<td>&lt; 1 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project</th>
<th>Maximum height</th>
<th>Project size (MW)</th>
<th>Size (ha)</th>
<th>Footprint (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>16-4-m</td>
<td>250</td>
<td>1000</td>
<td>&lt; 2.15 % (1 000 ha)</td>
</tr>
</tbody>
</table>

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aurecongroup.com
Good Day

Can you please give me the footprint of the area were the proposed wind and solar energy.

The total hectares that is going to be used for the project.

Urgently please

Serah Masala Muobeleni
Department of Agriculture, Forestry and Fisheries
Directorate: Land Use and Soil Management
Tel: 012 319 7480
Cell: 083 779 6631
Fax: 012 319 5938/086 266 5262
Email Address: SerahMu@nda.agric.za
Interim Comment
In terms of section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Cornelia Steyn
Aurecon South Africa
PO Box 494
Cape Town
8000

Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape

Harris, C. May 2012. Report on site visit to potential meteorite impact site near Kangnas

South African Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) has proposed the construction of a 750 MW wind energy facility and a 250 MW Photovoltaic (PV) solar energy facility on farms near Springbok in the Northern Cape. These farms are Portion 3 and the Remainder of Kangnas Farm 77, Portion 1 of Koeris Farm 78, Portion 0 of Areb Farm 75 and Portion 0 of Smorgenschaduwe Farm 127. These farms are located approximately 48 km east of Springbok and cover an area of approximately 46,535 ha.

The wind energy facility will consist of between 185 and 500 wind turbines, each capable of generating 1.5-4 MW. Each turbine will be built on a 3m deep foundation approximately 20 m x 20 m, accompanied by a construction area of 20 m x 40 m. Access roads 6 – 10 m wide will be required between each turbine. The proposed 250 MW solar energy facility will consist of either Photovoltaic (PV) and/or Concentratred PV (CPV) technology, possibly including tracking systems, and would have an approximate footprint of 1,000 hectares (ha). Onsite connection is proposed via an existing 220 kilovolt Eskom line. One main substation will link the proposed facilities and the Eskom line, while up to four new substations will link sectors of the facility to the main substation via overhead lines.

The receiving environment is predominantly low-lying and flat with granite inselbergs in the northwest. The site vegetation is Bushmanland Arid Grassland, typical of the area. The land is currently used for livestock grazing, while mining is prominent in the regional economy. No alternative location has been provided for the facilities.

The geologist conducted a preliminary site visit to determine whether the two craters located on the proposed site were the result of meteorite impacts. One was considered too small to be such a crater, while the origins of the other, which measured 1km in diameter, are unclear. The feature was possibly caused by the eruption of an olivine melilitite pipe, although none of the expected minerals were identified in the crater samples. There was no exposed rock, which might have shown stress fractures, so to determine positively that it is a meteorite crater, samples would have to be drilled from the bedrock below the calcrete, which is 80m thick inside the crater. The feature is possibly merely a reflection of the morphology of the underlying bedrock below the calcrete.
A full Heritage Impact Assessment inclusive of a Palaeontological Impact Assessment is proposed for the EIA process.

**Decision:**

In light of the inconclusive findings regarding the origin of the larger crater, SAHRA requires that:

- A buffer should be observed around the crater and no construction should take place within that buffer zone. As the crater falls within the area demarcated for the WEF development, this buffer should be 50m from the perimeter of the crater. It is recommended that the buffer zone is demarcated by temporary fencing during construction. The no-go area should be marked on all construction maps and the ECO should be informed of the possible sensitivity of the site.

SAHRA looks forward to receiving the outstanding heritage reports. Please ensure that the impact of the wind energy facility on possible cultural landscapes is considered in the assessment.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Kathryn Smuts  
Heritage Officer: Archaeology  
South African Heritage Resources Agency

Colette Scheermeyer  
SAHRA Head Archaeologist  
South African Heritage Resources Agency

**ADMIN:**
Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.
Hi Cornelia

Thanks for your patience.

WWF-SA has recently developed internal guidelines regarding renewable energy applications specifically, wind energy applications.

These guidelines are still in a draft format, used within WWF to aid decision making when it comes to commenting on applications.

The internal guidelines are specific to areas that fall inside of the protected area expansion strategy or adjacent to already protected areas.

The approach we have taken is to avoid the NIMBY standpoint but to consider the applications as they are received on a case by case basis.

We also acknowledge that renewable energy has a role to play in the future of South Africa’s energy needs.

I hope this will suffice.

Many thanks

Natasha

Natasha Wilson
:: Programme Manager: WWF Land Programme ::
Boundary Terraces, Bridge House 1st Floor
Mariendahl Lane, Newlands, 7700, Cape Town.
PO Box 23273, Claremont, 7735
Tel: (+27 21) 657 6600 Direct: (+27 21) 657 6656 Mobile: (+27) 76 889 5825
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Annexure B3
Dear Simon,

Apologies for the delay in forwarding our comments on this application within the stipulated deadline. Our comments on this application are listed below:

- BirdLife South Africa supports renewable energy production, however renewable energy facilities can have unintended negative impacts on avifauna.
- The proposed wind energy component of this proposed development consists of approximately 180, 4 MW turbines. This is considered to be a large facility.
- 115 species of birds, 12 which are red data species, 59 are endemics and three red-listed endemics have been recorded in the broader area. Many of these are possibly vulnerable to the impacts of wind and solar energy and the associated infrastructure.
- BirdLife South Africa is therefore disappointed that the BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa has not been used to help guide the scope of the impact assessment. A site visit over one season is not considered sufficient to identify and mitigate potential impacts on avifauna. Please see the attached letter which outlines our position in this regard.
- BirdLife is therefore of the opinion that there is insufficient information on which to base an informed decision and cannot support this application.
- Should the proposed development be approved despite our concerns, we recommend the following:
  - No-go and buffer areas should be clearly defined in the environmental authorisation and indicated on a topographical map.
  - Monitoring must be implemented in accordance with BirdLife South Africa / Endangered Wildlife Trust: best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.
  - Pre-construction monitoring must be completed for both the proposed development site and a reference site (if available).
  - The final layout must be informed by the results of the monitoring and must be submitted to BirdLife South Africa for review.
  - Post-construction monitoring should use similar methodology as pre-construction monitoring to ensure comparability of results, but should also include the collection of mortality data.
  - Post-construction monitoring should start within 6 months of the turbines becoming operational and should span a period of at least 12 months.
  - BirdLife South Africa and any other relevant party identified by DEA should be given the opportunity to review and approve the methodology.
o Monitoring reports, as well as the raw monitoring data, should be forwarded to DEA, BirdLife South Africa and the Endangered Wildlife Trust any other relevant party identified by DEA.

o The results of post-construction monitoring may highlight the need for additional mitigation measures that may need to be incorporated in the environmental management programme. The applicant should be required to take all feasible and reasonable steps to reduce significant impacts on avifauna.

o Construction-phase monitoring (observations over a period of at least three days per season) should be conducted by an avifaunal specialist. The results of this should inform any additional mitigation that may be required.

o The environmental management programme should be reviewed annually for the first five years of the operational phase of the facility. BirdLife South Africa and EWT (and any other party nominated by DEA) should be given the opportunity to comment on the bird monitoring specifications every year for as long as post construction monitoring continues.

o If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible.

o Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards.

o Where possible the applicant should be encouraged to conduct controlled experiments to test the effectiveness mitigation measures that may increase the visibility of wind turbines and associated infrastructure and reduce bird collision rates.

o Clearing of natural vegetation during construction should be kept to a minimum.

o Sufficient drainage should be provided along access roads to prevent erosion and pollution of adjacent watercourses or wetlands.

o Hunting of birdlife should be prohibited on site.

o All powerlines linking wind turbines to each other and to the internal substation must be buried and should follow access roads. Only powerlines linking the wind energy facility to the grid may be above ground. Where these movement corridors or habitat capable of supporting sensitive species, these should be buried below ground or in cases where this is not feasible, lines must be fitted with bird flight diverters. Only Eskom approved bird friendly pole structures may be used.

o The use of guyed towers (for example for wind monitoring or communication) should be minimised and if necessary steps should be taken to increase the visibility of the guy wires through the use of markers.

o Maintenance staff should be encouraged to keep noise and other disturbances to a minimum. Where possible maintenance should take place outside of the breeding season of priority bird species.

o Maintenance staff should report bird mortalities through a formalised reporting system.

o Land management practices beneath the towers should not attract raptors or other species vulnerable to collision. Structures should be designed to reduce the availability of perching sites.

Regards,

Carolyn Ah Shene-Verdoorn
Policy & Advocacy Manager

BirdLife
SOUTH AFRICA

Giving Conservation Wings

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Tel: +27 (0)11 789 1122 / 0860 BIRDER
Fax: +27 (0)11 789 5188
Cell: +27 (0) 82 776 8333
E-mail: advocacy@birdlife.org.za
SMS ‘birdlife’ to 38878 and help Give Conservation Wings

R10 per SMS. Free SMS and SMS bundles do not apply. All proceeds, less service provider fees, will be donated to BirdLife South Africa. Error messages will be billed. More details on BirdLife South Africa website.

The Policy & Advocacy Division is supported by The Royal Society for Protection of Birds (RSPB), Aage V. Jensen Charity Foundation, BirdLife International, the Spanish Agency for International Development Cooperation (AECID), Association of Veterinary and Crop Associations of South Africa and CropLife South Africa.
BirdLife South Africa position on the applicability of the BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites to impact assessment processes.

BirdLife South Africa supports the responsible development of a renewable energy industry in South Africa, including wind energy, as this is critical for reducing greenhouse gas emissions. Wind energy can, however, have unintended negative impacts on birds. Impacts include mortality of susceptible species from collisions with the turbines, as well as the displacement and disturbance of sensitive, threatened, endemic and range restricted species. The significance of these impacts varies and is influenced by both the location of the wind farm and turbines and the characteristics of the species involved.

**Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa**

BirdLife South Africa, in partnership with the Wildlife Energy Programme of the Endangered Wildlife Trust, has developed “Best Practice Guidelines for Avian Monitoring and Impact Mitigation at proposed wind energy development sites in southern Africa”. The aim of these “Best Practice Guidelines” is to bring the assessment and monitoring of impacts of wind farms on birds in line with internationally-accepted best practice. These guidelines are intended to guide the environmental impact assessment (EIA) process, as well as post-construction monitoring.

The guidelines were first released in early 2011 and were reviewed by two internationally-recognised scientists, Professor Peter Ryan and Dr Rowena Langston. They were revised in 2012 after further consultation with stakeholders. The second revision of the guidelines has been endorsed by the South African Wind Energy Association, CapeNature and Eskom.

**Best practice guidelines not implemented in EIAs**

BirdLife South Africa is becoming increasingly concerned that impact assessments for wind energy facilities are not conforming to the recommendations of the Best Practice Guidelines. In particular, we note that avian specialist assessments are usually based on site visits that rarely span more than one or two seasons. The Best Practice Guidelines suggest that site visits must be of sufficient frequency to adequately sample all major variations in environmental conditions, with no fewer than
four visits spanning all four seasons. The degree of effort during each survey should be informed by the likely sensitivity of the site and the species it contains, as well as the size of the proposed wind farm.

International experience indicates that the location of the wind turbines can be as important as the location of the wind farm itself in determining the rates of bird collisions. In many cases a small proportion of the turbines are responsible for most of the mortalities. In order to accurately identify, evaluate and mitigate the likely impacts of a proposed wind farm on birds it is critical that sufficient information is provided with regards to (1) the location of important sensitive areas and/or frequently used flyways or landscape features relative to the location of the proposed turbines and (2) the number and species of birds at risk of collision and displacement.

While the requirement for avian specialists to conduct site surveys over all four seasons within the impact assessment may seem onerous, this is necessary to address seasonal variance in the abundance and movements of migratory species, different altitudinal and seasonal movements of local non-migratory species, as well as the changes in behaviour and flight patterns linked to breeding behaviour.

To avoid delays, these site assessments can be initiated prior to the formal EIA process and can run parallel with the 12 months meteorological monitoring that is required for a wind farm development. There may be exceptional cases where monitoring over a shorter period time will provide sufficient information, but in most cases the absence of data representative of all four seasons of monitoring will imply that there is not enough information to assess the impacts adequately.

**Incremental decision-making**

The Best Practice Guidelines were released after environmental impact assessment processes for some wind energy facilities had already begun. It is therefore considered reasonable to allow some flexibility where the EIA process was well advanced prior to the release of the guidelines. However, we are concerned that an approach of incremental decision-making is still being promoted in many EIAs, where EIAs are completed and environment authorisations are issued without full compliance with the Best Practice Guidelines. The proposed solution to the inadequate assessment of the potential impacts on birds within the EIA is the inclusion of a condition of authorisation that indicates that final layout must be informed by the results of further bird monitoring.

BirdLife South Africa is concerned that without sufficient information with regards to the species, number and flight patterns of birds on site, and without a clearly defined development envelope:

- it is impossible to identify, predict and evaluate the actual and potential impact on the environment (and birds in particular),
- it is impossible to evaluate the risks, consequences, alternatives and options for mitigation, with a view to minimising negative impacts, and maximising benefits;
- it is impossible to determine whether the needs of the developer/proposed development can be accommodated within the environmental constraints of a site, and
• it is unclear how potential conflicts can be resolved once an environmental authorisation has been issued without compromising either the financial viability of a project or the environment.

While we recognise that a degree of flexibility in the layout is required, a complete and adequate EIA (which would include compliance with the recommendations of the Best Practice Guidelines) would enable the development of a map indicating sensitive no-go areas as well as the potential development envelop (within which the layout and possibly even the number of turbines can be changed). This would provide a clear indication to decision-makers and interested and affected parties of what the likely impacts of the facility would be, and proponents would have more certainty as to what could be accommodated on site.

Cumulative impacts

The Department of Environmental Affairs (DEA) has already issued environmental authorisations for over 7000 MW of wind energy. The urgency to meet national targets has therefore passed. Given the large number of wind farms that have already been approved based on very limited information, BirdLife South Africa is concerned that there are increasingly high risks of cumulative impacts on birds.

BirdLife South Africa therefore calls on DEA, developers and environmental assessment practitioners to:
• ensure that the potential impacts of wind energy on birds are adequately identified, predicted and evaluated within the environmental impact assessment process.
• ensure that options for mitigating impacts, with a view to minimising negative impacts and maximising benefits are evaluated within the environmental impact assessment process.
• adopt a risk-averse and cautious approach, which takes into account the limits of current knowledge about the consequences of our decisions and actions.

We further call on DEA to:
• Provide clarity to applicants and environmental assessment practitioners with regards to the applicability of the Best Practice Guidelines to EIA.

We call on Environmental Assessment Practitioners (EAPS) to:
• Conduct their work in accordance with the principles of sustainable development, place the integrity of the environment above any commitment to sectional or private interests, not to neglect or subvert good professional practice, advise the incorporation of environmental considerations from the earliest stages of project conception, and to voluntarily implement the Best Practice Guidelines.

We call on the developers of wind energy facilities to:
• Consider their environmental responsibilities, the environmental and financial risks associated with taking decisions on limited or flawed information, as well as the reputation of the industry, and ensure that appointed environmental assessment practitioners implement the Best Practice Guidelines.
We call on the financiers and insurers of wind energy projects to:

- Consider the Equator Principles (www.equator-principles.com), as well as the environmental and financial risks associated with taking decisions on limited information, and only offer support to applicants who are willing to implement the Best Practice Guidelines.

Finally, BirdLife South Africa would like to place on record that it will consider appealing environmental authorisations where an environmental impact assessment has not complied with the Best Practice Guidelines, and as a result the wind energy facility will pose a significant risk to birdlife.

If you have any questions please contact:

Samantha Ralston
Birds and Renewable Energy Manager
BirdLife South Africa
Winter House, Private Bag X7, Claremont, 7735
Cell: +27 (0) 83 673 3948
E-mail: energy@birdlife.org.za

The Best Practice Guidelines and further information regarding birds and renewable energy can be found at: www.birdlife.org.za/conservation/birds-and-wind-energy

November 2012
Appendix 1: Guidance from the National Environmental Management Act

The principles outlined in the National Environmental Management Act (Aco 107 of 1998)(NEMA) provide some guidance. These principles include:

- Sustainable development requires the consideration of all relevant factors including:
  - “that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”; and
  - “that negative impacts on the environment and on people’s environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.”

- “Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option”.

- “The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment”.

Chapter 5 of NEMA states further that the general objectives of integrated environmental management is to:

- “promote the integration of the principles of environmental management set out in section 2 into the making of all decisions which may have a significant effect on the environment;
- “identify, predict and evaluate the actual and potential impact on the environment, socioeconomic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities, with a view to minimising negative impacts, maximising benefits, and promoting compliance with the principles of environmental management set out in section 2”;
- “ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them”;
- “ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment”;
- “ensure the consideration of environmental attributes in management and decision-making which may have a significant effect on the environment; and identify and employ the modes of environmental management best suited to ensuring that a particular activity is pursued in accordance with the principles of environmental management set out in section 2”.

Chapter 5 also indicates that procedures for the investigation, assessment and communication of the potential impact of activities must, as a minimum, ensure:

- “Investigation of the environment likely to be significantly affected by the proposed activity and alternatives thereto;”
- “Investigation of the potential impact, including cumulative effects, of the activity and its alternatives on the environment, socioeconomic conditions and cultural heritage, and assessment of the significance of that potential impact;”
- “Investigation of mitigation measures to keep adverse impacts to a minimum, as well as the option of not implementing the activity.”
Eskom requirements for work in or near Eskom servitudes.

1. Eskom’s rights and services must be acknowledged and respected at all times.

2. Eskom shall at all times retain unobstructed access to and egress from its servitudes.

3. Eskom’s consent does not relieve the developer from obtaining the necessary statutory, land owner or municipal approvals.

4. Any cost incurred by Eskom as a result of non-compliance to any relevant environmental legislation will be charged to the developer.

5. If Eskom has to incur any expenditure in order to comply with statutory clearances or other regulations as a result of the developer’s activities or because of the presence of his equipment or installation within the servitude restriction area, the developer shall pay such costs to Eskom on demand.

6. The use of explosives of any type within 500 metres of Eskom’s services shall only occur with Eskom’s previous written permission. If such permission is granted the developer must give at least fourteen working days prior notice of the commencement of blasting. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued in terms of the blasting process. It is advisable to make application separately in this regard.

7. Changes in ground level may not infringe statutory ground to conductor clearances or statutory visibility clearances. After any changes in ground level, the surface shall be rehabilitated and stabilised so as to prevent erosion. The measures taken shall be to Eskom’s satisfaction.

8. Eskom shall not be liable for the death of or injury to any person or for the loss of or damage to any property whether as a result of the encroachment or of the use of the servitude area by the developer, his/her agent, contractors, employees, successors in title, and assignees. The developer indemnifies Eskom against loss, claims or damages including claims pertaining to consequential damages by third parties and whether as a result of damage to or interruption of or interference with Eskom’s services or apparatus or otherwise. Eskom will not be held responsible for damage to the developer’s equipment.

9. No mechanical equipment, including mechanical excavators or high lifting machinery, shall be used in the vicinity of Eskom’s apparatus and/or services, without prior written permission having been granted by Eskom. If such permission is granted the developer must give at least seven working days’ notice prior to the commencement of work. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued by the relevant Eskom Manager

Note: Where an electrical outage is required, at least fourteen work days are required to arrange it.
10. Eskom’s rights and duties in the servitude shall be accepted as having prior right at all times and shall not be obstructed or interfered with.

11. Under no circumstances shall rubble, earth or other material be dumped within the servitude restriction area. The developer shall maintain the area concerned to Eskom’s satisfaction. The developer shall be liable to Eskom for the cost of any remedial action which has to be carried out by Eskom.

12. The clearances between Eskom’s live electrical equipment and the proposed construction work shall be observed as stipulated by Regulation 15 of the Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

13. Equipment shall be regarded electrically live and therefore dangerous at all times.

14. In spite of the restrictions stipulated by Regulation 15 of the Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act 85 of 1993), as an additional safety precaution, Eskom will not approve the erection of houses, or structures occupied or frequented by human beings, under the power lines or within the servitude restriction area.

15. Eskom may stipulate any additional requirements to highlight any possible exposure to Customers or Public to coming into contact or be exposed to any dangers of Eskom plant.

16. It is required of the developer to familiarise himself with all safety hazards related to Electrical plant.

17. Any third party servitudes encroaching on Eskom servitudes shall be registered against Eskom’s title deed at the developer’s own cost. If such a servitude is brought into being, its existence should be endorsed on the Eskom servitude deed concerned, while the third party’s servitude deed must also include the rights of the affected Eskom servitude.

John Geeringh (Pr Sci Nat)
Senior Environmental Advisor
Eskom GC: Land Development
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8. Eskom shall not be liable for the death of or injury to any person or for the loss of or damage to any property whether as a result of the encroachment or of the use of the servitude area by the developer, his/her agent, contractors, employees, successors in title, and assignees. The developer indemnifies Eskom against loss, claims or damages including claims pertaining to consequential damages by third parties and whether as a result of damage to or interruption of or interference with Eskom’s services or apparatus or otherwise. Eskom will not be held responsible for damage to the developer’s equipment.

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18. Eskom request that any wind turbine structures be placed at least four (4) times the blade diameter of the wind turbine to be used away from any Eskom High voltage power line servitudes (220kV and above). This is to allow for future possible expansion of the Eskom servitude to allow for additional power lines to be constructed parallel to existing lines, upgrading of existing lines to higher voltage Transmission power lines in future, combat the effects of turbulence from the turbines on the power lines, limit the possible effect of electromagnetic interference and to decrease the risk of catastrophic failure of the turbine to impact on the power line. Eskom does a lot of live line maintenance work on High Voltage lines and thus use helicopters in close proximity to high voltage lines. Turbines in close proximity to Eskom Microwave radio sites and substations should also not be placed within the line of site of the antennae on such sites and towers.

John Geeringh (Pr Sci Nat)
Senior Environmental Advisor
Eskom GC: Land Development
Final Scoping Report For the Proposed 750 MW and 250 MW Wind and Solar Energy Facility on Kangnas Farm Near Springbok in the Northern Cape.

The Department of Water Affairs (DWA) hereby acknowledges receipt of your Final Scoping Report for the proposed Wind and Solar Energy Facility on Kangnas Farm. The proposed project will be located on Portion 3 and Remaining of Farm 77, which is on quaternary catchment D82D.

The water user / developer is expected to assess all the potential water uses [associated with the development] as defined under section 21 of the National Water Act, 1998 [Act 36 of 1998]. All identified water uses will need to be authorised in terms of section 40 of the National Water Act unless such a water use is permissible under section 22 of the Act.

Our assessment indicates that quaternary drainage region D82D is included in the General Authorisations for taking of water from a [ground] water resource [as extended under Notice 837 in the Government Gazette of 23 September 2010]. According to the General authorization a water user may take up to 45m³ per hectare per annum [identified under groundwater taking zone B] to subject to the conditions and obligation on the water user as set out in the General Authorization.

Activities that might have an impact on water resources such as (i) storm water management (ii) waste management (iii) sanitation (iv) sedimentation and erosion (where it is not defined as a water use) (v) storage of hazardous substances should be managed and mitigated as stated in your basic assessment report. The Department will be content with the inclusion of these proposed management and mitigation measures in the environmental management plan for the project. Kindly note that any deviations to these measures should be communicated to DWA in writing.
Due to the high number of renewable energy projects that are taking part in the Department of Energy (DOE) bidding process, the Department (DWA) has resolved to only processing applications for water use authorisations received from developers who have attained preferred bidder status. Developers who wish to submit applications for water use authorisations may however proceed to do so, with the understanding that their applications will be processed as soon as we have confirmation of their status with the DOE. Attached to this letter is annexure 1 that details information, which must be submitted as part of the application for water use authorisation.

As part of the requirements for the DOE proposals, the Department (DWA) will issue non-binding letters to water users / bidders as required under clauses 2.4.4.1.2. and 2.4.4.1.3 of Part B: Qualification Criteria of Tender Number DOE/001/2011/2012. The information required by the Department in order to issue the non-binding letters is contained on the attached annexure 2 [notes on the confirmation to be provided by DWA on water availability on request from bidders in the REFIT programme].

Yours faithfully,

[Signature]

ACTING DIRECTOR: PROVINCIAL OFFICE NORTHERN CAPE

DATE: 01/10/2012
Annexure 1

INFORMATION TO BE SUBMITTED AS PART OF WATER USE LICENSE APPLICATIONS

Application Forms
  Part 1 Application Forms
  Supplementary Forms

Property Details
  Title Deed(s) of Property(ies)
  Letter of Consent of Land Owner
  Lease Agreement (where applicant is not the registered owner of the property)

Legal Entity
  Certified Copy of Identity Document/Company Registration Certificate

BBBEE (Information submitted as part of NERSA/National Treasury bid will suffice)
  Social and Labour Plan (Job Creation/Social Investment)
  Proof of BEE Status
  Copy of Share Certificates
  Details of HDI Partners/Beneficiaries

Other Regulatory Requirements
  Copy of Environmental Impact Assessment Report
  Copy of Environmental Authorization (Record of Decision)
  Copy of NERSA Licence/Proof of Bid Allocated by National Treasury
  Viability/feasibility reports

Water Resource Technical Report
  Water requirements and availability
  Water balance
  Design drawings
  Water use efficiency
  Integrated water and waste management plan (pollution control; emergency preparedness, etc.)
  Section 27 NWA Motivation
Annexure 2

Notes on the confirmation to be provided by DWA on water availability on request from bidders in the REFIT programme

On written request to the Regional Head of the relevant Regional Office of the Department of Water Affairs (DWA), and after a consultation with the intended water user and after a subsequent investigation into the matter, it will be determined whether a specific volume of water would be available in a specific water resource in a specific area. It is however recognized that water use for renewable energy projects will be treated as strategic water use.

If it is found that water could be made available depending on certain processes, a non-binding written confirmation of the availability of that volume of water will be issued by the DWA to those who requested it.

It should however be understood that for a water use licence to be issued, apart from water availability, a number of other requirements are necessary to comply with as prescribed in the National Water Act (Act 36 of 1998) (NWA), and this indication that water may be available should not be regarded as confirmation of or a guarantee that a water use licence will eventually be issued. The responsibility will then rest on the intended water user to comply with all other reasonable requirements in terms of the NWA before a licence could be issued.

This indication of water availability would be provided only after the "Pre-application Consultation" has taken place, which is compulsory for any person with the intention of applying for a water use licence.

The function of the Pre-application Consultation is to inform the prospective water user of the process to be followed and what will be required should the prospective water user decides to apply for a water use licence. In this specific case the Pre-application Consultation must produce the necessary information to enable the Regional Head to decide whether he/she could make such a confirmation that water availability will not prevent the issuance of a licence, if it happens that the applicant's bid to National Treasury is successful. The licence applications of successful bidder(s) will then be required, processed and considered for approval by the Minister's delegated official.

Attached in Appendix A is a list with contact information of the nine Regional Offices of the DWA. An appointment should be made at the relevant Regional Office with the official responsible for water resource management in the specific area where the water use(s) is intended to be undertaken.
Limpopo
Limpopo Region
Private Bag X9506
POLOKWANE
0700
Regional Head: Mr Alison Matukane
Telephone: (015) 290 1200

Mpumalanga
Mpumalanga Region
Private Bag X11259
NELSPRUIT
1200
Regional Head: Mr Fanyana Mntambo
Telephone: (013) 759 7300

North West
North West Region
Private Bag X5
MMABATHO
2735
Regional Head: Ms Marie Brisley (Acting)
Telephone: (018) 384 3270

Northern Cape
Northern Cape Region
Private Bag X6101
KIMBERLEY
8300
Regional Head: Mr A Abrahams
Telephone: 053 836 7600

Western Cape
Western Cape Region
Private Bag X16
SANNAMHOP
7532
Regional Head: Mr Rashid Khan
Telephone: (021) 950 7100
Dear Corlie

PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES NEAR SPRINGBOK, NORTHERN CAPE (DEA REF. NO.: 14/12/16/3/3/2/346 (WIND), 14/12/16/3/3/2/342 (SOLAR)): AVAILABILITY OF DRAFT SCOPING REPORT FOR REVIEW

Thank you for including us as an Interested and Affected Party with regard to the above-mentioned project.

We have assessed the application and currently do not have any concerns at this stage. Nonetheless, we will revert back to you should any issues of concern arise.

Also, we would like to be retained as an Interested and Affected Party and kept up-to-date with progress.

Kind regards

Justin Phama
:: Professional Intern: Land Programme, WWF-SA ::
1st Floor, Bridge House
Boundary Terraces
Mariendahl Lane, Newlands
P.O.Box23273
Claremont 7735
Tel: (+2721) 657 6643 Mobile: +2783 471 6080
Fax: 086 535 9433 Email: jphama@wwf.org.za
Web: http://www.wwf.org.za

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Click here to view our online disclaimer and legal notice. If you are unable to access the link please call +27 21 657 6600 for a copy.
Final Comment

In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Comelia Steyn
Aurecon South Africa
PO Box 494
Cape Town
8000

Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape


South African Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) has proposed the construction of a 560 MW wind energy facility and a 225 MW Photovoltaic (PV) solar energy facility on farms 48kms east of Springbok in the Northern Cape. These farms are Portion 3 and the Remainder of Kangnas Farm 77, Portion 1 of Koeris Farm 78, Portion 0 of Areb Farm 75 and Portion 0 and Remainder of Smorgen Schaduwe Farm 127.

The wind energy facility will consist of 180 wind turbines, each capable of generating 4 MW. Each turbine will be built on a 3m deep foundation approximately 20 m x 20 m, accompanied by a construction area of 20 m x 40 m and a 6 – 10 m wide access road. The proposed 225 MW solar energy facility will consist of either Photovoltaic (PV) and/or Concentrated PV (CPV) technology, possibly including tracking systems, and would have an approximate footprint of 793 ha. One main substation will link the proposed facilities and the existing 220kV Eskom line, while up to four new substations will link sectors of the facility to the main substation. The receiving environment is predominantly low-lying and flat Bushmanland Arid Grassland with granite inselbergs in the northwest. The developer has proposed siting the facility where the impact on various environmental and heritage factors will be the slightest. The archaeological background research showed that little prior work has been done in the area, although ESA and MSA material, and manufacturing sites are known from the wider vicinity. Most material is LSA in age and rock art is found in the region. Historical development of the area is mainly linked to the mining industry.

The site survey noted that most sites were clustered around six landscape foci. These were recorded as Orange Hill, SMS Hill, Gobees se Pan, Springbokvlei, KNG2012/007 and Kromneus. Four caves were found within the survey area, two with rock art, one with only a scattering of artefacts and one with evidence for occupation in the form of burnt bone, ostrich eggshell, pottery and stone tools, including a lower grindstone on the talus slope. In addition to the two shelters containing rock art, similar motifs, painted in the style of Khoekhoen herders, with finger painted circles and grids, were found at an additional two sites, Kromneus
being the best known of these. Further rock art, this in the form of small hollows or “cupules”, chipped and ground into the rock surface, was identified at eight locations on Smorgen Schadwe, particularly near Orange Hill. This is an unusual style of art to be found outside of areas of Iron Age occupation. The nature of artefacts associated with these sites varied from large scatters of Stone Age material to European ceramic and glass and are particularly clustered near SMS Hill. In addition to these sites, scatters of stone artefacts, predominantly on quartz, cryptocrystalline silica, some quartzite and other materials, were found, particularly clustered near the base of a hill to the west of the study area (e.g. SMS2012/034). Many deflated areas also contained ephemeral, background scatters of artefacts, although some of these, where they contained denser concentrations of scatters, could represent camp sites (e.g. KNG2012/002). Many scatters were clustered around the few large pans on the site, where more than 70 occurrences identified near the largest Gobees se Pan and more found near Springboklei and KNG2012/007. Many sites contained sherds of indigenous pottery of the type associated with San groups. Grindstones were occasionally encountered, as were areas where exposed bedrock had been used as a lower grindstone, identifiable by worn grooves in the rock. European artefacts were also identified, with at least one sherd of glass appearing to show reshaping, presumably by indigenous people.

Several informal structures on the farm were identified by the farm owners, as relating to the South African War, although these were not obviously fortifications (SMS2012/002; 004 and 005). Several other piled stone structures were identified as related to livestock herding and probably served as kraals, dating to the late 19th to early 20th Centuries. These ranged from large, fairly formal circular structures (e.g. SMS2012/026) to low stone alignments (e.g. SMS2012/045). One large, well built kraal (ARB2012/007) was probably in use until fairly recently, and seems associated with a small enclosure that was possibly a shepherd’s shelter. Crude stone walling at ARB2012/002 formed some kind of shelter between boulders and was associated with various historical artefacts, including Chinese porcelain and late 19th Century European ceramics, while historical graffiti occurred on Kromnes. Several hand dug “pulse”, stone-lined wells, were identified within the study area, some located in pans to maximise their yield. Some are now covered by windmills, while an older water pump exists on Koiris (KOE2012/005). With regard to the built environment, most farm houses in the area date to the 1930s to 1960s, with the oldest dating to 1912/1913. Some flat roofed buildings on Smorgen Schadwe appear older, built in the Karoo vernacular style and probably dating to the late 19th century. The only farm graveyard investigated was at Areb, although each farm probably has a graveyard. A few isolated, potential grave sites were also identified, consisting of small mounds of stones. Site ARB2012/007 is however almost certainly a burial.

A desktop palaeontological assessment noted that the proposed development areas are mainly underlain by ancient Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province that crop out as low inselberge and are unfossiliferous. In the intervening, flatter areas, these older rocks are extensively mantled with younger superficial deposits that have low palaeontological sensitivity. However, significant older fossiliferous sediments are known from within the Kangnas study area and have yielded scientifically important vertebrate and plant fossil material. These known fossil sites are unlikely to be impacted by the proposed development unless bulk earthworks and excavations exceed 3m in depth. No mitigation is therefore required in terms of palaeontological heritage.
Case Decision:
SAHRA supports the recommendations of the authors and requests that:

- All buffer zones recommended in the specialist environmental reports be respected; the archaeology, which is largely clustered around hills and pans, will be protected by these buffers.
- The locations identified as sensitive should also be protected by buffers. These should be 1.5km in diameter for Orange Hill, 1.5 km east/west and 1.9 km north/south for SMS Hill, 1.2 km east/west and 1.3 km north/south for Gobees se Pan, 0.9 km east/west and 1.0 km north/south for Springbokvlei and 1.0 km in radius from the Kromneus rock art site. KNG2012/007 does not require a buffer.
- The potential graves and grave ARB2012/007 should be protected and conserved. SAHRA recommends that during the construction phase a temporary fence be built around them. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection. Alternatively, if the area where the potential burials are located falls within the development footprint, test excavation must be undertaken. The archaeologist will require a permit from SAHRA in terms of s. 35(4) of the National Heritage Resources Act (Act No. 25 of 1999). If the outcome of the test excavation is positive, then provisions stipulated in s. 36 of the National Heritage Resources Act (Act No. 25 of 1999) are applicable, and relocation of these might proceed, following a public consultation process is followed (see http://www.sahra.org.za/sites/default/files/website/articledocs/SahraReg...). Farm graveyards should not be impacted upon.
- The final layout of the turbines should respect these recommendations and must be submitted to the ACO to ensure that all identified heritage resources have been taken into consideration and cared for.

The Environmental Control Officer (ECO) should be trained in order to be able to identify fossil remains in sedimentary bedrock and should monitor all substantial excavations into this bedrock for fossil remains and, if any fossils are found during construction, SAHRA should be immediately notified.

If the above recommendations are adhered to, the SAHRA Archaeology, Palaeontology and Meteorites Unit has no objection to the development (in terms of the archaeological and palaeontological components of the heritage resources). If any new evidence of archaeological sites or artefacts, palaeontological fossils, graves or other heritage resources are found during construction, SAHRA (Katie Smuts, Tel: 021 462 4502) and a professional archaeologist and/or palaeontologist, depending on the nature of the finds, must be alerted immediately.

Decisions on Built Environment (e.g. structures over 60 years) and associated Living Heritage (e.g. sacred sites) must be made by the Provincial Heritage Resources Authority of the Northern Cape,(Mr. Andrew Timothy, email: ratha.timothy@gmail.com) to whom this Archaeological Review Comment will be copied.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.
Kangnas Wind and Solar Project

Our Ref: 9/2/066/0001

Enquiries: Kathryn Smuts
Tel: 021 462 4502
Email: ksmuts@sahra.org.za
CaseID: 136

Date: Wednesday January 30, 2013
Page No: 4

Yours faithfully

Kathryn Smuts
Heritage Officer: Archaeology
South African Heritage Resources Agency

Colette Scheermeyer
SAHRA Head Archaeologist
South African Heritage Resources Agency

ADMIN:
(DEA, Ref: 14/12/16/3/2/342) (DEA, Ref: 14/12/16/3/2/346)

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.
Annexure B4
<table>
<thead>
<tr>
<th>Organisation</th>
<th>I&amp;AP</th>
</tr>
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<tbody>
<tr>
<td>Kangnas Trust &amp; Kouberg Beleggings (Pty) Ltd</td>
<td>Mr Weich van Niekerken</td>
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<tr>
<td>Farm Areb</td>
<td>Mr Frank John Agenbag</td>
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<td>Mr J Kennedy</td>
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<td>Loubser Jannie Mr/ Madeleinne Brandt (Municipal Manager)</td>
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<td>Shaun Cloete</td>
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<td>Andrew Timothy</td>
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<td>Mark Anderson</td>
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<td>Adrian Tiplady</td>
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<td>B Thoko</td>
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<td>WVD Mothibi</td>
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<td>Carel Oberholzer</td>
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<td>Ms Lucille Karsten</td>
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<td>Natasha Wilson / Samantha Sithole</td>
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<td>Curtis Meintjies</td>
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<td>Xolisa Songcaka</td>
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<td>Suzanne Erasmus</td>
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<tr>
<td>SANRAL</td>
<td>Ms René de Kock</td>
</tr>
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Annexure B5
PROPOSED WIND ENERGY FACILITY ON KANGNAS FARM NEAR SPRINGBOK, NORTHERN CAPE
(DEA ref. No: 14/12/16/3/3/2/346) (NEA Ref No: DEA/EIA/0001222/2012)
AND
PROPOSED SOLAR PHOTOVOLTAIC ENERGY FACILITY ON KANGNAS FARM NEAR SPRINGBOK,
NORTHERN CAPE
(DEA ref. No: 14/12/16/3/3/2/342) (NEA Ref No: DEA/EIA/0001217/2012)
AND
PROPOSED SUBSTATION AND GRIDLINE ASSOCIATED WITH THE PROPOSED WIND ENERGY FACILITIES ON KANGNAS FARM NEAR SPRINGBOK, NORTHERN CAPE
(DEA ref. No: 14/12/16/3/3/2/386) (NEA Ref No: DEA/EIA/0001344/2012)
AND
PROPOSED SUBSTATION AND GRIDLINE ASSOCIATED WITH THE PROPOSED SOLAR ENERGY FACILITIES ON KANGNAS FARM, NEAR SPRINGBOK IN THE NORTHERN CAPE
(DEA REF. NO: 14/12/16/3/3/2/447; NEA REF NO: DEA/EIA/0001597/2012)

Notes of Public Meeting, 12 December 2012, 17h00 – 19h00, Exhibition Hall, Springbok

1. ATTENDEES

Santie Coetzee (Botes & Kennedy) SC
Maritz Myburgh (Private) MM
Arika Myburgh (Private) AM

Project Team:
Hein Reyneke (Mainstream Renewable Power (Mainstream)) HR
Louise Corbett (Aurecon) LC
Nelis Bezuidenhout (Aurecon) NB

2. INTRODUCTION

LC welcomed all attendees to the meeting. LC suggested a less formal meeting as there were only three (3) Interested & Affected Parties (I&APs) present. All attendees agreed to LC’s suggestion.

LC explained that the purpose of the meeting was to:
• provide a brief description of the proposed project;
• present contents of the Draft Environmental Impact Report (EIR) for the proposed Projects; and
• provide an opportunity for Interested and Affected Parties (I&APs) to comment on the Draft EIR.

A copy of the presentation is included in Annexure 1 of these meeting notes.
3. DISCUSSIONS

1. MM queried whether the hard stands surface for the turbines would be a hard surface or gravel. HR replied that it would not be a concrete slab surface and that it would be compacted gravel.

2. MM questioned whether landowners would be able to continue farming around the turbines once they are erected. HR replied that the contracts with landowners read that they can farm around the turbines once they are erected.

3. MM wondered what the height of the turbines was. HR noted that the hub height of turbines would be up to 120 m in height. The maximum rotor diameter would be 120 m thus the maximum tip height could be up to 180m.

4. SC asked in what phase the project is. HR replied that Mainstream was busy with all the necessary applications, including the Environmental Impact Assessment (EIA) application, and Mainstream would be targeting the Department of Energy’s third bidding round.

5. SC queried whether local manufacturers would be used. HR responded that where possible Mainstream would make use of local manufacturers, but considering that renewable energy was a relatively new industry in South Africa it would not always be possible to find local suppliers.

6. MM queried what the timeframe of the proposed development was. HR noted that Mainstream needs to have constructed the projects by the end of 2016 as this was the current requirement from the DoE.

7. SC queried whether the project would create jobs locally. HR noted that local jobs would be created as far as possible and that Mainstream may consider providing bursaries in the long term to facilitate employment for local people. HR also noted that Mainstream was also in the process of appointing a dedicated internal representative to look at the socio-economic concerns of their various projects across South Africa.

8. SC again noted that job creation is a problem for the area and whether the proposed development would directly create jobs. HR replied that the project will create local jobs, especially during the construction phase when approximately 130 jobs would be created.

9. AM queried whether there were alternative sites available if Mainstream did not get a positive Environmental Authorisation (EA). HR replied that because of the uncertainties of these projects, Mainstream was busy with numerous projects all around the country.

10. MM queried whether turbines and/or panels would be visible from the road. HR replied that they would be visible, particularly the panels. LC added that while the turbines would be visible their colour would make them fade into the background.

11. MM noted that there were studies available that show that turbines could have an impact on
farming and that there was recently an article noting that wind turbines have an impact on cattle farming. HR replied that some studies in the world had been done, but that there was no concrete evidence available to prove that there was an impact. HR continued that one should always be cautious of these studies and make sure that they have been peer reviewed.

12. MM queried what type of construction would be required for the turbines. HR noted that the construction would mostly consist of concrete for the base of the turbines, substation buildings, roads and cabling

13. MM queried whether the topography of the study area influenced the wind readings. HR noted that the topography could influence the wind somewhat and that wind readings at the Kangnas site were above average at this stage. HR continued that people were of the impression that wind mostly blows along the coast, but in actual fact the wind in the Northern Cape was also very good.

14. MM queried whether the turbines changed their speed with the wind strength. HR replied that the turbines keep their speed in a relatively narrow band and that power control and frequency synchronisation with the national grid is performed by power electronics.

4. WAY FORWARD

LC thanked the participants for their valuable input and encouraged I&APs to submit comments so that issues could be responded to and informed decisions could be made by the authorities. She noted that I&APs had until 14 January 2013 to submit comments on the Draft Environmental Impact Assessment Report and that there would be a 21 day comment period on the Final EIR.

The meeting closed at 19h00.
PUBLIC MEETING

WEDNESDAY, 12 DECEMBER 2012
17H00 - 19H00

PROPOSED WIND AND SOLAR (PHOTOVOLTAIC)
ENERGY FACILITIES ON KANGNAS FARM NEAR
SPRINGBOK, NORTHERN CAPE

AURECON

MAINSTREAM
RENEWABLE POWER
SOUTH AFRICA
<table>
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<tr>
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<th>Organisation/Farm name</th>
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<tr>
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<td>MRP</td>
<td></td>
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<td>AFR.</td>
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<tr>
<td>M. Hen Burcha</td>
<td>BUI Consulting</td>
<td>KeK 683, SPRK</td>
<td>0824657017</td>
<td>02712999</td>
<td>027129990</td>
<td>mordem@buinam</td>
<td>AFR.</td>
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# Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm Near Springbok, Northern Cape: Draft EIR Public Meeting

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<tr>
<td>Sannie Coetsee</td>
<td>fast + Kennedy Magagye</td>
<td>Postbus 158, Springbok 8240</td>
<td>027 71</td>
<td>086 556 3240</td>
<td>083 469 6979</td>
<td>sannie.elephant.co</td>
<td>Afr.</td>
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PRESENTATION OF DRAFT ENVIRONMENTAL IMPACT REPORT

THE PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES AND TWO SUBSTATIONS NEAR SPRINGBOK, NORTHERN CAPE

Welcome, introduction & objectives (Aurecon)
Overview of the proposed project (Mainstream)
Environmental Impact Assessment Process (Aurecon)
Presentation of Draft Environmental Impact Report (Aurecon)
Discussion on Draft Environmental Impact Report (All)
Way forward (Aurecon)
Meeting closure

Agenda

Introductions

• Mr Hein Reyneke (South Africa Mainstream Renewable Power (Mainstream))
• Miss Louise Corbett (Aurecon)
• Mr Nelis Bezuidenhout (Aurecon)

Meeting Guidelines

• Language
• Record of the Meeting
• Timing
• Respect others
  • Turn off cellphone
  • Say your name before you speak
  • Speakers must be recognised by facilitator before speaking
  • Agree to disagree

Objectives

• Provide brief description of project
• Present contents of Draft Environmental Impact Report (DEIR) for the proposed PV & wind energy facilities
• Provide opportunity for public to comment on DEIR
OVERVIEW OF THE PROPOSED PROJECT

Hein Reyneke

Summary of proposed WEF

Mainstream proposes the construction of up to 180 turbines of up to 4 MW with a capacity of 560 MW, constructed in four 140 MW phases.

The associated infrastructure would include:

- Power lines to connect to existing grid
- Gravel surface access roads 6 - 10 m wide
- Hard standings of 20 m x 40 m alongside turbines
- Two satellite substations (100 x 100 m each) that would link sectors of the facility to a main substation

Summary of WEF substation & grid connection

- Double circuit transmission line (~20 km) between WEF main substation and existing Eskom Nama Aggeneys 220 kV grid line
- Substation would consist of Eskom required switchgear, telecommunications, storage, control room, access road (single track – for maintenance), bus bars, overhead gantries, fencing and all other generic substation infrastructure
- Total main substation size max. 200 x 200 m (4 ha)

Proposed solar project

Mainstream proposes to construct a 225 MW PV and/or CPV facility, including:

- Three phases of 75 MW
- Access roads of 6 - 10 m wide
- Onsite grid connection
- Cables connecting arrays would interconnect with overhead transmission lines that would follow route of access roads
- Storm water management infrastructure
- Electric fencing
- Water could be obtained from underground water sources
Summary of solar substation & grid connection

- Double circuit transmission line (~1 km) between solar substation and existing Eskom Nama Aggeneys 220 kV grid line
- Substation would consist of Eskom required switchgear, telecommunications, storage, control room, access road (single track – for maintenance), bus bars, overhead gantries, fencing and all other generic substation infrastructure
- Total main substation size max. 200 x 200 m (4 ha)

Solar layout

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

Louise Corbett

Purpose of EIA process

- To satisfy requirements of:
  - National Environmental Management Act (NEMA) (No. 107, 1998)
  - National Heritage Resources Act (NHRA) (No. 25, 1999)
- To identify potential environmental impacts (socio-economic & biophysical) and determine their likely significance
- To recommend mitigation measures

Purpose of EIA process cont.

- To allow for public involvement
- To inform Mainstream’s decision-making
- To inform Environmental Authority’s decision-making (Department of Environmental Affairs (DEA))

Scoping and EIA process

We are currently at this stage

PPP to date:
- Advertisement: Die Plattelander
- Site notices
- Notice in Springbok library
- Letters to I&APs
- Chain referral
- Comment period on DSR
- Public meeting for DSR

Three phases
Impact Assessment Methodology: Significance

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DRAFT ENVIRONMENTAL IMPACT REPORT
PROPOSED WIND AND PV ENERGY FACILITIES
Louise Corbett

EIA Applications

- Four EIA applications in one EIA process
  1. Wind energy facility
  2. Substation and grid connection for wind energy facility
  3. Solar energy facility
  4. Substation and grid connection for solar energy facility
- 1 & 2 assessed together
- 3 & 4 assessed together
- Cumulative impacts of all, and other renewable energy projects in area assessed

Specialist Studies

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<th>Company/Contact</th>
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<tr>
<td>Botanical</td>
<td>Bergendorn Botanical Surveys and Tours David MacDonald</td>
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<tr>
<td>Avifauna</td>
<td>Independent consultant</td>
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<tr>
<td>Bat</td>
<td>Animalia Zoological and Ecological Consultation Werner Marais</td>
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<td>Cultural heritage, archaeology</td>
<td>ACO Associates</td>
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<td>Natural History</td>
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<td>Visual</td>
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<td>Noise</td>
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Summary of Potential Impacts: Operational Phase

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<td>Impact on Flora</td>
<td>Potential Flora Species</td>
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<tr>
<td>Impact on Fauna</td>
<td>High species richness</td>
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<tr>
<td>Impact on Biodiversity</td>
<td>Increased likelihood of finding endemic plant species</td>
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<tr>
<td>Impact on Vegetation</td>
<td>Small no. of turbines within Platbakkies Succulent Shrubland gravel patches - high magnitude impact</td>
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<tr>
<td>Impact on Noise</td>
<td>With mitigation measures impact would be low (-)</td>
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<tr>
<td>Impact on Agriculture</td>
<td>Note, greatest impact on flora (high :-)) within greater Kangnas area is fragmentation by access roads. Not possible to mitigate, but considered to be acceptable based on low sensitivity of vegetation and its widespread distribution</td>
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Impact on Avifauna

- Potential impacts:
  - Disturbance and displacement of resident/breeding Karoo species, large terrestrial birds and/or resident/migrant raptor species from foraging/breeding areas and/or mortality in collisions with powerlines or electrocution
  - Effect of above considering cumulative effect for large, long lived, slow reproducing and/or threatened species, many collision prone
  - Large project = many turbines so higher risk of bird casualties
  - With mitigation measures impact would be medium (-)

Impact on Visual Aesthetics

- Turbines have high visibility and large viewshed, limited by Klein Koperberg Mountains and to north by low hills located between site and N14.
  - Generally weak contrast with background except N14 foreground
  - In Goegap Nature Reserve, wind facility only visible from high-lying sections in east. It is highly unlikely that sense of place would be affected. Scenic resources of Goegap Nature Reserve would not be impacted.
  - Installation of lights on turbines would have a greater impact on night-time sense of place, but can be contained.
  - With mitigation measures impact would be low (-)

Impact on Socio-economic Environment:

Visual

- Turbines have high visibility and large viewshed, limited by Klein Koperberg Mountains and to north by low hills located between site and N14.
- Generally weak contrast with background except N14 foreground.
- In Goegap Nature Reserve, wind facility only visible from high-lying sections in east. It is highly unlikely that sense of place would be affected. Scenic resources of Goegap Nature Reserve would not be impacted.
- Installation of lights on turbines would have a greater impact on night-time sense of place, but can be contained.
- With mitigation measures impact would be low (-)

Summary of Potential Impacts: Construction Phase

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<th>Typical mitigation strategies</th>
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<td>Impact on local economy, employment and social conditions</td>
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<td>Impact on agriculture</td>
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<td>Impact on transport</td>
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<td>Noise pollution</td>
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<td>Storage of hazardous substances on site</td>
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Construction Phase: Impact on Flora

- Areas of Platbakkies Succulent Shrubland considered botanically sensitive
  - higher species richness
  - increased likelihood of finding endemic plants species
- Construction activities for a small no. of turbines within Platbakkies Succulent Shrubland gravel patches - high magnitude impact
- With mitigation measures impact would be low (-)
Availability of the DEIR

- DEIR is available from 27 November 2012 until 14 January 2013, at:
  - Springbok Public Library
  - Pofadder Public Library
- Registered I&APs notified & Summary Document sent on 23 November 2012
- Available on the Internet: http://www.aurecongroup.com

Comments on DEIR

- Captured at Public Meeting
- All comments received on DEIR will be responded to in Comments & Response Report (CRR)
- All comments will be included in FEIR submitted to DEA

Way Forward

- Provide comments on DEIR till 14 January 2013
- Report will be updated & finalised- FEIR
- 21 day comment period on final report & final report submitted to DEA
- EIA phase
- DEA will either reject or approve
- I&APs will be notified of decision and will have opportunity to appeal

THANK YOU FOR PARTICIPATING.
Annexure C1
ENVIRONMENTAL IMPACT ASSESSMENT: PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES NEAR SPRINGBOK, NORTHERN CAPE
COMMENTS AND RESPONSE REPORT 3 (FINAL SCOPING PHASE)

This Comments and Response Report (CRR) reflects the comments submitted in writing from 3 August 2012 until 24 August 2012 during the final scoping phase of the proposed project. In order to address the comments received, the CRR table has been divided into themed issues and the comments relevant to each issue have been included under the relevant (themed) section. A total of six comments were received and have been summarised and responded to below.

List of submissions:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Organisation</th>
<th>Date Received</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K. Smuts</td>
<td>South African Heritage Resources Agency</td>
<td>20/08/12</td>
<td>E-mail</td>
</tr>
<tr>
<td>2</td>
<td>Mr C Geldenhuys</td>
<td>Department of Environmental Affairs &amp; Nature Conservation</td>
<td>06/07/12</td>
<td>Letter</td>
</tr>
<tr>
<td>3</td>
<td>NJ. Toerien</td>
<td>Northern Cape Department of Agriculture, land reform &amp; rural development</td>
<td>11/09/12</td>
<td>Fax</td>
</tr>
<tr>
<td>4</td>
<td>Natasha Wilson</td>
<td>WWF Land Programme</td>
<td>13/07/12</td>
<td>E-mail</td>
</tr>
<tr>
<td>5</td>
<td>Shaun Cloete</td>
<td>Department of Agriculture</td>
<td>19/08/12</td>
<td>E-mail</td>
</tr>
<tr>
<td>6</td>
<td>S. Muobeleni</td>
<td>Department of Agriculture, Forestry and Fisheries</td>
<td>30/08/12</td>
<td>E-mail</td>
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LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CRR</td>
<td>Comments and Responses Report</td>
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<tr>
<td>DEA</td>
<td>Department of Environmental Affairs (previously Department of Environmental Affairs and Tourism)</td>
</tr>
<tr>
<td>DEANC</td>
<td>Department of Environmental Affairs &amp; Nature Conservation</td>
</tr>
<tr>
<td>FSR</td>
<td>Final Scoping Report</td>
</tr>
<tr>
<td>ECO</td>
<td>Environmental control officer</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EIAR</td>
<td>Environmental Impact Assessment Report</td>
</tr>
<tr>
<td>LEMPr</td>
<td>Life cycle Environmental Management Programme</td>
</tr>
<tr>
<td>I&amp;APs</td>
<td>Interested and Affected Parties</td>
</tr>
<tr>
<td>NIMBY</td>
<td>Not in my Back Yard</td>
</tr>
<tr>
<td>SAHRA</td>
<td>South African Heritage Resources Agency</td>
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<tr>
<td>WEF</td>
<td>Wind Energy Facility</td>
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<tr>
<td>WWF</td>
<td>World Wildlife Fund</td>
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**ISSUES HAVE BEEN GROUPED UNDER THE FOLLOWING THEMES:**

A. HERITAGE RESOURCES  
B. BIOPHYSICAL RESOURCES  
C. WATER RESOURCES  
D. AGRICULTURAL RESOURCES

<table>
<thead>
<tr>
<th>Comments and responses:</th>
<th>Summary of Issue</th>
<th>Response</th>
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<td><strong>1</strong></td>
<td>K. Smuts</td>
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</table>
Other similar developments are proposed around the Springbok area with some developments directly adjacent to Goegap Nature Reserve. The renewable energy targets presume an even more concerted effort in the near future to expand the renewable energy network which will impact on biodiversity around and on current protected areas (e.g. birds and bats), other wilderness areas away from protected areas, sensitive habitats, water resources etc.

The cumulative impacts of the proposed projects considered in the DEIR. However, it should be noted that not all renewable energy projects proposed will be constructed as there are many requirements to be met.
It is highly recommended that the locality of the Renewable Energy facilities be reconsidered and not placed within the Protected Area expansion.

See response to 1 above.

Mainstream undertook a fatal flaw analysis of four sites in the Northern and Western Cape, of which the current site was one. These sites were identified by considering various technical aspects, including surrounding land uses and existing services infrastructure as well as environmental aspects such as botany, avifauna, bats and more. Site visits and desktop studies were undertaken, and input was received from specialists in botany, avifauna, heritage and bats.

One of the sites considered in the fatal flaw analysis was located immediately adjacent to Goegap Nature Reserve and it was decided not to pursue this site in order to limit potential impacts on the reserve as well as the WWF site. Based on the Fatal Flaw Analysis, Mainstream decided to pursue two of the four sites, namely the Kangnas site and a site closer to Pofadder (currently the subject of a separate EIA process). Based on the selection process undertaken by Mainstream in selecting the site, no other site location alternatives are assessed in the EIA.

See response to 1 above. We are not aware of any legally applicable buffer zones around protected areas and would appreciate if these could be provided.

Various specialist studies have been undertaken for the proposed projects, including a visual, botanical, aquatic ecology, avifaunal...
It is recommended that climate change migration corridors be considered and not be impacted on by Renewable Energy facilities.

It is recommended that a more strategic planning of placement of Renewable Energy facilities be implemented as the current ad hoc and random method is causing negative impacts on the Northern Cape’s biodiversity, eco-tourism and planning processes.

As this comment is addressed to DEA no response is required.

| 2.2 | Natasha Wilson | 13/07/12 | WWF-SA has recently developed internal guidelines regarding renewable energy applications specifically, wind energy applications. These guidelines are still in a draft format, used within WWF to aid decision making when it comes to commenting on applications. The internal guidelines are specific to areas that fall inside of the protected area expansion strategy or adjacent to already protected areas. | Noted. EIA documentation will be submitted to the Environmental Division (EIA applications receiving and handling). | Noted. |
The approach we have taken is to avoid the NIMBY standpoint but to consider the applications as they are received on a case by case basis. We also acknowledge that renewable energy has a role to play in the future of South Africa’s energy needs.

### C. WATER RESOURCES

#### 3.1 Shaun Cloete 19/08/12

Commenting has been delayed due to technical difficulty and will be made shortly.

### D. AGRICULTURAL RESOURCES

#### 4.1 NJ. Toerien 11/09/2012

The developer must comply with Act 43 of 1983 and also take care of the following: Article 7.(3)b of Regulation 9238: CONSERVATION OF AGRICULTURE RESOURCES, 1983 (Act 43 of 1983). Utilisation and protection of vleis, marshes, water sponges and water courses 7.(1) "..... no land user shall utilize the vegetation in a vlei, marsh or water sponge or within the flood area of a water course or within 10 meters horizontally outside such flood area in a manner that causes or may cause the deterioration of or damage to the natural agriculture resources."

(3)(b) "cultivate any land on his farm unit within the flood area of a water course or within 10 meters horizontally outside the flood area of a water course" Take also care of the following: who is the current landowner, will it be a subdivision of land or a lease contract between the developer and the landowner? Rezoning will also be applicable because the land use will change from the current agricultural status. The Department of Agriculture, Land Reform and Rural Development foreseen no problems in the development as mentioned above as long as the developer adheres to the articles of Act 43 of 1983

#### 4.2 S. Muobeleni 30/08/2012

Can you please be specific on the footprint were the wind and solar is going to be erected. I need you to tell me that out of 46 535 (ha) how many hectares will be used.

Noted. Layouts have been revised taking cognisance of specialist recommendations and sensitivity buffers have been applied to areas with identified Agricultural potential. Please refer to Annexure M for the Agricultural impact report and Figures 2.1 and 2.2 of the LEMPr for the revised layouts and associated sensitivity buffers.

Please refer to Table 3.2 and 3.4 of the DEIR for specific footprint requirements for both the wind and solar facilities.
Annexure C2
This Comments and Response Report (CRR) reflects the comments submitted in writing from 26 November 2012 until 14 January 2013 during the impact assessment phase of the proposed projects. A total of five comments were received and have been summarised and responded to below.

List of submissions:

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>M. Cebekhulu</td>
<td>Department of Water Affairs (DWA)</td>
<td>01/10/12</td>
<td>Letter</td>
</tr>
<tr>
<td>2</td>
<td>J. Phama</td>
<td>World Wide Fund -SA Land Programme (WWF)</td>
<td>12/12/12</td>
<td>Email</td>
</tr>
<tr>
<td>3</td>
<td>C.A. Shene-Verdoorn</td>
<td>BirdLife South Africa</td>
<td>23/01/12</td>
<td>E-mail &amp; Letter</td>
</tr>
<tr>
<td>4</td>
<td>J. Geeringh</td>
<td>Eskom Holdings Pty Ltd (Eskom)</td>
<td>25/01/13</td>
<td>E-mail &amp; Letter</td>
</tr>
<tr>
<td>5</td>
<td>Kathryn Smuts</td>
<td>SAHRA</td>
<td>30/01/13</td>
<td>E-mail &amp; Letter</td>
</tr>
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Comments and responses:

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<tbody>
<tr>
<td>1.1</td>
<td>M Cebekhulu (DWA)</td>
<td>01/10/12</td>
<td>The Department of Water Affairs (DWA) acknowledged receipt of the Final Scoping Report for the proposed Wind and Solar Energy Facility on Kangnas.</td>
<td>Noted.</td>
</tr>
<tr>
<td>1.2</td>
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<td>The water user is expected to assess the potential water uses (associated with the development) as defined under section 21 of the National Water Act, 1998 (Act 36 of 1998). All identified water uses will need to be authorised in terms of section 40 of the National Water Act unless such a water use is permissible under section 22 of the Act.</td>
<td>The Applicant has already applied to DWA for a non binding letter of water availability as required by the Department of Energy’s bidding process. Furthermore the applicant is preparing an application, informed by this EIA and DWA’s requirements, for a Water Use Licence. The DWA will only process the WUL application if the project is announced a preferred bidder.</td>
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<td>1.3</td>
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<td>Activities that might have an impact on water resources such as (i) storm water management (ii) waste management (iii) sanitation (iv) sedimentation and erosion (where it is not defined as a water use) (v) storage of hazardous substances should be managed and mitigated as stated in your basic assessment report. The Department will be content with the inclusion of these proposed management and mitigation measures in the environmental management plan for the project. Kindly note that any deviations to these measures should be communicated to DWA in writing.</td>
<td>These measures are included in the Lifecycle EMP.</td>
</tr>
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<td>1.4</td>
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<td>Due to the high number of renewable energy projects that are taking part in the Department of Energy (DOE) bidding process, the DWA has resolved to only process applications for water use authorisations received from developers who have attained preferred bidder status. Developers who wish to submit applications for water use authorisations may however proceed to do so, with the understanding that their applications will be processed as soon as we have confirmation of their status with the DOE. Attached to this letter is that details information, which must be submitted as part of the application for water use authorisation.</td>
<td>Noted.</td>
</tr>
<tr>
<td>2.1</td>
<td>J Phama (WWF)</td>
<td>12/12/12</td>
<td>WWF-SA has assessed the application and do not have any concerns at this stage. We would like to be retained as</td>
<td>Noted.</td>
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<tr>
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<tr>
<td>3.1</td>
<td>CA Shene-Verdoorn (BirdLife South Africa)</td>
<td>22/01/2013</td>
<td>BirdLife South Africa supports renewable energy production, however renewable energy facilities can have unintended negative impacts on avifauna.</td>
<td>Noted. An Avifaunal study was undertaken to assess the potential impacts on birds. See Annexure F in this regard. Additionally a 12 month pre-construction monitoring program is underway.</td>
</tr>
<tr>
<td>3.2</td>
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<td>The proposed wind energy component of this proposed development consists of approximately 180, 4 MW turbines. This is considered to be a large facility.</td>
<td>Note that the proposed wind energy facility would consist of four phases of 140 MW using turbines with a rating between 1.5 and 4 MW, thus actual turbines per 140 MW phase would range from 35 to 94.</td>
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<td>3.3</td>
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<td>115 species of birds, 12 which are red data species, 59 are endemics and three red-listed endemics have been recorded in the broader area. Many of these are possibly vulnerable to the impacts of wind and solar energy and the associated infrastructure.</td>
<td>Recommendations from the Avifaunal study included the need for long term monitoring. <strong>This monitoring has already been initiated and interim reports will be submitted to DEA.</strong> Recommendations from the long term monitoring will be included in the Construction and Operational Environmental Management Programme (EMP).</td>
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<td>BirdLife South Africa is therefore disappointed that the BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa has not been used to help guide the scope of the impact assessment. A site visit over one season is not considered sufficient to identify and mitigate potential impacts on avifauna. Please see the attached letter which outlines our position in this regard.</td>
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<td>BirdLife is therefore of the opinion that there is insufficient information on which to base an informed decision and cannot support this application.</td>
<td>This process has been followed in numerous wind energy applications and has been acceptable to the Department of Environmental Affairs (DEA). While it is understood that DEA is requiring that the long term monitoring is undertaken within the EIA for new wind energy applications DEA has not required this of these specific projects. As such DEA is likely to make the requirement for long term monitoring the condition of an Environmental Authorisation, should the project be approved.</td>
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<tr>
<td>3.4</td>
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<td>Should the proposed development be approved despite our concerns, we recommend the following:</td>
<td>No go areas have been identified and included in the sensitivity map included in the Lifecycle</td>
</tr>
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</table>

*Note: The text is a summary of comments and response report 4 (impact assessment phase) for proposed wind and solar energy facilities near Springbok, Northern Cape.*
<table>
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<tr>
<td>3.5</td>
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<td>No-go and buffer areas should be clearly defined in the environmental authorisation and indicated on a topographical map.</td>
<td>EMP in Annexure N.</td>
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<td>3.6</td>
<td></td>
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<td>Monitoring must be implemented in accordance with BirdLife South Africa / Endangered Wildlife Trust: best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.</td>
<td>Long term monitoring, in accordance with the best practice guidelines, is currently being undertaken and recommendations from the monitoring will be incorporated into the Lifecycle EMP and the sensitivity and layout maps it contains. Results of the monitoring shall be submitted to DEA and Birdlife South Africa. The comment submitted by Birdlife South Africa has been submitted to the avifaunal specialist undertaking the monitoring for their consideration.</td>
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<td>3.7</td>
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<td>Pre-construction monitoring must be completed for both the proposed development site and a reference site (if available).</td>
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<td>3.8</td>
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<td>The final layout must be informed by the results of the monitoring and must be submitted to BirdLife South Africa for review.</td>
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<td>3.9</td>
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<td>Post-construction monitoring should use similar methodology as pre-construction monitoring to ensure comparability of results, but should also include the collection of mortality data.</td>
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<td>3.10</td>
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<td>Post-construction monitoring should start within 6 months of the turbines becoming operational and should span a period of at least 12 months.</td>
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<td>3.11</td>
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<td>BirdLife South Africa and any other relevant party identified by DEA should be given the opportunity to review and approve the methodology.</td>
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<td>3.12</td>
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<td>Monitoring reports, as well as the raw monitoring data, should be forwarded to DEA, BirdLife South Africa and the Endangered Wildlife Trust any other relevant party identified by DEA.</td>
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<td>3.13</td>
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<td>The results of post-construction monitoring may highlight the need for additional mitigation measures that may need to be incorporated in the environmental management programme. The applicant should be required to take all</td>
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<td>3.14</td>
<td>feasible and reasonable steps to reduce significant impacts on avifauna.</td>
<td>Construction-phase monitoring (observations over a period of at least three days per season) should be conducted by an avifaunal specialist. The results of this should inform any additional mitigation that may be required.</td>
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<td>3.15</td>
<td>The environmental management programme should be reviewed annually for the first five years of the operational phase of the facility. BirdLife South Africa and EWT (and any other party nominated by DEA) should be given the opportunity to comment on the bird monitoring specifications every year for as long as post construction monitoring continues.</td>
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<tr>
<td>3.16</td>
<td>If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible.</td>
<td>This has been incorporated into the Lifecycle EMP. The Civil Aviation Authorities (CAA) will inform the amount and type of lights that are to be used driven by the aviation safety requirements. Not every turbine may have lights.</td>
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<td>3.17</td>
<td>Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards.</td>
<td>Turbines would not be lit at night, apart from the aviation safety lights.</td>
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<td>3.18</td>
<td>Where possible the applicant should be encouraged to conduct controlled experiments to test the effectiveness mitigation measures that may increase the visibility of wind turbines and associated infrastructure and reduce bird collision rates.</td>
<td>Recommendations by the visual specialist regarding lighting have been included in the Lifecycle EMP and includes downward facing lights. The CAA will set requirements and will safety light requirements.</td>
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<td>3.19</td>
<td>Clearing of natural vegetation during construction should be kept to a minimum.</td>
<td>Noted.</td>
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<tr>
<td>3.20</td>
<td>Sufficient drainage should be provided along access roads to prevent erosion and pollution of adjacent watercourses or wetlands.</td>
<td>This is included in the Lifecycle EMP.</td>
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<tr>
<td>3.21</td>
<td>J Geeringh (Eskom)</td>
<td>25/01/2013</td>
<td>The development does not seem to have a direct impact on existing Transmission infrastructure. Please find attached the requirements for works at or near Eskom infrastructure. I attach two documents as the development comprise of a solar and wind development.</td>
<td>Land use below the turbines would continue as before i.e. sheep farming.</td>
</tr>
<tr>
<td>3.22</td>
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<td>Hunting of birdlife should be prohibited on site.</td>
<td>This has been incorporated in the Lifecycle EMP.</td>
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<td>3.23</td>
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<td>All powerlines linking wind turbines to each other and to the internal substation must be buried and should follow access roads. Only powerlines linking the wind energy facility to the grid may be above ground. Where these movement corridors or habitat capable of supporting sensitive species, these should be buried below ground or in cases where this is not feasible, lines must be fitted with bird flight diverters. Only Eskom approved bird friendly pole structures may be used.</td>
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<td>3.24</td>
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<td></td>
<td>The use of guyed towers (for example for wind monitoring or communication) should be minimised and if necessary steps should be taken to increase the visibility of the guy wires through the use of markers.</td>
<td>This has been incorporated in the Lifecycle EMP.</td>
</tr>
<tr>
<td>3.25</td>
<td></td>
<td></td>
<td>Maintenance staff should be encouraged to keep noise and other disturbances to a minimum.</td>
<td>This is included in the Lifecycle EMP.</td>
</tr>
<tr>
<td>3.26</td>
<td></td>
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<td>Maintenance staff should report bird mortalities through a formalised reporting system.</td>
<td>This has been incorporated in the Lifecycle EMP.</td>
</tr>
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<td>3.27</td>
<td></td>
<td></td>
<td>Where possible maintenance should take place outside of the breeding season of priority bird species.</td>
<td>This has been incorporated in the Lifecycle EMP.</td>
</tr>
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<td>3.28</td>
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<td>Land management practices beneath the towers should not attract raptors or other species vulnerable to collision. Structures should be designed to reduce the availability of perching sites.</td>
<td>This has been incorporated in the Lifecycle EMP.</td>
</tr>
<tr>
<td>3.29</td>
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<td></td>
<td>Maintenance staff should report bird mortalities through a formalised reporting system.</td>
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<tr>
<td>5.1</td>
<td>Kathryn Smuts</td>
<td>30/0113</td>
<td>All buffer zones recommended in the specialist environmental reports be respected; the archaeology, which is largely clustered around hills and pans, will be protected by these buffers. The locations identified as sensitive should also be protected by buffers. These should be 1.5km in diameter for Orange Hill, 1.5 km east/west and 1.9 km north/south for SMS Hill, 1.2 km east/west and 1.3 km north/south for Gobeese se Pan, 0.9 km east/west and 1.0 km north/south for Springbokvlei and 1.0 km in radius from the Kromneus rock art site. KNG2012/007does not require a buffer.</td>
<td>Noted. This has been incorporated in the Lifecycle EMP.</td>
</tr>
<tr>
<td>5.2</td>
<td></td>
<td></td>
<td>The potential graves and grave ARB2012/007 should be protected and conserved. SAHRA recommends that during the construction phase a temporary fence be built around them. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection. Farm graveyards should not be impacted upon.</td>
<td>Noted. This has been incorporated in the Lifecycle EMP.</td>
</tr>
<tr>
<td>5.3</td>
<td></td>
<td></td>
<td>The final layout of the turbines should respect these recommendations and must be submitted to the ACO to ensure that all identified heritage resources have been taken into consideration and cared for.</td>
<td>Noted. ACO will be provided with the final turbine layouts to confirm that Heritage Resources are safeguarded.</td>
</tr>
<tr>
<td>5.4</td>
<td></td>
<td></td>
<td>If the above recommendations are adhered to, the SAHRA Archaeology, Palaeontology and Meteorites Unit has no objection to the development (in terms of the archaeological and palaeontological components of the heritage resources).</td>
<td>Noted.</td>
</tr>
<tr>
<td>5.5</td>
<td></td>
<td></td>
<td>If any new evidence of archaeological sites or artefacts, palaeontological fossils, graves or other heritage resources are found during construction, SAHRA (Katie Smuts, Tel: 021 462 4502) and a professional archaeologist and/or palaeontologist, depending on the nature of the finds, must be alerted immediately.</td>
<td>Noted. Should additional Heritage resources be discovered, construction would cease and SAHRA would be contacted immediately.</td>
</tr>
</tbody>
</table>
Annexure D
1 ASSESSMENT METHODOLOGY

The purpose of this Chapter is to describe the assessment methodology that is applied to the assessment of the impacts. The assessment context and cumulative impacts are also discussed in this chapter.

1.1 INTRODUCTION

The purpose of this chapter is to describe the assessment methodology utilised in determining the significance of the construction and operational impacts of the proposed project, and where applicable the possible alternatives, on the biophysical and socio-economic environment. The methodology was developed by Aurecon (previously Ninham Shand) in 1995 and has been continually refined based on our experience of its application to over 300 EIA processes. The methodology is broadly consistent with requirements of Regulation 32(2)(k) of Regulation 385. Furthermore, the methodology is consistent with that described in the DEAT Guideline Document on the EIA Regulations (1998). The methodology was outlined in the Plan of Study for EIA and in accepting the FSR, DEA has ratified this approach.

1.2 ASSESSMENT METHODOLOGY

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) would be described. These criteria would be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIAR would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.¹

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 1.1 Assessment criteria for the evaluation of impacts

¹ The applicant will be requested to indicate at the Draft EIAR stage which alternative and mitigation measures they are prepared to implement.
<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent or spatial</td>
<td>Regional</td>
<td>Beyond a 10 km radius of the candidate site.</td>
</tr>
<tr>
<td>influence of impact</td>
<td>Local</td>
<td>Within a 10 km radius of the candidate site.</td>
</tr>
<tr>
<td></td>
<td>Site specific</td>
<td>On site or within 100 m of the candidate site.</td>
</tr>
</tbody>
</table>

| Magnitude of impact   | High           | Natural and/or social functions and/or processes are severely altered        |
| (at the indicated     | Medium         | Natural and/or social functions and/or processes are notably altered         |
| spatial scale)        | Low            | Natural and/or social functions and/or processes are slightly altered        |
|                       | Very Low       | Natural and/or social functions and/or processes are negligibly altered      |
|                       | Zero           | Natural and/or social functions and/or processes remain unaltered            |

| Duration of impact    | Construction period | Up to 3 years                                                              |
|                       | Short Term          | Up to 5 years after construction                                           |
|                       | Medium Term         | 5-15 years after construction                                              |
|                       | Long Term           | More than 15 years after construction                                       |

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in Table 1.2.

**Table 1.2 Definition of significance ratings**

<table>
<thead>
<tr>
<th>SIGNIFICANCE RATINGS</th>
<th>LEVEL OF CRITERIA REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>• High magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with either a regional extent and medium term duration or a local extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Medium</td>
<td>• High magnitude with a local extent and medium term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with a regional extent and construction period or a site specific extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term</td>
</tr>
<tr>
<td></td>
<td>• Low magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Low</td>
<td>• High magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term</td>
</tr>
<tr>
<td></td>
<td>• Very low magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Very low</td>
<td>• Low magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Very low magnitude with any combination of extent and duration except regional and long term</td>
</tr>
<tr>
<td>Neutral</td>
<td>• Zero magnitude with any combination of extent and duration</td>
</tr>
</tbody>
</table>
Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact, would be determined using the rating systems outlined in Table 1.3 and Table 1.4 respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in Table 1.5.

<table>
<thead>
<tr>
<th>Table 1.3 Definition of probability ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROBABILITY RATINGS</td>
</tr>
<tr>
<td>Definite</td>
</tr>
<tr>
<td>Probable</td>
</tr>
<tr>
<td>Unlikely</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1.4 Definition of confidence ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONFIDENCE RATINGS</td>
</tr>
<tr>
<td>Certain</td>
</tr>
<tr>
<td>Sure</td>
</tr>
<tr>
<td>Unsure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1.5 Definition of reversibility ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVERSIBILITY RATINGS</td>
</tr>
<tr>
<td>Irreversible</td>
</tr>
<tr>
<td>Reversible</td>
</tr>
</tbody>
</table>

1.2.1 Subjectivity in Assigning Significance

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, EIA processes can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity or magnitude of that impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.
This notwithstanding, in order to facilitate informed decision-making, EIAs must endeavour to come to terms with the significance of the potential environmental impacts associated with particular development activities. Recognising this, we have attempted to address potential subjectivity in the current EIA process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above;
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail in the Plan of Study for EIA and in this EIAR. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing towards the determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the EIAR with a clear summary of how the assessor derived the assigned significance;
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties; and
- Utilising input from specialists, a team approach and internal review of the assessment to facilitate a more rigorous and defensible system.

Please note that in certain circumstances, the assessment provided by the specialist subconsultants, and that occurring in the EIAR can differ. The reason for this is that Aurecon may have described the impacts differently and as required from EAPs, have used the information provided by the specialists in order to formulate a robust and balanced assessment of significance. In this manner, Aurecon take full responsibility for the assessment of impacts contained in this EIAR, but readers may wish to read the full specialist reports contained in the Annexures in order to gain a greater appreciation of the content and detail surrounding each impact. In situations where the impact significance differs this has been noted and explained immediately after each impact assessment in order to highlight and contextualise any differences between the assessments provide by the specialists, and that undertaken by Aurecon.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

### 1.2.2 Mitigation Measures

As shown in Figure 1.1, there is a hierarchy of actions which can be undertaken to respond to any proposed project or activity. These cover avoidance, minimisation and compensation. It is possible, and considered sought after, to enhance the environment by ensuring positive gains are included in the proposed activity or project. If negative impacts occur then the hierarchy indicates the following steps.

![Figure 1.1 Hierarchy of mitigation measures](image-url)
**Impact avoidance**: This step is most effective when applied at an early stage of project planning. It can be achieved by:
- not undertaking certain projects or elements that could result in adverse impacts;
- avoiding areas that are environmentally sensitive; or
- putting in place preventative measures to stop adverse impacts from occurring.

**Impact minimisation**. This step is usually taken during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. It can be achieved by:
- scaling down or relocating the proposal;
- redesigning elements of the project; or
- taking supplementary measures to manage the impacts

**Impact compensation**: This step is usually applied to remedy unavoidable residual adverse impacts. It can be achieved by:
- rehabilitation of the affected site or environment to an improved state;
- restoration of the affected site or environment to its previous state or better; and
- replacement of the same resource values at another location, for example, where a wetland is to be destroyed, constructing an equivalent wetland elsewhere.

The mitigation described in the EIAR represents the full range of plausible and pragmatic measures but does not necessarily imply that they should or will all be implemented. The decision as to which mitigation measures to implement lies with Plan 8 and ultimately with the competent authority, namely DEA.

### 1.2.3 Consideration of cumulative impacts

Section 2 of NEMA requires the consideration of cumulative impacts as part of any environmental assessment process. Cumulative effects are commonly understood as “…the impacts which combine from different projects and which result in significant change, which is larger than the sum of all the impacts” (DEAT Guideline on Cumulative Effects 2004). Cumulative impacts can be incremental, interactive, sequential or synergistic. EIAs have traditionally failed to come to terms with such impacts, largely as a result of the following considerations:
- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires co-ordinated institutional arrangements;
- Complexity - dependent on numerous fluctuating influencing factors which may be completely independent of the controllable actions of the proponent or communities; and

---

22 1 The applicant will be requested to indicate which alternative and mitigation measures they are prepared to implement. On the basis of the information contained in the EIR, PPC have compiled a letter of commitment which states which mitigation measures they are prepared to implement (refer to Annexure R).
- Project level investigations are ill-equipped to deal with broader biophysical, social and economic considerations.

Despite these challenges, cumulative impacts have been afforded increased attention in the EIR and for each impact a separate section has been added which discusses any cumulative issues, and where applicable, draws attention to other issues that may contextualise or add value to the interpretation of the impact.
Annexure E
Botanical Impact Assessment: Kangnas Renewable Energy Facilities, Northern Cape

Dr David J. McDonald
Bergwind Botanical Surveys & Tours CC.
14A Thomson Road, Claremont, 7708
Tel: 021-671-4056
Fax: 086-517-3806

Prepared for Aurecon South Africa (Pty) Ltd

August 2012
National Legislation and Regulations governing this report

This is a ‘specialist report’ and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2010.

Appointment of Specialist

Dr David J. McDonald of Bergwind Botanical Surveys & Tours CC was appointed by Aurecon South Africa (Pty) Ltd on behalf of the client, South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream), to provide specialist botanical consulting services for the Environmental Impact Assessment for the proposed Kangnas Renewable Energy Projects in the Northern Cape Province. The consulting services comprise an assessment of potential impacts on the flora and vegetation in the designated study area by the proposed project.

Details of Specialist

Dr David J. McDonald Pr. Sci. Nat.
Bergwind Botanical Surveys & Tours CC
14A Thomson Road
Claremont
7708
Telephone: 021-671-4056
Mobile: 082-876-4051
Fax: 086-517-3806
e-mail: dave@bergwind.co.za
Professional registration: South African Council for Natural Scientific Professions No. 400094/06

Expertise

Dr David J. McDonald:

• Qualifications: BSc. Hons. (Botany), MSc (Botany) and PhD (Botany)
• Botanical ecologist with over 30 years’ experience in the field of Vegetation Science.
• Founded Bergwind Botanical Surveys & Tours CC in 2006
• Has conducted over 300 specialist botanical / ecological studies.
• Has published numerous scientific papers and attended numerous conferences both
nationally and internationally (details available on request)

Independence

The views expressed in the document are the objective, independent views of Dr
McDonald and the survey was carried out under the aegis of, Bergwind Botanical Surveys
and Tours CC. Neither Dr McDonald nor Bergwind Botanical Surveys and Tours CC have
any business, personal, financial or other interest in the proposed development apart from
fair remuneration for the work performed.

Conditions relating to this report

The content of this report is based on the author’s best scientific and professional
knowledge as well as available information. Bergwind Botanical Surveys & Tours CC, its
staff and appointed associates, reserve the right to modify the report in any way deemed fit
should new, relevant or previously unavailable or undisclosed information become known
to the author from on-going research or further work in this field, or pertaining to this
investigation.

This report must not be altered or added to without the prior written consent of the author.
This also refers to electronic copies of the report which are supplied for the purposes of
inclusion as part of other reports, including main reports. Similarly, any recommendations,
statements or conclusions drawn from or based on this report must make reference to this
report. If these form part of a main report relating to this investigation or report, this report
must be included in its entirety as an appendix or separate section to the main report.
**PROJECT TITLE**

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

<table>
<thead>
<tr>
<th>Specialist:</th>
<th>Botanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person:</td>
<td>Dr David J. McDonald</td>
</tr>
<tr>
<td>Postal address:</td>
<td>Bergwind Botanical Surveys &amp; Tours CC, 14A Thomson Road, Claremont</td>
</tr>
<tr>
<td>Postal code:</td>
<td>7708</td>
</tr>
<tr>
<td>Telephone:</td>
<td>021-671-4056</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:dave@bergwind.co.za">dave@bergwind.co.za</a></td>
</tr>
<tr>
<td>Professional affiliation(s) (if any)</td>
<td>SACNASP (Pr. Sci. Nat. Reg No. 400094/06), IAIAAsa</td>
</tr>
</tbody>
</table>

| Project Consultant: | Aurecon South Africa (Pty) Ltd |
| Contact person: | Louise Corbett / Cornelia Steyn |
| Postal address: | PO Box 494, Cape Town |
| Postal code: | 8000 |
| Telephone: | 021-526-6027 |
| E-mail: | Louise.corbett@aurecongroup.com / cornelia.steyn@aurecongroup.com |

I, **David Jury McDonald**, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

[Signature of the specialist]

**Bergwind Botanical Surveys & Tours CC**

Name of company (if applicable):

6 August 2012

Date:
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1. Introduction

Northern Bushmanland in the Northern Cape Province is known for its wide open spaces with high insolation and strong winds. The energy from the wind and sun can be harnessed and converted to electrical energy by wind and solar generators which in turn can be fed into the National Electricity Grid. The northern Bushmanland areas are therefore ideally suited to the establishment of renewable energy infrastructure in the form of wind and solar farms. South African Mainstream Renewable Energy (Pty) Ltd has identified potential areas for renewable energy facilities of which Kangnas and some surrounding farms form one area (Aurecon 2012). Environmental authorisation would be required to develop the Kangnas wind facility (750 MW) and solar facility [photovoltaic “PV” and / or concentrated photovoltaic “CPV”] (250 MW). Aurecon South Africa (Pty) Ltd has been appointed to carry out an Environmental Impact Assessment (EIA) to obtain the required authorisations. For the environmental assessment process, specialist studies are required. They include a study of the potential impacts of the proposed facilities on the vegetation of the envisaged footprint.

Bergwind Botanical Surveys and Tours CC was appointed by Aurecon South Africa (Pty) Ltd to conduct a botanical impact assessment for the proposed Kangnas Renewable Energy Projects. A botanical ‘fatal flaw’ analysis was previously prepared as a desk-top study (McDonald 2012) as part of the pre-feasibility process to inform the project scoping (Aurecon, 2012). The main objective of the ‘fatal flaw’ study was to determine if there were any ‘red flag’ issues from a botanical perspective that could have negatively influenced the outcome of the application for authorisation of the projects.

The botanical impact assessment presented here incorporates information from the botanical fatal flaw analysis (McDonald, 2012) and conclusions from a visit to the designated Kangnas study area by the author in July 2012. The specialist fatal flaw analysis did not include consideration of a solar energy component which has subsequently been added into the terms of reference for the impact assessment phase.

2. Terms of Reference

The terms of reference for the impact assessment are:
Botanical Impact Assessment: Kangnas Renewable Energy Project, Northern Cape Province

- A broad description of the botanical characteristics of the site and surrounds;
- Identification and description of biodiversity patterns at community and ecosystem level (main vegetation type, plant communities in vicinity and threatened/vulnerable ecosystems species), at species level (Red Data Book species, presence of alien species) and in terms of significant landscape features;
- An assessment of the potential direct and indirect and cumulative impacts resulting from the proposed developments (including the wind turbines, associated infrastructure e.g. access roads), both on the footprint and the immediate surrounding area during construction and operation;
- Comment on whether or not biodiversity processes would be affected by the proposed project, and if so, how these would be affected;
- A detailed description of appropriate mitigation measures that can be adopted to reduce negative impacts and improve positive impacts for each phase of the project, where required; and
- Cognisance must be taken of the Department of Environmental Affairs and Development Planning guideline: “Guideline for involving biodiversity specialists in EIA processes” (Brownlie, 2005) as well as the requirements of the Botanical Society of South Africa (BotSoc) and CapeNature in developing an approach to the botanical investigation.

3. Methodology

3.1 Vegetation information and sampling

General baseline botanical information was sourced and compiled for four sites in the Northern and Western Cape Provinces during a constraints analysis study (McDonald, 2012). Aurecon (2012) used the information presented by McDonald (2012) as well as other baseline information compiled in the pre-feasibility phase to inform for selection of suitable sites for the proposed renewable energy projects. Two sites were selected by Mainstream; the site at Kangnas and a site near Pofadder for which a separate environmental process is being conducted. The second phase, the botanical impact assessment dealt with here for the Kangnas site, is based on a site visit when data and additional botanical information, indicated as necessary in the pre-feasibility phase, was obtained first-hand and integrated into the assessment. Owing mainly to the current intense drought in Bushmanland and seasonal constraints (winter), data collected during the site visit in July 2012 was not optimal. This is recognized as a limitation. However, the recorded information provides an adequate basis for the description of the site, physiognomy and dominant floral components.
of the vegetation which has enabled compilation of a meaningful assessment and report on the potential impacts of the proposed project.

The methods employed during the single site visit were standard vegetation survey methods developed to conduct rapid appraisal of the vegetation found on any given site. These methods entail recording of geo-referenced 'sample waypoints' where lists of plant species are compiled and a photographic record made of the vegetation. Condition of the sample sites in terms of historical and current disturbance was also assessed.

3.2 EIA methodology

The potential impacts on the plant communities in the study area are identified, described and assessed according to standard assessment practice. The Nature, Duration, Extent, Magnitude, Probability and Significance of each of the identified impacts are assessed. In addition Critical Biodiversity Areas (CBAs), areas identified in the detailed vegetation survey as sensitive and the possible the presence of Red List and endemic species are given attention in the assessment. The impact assessment methodology is provided in Appendix 1.

4. Study Area

4.1 Location

Geographically the study area is 46 535 hectares (ha) in extent and consists of five portions of four farms located approximately 48 km east of Springbok in the Nama Khoi Local Municipality, Namakwa District Municipality, Northern Cape Province (Figure 1). For ease of reporting the site is referred to as the 'Kangnas site' but comprises of Farm Kangnas 77, Portion 3 and Remainder (RE); Farm Koeris 78, Portion 1; Farm Areb 75, Remainder and Farm Smorgensschaduwe 127 Portion 0. Access to these farms is from the N14 national road between Springbok and Pofadder.

From a biome perspective the study area is located in the western part of the Nama Karoo Biome, Bushmanland Bioregion close to the boundary with the Succulent Karoo Biome Figure 2. (See Rutherford & Westfall (1994) and Rutherford, Mucina & Powrie (2006) for definitions of biome and bioregion).
Figure 1. Map of Northern Cape Province (light cream colour) with the Nama Khoi District Municipality (red) extending from the west coast of Namaqualand eastwards and northwards to the Orange River.

Figure 2. The ‘Wind Focus Area’ is seen as the shaded light pink area in the southern part of the Kangnas study site. The ‘Solar Focus Area’ is the light blue shded area in the northern corner of Areb 75/RE.
**Figure 3.** Map of the western part of South Africa showing bioregions with Kangnas indicated in the Bushmanland Bioregion.
Figure 4. Land-type map of the area east of Springbok in the Northern Cape Province with the Kangnas study area outlined in red. Three land types are found in the study area; Ae90, Ag59 and lc148.
4.2 Geology, topography and soils

The Kangnas study area is underlain by rocks of the Namaqua-Natal Metamorphic Province also known as the Namaqualand Metamorphic Complex (Watkeys, 1999; Cornell et al. 2006). A large part of the area in the south and east is low-lying flat country with little relief. The underlying granitic rocks are covered by Tertiary to Recent sand deposits. Three land types occur in the study area with the southern and eastern area comprising Land Type Ae90 which consists of red apedal, freely drained soils with high base status and > 300 mm deep; the central to north area has Land type Ag59 also with red apedal, freely drained soils with high base status but < 300 mm deep. The third land type, Ic148, occur in the high lying parts in the north of the study area areas consisting of granite inselbergs with exposed rock or shallow soils of the Mispah, Moriah and Paardeberg forms (Figure 4) (Land Type Survey Staff 1972 – 2006).

4.3 Climate

The Bushmanland Bioregion falls within the summer rainfall zone of the Northern Cape Province. Kangnas is more or less on the boundary between the winter and summer rainfall zones tending more to summer rainfall. The rainfall is, however, highly unpredictable and occurs mostly in the summer to autumn months. It can vary between 50 to 200 mm per annum. [There has been no rain in the area since February 2012 and the total rainfall recorded to date for 2012 is marginally more than 20 mm – J. Kennedy, Smorgenschaduwe]. Rain normally falls as scattered thunder showers when tropical thunderstorm activity extends southwards over the Kalahari. It is not uncommon for a heavy shower to occur in one place and for a nearby area to be completely missed, remaining dry.

Summer daytime temperatures can reach above 40 °C (range 20 – 40+ °C) whereas the dry winters are mild to cold. Winter daytime temperatures can reach 25 °C but at night frost can occur and temperatures can average below 0 °C (-3.3 °C) (Mucina et al. 2006b). A climate diagram for Bushmanland Arid Grassland (Figure 5) summarizes the climate typically found in the study area.

The upland areas in the north and east with Bushmanland Inselberg Shrubland have lower rainfall than the plains in the study area but slightly less mean annual potential evaporation. Mean annual temperatures are also marginally lower (Figure 6). These areas will not be affected by the proposed renewable energy infrastructure.
**Figure 5.** Climate diagram for Bushmanland Arid Grassland (from Mucina et al., 2006b) showing MAP – Mean Annual Precipitation; ACPV = Annual Precipitation Coefficient of Variance; MAT = Mean Annual Temperature; MFD = Mean Frost Days; MAPE = Mean Annual Potential Evaporation; MASMA = Mean Annual Soil Moisture.

**Figure 6.** Climate diagram for Bushmanland Inselberg Shrubland (from Mucina et al., 2006b) showing MAP – Mean Annual Precipitation; ACPV = Annual Precipitation Coefficient of Variance; MAT = Mean Annual Temperature; MFD = Mean Frost Days; MAPE = Mean Annual Potential Evaporation; MASMA = Mean Annual Soil Moisture.
Figure 7. Portion of the Vegetation Map of South Africa, Lesotho and Swaziland (Mucina et al. 2005) with the Kangnas study area outlined in black and found in Bushmanland Arid Grassland (N Kb3), Bushmanland Inselberg Shrubland (SKr18) and a small area of Platbakkies Succulent Shrubland (SKn5).
5. The Vegetation

5.1 Broad context

The Nama Karoo Biome covers an extensive area from the north-west through the central part of South Africa to the south and southeast of the country. It is an arid zone and is subdivided into three bioregions, the Upper Karoo Bioregion, Lower Karoo Bioregion and Bushmanland Bioregion. The Kangnas study area is located in the Bushmanland Bioregion at the western limit of its extent, close to the Succulent Karoo Biome (Rutherford & Westfall, 1994; Rutherford et al. 2006; Mucina et al. 2006b in Mucina & Rutherford, 2006) (Figure 7).

5.2 Critical Biodiversity Areas

Critical Biodiversity Areas (CBAs) were delimited for the Namaqua District Municipality (NDM) by Desmet & Marsh (2008). The maps they compiled included parts of the Kangnas study area (see Figure 15) which falls within the NDM. They mapped biodiversity corridors which are ‘ecological support areas’ and are intended to link areas of higher biodiversity value i.e. the ‘expert mapped areas’ which are ‘areas in the terrestrial environments identified by experts as being most important for biodiversity’. The ecological support areas (corridors) and higher biodiversity areas (‘expert mapped areas’) are shown as purple and yellow areas respectively in Figure 15. It should be noted that most of the ‘higher biodiversity areas’ include the granite hills which support Bushmanland Inselberg Shrubland (red boundaries in Figure 15). These hills would not be affected by the proposed wind turbines. From the field survey in this study it has been concluded that the lowland areas mapped by Desmet & Marsh (2008) as part of the ‘higher biodiversity areas’ both within the ‘wind focus area’ and the ‘solar focus area’ (Figure 18) do not have a high biodiversity status as indicated by the mapping. Therefore, contrary to what is indicated by the maps, the latter areas are, in the opinion of the author, acceptable for consideration for development of wind and solar renewable energy facilities.

5.3 Vegetation of Kangnas

The greater part of the Kangnas study area was mapped by Mucina et al. (2005) as Bushmanland Arid Grassland, a widespread vegetation type in the Bushmanland Bioregion. This vegetation type is characteristically dominated by ‘white grasses’ in
the genus *Stipagrostis* but has a complement of low shrubs with *Salsola sp.* important in some places. In the ‘fatal flaw’ analysis of the Kangnas area (McDonald, 2012) the desktop study interpretation of aerial imagery indicated that ‘heuweltjies’ (Midgley & Musil, 1990, Milton & Dean 1990) are present in certain parts of the study area. The field-survey carried out in July 2012 by the author found that in general it was difficult to detect heuweltjies ‘on the ground’. They are not as obvious as those seen for example in Namaqualand, in the Succulent Biome. At Kangnas seen, they are very widely scattered and not an overriding feature of the landscape.

The *Vegetation Map of South Africa, Lesotho & Swaziland* (Mucina *et al.* 2005) National Vegetation Map was mapped at a broad scale and therefore did not accommodate an area of granite in the central part of the Kangnas site, within the larger area of Bushmanland Arid Grassland. This area was visited and noted by the Aurecon team in November 2011 and referred to as a ‘Granite Pan’ (co-ordinates: S 29°34'6.40" E 18°25'57.69"). A seasonal pan called Steenbok Pan was also noted at the location S 29°36'37.85" E 18°30'10.26".

The second vegetation type found in the study area is Bushmanland Inselberg Shrubland. It is found on the low but prominent granite-gneiss hills which stand proud of the extensive plains on the farms Kangnas 77 Portion 3, Smorgenschaduwe 127 RE and Areb 75 RE. This vegetation is botanically important with many succulent species and notably *Aloe dichotoma* (quiver tree or kokerboom) and *Aloe gariepensis* (Orange River aloe). A ‘quartz patch’ which is important for plant diversity was found by the Aurecon team at the location S 29°33'59.90" E 18°20'47.23". It is reported that botanically important and endemic *Lithops* sp. (living stones) are found as well as *Avonia* sp. In the ‘fatal flaw’ analysis (McDonald, 2012), the areas of Bushmanland Inselberg Shrubland were ‘screened’ out as botanically sensitive and ‘no go’ areas for any renewable energy infrastructure. These areas were consequently not visited during the field survey in July 2012 since, based on the recommendations in the constraints analysis, the proposed infrastructure (see layouts and discussion below) is not targeted for any areas of Bushmanland Inselberg Shrubland.

A small area of Platbakkies Succulent Shrubland was mapped by Mucina *et al.* (2005) as occurring in the southern corner of Smorgenschaduwe 127 RE. This vegetation type falls within the Succulent Karoo Biome but transgresses eastwards into the Bushmanland Arid Grassland on gravel patches many of which are too small to map as discrete units (Mucina *et al.* 2006b). The vegetation type is poorly described but it is known to have numerous important endemic species.
The conservation status of all the vegetation types found on the Kangnas site is given in Table 1.

5.3.1 Results of the vegetation survey of Kangnas

A large area was covered by vehicle and on foot over a two-day period. The objective was to ‘test’ the proposed wind turbine and solar PV array footprint against the vegetation of the receiving environment. Although the whole Kangnas study area was not covered, a high level of confidence is placed on the recorded information within the constraints of the winter season and extremely dry conditions prevailing at the time of the field survey.

5.3.1.1 Vegetation of the ‘Wind Focus Area’

The vegetation of the ‘Wind Focus Area’ is mostly Bushmanland Arid Grassland on deep red sandy soil (Figures 8 & 9). The dominant species are *Stipagrostis* sp. and *Centropodia glauca*. No other grass species and no other shrub or herbaceous species were recorded due to the extremely dry conditions. This vegetation was sampled at waypoints KTS1, KTS8, KTS9, KTS12, KTS16, KTS17 (Figures 8 –10).

Within this apparently uniform grassy matrix on deep sandy soil is some fine-scale variation with areas of shallow soil due to presence of calcrete as well as exposure of gravel patches with mostly quartz pebbles scattered in variable density on the soil surface. In some places bedrock granite is also exposed. These areas of shallow soil and exposed rock support succulent shrub vegetation of a unit that can be classified as Platbakkies Succulent Shrubland. It was sampled at waypoints KTS2, KTS3, KTS4, KTS5, KTS6, KTS7, KTS10, KTS11, KTS14 and KTS15 (Figures 11 – 14). The discernible areas of Platbakkies Succulent Shrubland in the study area were mapped and are shown in Figure 15 as pink areas. These areas are considered botanically sensitive due to higher species richness and likelihood of finding endemic plants species (Mucina *et al.* 2006a) than in the extensive areas of Bushmanland Arid Grassland which are not botanically sensitive.

Only a small area of wind turbines would be located within an ecologically sensitive ‘yellow area’ according to the classification of Desmet & Marsh (2008) (see Figure 15). The field survey (waypoint KTS1) revealed that this area is open Bushmanland Arid Grassland (Figure 10) and is not botanically or ecologically sensitive.
Table 1. Sample sites for the vegetation in the Kangnas study area and the vegetation found in the Wind Focus Area.

<table>
<thead>
<tr>
<th>Waypoint</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Vegetation Type</th>
<th>Conservation Status (according to NSBA)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTS1</td>
<td>S 29 34 45.2</td>
<td>E 18 18 06.0</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS2</td>
<td>S 29 37 27.8</td>
<td>E 18 19 55.8</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS3</td>
<td>S 29 37 50.0</td>
<td>E 18 19 09.3</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS4</td>
<td>S 29 37 57.8</td>
<td>E 18 18 53.0</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS5</td>
<td>S 29 28 20.9</td>
<td>E 18 18 04.1</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS6</td>
<td>S 29 38 25.0</td>
<td>E 18 17 55.1</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS7</td>
<td>S 29 38 32.6</td>
<td>E 18 17 22.5</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS8</td>
<td>S 29 38 44.3</td>
<td>E 18 16 29.0</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS9</td>
<td>S 29 38 27.5</td>
<td>E 18 15 11.1</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS10</td>
<td>S 29 40 17.0</td>
<td>E 18 24 55.2</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS11</td>
<td>S 29 40 16.8</td>
<td>E 18 24 47.0</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS12</td>
<td>S 29 38 58.8</td>
<td>E 18 26 20.5</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS13</td>
<td>S 29 38 32.2</td>
<td>E 18 26 46.4</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS14</td>
<td>S 29 36 46.5</td>
<td>E 18 27 44.7</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS15</td>
<td>S 29 36 33.3</td>
<td>E 18 27 09.1</td>
<td>Platbakkies Succulent Shrubland</td>
<td>Least threatened (Vulnerable)</td>
</tr>
<tr>
<td>KTS16</td>
<td>S 29 35 39.9</td>
<td>E 18 26 04.2</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
<tr>
<td>KTS17</td>
<td>S 29 36 43.0</td>
<td>E 18 23 20.5</td>
<td>Bushmanland Arid Grassland</td>
<td>Least threatened</td>
</tr>
</tbody>
</table>

¹ Mucina et al. (2006) based the conservation status of the vegetation types on the National Spatial Biodiversity Assessment (Rouget et al. 2004). This classification is now outdated and Platbakkies Succulent Shrubland is described by Mucina et al. (2006) as vulnerable to impacts from grazing *inter alia*. For this reason it is interpreted as *Vulnerable* rather than *Least threatened* in the above table.
Figure 8. Bushmanland Arid Grassland in the foreground on red sandy soil. Bushmanland Inselberg Shrubland occurs on the granitic hill in the background.

Figure 9. Bushmanland Arid Grassland on widely undulating plains in the Kangnas study area.

Figure 10. Track in the sandy red soil. Looking westwards across the ‘white grass’ plains of Bushmanland Arid Grassland on the farm Smorgenschaduwe 127/RE in the Kangnas study area.
Figure 11. An area of red sandy soil covered with quartz pebbles and sparse shrubs.

Figure 12. Platbakkies Succulent Shrubland with dwarf succulent shrubs amongst small boulders at waypoint.

Figure 13. Platbakkies Succulent Shrubland as seen at waypoint KTS11.
Figure 14. Dwarf shrubland on shallow calcrite. Such areas although within the Bushmanland Arid Grassland show affinities to the Platbakkies Succulent Shrubland.
Figure 15. Vegetation of the Kangnas study area based on a Google Earth™ image. The general matrix is Bushmanland Arid Grassland (uncoloured); the yellow area is a botanically important area which includes Bushmanland Inselberg Shrubland (areas outlined in red). The mauve areas indicate ‘biodiversity corridors’ as mapped by Desmet & Marsh (2008); the pink areas are Platbakkies Succulent Shrubland within the Kangnas study area and the green area is Platbakkies Succulent Shrubland as mapped by Mucina et al. (2005). The survey track is shown as light blue lines with waypoints indicated as red dot icons with KTS# labels. The white dots represent the proposed locations of wind turbines and the cyan line represents the proposed route for overhead transmission lines. The ‘Solar Focus Area’ is outlined in white in the northeastern corner of Areb 75/RE within the Kangnas study area. Note the dark blue lines in the latter area indicating seasonal drainage lines.
5.3.1.2 Vegetation of the ‘Solar Focus Area’

The vegetation of the ‘Solar Focus Area’ is all Bushmanland Arid Grassland. However, in this area there is a significant shallow seasonal drainage system (Figure 15) (Similar drainage systems were not seen in the ‘Wind Focus Area’). The vegetation is generally low shrubland with sparse grass cover, due mainly to the drought conditions. In this area are numerous tall shrubs of *Parkinsonia africana* (wild green hair tree). This is not an uncommon shrub species in the arid areas of South Africa and Namibia.

The drainage system is ecologically sensitive.

**Figure 16.** Part of the ‘Solar Focus Area’ at Areb 75/RE within the Kangnas study area. The track runs lengthwise through the seasonal drainage line.

**Figure 17.** *Parkinsonia africana* (wild green hair tree) in the ‘Solar Focus Area’
Table 2. Sample sites for the vegetation in the Kangnas study area and the vegetation found in the Solar Focus Area.

<table>
<thead>
<tr>
<th>Solar Focus Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ar1</td>
</tr>
<tr>
<td>Ar2</td>
</tr>
<tr>
<td>Ar3</td>
</tr>
</tbody>
</table>

Figure 18. The ‘Solar Focus Area’ (white boundary) in the northeast part of Areb 75/RE in the Kangnas study area. The yellow area is demarcated as ecologically sensitive and the mauve shading indicates a biodiversity corridor according to Desmet & Marsh. Three waypoint samples Ar 1, Ar2 and Ar3 were recorded on the edge of the area. Apart from the drainage line (dark blue) which should be buffered, it is the author’s view that this area is not botanically or ecologically sensitive.
6. Impact Assessment

6.1 Elements assessed for direct impacts

The elements of the wind energy facility and solar PV facility proposed for Kangnas assessed for direct impacts from botanical and ecological perspectives are:

**Wind energy facility**

- Wind turbines and the concrete foundations required for their support
- Crane hard standings for construction purposes.
- Cabling between the turbines, to be laid underground.
- Internal access roads to each turbine, of 6 – 10 m width and the linking roads.
- A main substation, potentially four satellite substations and a new overhead transmission line to connect the power-generating facilities with the national grid.

**Solar energy facility**

- Site clearing and preparation of laydown areas.
- Construction of foundations and erection of PV panels.
- Construction of a substation and overhead power-lines to connect the power-generating facilities with the national grid.

6.2 Direct Impacts

The ‘sources of impacts’ are grouped into three groups based on how they would affect the vegetation namely, (a) wind turbines and crane hard-standing areas as well as sub-station sites (b) internal access roads and underground cabling, and (c) overhead transmission lines.

The Kangnas wind energy facility and the solar energy facility are assessed separately for the principal impacts which are **loss of vegetation** which includes the constituent plant species and **loss of ecological processes** which includes the habitat created by the plant communities.
A general mitigation measure that is recommended throughout is that should the project be approved, micro-siting of wind turbines would be necessary prior to final design layouts to ensure that sensitive sites within the broad habitat matrix are recognized and either avoided or the possible negative impacts on those sites mitigated.

### 6.2.1 Kangnas Wind Energy Facility – direct impacts

The ‘No Go’ scenario which holds generally for botanical and ecological impacts would be one of on-going sheep-farming in the Kangnas study area. The effect of sheep-farming is dependent on stocking rates. The intensity of grazing can vary from high to low with parallel effects of high to low negative impacts on vegetation and ecological processes. There will always be some level of negative impact on the vegetation due to sheep-farming therefore the ‘No Go’ scenario is conservatively rated as **Low negative** throughout (Tables 3–10).

The anticipated loss of Bushmanland Arid Grassland due to the proposed turbines and hard-standing areas as well as substations would be high at a local scale. However, taken over the broad distribution of this vegetation type, the anticipated loss would be small and is thus rated as **Low negative** without mitigation. Wherever possible, the local negative effects should be mitigated by restriction of construction activities to designated turbine sites and lay-down areas.

Location of turbines on the gravel patches would have a **High negative** impact on the sensitive vegetation and ecological processes and for this reason the gravel patches should be **AVOIDED** (Table 3).
Table 3. Impact: Loss of natural vegetation due to construction of wind turbines and associated lay-down or hard-standing areas at Kangnas.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Go</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Without mitigation Kangnas turbine sites and construction areas</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>With mitigation Kangnas turbine sites and construction areas</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Without mitigation Kangnas turbine sites and construction areas</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>With mitigation Kangnas turbine sites and construction areas</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
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</tbody>
</table>

Ecological processes are strongly tied to the vegetation and habitat it creates. Therefore the turbines and lay-down areas would have similar impacts on ecological processes within Bushmanland Arid Grassland and the gravel patches habitat to those impacts identified as likely to occur on the vegetation and flora of these respective vegetation types i.e. **Low negative** for Bushmanland Arid Grassland and **High negative** for gravel patches habitat. The ‘No Go’ alternative would have a **Low negative** impact (Table 4).
Table 4. Impact: Loss of ecological processes due to construction of wind turbines and associated lay-down or hard-standing areas at Kangnas.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confide nce</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Go</td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas turbine sites and construction areas</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas turbine sites and construction areas</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas turbine sites and construction areas</td>
<td>Loss of ecological processes in gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
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<tr>
<td>With mitigation</td>
<td>Kangnas turbine sites and construction areas</td>
<td>Loss of ecological processes in gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

Internal access roads in an area targeted for a wind energy facility such as at Kangnas would have a strong impact on the receiving environment, probably more so than the turbines themselves. The impact of such roads in the Bushmanland Arid Grassland without mitigation would be High negative and with mitigation could be ameliorated to Medium negative. Underground cables should be placed in shallow trenches alongside the internal access roads. In this way they would not cause additional impacts that exceed those which would be caused by the roads.

The most important mitigation measure would be to restrict access to all areas of the Kangnas study area except for the designated access roads, lay-down areas and turbine sites i.e. access only to construction areas. All non-construction areas should be ‘out-of-bounds’. In the case of the gravel patches construction in these areas would result in High negative impacts if roads and cable trenches were to be built in this environment. Mitigation would be AVOIDANCE of these areas at the outset which would keep the impact to Low negative as for the ‘No Go’ scenario.
**Table 5.** Impact: Loss of natural vegetation due to construction of internal access roads and underground cabling at Kangnas.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>No Go</td>
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<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of Bushmanland Arid Grassland</td>
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<td>Long-term</td>
<td>Medium</td>
<td>Medium</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
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</tbody>
</table>

Roads have an effect on ecological processes by fragmenting the habitat. In the case of Kangnas, the roads through the Bushmanland Arid Grassland are anticipated to have no great fragmentary effect on ecological processes which would result in a **Medium negative** impact before mitigation. However, in areas where there are gravel patches such an effect could be much more negative, resulting in a **High negative** impact before mitigation. If cables are laid in close proximity to the internal access roads, their additional effect is anticipated to be minimal. In the Kangnas area there are also very few drainage lines which, if present, would introduce sensitivity to the environment. The roads and cables would therefore not affect such landscape features (Table 6).

Limited opportunities are open for mitigation measures during the construction and operational phases. The most effective mitigation would be to limit disturbance to a minimum by careful planning of roads and access routes to turbine sites and restricting access to all non-construction areas as described above. In the post-operational phase rehabilitation of
disturbed areas would be advocated but since this is a long-term scenario predictions of success of such restorative work would be speculative.

**Table 6.** Impact: Loss of ecological processes due to construction of internal access roads and underground cabling at Kangnas.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Go</td>
<td></td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Medium</td>
<td>Medium</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of ecological processes in gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas internal access roads and underground cabling</td>
<td>Loss of ecological processes in gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

The overhead transmission lines to link the Kangnas Wind Energy Facility would be aligned along an existing road on Kangnas 77/3 (see Figure 15). Impacts additional to those caused by road and turbine construction would be minimal and consequently negative effects on both the Bushmanland Arid Grassland vegetation and gravel patches (Table 7) would be **Low negative**. Limited mitigation would be required but should be included in the process of rehabilitation of the areas where vegetation is disturbed.

**Table 7.** Impact: Loss of natural vegetation due to construction of overhead transmission lines at Kangnas.
### Table 8: Botanical Impact Assessment

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of undisturbed vegetation on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

The ecological processes prevailing at Kangnas are functional at variable scales from fine-scale to broad-scale. The construction and alignment of overhead transmission lines will have a limited effect on ecological processes in Bushmanland Arid Grassland and the impact is rated as **Low negative** with no mitigation apart from limitation of disturbance required. Fine-scale ecological processes could be disturbed on gravel patches if poles for transmission lines were to be located in these areas with a **High negative** impact. It is therefore strongly recommended that gravel patches should be avoided when designing and aligning transmission lines. If this recommendation is applied the impact could be mitigated to **Low negative** (Table 8).
Table 8. Impact: Loss of ecological processes due to construction overhead transmission lines at Kangnas.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Go</td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of ecological processes in Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of ecological processes on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Overhead transmission lines</td>
<td>Loss of ecological processes on gravel patches</td>
<td>Local</td>
<td>Long-term</td>
<td>Low</td>
<td>Low</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

### 6.2.2 Kangnas Solar Energy Facility – direct impacts

The solar PV array is targeted to cover an area of 1 861 ha. Most of the area is covered with Bushmanland Arid Grassland. However, the exception is the seasonal drainage lines. Impacts on the Bushmanland Arid Grassland would be Medium negative because more vegetation would be lost per unit area. This could be mitigated to some extent but it is doubtful that the impact could be lowered significantly.

Given the importance of the seasonal drainage lines and their tendency to flash flood it would be inadvisable to build solar panels in or close to the drainage lines. If the drainage lines are affected the impact would be High negative. Mitigation would be to AVOID the drainage lines and buffer them by at least 30 m. In this way the impact would be lessened to Low negative (Table 9). No gravel patches are found in the ‘Solar Focus Area’ of the Kangnas study area.

As seen in Figure 18, the “Solar Focus Area” is within the area highlighted by Desmet and Marsh (2008) as important from a biodiversity perspective as a corridor. This corridor or ecological support area is, however, not a ‘fixed entity’; it is rather a ‘desirable zone’ which links areas of high biodiversity importance (see 5.2 above) From field observations in this
study it is concluded that the ‘Solar Focus Area’ (in contrast to the map of Desmet & Marsh as reproduced in Figure 18) is not botanically sensitive and is ecologically sensitive only inasmuch as there are drainage lines. The mapped corridors were recognized in the impact assessment but it is believed that the ‘ecological support areas’ as designated by Desmet & Marsh (2008) do not greatly influence the significance ratings presented here.

One of the noticeable losses in the ‘Solar Focus Area’ would be the necessary removal of shrubs or small trees of Parkinsonia africana (wild green hair tree). These trees are not uncommon or threatened. However, it is recommended that seeds should be collected from these shrubs and cultivated \textit{ex situ}. The cultivated shrubs could be planted on the site and effectively used for visual screening of the solar PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

\textbf{Table 9.} Impact: Loss of natural vegetation due to construction of the solar PV panel array at Areb 75/RE in the Kangnas study area.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Kangnas solar PV construction areas</td>
<td>Loss of Bushmanland Arid Grassland</td>
<td>Local</td>
<td>Long-term</td>
<td>Medium</td>
<td>Medium</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

With mitigation

| Kangnas solar PV construction areas | Loss of Bushmanland Arid Grassland | Local     | Long-term | Medium    | Medium       | -ve    | Probable                  | High       |

| Kangnas solar PV construction areas | Loss of drainage line vegetation | Local     | Long-term | High      | High         | -ve    | Probable                  | High       |

| Kangnas solar PV construction areas | Loss of drainage line vegetation | Local     | Long-term | Low       | Low          | -ve    | Probable                  | High       |

Once again ecological processes are strongly tied to vegetation and plant communities. In the ‘Solar Focus Area’ the impact of the solar PV panels on ecological processes will be much higher than in the ‘Wind Focus Area’ because more vegetation would be lost and fragmentation would be higher. The impact is therefore rated as \textbf{High negative} which could be mitigated by leaving corridors of vegetation between the panels and limiting removal of...
vegetation as much as possible. This would reduce the impact to **Medium negative** (Table 10).

**Table 10.** Impact: Loss of ecological processes due to construction of the solar PV panel array at Areb 75/RE in the Kangnas study area.

<table>
<thead>
<tr>
<th>Action</th>
<th>Alternative</th>
<th>Impact</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Significance</th>
<th>Status</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Go</td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>+ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Kangnas solar PV construction areas</td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>High</td>
<td>High</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Kangnas solar PV construction areas</td>
<td>Loss of ecological processes</td>
<td>Local</td>
<td>Long-term</td>
<td>Medium</td>
<td>Medium</td>
<td>-ve</td>
<td>Probable</td>
<td>High</td>
</tr>
</tbody>
</table>

### 6.3 Cumulative impacts

Numerous wind energy and solar energy projects are proposed for the Northern Cape Province and many are targeted on the ‘wide open spaces’ of Bushmanland and more specifically in the Bushmanland Arid Grassland. Owing to the vast expanse of this vegetation type and the relatively low botanical sensitivity, with only a limited number of endemic and Red List species the cumulative impacts in the foreseeable future would be **Low negative**. This may change with time as more renewable energy projects are proposed. As is the case at Kangnas, there are, however, special localised habitats with special plant communities embedded within the more widespread arid grasslands. Such habitats are drainage line vegetation and gravel patches with specialised succulent flora confined to these habitats. They must, wherever possible, be identified and excluded from impacts by renewable energy projects since disturbance of plant communities in such habitats could have **High negative** cumulative impacts.

### 6.4 Indirect impacts

No indirect impacts were identified for the flora and vegetation of the Kangnas study area which would result from the proposed renewable energy projects.
7. Conclusions and Recommendations

The vegetation of the area targeted for the Kangnas Renewable Energy Facilities is mostly Bushmanland Arid Grassland with **Low Botanical Sensitivity**. Therefore construction of renewable energy facilities in this environment will generally result in a **Low Negative** impact. There are some exceptions, however, with some relatively small and localized areas of sensitive vegetation along drainage lines in the ‘Solar Focus Area’ and vegetation on **gravel patches** in the ‘Wind Focus Area’. The gravel patch vegetation which is analogous to Platbakkies Succulent Shrubland (Mucina et al. 2006a) was not mapped by Mucina et al. (2005). The gravel patches in the Kangnas study area were also not mapped or recognized by Desmet & Marsh (2008) as botanically or ecologically sensitive. Impacts on these areas of sensitive vegetation should be **avoided** and if this is not possible, impacts should be strongly mitigated. Approximately 50 wind turbines proposed for location on gravel patches would be affected. It is recommended that those turbines should be relocated into less botanically sensitive areas within the greater Kangnas area.

Although a ‘fatal flaw’ analysis was carried out by the author (McDonald, 2012) prior to the design of the proposed renewable energy facility, the information compiled did not provide adequate details about the site to identify special habitats such as the gravel patches. It was only during the field survey that these sites were clearly identified. It is also highly possible that not all gravel patches were identified. This emphasizes the need for micro-siting of turbine positions prior to final design layouts to ensure that botanically and ecologically sensitive sites are avoided.

There are, however, even further limitations. It was stated above that a high level of confidence is maintained for the study but it is nevertheless recognized that the severe drought in the study area influenced the ability to obtain detailed records of the plant communities encountered. A second limitation is the vast expanse of the study area. It is almost impossible to cover all possible habitats and vegetation conditions in a single survey that has strict time-limits and seasonal constraints. Now that a general appraisal of the study area based on field observations is available, a more rigorous design of the layout of wind turbines and solar PV array should be possible which would take into account the constraints imposed by botanically and ecologically sensitive sites within the study area as a whole.
8. References


Land Type Survey Staff 1972—2006. Land Types of South Africa: Digital Map (1 250 000 scale) and soil inventory databases. ARC – Institute for Soil, Climate & Water, Pretoria.


Report submitted: 6 August 2012; revised 17 August 2012

**Appendix 1: Convention for assigning significance ratings to impacts.**

Specialists will consider seven rating scales when assessing potential impacts. These include:

- extent;
- duration;
- intensity;
- status of impact;
- probability;
- degree of confidence; and
- significance.

In assigning significance ratings to potential impacts before and after mitigation specialists are instructed to follow the approach presented below:
1. The core criteria for determining significance ratings are “extent” (Section 6.3.1), “duration” (Section 6.3.2) and “intensity” (Section 6.3.3). The preliminary significance ratings for combinations of these three criteria are given in Section 6.3.7.

2. The status of an impact is used to describe whether the impact will have a negative, positive or neutral effect on the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

3. Describe the impact in terms of the probability of the impact occurring (Section 6.3.5) and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge (Section 6.3.6).

4. Additional criteria to be considered, which could “increase” the significance rating if deemed justified by the specialist, with motivation, are the following:
   • Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
   • Potentially substantial cumulative effects (see Item 7 below); and
   • High level of risk or uncertainty, with potentially substantial negative consequences.

5. Additional criteria to be considered, which could “decrease” the significance rating if deemed justified by the specialist, with motivation, is the following:
   • Improbable impact, where confidence level in prediction is high.

6. When assigning significance ratings to impacts after mitigation, the specialist needs to:
   • First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
   • Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:
     o Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
     o The technical and financial ability of the proponent to implement the measure; and
     o The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

7. The cumulative impacts of a project should also be considered. “Cumulative impacts” refer to the impact of an activity that may become significant when added to the existing activities currently taking place within the surrounding environment.

8. Where applicable, assess the degree to which an impact may cause irreplaceable loss of a resource. A resource assists in the functioning of human or natural systems, i.e. specific vegetation, minerals, water, agricultural land, etc.

9. The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances,
therefore, whilst the significance rating of potential impacts might be “low” or “very low”, the importance of these impacts to local communities or individuals might be extremely high. The importance which I&APs attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and/or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows (see overleaf): substance

<table>
<thead>
<tr>
<th>Significance rating</th>
<th>Effect on decision-making</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY LOW; LOW</td>
<td>Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.</td>
</tr>
<tr>
<td>HIGH; VERY HIGH</td>
<td>Would strongly influence the decision to proceed with the proposed project.</td>
</tr>
</tbody>
</table>

1. **Extent**

“Extent” defines the physical extent or spatial scale of the impact.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCAL</td>
<td>Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.</td>
</tr>
<tr>
<td>REGIONAL</td>
<td>Provincial (e.g. Western Cape., Northern Cape). Specialist studies to specify extent.</td>
</tr>
<tr>
<td>NATIONAL</td>
<td>South Africa</td>
</tr>
<tr>
<td>INTERNATIONAL</td>
<td></td>
</tr>
</tbody>
</table>

2. **Duration**

“Duration” gives an indication of how long the impact would occur.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHORT TERM</td>
<td>0 - 5 years</td>
</tr>
<tr>
<td>MEDIUM TERM</td>
<td>5 - 15 years</td>
</tr>
<tr>
<td>LONG TERM</td>
<td>Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention.</td>
</tr>
<tr>
<td>PERMANENT</td>
<td>Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be</td>
</tr>
</tbody>
</table>
considered transient.

3. Intensity

“Intensity” establishes whether the impact would be destructive or benign.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZERO TO VERY LOW</td>
<td>Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.</td>
</tr>
<tr>
<td>LOW</td>
<td>Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way.</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.</td>
</tr>
</tbody>
</table>

4. Loss of resources

“Loss of resource” refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Where the activity results in an irreplaceable loss of a resource.</td>
</tr>
</tbody>
</table>

5. Status of impact

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

6. Probability

“Probability” describes the likelihood of the impact occurring.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPROBABLE</td>
<td>Where the possibility of the impact to materialise is very low either because of design or historic experience.</td>
</tr>
<tr>
<td>PROBABLE</td>
<td>Where there is a distinct possibility that the impact will occur.</td>
</tr>
<tr>
<td>HIGHLY PROBABLE</td>
<td>Where it is most likely that the impact will occur.</td>
</tr>
<tr>
<td>DEFINITE</td>
<td>Where the impact will occur regardless of any prevention measures.</td>
</tr>
</tbody>
</table>
7. **Degree of confidence**

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>Greater than 70% sure of impact prediction.</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Between 35% and 70% sure of impact prediction.</td>
</tr>
<tr>
<td>LOW</td>
<td>Less than 35% sure of impact prediction.</td>
</tr>
</tbody>
</table>

8. **Significance**

“Significance” attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY HIGH</td>
<td>Impacts could be EITHER: of <strong>high intensity</strong> at a <strong>regional level</strong> and endure in the <strong>long term</strong>; OR of <strong>high intensity</strong> at a <strong>national level</strong> in the <strong>medium term</strong>; OR of <strong>medium intensity</strong> at a <strong>national level</strong> in the <strong>long term</strong>.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Impacts could be EITHER: of <strong>high intensity</strong> at a <strong>regional level</strong> and endure in the <strong>medium term</strong>; OR of <strong>high intensity</strong> at a <strong>national level</strong> in the <strong>short term</strong>; OR of <strong>medium intensity</strong> at a <strong>national level</strong> in the <strong>medium term</strong>; OR of <strong>low intensity</strong> at a <strong>national level</strong> in the <strong>long term</strong>; OR of <strong>high intensity</strong> at a <strong>local level</strong> in the <strong>long term</strong>; OR of <strong>medium intensity</strong> at a <strong>regional level</strong> in the <strong>long term</strong>.</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Impacts could be EITHER: of <strong>high intensity</strong> at a <strong>local level</strong> and endure in the <strong>medium term</strong>; OR of <strong>medium intensity</strong> at a <strong>regional level</strong> in the <strong>medium term</strong>; OR of <strong>high intensity</strong> at a <strong>regional level</strong> in the <strong>short term</strong>; OR of <strong>medium intensity</strong> at a <strong>national level</strong> in the <strong>short term</strong>; OR of <strong>medium intensity</strong> at a <strong>local level</strong> in the <strong>long term</strong>; OR of <strong>low intensity</strong> at a <strong>national level</strong> in the <strong>medium term</strong>; OR of <strong>low intensity</strong> at a <strong>regional level</strong> in the <strong>long term</strong>.</td>
</tr>
<tr>
<td>LOW</td>
<td>Impacts could be EITHER of <strong>low intensity</strong> at a <strong>regional level</strong> and endure in the <strong>medium term</strong>; OR of <strong>low intensity</strong> at a <strong>national level</strong> in the <strong>short term</strong>; OR of <strong>high intensity</strong> at a <strong>local level</strong> and endure in the <strong>short term</strong>; OR of <strong>medium intensity</strong> at a <strong>regional level</strong> in the <strong>short term</strong>; OR of <strong>low intensity</strong> at a <strong>local level</strong> in the <strong>long term</strong>; OR of <strong>medium intensity</strong> at a <strong>local level</strong> and endure in the <strong>medium term</strong>.</td>
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<tr>
<td>VERY LOW</td>
<td>Impacts could be EITHER</td>
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9. **Degree to which impact can be mitigated**

This indicates the degree to which an impact can be reduced / enhanced.

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<tr>
<td>NONE</td>
<td>No change in impact after mitigation.</td>
</tr>
<tr>
<td>VERY LOW</td>
<td>Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.</td>
</tr>
<tr>
<td>LOW</td>
<td>Where the significance rating drops by one level, after mitigation.</td>
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<tr>
<td>MEDIUM</td>
<td>Where the significance rating drops by two to three levels, after mitigation.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Where the significance rating drops by more than three levels, after mitigation.</td>
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10. **Reversibility of an impact**

This refers to the degree to which an impact can be reversed.

<table>
<thead>
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<tbody>
<tr>
<td>IRREVERSIBLE</td>
<td>Where the impact is permanent.</td>
</tr>
<tr>
<td>PARTIALLY REVERSIBLE</td>
<td>Where the impact can be partially reversed.</td>
</tr>
<tr>
<td>FULLY REVERSIBLE</td>
<td>Where the impact can be completely reversed.</td>
</tr>
</tbody>
</table>
Appendix 2: Curriculum Vitae

Dr David Jury McDonald Pr.Sci.Nat.

Name of Company: Bergwind Botanical Surveys & Tours CC. (Independent consultant)

Work and Home Address: 14 A Thomson Road, Claremont, 7708

Tel: (021) 671-4056 Mobile: 082-8764051 Fax: 086-517-3806

E-mail: dave@bergwind.co.za

Website: www.bergwind.co.za

Profession: Botanist / Vegetation Ecologist / Consultant / Tour Guide

Date of Birth: 7 August 1956

Employment history:

- 19 years with National Botanical Institute (now SA National Biodiversity Institute) as researcher in vegetation ecology.
- Five years as Deputy Director / Director Botanical & Communication Programmes of the Botanical Society of South Africa
- Six years as private independent Botanical Specialist consultant (Bergwind Botanical Surveys & Tours CC)

Nationality: South African (ID No. 560807 5018 080)

Languages: English (home language) – speak, read and write

Afrikaans – speak, read and write

Membership in Professional Societies:

- South Africa Association of Botanists
- International Association for Impact Assessment (SA)
- South African Council for Natural Scientific Professions (Ecological Science, Registration No. 400094/06)
- Field Guides Association of Southern Africa

Key Qualifications:

- Research in Cape fynbos ecosystems and more specifically mountain ecosystems.
- From 1995 to 2000 managed the Vegetation Map of South Africa Project (National Botanical Institute)
- Conducted botanical survey work for AfriDev Consultants for the Mohale and Katse Dam projects in Lesotho from 1995 to 2002. A large component of this work was the analysis of data collected by teams of botanists.
- **Director: Botanical & Communication Programmes** of the Botanical Society of South Africa (2000—2005), responsible for communications and publications; involved with
conservation advocacy particularly with respect to impacts of development on centres of plant endemism.

- Further tasks involved the day-to-day management of a large non-profit environmental organisation.

- Independent botanical consultant (2005 – to present) over 300 projects have been completed related to environmental impact assessments in the Western, Southern and Northern Cape, Karoo and Lesotho. A list of reports (or selected reports for scrutiny) is available on request.

**Higher Education**

Degrees obtained and major subjects passed:

B.Sc. (1977), University of Natal, Pietermaritzburg
  Botany III
  Entomology II (Third year course)

B.Sc. Hons. (1978) University of Natal, Pietermaritzburg
  Botany (Ecology /Physiology)

M.Sc - (Botany), University of Cape Town, 1983.

PhD (Botany), University of Cape Town, 1995.
  Thesis title: ‘Phytogeography endemism and diversity of the fynbos of the southern Langeberg’.

Certificate of Tourism: Guiding (Culture: Local)
  Level : 4 Code: TGC7 (Registered Tour Guide: WC 2969).

**Employment Record :**

January 2006 – present: Independent specialist botanical consultant and tour guide in own company: **Bergwind Botanical Surveys & Tours CC**

August 2000 - 2005 : Deputy Director, later Director Botanical & Communication Programmes, Botanical Society of South Africa


Further information is available on my company website: [www.bergwind.co.za](http://www.bergwind.co.za)
Annexure E2
Dear Corlie

I have received your e-mail concerning Kangnas. I have annotated the diagram you sent for the wind turbines, indicating those turbines that I believe would have a MODERATE to HIGH NEGATIVE impact on areas of gravel / quartzite which are more botanically sensitive than the matrix Bushmanland Arid Grassland. (The turbines concerned are circled with yellow circles in the attached diagram). My recommendation is that these 31 turbines should somehow be accommodated away from the gravel patches i.e. the gravel patches should be buffered.

As for the proposed layout of the solar PV panels, I am confident that if the construction is confined to the areas outlined in yellow in the supplied diagram, the impact would be LOW NEGATIVE.

I trust this is the information you require.

Best wishes

Dave

Dr D.J. McDonald (Pr. Sci. Nat.)
Botanical Specialist

In the hopes of reaching the moon men fail to see the flowers that blossom at their feet.
Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON'T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Corlie Steyn | Environmental Management

Environmental Practitioner | Aurecon

T +27 44 805 5421 | M +27 82 575 7415

E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George | South Africa
aurecongroup.com
Annexure E3
Annexure F
CONSTRUCTION OF WIND ENERGY AND SOLAR ENERGY FACILITIES, NEAR SPRINGBOK, NORTHERN CAPE

AVIFAUNAL IMPACT ASSESSMENT

Specialist report compiled by:

Dr Doug M. Harebottle

in collaboration with Arnold van der Westhuizen (Arnwalt Enviro Watch)

For Mainstream Renewable Power South Africa Limited, on behalf of Aurecon (Pty) Ltd

August 2012
Executive summary

An avifaunal assessment for a wind energy facility (WEF) and solar energy facility (SEF) was carried out on the farms Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77), Farm Koeris (Portion 1 of Farm No. 78) and Farm Smorgenschaduwe (Portion 0 of Farm No. 127) and Areb (No.75 Remainder) near Springbok, Northern Cape province. The assessment was to gauge the impacts of the construction of up to 500 wind turbines and a 250 MW photo-voltaic array, and associated infrastructure, on bird species and their respective on-site populations and to propose mitigation measures to reduce impacts.

The development areas fall primarily within the Nama-Karoo biome. The impact zone of the proposed WEF and SEF constitute arid grassland and inselberg shrubland, with typical karroid scrub vegetation. The surrounding landscape is used primarily for sheep grazing. Overall, the avifauna comprises a rich Nama-Karoo assemblage which reflects the major habitat types within the Springbok-Pofadder region. Based on atlas data from the first (SABAP1) and second (SABAP2) bird atlas projects, up to 115 species can be recorded within a 25 km radius of the development zone; twelve Red Data species and 59 southern African endemics and three red-listed endemics occur in the broader area. The site surveys (i.e. the affected pentads) produced a list of 60 species. Fifty-one and 48 species were recorded in the WEF and SEF sites respectively and included three red-list species and forty regional endemics. The birds which are likely to have the greatest potential relevance relative to the WEF and SEF impacts are (a) resident and potentially breeding raptors, notably Verreaux’s Eagle *Aquila verreauxii*, Martial Eagle *Polemaetus bellicosus*, Southern Pale Chanting Goshawk *Melierax canorus*, Secretarybird *Sagittarius serpentarius* and possibly Rock Kestrel *Falco rupicolus* and Jackal Buzzard *Buteo rufofuscus*; (b) large terrestrial birds and raptors nesting, foraging on, or moving over, the lowland/ridge interface, including Booted Eagle *Aquila pennatus*, Jackal Buzzard, Southern Pale-chanting Goshawk, Kori Bustard *Ardeotis kori*, Ludwig’s Bustard *Neotis ludwigi*, Karoo Korhaan *Eupodotis vigorsii* and Northern Black Korhaan *Afrotis afraoides*, (c) endemic species that utilise the karroid vegetation on the plains including Red Lark *Calendulauda burra*, Stark’s Lark *Spizocorys starki*, Sclater’s Lark *Spizocorys sclateri* and Burchell’s Courser *Cursorius rufus* (d) waterbirds and other water-associated species, moving between farm reservoirs and pans in and around the development sites, notably South African Shelduck *Tadorna cana* and Namaqua Sandgrouse *Pterocles namaqua*, and possibly Pied Avocet *Recurvirostra avosetta* and Little Grebe *Tachybaptus ruficollis*.

Overall, the construction of the WEF is envisaged to have a medium-high, impact on the avifauna present in the impact zone and possibly in the surrounding areas. The operational phase of the WEF may have short to medium-term impacts at a regional scale. The construction of the SEF is envisaged to have a low-medium, short-term impact on the avifauna present in the impact zone and possibly in the surrounding areas. The primary proposed avifaunal impacts would arise from (a) disturbance caused by vehicular and...
people traffic during construction, (b) displacement caused from habitat loss and disturbance during the construction phase and from maintenance activities, and (c) risk of collision with wind turbine blades and powerlines associated with the WEF, and behavioural displacement (alteration of flight paths) during the operational phases of both the WEF and SEF.

Effective mitigation measures proposed to reduce impacts on the avifauna, include inter alia: (a) carrying out construction before or after the main breeding season (i.e. from March–July) in order to reduce disturbance to breeding birds, (b) marking the blades during the operational phase to make them more visible to birds flying through the area, (c) considering different sitings and orientation of turbines and (d) monitoring collision incidence.

Greater clarity on the environmental impact of this, and indeed other WEFs, is required and can only be reached once pre-construction monitoring (section 12) has been carried out and assessed in terms of the cumulative impacts of other renewable energy projects on the region’s bird populations. A comprehensive pre- and post-construction programme to monitor the real impacts of the proposed Kangnas WEF and SEF on the broader avifauna is recommended and outlined.
Specialist declaration

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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PROJECT TITLE

| Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape |

<table>
<thead>
<tr>
<th>Specialist:</th>
<th>Dr Doug Harebottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person:</td>
<td>Dr Doug Harebottle</td>
</tr>
<tr>
<td>Postal address:</td>
<td>14 Seaton Street, Plumstead, Cape Town</td>
</tr>
<tr>
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<td>7800</td>
</tr>
<tr>
<td>Telephone:</td>
<td>0217068406</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:Doug.harebottle@uct.ac.za">Doug.harebottle@uct.ac.za</a></td>
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<th>Project Consultant:</th>
<th>Aurecon South Africa (Pty) Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person:</td>
<td>Louise Corbett / Cornelia Steyn</td>
</tr>
<tr>
<td>Postal address:</td>
<td>PO Box 494, Cape Town</td>
</tr>
<tr>
<td>Postal code:</td>
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</tr>
<tr>
<td>Telephone:</td>
<td>021-526-6027</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:Louise.corbett@aurecongroup.com">Louise.corbett@aurecongroup.com</a> / <a href="mailto:cornelia.steyn@aurecongroup.com">cornelia.steyn@aurecongroup.com</a></td>
</tr>
</tbody>
</table>

| (if any)                     |                              |

|                                  |                              |
4.2 The specialist appointed in terms of the Regulations

I, Doug Harebottle, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Date:
23/08/2012
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1. Proposed development

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) intends to develop a 750 MW wind energy facility (WEF) and a 250 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility (SEF) on the farms Kangnas, Koeris, Smorgenschaduwe and Areb near Springbok in the Northern Cape. The proposed wind and solar energy facilities are located approximately 48 km east of Springbok and can be accessed via the N14. The site for both facilities covers approximately 46 535 hectares (ha) in extent and consists of five portions of four farms.

A total of 185-500 wind turbines have been proposed for the WEF facility which will have an expected footprint of about 465,53ha. The generation capacity for each turbine will be between 1.5-4.0 MW. Each of the turbines will stand between 65–100m at hub height with a rotor diameter of about 80–120 m. Inter-turbine distance has not been specified but is likely to be between 300–500 m. The SEF will comprise 250 MW of photo-voltaic arrays and cover an area of 1000 ha. Each rack/array will be mounted not more than 4 m above the ground. Additional on-site infrastructure would include a substation in each site and network of access and service roads. Overhead power lines will connect each substation via existing transmission lines into the national grid. The proposed WEF and SEF will be located on various sections of the following farms: Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77), Farm Koeris (Portion 1 of Farm No. 78) and Farm Smorgenschaduwe (Portion 0 of Farm No. 127). The SEF is planned for Farm Areb (remaining portion of Farm No. 75). The farms are zoned Agriculture and are currently used for grazing sheep, goats and cattle.

2. Brief

In terms of the National Environmental Management Act (NEMA, Act 107 of 1998) any development which could have substantial detrimental effect on the environment requires an Environmental Impact Assessment (EIA) to be undertaken in order to assess the impact of these activities on ecological systems and formulate alternatives and mitigation to minimize negative impacts.

This reports deals with the proposed impact of the above activities on the avifauna on and adjacent to the site. The brief, as outlined in the sub-contract agreement, is as follows:

1. **Undertake the requisite field work to directly assess the habitats present within the inclusive impact zone, and to determine the in situ avifauna and identify any significant bird flight corridors present in the area;**

2. **Integrate the site information with bird atlas (SABAP 1&2) and any other relevant bird data available for the general area to develop an inclusive, annotated list of the avifauna expected to occur on the site;**

3. **Highlight Red Data species, endemic, restricted-range or other species of particular concern which may be present in the study area;**
4. **Identify, describe and assess potential direct and indirect and cumulative impacts resulting from the proposed development both on the footprint and the immediate surrounding area during construction and operation; and**

5. **Recommend mitigation measures to reduce or eliminate potential negative impacts on avifauna and improve positive impacts.**

### 3. Methods

This study was done in two stages – a site visit and impact assessment. The site visit looked at the on-site assessment of the birds and habitats present and the impact assessment considered the likely impacts of the development on the avifauna with recommendations for mitigation. A detailed fatal flaw study was initially undertaken by van der Westhuizen and Harebottle 2012 which considered the likely bird species and habitats to be present in the proposed development area; a summary is included in the Draft Scoping Report (Aurecon 2012).

The impact assessment was carried out using methods outlined and provided by Aurecon (L. Corbett *in litt.*). The extent (spatial scale), and magnitude and duration (temporal scale) of each impact was initially assessed. From these criteria, the significance of each impact was then rated as high, medium, low, very low or neutral. Probability (definite, probable, unlikely) and confidence (certain, sure or unsure) ratings were then determined and applied to each impact. Finally each impact was given a reversibility rating to determine if the impact was reversible or irreversible.

### 4. Site visit

The field survey was undertaken from 24–28 June 2012, which encompassed:

1. **Visiting as much of the inclusive area of the proposed development (including the impact zone) as possible and ground-truthing predicted habitats and birds present. A concerted effort was made to sample the avifauna in all of the primary habitats that were available.**

2. **The compilation of Southern African Bird Atlas Project (SABAP2) checklists for all the pentads visited.**

3. **Searching for raptors, endemic passerine species and large terrestrial species within the proposed development area to determine the relevant importance and on-site distribution of local populations of these taxa.**

4. **Estimating the extent and direction of possible bird movements within/through the impact zone in relation to the occurrence of resources (nesting/roosting areas and foraging areas).**
5. Impact assessment

With the site information obtained, the avifaunal assessment included:

(i) The production of an avian impacts matrix for the proposed development.
(ii) Identification of no-go areas and/or the lowest risk/least sensitive areas to locate the wind turbines within the broader study area.
(iii) Appropriate mitigation measures.
(iv) A comprehensive, medium to long-term monitoring programme to measure the actual impacts from pre- to post construction phases of the project. This would vastly improve our knowledge and understanding of the long-term effects of wind energy developments on South African birds.

6. Data sources

The following published and unpublished sources were used for this study:

(i) Bird distribution and relative abundance data were obtained from the first (Harrison et al. 1997) and second Southern African Bird Atlas Projects (http://sabap2.adu.org.za/index.php) stored and curated at the Animal Demography Unit, University of Cape Town; data was obtained directly through data requests. For SABAP1, data was accessed for the Quarter-Degree Grid Cells (QDGC - 15’ x 15’ grid) covering the proposed WEF, PVEF and associated infrastructure (2918AC Kontorogab – 4 cards, 2918AD – 10 cards, 2918BC – 12 cards, 2918CA Kaip – 20 cards, 2918CB Kangnas – 8 cards and 2918DA – 2 cards). For SABAP2 data for the relevant pentads (n=54) comprising the above QDGCs was sourced and totalled 39 cards; total for SABAP1 + 2 = 95 cards). The SABAP2 data was useful particularly at the site level due to the refined spatial scale. It is important to note that the SABAP1 data is > 20 years old. A composite list of species likely to occur in the habitats within the impact zone of the WEFs and PVEFs was drawn up as a combination of these data, supplemented with the on-site surveys which were undertaken as pentad surveys.

(ii) Conservation status and endemism was sourced from the national Red List for birds (Barnes 2000) and from Hockey et al. (2005).

(iii) Large terrestrial bird data was sourced from the Coordinated Avifaunal Roadcount (CAR) project (Young et al. 2003) and Waterbird Count data from the Coordinated Waterbird Counts (CWAC) project (Taylor et al. 1999), both available from the Animal Demography Unit, University of Cape Town.

(iv) Information on raptors (particularly nesting data) was sourced from local farmers.

7. The Affected Environment

This section has been written to incorporate both the WEF and SEF sites due to the topography and vegetation being similar in both areas.

7.1 The natural environment

The study area falls within the Nama-Karoo and Succulent-Karoo biomes; the former constitutes the larger biome within the study area. The natural vegetation present within the study area and impact zones comprises three main vegetation types: Bushmanland Arid Grassland (Figure 3.1), Bushmanland Inselberg Shrubland (Figure 3.2) and Platbakkies Succulent Shrubland; surrounding vegetation types include Bushmanland Sandy Grassland, Namaqualand Klikkoppe Shrubland and Namaqualand Blomveld. (Mucina and Rutherford 2006). The landscape within the study area is dominated by low-lying flat country (plains) and granite inselbergs (particularly in the north-west) (Aurecon 2012). The vegetation on the plains is typically karroid and consists of low shrubland (c. 1 m in height) with sparsely scattered trees and other woody vegetation, including *Aloe dichotoma* (Kokerboom) which are more prevalent in the SEF site. In some of the southern sections of the WEF site there are large patches of boulder-strewn shrubland with distinct boulder-koppies/outcrops (Figure 3.3). The site is underlain by bedrock of the Namaqua-Natal Metamorphic Province and the soils are largely sandy but are poorly structured (Aurecon 2012).

The development zones and general surroundings are all located on privately owned farmland. The Goegap Nature Reserve lies approximately 20 km west of Kangnas and comprises a similar avifauna to that of Kangnas and surrounds.

7.2 The transformed environment

There is little altered habitat within the study area; most of the natural vegetation is intact. The landscape is used primarily for livestock (mainly sheep and cattle) grazing. There are numerous reservoirs, water troughs and windmills scattered over the study area which are heavily utilised by livestock and as such are devoid of vegetation and are generally degraded areas. There is currently a single 220 kV transmission line running approximately east-west along the N14 and which connects Springbok and Pofadder. This is the main transmission line into which both the proposed WEF and SEF facilities will feed. The proposed WEF and SEF sites are bordered to the north and south by the N14 respectively; all other boundaries are delineated by farm boundaries.

7.3 Avifaunal habitats

Most of the vegetation that falls within the study area and the impact zone comprises Bushmanland Arid Grassland and Bushmanland Inselberg Shrubland and support a large proportion of the Karoo grassland and shrubland endemics (see section 7.4). The inselbergs comprise ridges and rocky cliffs faces and are likely to be important sources of lift for
soaring species, notably raptors and possibly some of the large terrestrial birds (e.g. bustards) (Figure 3.4). The ridge slopes are well vegetated and boulder-strewn and provide habitat for species with montane affinities. The boulder-koppies/outcrops provide additional habitat for cliff-nesting and foraging species. The only wetland areas within the study area are Goebbeesvlei, a granite pan, (-29.5675 18.4325E) and Steenbok Pan (-29.6100S 18.5032E) (Figure 3.5). These would provide seasonal habitat for wetland associated species in the area. Alien trees (pines and blue gums) were usually dominant around farmsteads. There are scattered farm reservoirs in the greater study area; the nearest permanent water is the Orange (Gariep) River about 80 km to the north of the study area. Eskom powerlines and pylons would provide suitable perches and nesting sites for certain species (raptors and corvids) (Figure 3.6).

7.4 The avifauna

A list of bird species that are most likely to occur on both the WEF and SEF sites is given in Appendix 2; a total of 115 species have been recorded from SABAP1 and SABAP2. Twelve species were seen for the first time in the area (Appendix 2). Of the 115 species, seven are red-list species, 59 endemics or near endemics and three are red-listed endemics (Ludwig’s Bustard, Red Lark and Sclater’s Lark). All of the red-listed endemics are likely to breed within the greater development area of the WEF and SEF.

The site visits from 24–28 June 2012 produced a composite list of 60 species, covering both the impact zone and immediate surrounds of the WEF and the SEF. A total of 51 species was recorded within the WEF zone and a total of 47 species within the SEF zone (Appendix 2). The following important aspects should be noted:

(i) Species composition between the WEF and SEF sites was similar and there are high levels of endemicity within the general study area;

(ii) Three species in the WEF development area are classified as Red Data species: Ludwig’s Bustard (Vulnerable), Kori Bustard (Vulnerable) and Red Lark (Vulnerable). Thirty-six species in the WEF site are endemic or near-endemics (Appendix 2); significant species within this group included Jackal Buzzard (endemic, possibly breeding), Ludwig’s Bustard (near-endemic, possibly breeding), Karoo Korhaan (endemic, possibly breeding), Northern Black Korhaan (endemic, possibly breeding), Red Lark (endemic, probably breeding), Sociable Weaver (endemic, breeding) and Southern Pale Chanting Goshawk (near-endemic, possibly breeding);

(iii) The SEF site contained 33 endemic or near-endemic species and 2 Red Data species (Appendix 2). There was considerable overlap within this group with the endemic/near-endemic group recorded on the plateau. The most important species here included Ludwig’s Bustard (near-endemic, possibly breeding), Karoo Korhaan (endemic, possibly breeding), Northern Black Korhaan (endemic, possibly breeding); Red Lark (endemic, probably breeding) and Sociable Weaver (endemic, breeding).
(iv) No summer migrants were recorded due to the surveys being carried out in mid-winter. An additional 10-15 migrant species could be expected to be added to the list if site surveys were carried out in mid-summer.

(v) Very few waterbirds were recorded. Previous atlas surveys have also recorded low proportions of waterbirds in the study area.

Additional specific observations that were noteworthy included (see Figure 4):

- A pair of Verreaux’s Eagles seen traversing a ridge along the southern boundary of the SEF site;
- A Martial Eagle observed on the 220 kV transmission line running adjacent to the N14 just to the south of the SEF site. Although no other sightings of this species were recorded it does provide some evidence that this species occurs in the general vicinity of both development sites making it susceptible to collisions with wind turbines;
- An old Secretarybird nest located just to the north of the WEF site. According to the farmer (Mr W. van Niekerk) a pair used the nest for at least the past few years.
- A Spotted Eagle-Owl was seen at one of the small boulder outcrops on the southern boundary of the WEF site;
- Small groups of Ludwig’s Bustards (5-7 birds) and Karoo Korhaans (2-3 birds) were seen flying on the northern edge of the WEF site, close to the position of the meteorological mast; these birds were seen regularly in the same vicinity during subsequent days of the site visit.
- A pair of South African Shelduck were observed flying in a north-south direction through the western edge of the WEF site;
- A single Kori Bustard was captured on a camera trap placed in pentad (29 37.314 S 18 19.914 E). This was the only recorded evidence of this species during the site visit;
- Several pairs of Double-banded and Burchell’s Coursers were observed within both WEF and SEF sites. These birds frequent the edges of the areas where the vegetation is over-utilised and sparse – especially if the area is strewn with pebbles. This species is uncommon and has a localised distribution in South Africa (Hockey et al. 2005).
- Five Sociable Weaver colonies were recorded in the study area; two colonies in the WEF site and three in the SEF site. The WEF colonies were located in a dead tree near the Kangnas farmhouse and on a telephone pole, while the SEF sites were all located in Kokerbooms (*Aloe dichotoma*). Sociable Weavers were not recorded in the area during SABAP1 and according to the farmers (Mr W van Niekerk and Mr Agenbach) have moved into the area in the last 5-6 years.

Although intensive searches were conducted no active raptor nests were found during the site survey; it is strongly suspected however that there is a Verreaux’s Eagle nest on the ridge where the pair was observed in the SEF site (Figure 4). These cliff lines and those in the
WEF and SEF sites could hold resident breeding pairs of other raptors including Booted Eagle, Jackal Buzzard, Lanner Falcon and Rock Kestrel. Access difficulties and the rugged terrain within the development areas prevented a thorough investigation of cliff lines for raptor nests.

The following species form part of the Namib-Karoo biome restricted bird assemblage (Barnes 1998) and which occur or probably occur in the development zones and surrounds: Ludwig’s Bustard, Karoo Korhaan, Karoo Long-billed Lark, Karoo Lark, Red Lark, Stark’s Lark, Karoo Chat, Tractrac Chat, Sickle-winged Chat, Rufous-eared Warbler, Layard’s Tit-babbler, and Pale-winged Starling.

A total of 32 species have been recognised as priority species that are key in the avifaunal assessment of both the WEF and SEF sites (Table 1). Most of these species have been identified based primarily on their national/international conservation status, occurrence (or likely occurrence) in relatively high numbers on site or the potential to be negatively affected by the development of a WEF. Seventeen species are listed as priority species by Retief et al. (2011) and five species were not recorded during SABAP1 (Table 1). Of the 32 species, the Kori Bustard is probably the most important in terms of possible impacts from wind turbines. It is probable that the species breeds in the area. Barn Swallow, Alpine and Little Swift have been included as they are aerial foragers with a high collision risk factor and they are likely to traverse and feed in the development zones. Booted Eagle, Rock Kestrel, Verreaux’s Eagle, and Southern Pale Chanting Goshawk are included because they occur as residents and are likely to breed on site due to availability of suitable habitat.

Overall the most important aspects of the avifauna on the Kangnas WEF and SEF and the most relevant to both or either of the sites, are:

(i) Resident and breeding raptors, especially Verreaux’s Eagle (at least one pair in the SEF site, and possibly breeding in the SEF site), Secretarybird (a known nest site just north of the WEF site), Martial Eagle, Rock Kestrel and Southern Pale Chanting Goshawk.

(ii) Large terrestrial bird species, especially Ludwig’s Bustard, Kori Bustard and Karoo Korhaan. All are susceptible to collisions with powerlines (Shaw et al. 2010a, b; Young et al. 2003); subsequently they are probably susceptible to turbine collision mortality and to displacement and disturbance by construction and operation of the WEF.

(iii) Populations of localised/range-restricted or biome-restricted species particularly Red Lark, Stark’s Lark, Karoo Lark and Sickle-winged Chat.

7.5 Assessment of bird flight paths

During the site survey, a preliminary assessment was carried out to determine which species used flight paths that would intersect or possibly intersect with the proposed location of the wind turbines. This was done to identify the possible impacts the turbines, specifically the
rotating blades, would have on birds colliding or striking the blades while flying. It is assumed that the flight paths described here are the paths that are frequently used or favoured by these species in this area.

Figure 5 summarises the flight paths for eight bird species considered important to the development of the WEF and SEF sites. It is clear that a variety of raptors and large terrestrial species, particularly Ludwig’s Bustard and Karoo Korhaan, frequent the areas where the proposed wind turbines will be located. These birds normally do not fly long distances – they flush when disturbed, fly a short distance and then land to hide in the vegetation. Southern Pale Chanting Goshawk and Jackal Buzzard were also noted using areas in and around the SEF site. Pied Crows and Cape Crows were observed flying around the WEF site daily, usually in small groups. They probably use this area to search for sheep carcasses.

South African Shelduck was the only waterbird that was seen flying through the WEF development zone; a pair was observed flying south through the western edge of the WEF site. This species occurs regularly in the Karoo biome and is known to frequent farm dams (Hockey et al. 2005). It is likely that they would be traversing the area between farm reservoirs in the area and they will visit Goebeesvlei (granite pan).

Namaqua Sandgrouse, a species restricted to the arid western parts of South Africa, was observed flying in a south-easterly direction into Goebeesvlei (granite pan). The birds would be using the pan as a drinking spot. Although this is located outside of the actual development zone of the WEF it seems likely that the birds may use additional flight paths some of which may include paths through the WEF; there is a pan located just to the south of the development zone in pentad 2940_1825 which, when full, may be used by the Sandgrouse when other water sources may be unavailable. This will have to be further investigated.

Sociable Weavers in the WEF study area were observed flying short distances (<200 m) from their colonies to feedlots where they were seen foraging. Due to limited time on site, it is not known if they forage further away, particularly further south where additional feedlots are located. Should they do this they would traverse the WEF impact zone. In the SEF, Sociable Weavers were only observed at the feedlots. Birds returning to the western colonies would fly directly over the proposed development area. It is unknown if the PV arrays would influence or alter their flight behaviour, but it is unlikely to have a significant impact on their behaviour.

The location and status of the Secretarybird nest provides evidence that the breeding pair would utilise the WEF development zone as a foraging zone, but actual movements of the birds would need to be tracked/monitored when the birds are actively breeding (September–December). Recent studies using satellite transmitters have shown that juvenile birds remain within a few kilometres of the nest site for the first two months before
moving further away (E. Retief in litt.). Consequently, they will most likely be impacted by the proposed location of the WEF.

Although Barn Swallows were not recorded during the site survey (due to them being absent in winter), they have been recorded during summer in the area. It is possible that their flight paths would take them through areas of high wind turbine density making them susceptible to collision mortalities. Other summer migrants that might potentially be at risk of colliding with turbine blades include Yellow-billed Kite, White Stork, Common Swift and European Bee-eater. These species may not necessarily spend the summer in the area but may use it as a flyway as they move further south or to nearby neighbouring areas.

Flight paths were noted for Verreaux’s Eagle and Ludwig’s Bustard in the SEF site (Figure 4). It is not known if PV panels will alter the movements of these species in the area although it does seem unlikely. This is something that will be investigated through the pre- and post-construction avifaunal monitoring programme (see below).
Table 1. Priority bird species considered important to the avian impact assessment for Kangnas WEF and SEF facilities, near Springbok. Species selected based on South African or global conservation status (Barnes 2000, IUCN 2010), endemicity and estimated conservation/ecological significance of the local population. Red listed endemics are shaded grey. Species in bold were not recorded during SABAP1 and those marked with an asterisk are priority species included in the Avian Wind Farm Sensitivity Map computation (Retief et al. 2011).

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Conservation status</th>
<th>Regional endemicity</th>
<th>S1</th>
<th>S2</th>
<th>WEFSite</th>
<th>SEFSite</th>
<th>Habitat</th>
<th>Susceptibility to</th>
<th>Breeding season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bustard, Kori*</td>
<td>Ardeotis kori</td>
<td>Vulnerable</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Bustard, Ludwig’s*</td>
<td>Neotis ludwigii</td>
<td>Vulnerable</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Buzzard, Jackal*</td>
<td>Buteo rufous</td>
<td>Endemic</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Courser, Burchell’s</td>
<td>Cursorius rufus</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>Moderate</td>
<td></td>
<td>Jun.-Nov.</td>
</tr>
<tr>
<td>Eagle, Booted*</td>
<td>Aquila pennatus</td>
<td>Vulnerable</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Eagle, Martial*</td>
<td>Polemaetus bellicosus</td>
<td>Vulnerable</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Eagle, Verreaux’s*</td>
<td>Aquila verreauxii</td>
<td>Vulnerable</td>
<td>Near-threatened</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Eagle-Owl, Cape*</td>
<td>Bubo capensis</td>
<td>Near-endemic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>High</td>
<td>Moderate</td>
<td>Aug.-Sep.</td>
</tr>
<tr>
<td>Falcon, Lanner*</td>
<td>Falco biarmicus</td>
<td>Near-threatened</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>X</td>
<td>High</td>
<td>Moderate</td>
<td>May–Sept.</td>
</tr>
</tbody>
</table>
Table 1. contd

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific Name</th>
<th>Conservation status</th>
<th>Regional endemicity</th>
<th>S1</th>
<th>S2</th>
<th>WEF site</th>
<th>SEF site</th>
<th>Habitat</th>
<th>Susceptibility to</th>
<th>Breeding season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Karoid shrublands</td>
<td>Koppies/Mountains</td>
<td>Wetlands</td>
<td>Collision</td>
<td>Electrocution</td>
<td>Disturbance/</td>
<td>habitat loss</td>
<td></td>
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<tr>
<td>Goose, Egyptian</td>
<td>Alopochen aegyptiacus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>High</td>
<td>High</td>
<td>Aug.-Nov.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goshawk, Southern Pale Chanting*</td>
<td>Melierax canorus</td>
<td>Near-endemic</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Jul.–Nov.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heron, Black-headed</td>
<td>Ardea melanocephala</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Jul.-Jan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grebe, Little</td>
<td>Tachybaptus ruficollis</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>High</td>
<td></td>
<td>Aug.-Feb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kestrel, Greater*</td>
<td>Falco rupicoloides</td>
<td></td>
<td></td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Sep.-Nov.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korhaan, Karoo*</td>
<td>Eupodotis vigorsii</td>
<td>Endemic</td>
<td></td>
<td>X</td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Sept.–Feb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korhaan, Northern Black*</td>
<td>Afrotis afroides</td>
<td>Endemic</td>
<td></td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Sept.–Feb.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lark, Slater’s*</td>
<td>Spizocorys sclateri</td>
<td>Near-threatened</td>
<td></td>
<td>X</td>
<td>X</td>
<td>High</td>
<td></td>
<td>Aug.-Nov.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lark, Stark’s</td>
<td>Spizocorys starki</td>
<td>Near-endemic</td>
<td></td>
<td>X</td>
<td>X</td>
<td>High</td>
<td></td>
<td>Mar.-Aug.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owl, Barn</td>
<td>Tyto alba</td>
<td></td>
<td></td>
<td>X</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Feb.-May</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secretarybird*</td>
<td>Sagittarius serpentinus</td>
<td>Near-threatened</td>
<td></td>
<td>X</td>
<td>X</td>
<td>High</td>
<td>Moderate</td>
<td>Jul.–Nov.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelduck, South African</td>
<td>Tadorna cana</td>
<td>Endemic</td>
<td></td>
<td>X</td>
<td>X</td>
<td>High</td>
<td></td>
<td>Jun.–Sept.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common name</td>
<td>Scientific name</td>
<td>Conservation status</td>
<td>Regional endemcity</td>
<td>S1</td>
<td>S2</td>
<td>WEF site</td>
<td>SEF site</td>
<td>Habitat</td>
<td>Susceptibility to</td>
<td>Breeding season</td>
</tr>
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</tr>
<tr>
<td>Snake-Eagle, Black-chested*</td>
<td><em>Circaetus pectoralis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Collision</td>
<td>Moderate</td>
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<td></td>
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</tr>
<tr>
<td>Swallow, Barn</td>
<td><em>Hirundo rustica</em></td>
<td></td>
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<td></td>
<td></td>
<td>Moderate</td>
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<td></td>
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</tr>
<tr>
<td>Swift, Alpine</td>
<td><em>Tachymarptis melba</em></td>
<td></td>
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<td></td>
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<td></td>
<td>Moderate</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Swift, Little</td>
<td><em>Apus affinis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderate</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Warbler, Cinnamon-breasted</td>
<td><em>Euryptila subcinnamomea</em></td>
<td>Endemic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High</td>
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<td></td>
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</tr>
<tr>
<td>Weaver, Sociable</td>
<td><em>Philetairus socius</em></td>
<td>Endemic</td>
<td></td>
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<td>High</td>
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</tbody>
</table>

Small dots indicate that the species is not present at the site. The table continues with more species and their details.
8. Impact assessment

Impacts of the proposed WEF and SEF are likely to manifest in the following ways (Table 2):

(a) Disturbance and displacement of resident or breeding Karoo species (notably Red Lark, Stark’s Lark, Scalter’s Lark and Karoo Lark) from foraging/breeding areas by construction and/or operation of the facilities;

(b) Disturbance and displacement of large terrestrial birds (notably Ludwig’s Bustard, Kori Bustard and Northern Black Korhaan) from nesting or foraging areas by construction and/or operation of the facility and/or mortality of these species in collisions with new power lines/turbines;

(c) Disturbance and displacement of resident/migrant raptor species (notably Verreaux’s Eagle, Secretarybird, Martial Eagle, Rock Kestrel and Jackal Buzzard) from foraging/breeding areas by construction and/or operation of the facility, and/or mortality of these species in collisions with new power lines, or electrocution when perched on powerlines;

(d) Disturbance and displacement of aerial species (notably raptors, swifts, swallows) from foraging areas by glare and glint from PV cells (for SEF) and/or mortality of these species in collisions with turbines and new power lines (for WEF);

Table 2. Impact characteristics: Kangnas WEF and SEF

<table>
<thead>
<tr>
<th>Summary</th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project aspect/activity</td>
<td>• Disturbance associated with noise and movement from construction activities • Loss of habitat/habitat destruction through site clearance, road construction/upgrade and establishment of the camp and assembly areas.</td>
<td>• Displacement and/or disturbance from foraging/nesting by noise and/or movement of turbine blades • Collision mortalities with turbine blades and/or powerlines, or electrocution on new power infrastructure</td>
</tr>
<tr>
<td>Impact type</td>
<td>Direct</td>
<td>Direct</td>
</tr>
</tbody>
</table>
| Receptors affected     | **WEF site**
All birds on site; key species –Southern Pale Chanting Goshawk, Secretarybird, Kori Bustard, Ludwig’s Bustard, Karoo Korhaan, Red Lark, Stark’s Lark

**SEF site**
All birds on site; key species –Namaqua Sandgrouse |

**WEF site**
All birds on site; key species –Southern Pale Chanting Goshawk, Secretarybird, Kori Bustard, Ludwig’s Bustard, Karoo Korhaan, Red Lark, Stark’s Lark

**SEF site**
All birds on site; key species –Namaqua Sandgrouse
Verreaux’s Eagle, Ludwig’s Bustard, Karoo Korhaan, Double-banded Courser, Burchell’s Courser

These potential impacts are described for the WEF and SEF sites, respectively, below.

8.1 Kangnas WEF – Birds

8.1.1 Construction impacts

(A) Habitat loss

<table>
<thead>
<tr>
<th>Nature: Construction activities would result in a negative direct impact on the avifauna of the WEF site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact magnitude</strong> – Low-Medium</td>
</tr>
<tr>
<td><strong>Extent</strong>: The extent of this impact is <strong>local</strong> as it is limited to the site</td>
</tr>
<tr>
<td><strong>Duration</strong>: The duration would be <strong>long-term</strong> as the affected areas will remain degraded for more than five years after completion of the project.</td>
</tr>
<tr>
<td><strong>Intensity</strong>: The footprint of the development is <strong>relatively large</strong>, and there will be some loss of habitat for specialised, karoo species. The magnitude of the change will be <strong>low-medium</strong>.</td>
</tr>
<tr>
<td><strong>Probability</strong> – There is a <strong>definite</strong> likelihood that areas of habitat will be lost</td>
</tr>
<tr>
<td><strong>IMPACT SIGNIFICANCE (PRE-MITIGATION)</strong> – <strong>LOW-MEDIUM</strong></td>
</tr>
<tr>
<td><strong>Degree of confidence</strong>: <strong>Certain</strong></td>
</tr>
<tr>
<td><strong>Reversibility</strong>: <strong>Irreversible</strong></td>
</tr>
</tbody>
</table>

(B) Disturbance and displacement

<table>
<thead>
<tr>
<th>Nature: Construction activities would result in a negative direct impact on the avifauna of the WEF sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact magnitude</strong> – <strong>Medium</strong></td>
</tr>
<tr>
<td><strong>Extent</strong>: The extent of this impact is <strong>local</strong>.</td>
</tr>
<tr>
<td><strong>Duration</strong>: The duration would be <strong>short-medium term</strong> as this effect will last as long as the construction of the turbines but will not extend beyond the construction phase.</td>
</tr>
<tr>
<td><strong>Intensity</strong>: Biome/restricted range and/or threatened species will be disturbed particularly if explosives are used for the turbine foundations, so the magnitude of the change will be <strong>medium-high</strong>.</td>
</tr>
<tr>
<td><strong>Probability</strong> – There is a <strong>definite</strong> likelihood that birds will be disturbed.</td>
</tr>
<tr>
<td><strong>IMPACT SIGNIFICANCE (PRE-MITIGATION)</strong> – <strong>MEDIUM-HIGH</strong></td>
</tr>
<tr>
<td><strong>Degree of confidence</strong>: <strong>Certain</strong></td>
</tr>
<tr>
<td><strong>Reversibility</strong>: <strong>Reversible</strong>, to some extent.</td>
</tr>
</tbody>
</table>

8.1.2 Operation impacts
(A) Disturbance and displacement

| Nature: Operational activities would result in a negative direct impact on the avifauna of the WEF sites |
| Impact magnitude – Medium-High |
| Extent: The extent of this impact would be regional if Jackal Buzzards or Booted Eagles are displaced, or local should only other priority species be affected. |
| Duration: The duration would be long-term as the ecology of the area will remain affected for as long as the facility is operational. |
| Intensity: Some priority species may be displaced for the duration of the project, so the magnitude of the impact will be medium-high. |
| Probability – There is a definite likelihood that some priority species will be disturbed and/or displaced. |
| IMPACT SIGNIFICANCE (PRE-MITIGATION) – MEDIUM-HIGH |
| Degree of confidence: Sure |
| Reversibility: Reversible, to some extent. |

(B) Mortality

| Nature: Operational activities would result in a negative direct impact on the avifauna of the WEF site |
| Impact magnitude – Medium-High |
| Extent: The extent of this impact would be regional if Jackal Buzzards or Booted Eagles are killed, or local should other priority species be affected. |
| Duration: The duration would be long-term as the ecology of the area will remain affected for as long as the facility is operational. |
| Intensity: Numbers of individuals of threatened species may be killed in collision or electrocution incidents so the magnitude of the change will be medium-high. |
| Probability – There is a probable likelihood that birds will be killed. |
| IMPACT SIGNIFICANCE (PRE-MITIGATION) – MEDIUM-HIGH |
| Degree of confidence: Unsure |
| Reversibility: Irreversible |

8.2 Kangnas SEF – Birds

8.2.1 Construction impacts

(A) Habitat loss

| Nature: Construction activities would result in a negative direct impact on the avifauna of the SEF site |
| Impact magnitude – Medium |
| Extent: The extent of this impact is local as it is limited to the site |
| Duration: The duration would be long-term as the affected areas will remain degraded for more than five years after completion of the project. |
| Intensity: The footprint of the development is relatively large and there will be some loss of habitat for specialised, karoo species. The magnitude of the change will be low-medium. |
| Probability – There is a definite likelihood that areas of habitat will be lost |
| IMPACT SIGNIFICANCE (PRE-MITIGATION) – LOW-MEDIUM |
| Degree of confidence: Certain |
**Reversibility: Irreversible**

**(B) Disturbance and displacement**

<table>
<thead>
<tr>
<th>Nature: Construction activities would result in a negative direct impact on the avifauna of the SEF site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact magnitude – Medium</strong></td>
</tr>
</tbody>
</table>
| **Extent:** The extent of this impact is local.  
**Duration:** The duration would be short-medium term as this effect will last as long as the construction of the panels but will not extend beyond the construction phase.  
**Intensity:** Biome/restricted range and/or threatened species will be disturbed, so the magnitude of the change will be medium. |
| **Probability** – There is a definite likelihood that birds will be disturbed. |
| **IMPACT SIGNIFICANCE (PRE-MITIGATION) – LOW-MEDIUM** |
| **Degree of confidence:** Sure |
| **Reversibility:** Reversible, to some extent. |

**8.2.2 Operation impacts**

**(A) Disturbance and displacement**

<table>
<thead>
<tr>
<th>Nature: Operational activities would result in a negative direct impact on the avifauna of the SEF site</th>
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</thead>
<tbody>
<tr>
<td><strong>Impact magnitude – Medium</strong></td>
</tr>
</tbody>
</table>
| **Extent:** The extent of this impact would be local should only priority species be affected, such as Ludwig’s Bustard.  
**Duration:** The duration would be long-term as the ecology of the area will remain affected for as long as the facility is operational.  
**Intensity:** Some priority species may be displaced for the duration of the project, so the magnitude of the impact will be low-medium. |
| **Probability** – There is a definite likelihood that some priority species will be disturbed and/or displaced. |
| **IMPACT SIGNIFICANCE (PRE-MITIGATION) – LOW-MEDIUM** |
| **Degree of confidence:** Sure |
| **Reversibility:** Reversible, to some extent |

**(B) Mortality**

<table>
<thead>
<tr>
<th>Nature: Operational activities would result in a negative direct impact on the avifauna of the SEF site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact magnitude – Low-Medium</strong></td>
</tr>
</tbody>
</table>
| **Extent:** The extent of this impact would be local should only priority species be affected, such as Ludwig’s Bustard and Karoo Korhaan.  
**Duration:** The duration would be long-term as the ecology of the area will remain affected for as long as the facility is operational.  
**Intensity:** Numbers of individuals of threatened species may be killed in collision or electrocution incidents so the magnitude of the change will be low-medium. |
| **Probability** – There is a probable likelihood that birds will be impacted. |
| **IMPACT SIGNIFICANCE (PRE-MITIGATION) –LOW- MEDIUM** |
9. Mitigation

Mitigation of these potential impacts, for both the WEF and SEF sites, will be best achieved in the following ways:

(i) Restricting the construction footprint to a bare minimum;
(ii) Demarcation of ‘no-go’ areas for the WEF and SEF sites identified during the pre-construction monitoring phase (see below); demarcation of no-go areas is important to minimise disturbance impacts associated with the construction of the facility;
(iii) Reducing and maintaining noise disturbance to a minimum particularly if blasting associated with excavations for foundations is carried out. Blasting should not take place during the breeding seasons of the resident avifaunal community and in particular for priority species (Table 1). Blasting should be kept to a minimum and, where possible, synchronized with neighbouring blasts.
(iv) Minimizing the disturbance associated with the operation of the facilities, by scheduling maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times – such areas will be identified during the pre-construction and operational monitoring programme - see below);
(v) Excluding development or disturbance from sensitive areas. Currently these include the Secretarybird nest site and the two wetland sites (Goebeesvlei (the ‘granite pan’) and Steenbok Pan)(see Figure 4). These currently fall outside or on the edge of the WEF development area but will be impacted during the construction phase.

Jenkins (2011b) states that territory boundaries of Verreaux’s Eagle in the Witberg ridge, near Laingsburg, extend to about 3 km radius around nest sites, an area of approximately 28 km², and that core activities of pairs usually occupy half this area). He suggested that an exclusion zone of a radius of at least 1.5 km. Given that only a single known Verreaux’s Eagle pair occurs within the SEF development area they probably have a slightly larger home range and therefore core activities take place over a wider area. It is therefore recommended that an exclusion zone of at least 1 km be adopted particularly if a nest site is located.

Activities of wetland species are usually concentrated around the wetland itself, but flight routes in to and away from wetlands may also be affected by the placement of turbines.

Hence, based on the site visit and published information, no development should take place:
• Within a radius of 2.5 km of any Verreaux’s Eagle nest sites, particularly if it is located in the WEF area. The aim is to reduce collision risk and disturbance for this species and any additional cliff-nesting species.

• Within 1.5 km of the Goebeesvlei (‘granite pan’) and Steenbok Pan to reduce disturbance and collision risk for Namaqua Sandgrouse, South African Shelduck and other wetland related species that may move between different wetland systems.

Additional sensitive areas for birds (nesting sites, important foraging areas and flight routes) are likely to be identified during the pre-construction monitoring programme (see below).

(vi) Minimising the length of any new powerlines installed, and ensuring that all new lines are marked with bird flight diverters (Jenkins et al. 2010) along their entire length. It is imperative that all new powerline infrastructure is adequately insulated and bird friendly when configured (Lehman et al. 2007).

(vii) The project should consider marking the turbine blades as a way to reduce collisions. Although there is no conclusive evidence, it has been proposed that painting one blade of each turbine black may enhance conspicuousness to oncoming birds (McIsaac 2001, Hodos 2002). An experimental approach should be adopted whereby a single blade is painted one of a number of pairs of potentially high risk turbines. Post-construction monitoring should allow empirical testing of efficacy, which would inform subsequent decisions about the need to mark blades more widely in this and other WEFs. Recommendations regarding the use of blade marking could be made as part of the bird monitoring programme.

(viii) Ensuring that lighting on the turbines is kept to a minimum, and is coloured (red or green) and intermittent, rather than permanent and white, to reduce confusion effects for birds flying at night.

(viii) Transmission lines connecting each turbine or PV array to the installation network should be buried underground, as far as possible, to mitigate the considerable risk of avian collision that would be posed by overhead lines.

(ix) Carefully monitoring the local avifauna pre-, during and post-construction (as per Section 12 below), and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report. An essential weakness of the EIA assessment here is the dearth of local knowledge about the actual movements of key species (especially raptors) through the impact area. Such knowledge must be generated as quickly and as accurately as possible in order for this
and other wind energy proposals in the area to proceed in an environmentally sustainable way.

(x) Additional mitigation arising from the results of pre-construction monitoring might include re-scheduling construction or maintenance activities on site, adjusting the siting of turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement sensitive, priority bird species, shutting down problem turbines either permanently or at certain times of year or in certain conditions, or installing a 'DeTect' or similar radar tracking system to monitor bird movements and institute temporary shutdowns as and when required.

Table 3. Pre- and post-mitigation significance: Kangnas WEF site - Birds

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pre-mitigation significance</th>
<th>Residual impact significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat loss</td>
<td>LOW-MEDIUM</td>
<td>LOW</td>
</tr>
<tr>
<td>Disturbance</td>
<td>MEDIUM-HIGH</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
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<tr>
<td>Displacement</td>
<td>MEDIUM-HIGH</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Mortality</td>
<td>MEDIUM-HIGH</td>
<td>MEDIUM</td>
</tr>
</tbody>
</table>

Table 4. Pre- and post-mitigation significance: Kangnas SEF site - Birds

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pre-mitigation significance</th>
<th>Residual impact significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
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<tr>
<td>Habitat loss</td>
<td>LOW-MEDIUM</td>
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<tr>
<td>Disturbance</td>
<td>MEDIUM</td>
<td>LOW-MEDIUM</td>
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<tr>
<td>Operation</td>
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<td></td>
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<tr>
<td>Displacement</td>
<td>LOW-MEDIUM</td>
<td>LOW</td>
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<tr>
<td>Mortality</td>
<td>LOW-MEDIUM</td>
<td>LOW</td>
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</table>

10. Cumulative impacts

It is important that the results of pre-construction monitoring (see below) are applied to project-specific impact mitigation in a way that allows for the potential cumulative effects on the local/regional avifauna of any other wind or solar energy projects proposed in the region. The nearest renewable energy developments to the Kangnas developments include (a) Springbok WEF (about 50-60 MW, 40 turbines, 8000 ha, just east of Okiep) (Simmons 2010) and (b) Pofadder WEF (1.5 MW-4MW, up to 500 turbines, 80 km east of Kangnas WEF) (L. Corbett in litt.). The Springbok development has not progressed past the EIA phase while the Pofadder WEF is currently in the EIA process (L. Corbet in litt.). An additional development is the Kannikwavlake WEF (110 MW, 55 turbines, 1560 ha) located about 90 km west-northwest of Springbok) for
which construction has been approved and the pre-construction bird monitoring programme has been finalised (C. van Rooyen pers. comm.).

These projects, when viewed in isolation, may pose a limited threat to the avifauna of the area. However, in combination with the development of a number of renewable energy facilities in the region the formation of significant barriers to birds either in the form of displacement from foraging areas or reducing energy-efficient travel between resource areas (Masden et al. 2010). Cumulative impacts from the proposed Springbok and Pofadder WEFs would be greatest considering the distances (less than 80 km) between the three development areas and all sites having similar topography and vegetation. Migrant raptors, swallows and swifts and long-distance flyers such as ducks, might be at risk from collisions should their flight paths traverse the locations of the WEFs. Displacement of large terrestrial birds such as bustards and korhaans, during construction and operational phase of the facilities, from either site could also be a major cumulative impact. Impacts from the Kannikwavlakte WEF will probably be negligible based on distance (140 km) from the Kangnas WEF site. Masden et al. (2010) and Jenkins (2011b) concur that a more strategic approach to assessing wind energy development in South Africa is required than is currently being applied. It would be necessary for the Department of Environmental Affairs (DEA), or a similar body, to undertake this strategic assessment as it cannot be assessed in a project specific application.

11. Conclusions

The Kangnas renewable energy projects can be described as two large developments located within an area that has a moderate to high degree of sensitivity with respect to avifauna. The Wind Farm Sensitivity Map produced by BirdLife South Africa (Retief et al. 2011, http://www.birdlife.org.za/conservation/birds-and-wind-energy/windmap) classifies the area as low-medium sensitivity but this is based on bird atlas data submitted up until December 2011. The map is intended as a tool to provide guidance regarding bird-sensitive areas in relation to proposed sites for renewable energy developments, notably WEFs. It should not be used as a ‘no-go’ tool for development. The site survey for this study produced additional species and on-site observations that the general bird atlas data does not provide. There are no known regionally or nationally critical populations of impact susceptible species within or close to the development areas, although there are red-listed endemic species that occur within the development areas.

The proposed sites are not known to impinge on any migration routes or avian fly-ways but they do encompass the foraging areas of some local populations (e.g. Ludwig’s Bustard, Kori Bustard, Northern Black Korhaan, Karoo Korhaan, Namaqua Sandgrouse and South African Shelduck). The inselbergs are important landscape features in the area and the proposed WEF and SEF may have significant negative effects on the avifauna of this ridge (including breeding pairs of large eagles and concentrations of localised endemic/range-restricted species) in both the construction and operational phases of the developments, but will probably be greater in the WEF than the SEF.
Jenkins (2011b) identified two key problems in assessing possible impacts on birds from WEF developments; these are (i) limitations on the quality of information available describing the composition, abundance and movements of the local avifauna, and (ii) the complete absence of any local, empirical data describing the known impacts of existing WEFs on birds. Consequently, avian impact assessment reports should include comprehensive pre-construction monitoring programmes as a prerequisite for further consideration by DEA. Such a monitoring programme is provided in this report in Section 12. Jenkins (2011b) further emphasizes that the results of such monitoring should be integral to developing an effective strategy for mitigating the potential bird impacts of each proposed development and that such mitigation measures could well include (a) refinements of the final turbine number and layout, (b) the selective marking of the blades of perceived problem turbines, and (c) adherence to prescribed operational schedules of selected turbines in relation to time of year and/or weather or lighting conditions. All of these stipulations apply to this project.

Should these stipulations be adhered to, the anticipated pre-mitigation impacts of the two proposals can be mitigated to more sustainable levels (Tables 3 and 4). This could mean a proposed re-design of the project, from the original layout which would reduce impacts on Verreaux’s Eagles, Martial Eagles, some large terrestrial species and wetland birds. The residual impacts remain at least of medium significance for the WEF and low for the SEF; this is based mainly on construction and operational impacts on cliff-nesting raptors in the area, as well as construction (and probable operational) impacts on localized red-listed species/endemics, resulting from turbine placements within the WEF.
12. Avifaunal Monitoring Programme

Birds, and bats, due to their mobility and wide use of the landscape, probably face the greatest impact from the development of WEFs. For the Kangnas WEF the high density of turbines coupled with the actual footprint of the developments could have serious implications for a number of bird species, notably raptors and large terrestrial birds. Desktop studies and site surveys only provide a basic understanding and ‘snapshot’ of the ecology of the avifauna in the study area and are therefore limited by the short-term nature of these activities. For effective mitigation to take place a long-term monitoring programme is required to better understand how birds utilise the study area, pre- and post-construction, and in particular the impact zone.

The Bird and Wind Energy Specialist Group (BAWESG), a group formed under the auspices of the Wildlife and Energy Programme of the Endangered Wildlife Trust (EWT) and BirdLife South Africa (BLSA), recognised the lack of empirical information of the effects of wind and solar energy developments on birds and produced a guideline document to measure these effects in order to identify and mitigate and detrimental impacts on threatened or potentially threatened species (Jenkins 2011a,b). The document outlines how this data needs to be gathered in a structured, methodical and scientific way in order to provide defensible answers to critical questions.

From the above, it is strongly recommended that Mainstream Renewable Energy implement a bird monitoring programme as this would determine the need for any additional mitigation requirements to be implemented during the construction phase and/or during the operational phase of the WEF and SEF projects. The primary objectives of a long-term monitoring programme are outlined below (taken from Jenkins 2011b) while a summary of the monitoring protocol is summarised thereafter; for details of the protocol please refer to Jenkins et al. (2010) and Jenkins (2011b).

12.1 Objectives of bird monitoring programme

(i) Determine the densities of birds resident within the impact area of the WEF and SEF before construction of the facility, and afterwards, once the facility, or phases of the facility, become operational.

(ii) Document patterns of bird activity and movements in the vicinity of the proposed WEF and SEF before construction, and afterwards, once the facility is operational.

(iii) Monitor patterns of bird activity and movement in relation to weather conditions, time of day and season for at least a full calendar year after the WEF and SEF are commissioned.

(iv) Register and as far as possible document the circumstances surrounding all avian collisions with the WEF turbines for at least a full calendar year after the facility becomes operational.

(v) Share key findings with the industry and other relevant stakeholders to ensure that the collective knowledge and understanding of the interface between South African birds and wind energy development is advanced as quickly and accurately as possible.

Ultimately the monitoring study should focus on rare and/or endemic and potentially collision or disturbance prone species. It should provide comprehensive quantitative information on how
WEFs and SEFs impact on the abundance and occurrence of birds, and the risks it poses to the local avifauna, and serve to inform and improve mitigation to reduce this risk. The study will establish a research precedent and provide opportunities to contribute to a collective understanding within the wind energy sector of the effects of WEFs and SEFs in South Africa. Monitoring studies should be carried out by an expert ornithologist or under the supervision of such an expert.

12.2 Monitoring protocol

Jenkins (2011a) suggests that monitoring should take place once per quarter for a period of up to 12 months prior to construction and 12 months after construction (operation phase). Aspects to consider in the monitoring programme should cover the following (Jenkins 2011a):

(i) Bird population surveys
(ii) Collision assessments/surveys

For the bird populations surveys the following monitoring should take place:

a) Avian densities before and after construction and operation using transect counts
b) Bird activity monitoring, counting priority species flying over or past the WEF impact zone, and opportunistic surveys of raptors and cranes and bustards
c) Passage rates of priority bird species using specific vantage points to count individuals or flocks of priority species, all raptors and any additional stipulated species flying within 500 m of the actual periphery of the WEF and in particular to the envisaged or actual array of turbines.

Data gathered and analysed from the pre- and post-construction monitoring could well refine mitigation for both phases and affect the construction or operational phases of the development.

For the collision surveys, two components are required:

(i) Experimental assessment of search efficiency and scavenging rates of bird carcasses on site, and
(ii) Regular searches of the vicinity of the WEF for collision casualties.

It is important to carry out experimental work to determine the accuracy of the survey method, as this will determine how valuable this exercise will be when actually searching for collision mortalities. This process, involving the random distribution of not less than 20 ‘acquired’ carcasses around the site, should be carried out opportunistically for the first two months of the monitoring period. The proportion of the carcasses located in the surveys will indicate the relative efficiency of the survey method. Scavenger rates should also be monitored during this time to determine scavenger and decomposition rates which would aid in adjusting the frequency of collision surveys to be undertaken.
When the collision surveys take place the area within a radius of 50 m of the outer arc of the blades of each turbine should be checked, and this should be done at least weekly for the first two months of the study. Further to this, quadrants in the larger WEF (such as these proposed projects) should be set up and each carefully searched for signs of a bird collision (carcass, feathers, injured birds, dismembered body parts). It is imperative that all suspected collision events be comprehensively documented, and physical evidence collected (bagged) and labelled for further examination. Injured birds should be placed in a box and taken to the nearest local office of the provincial Nature Conservation authority (or failing this to inform the monitoring specialist) whereupon they should be transported to the closest veterinary hospital or wildlife rehabilitation centre.
References


Harebottle DM 2011. Construction of a wind energy facility on Oliphant’s River Farm (Remainder of Farm 629), near Koekenaap, Western Cape: Avifaunal Assessment. Unpublished report to Aurecon (Pty) Ltd.


Jenkins AR 2001. The potential impact of a demonstration wind farm facility on the birds of the Darling / Yzerfontein area, Western Cape Province, South Africa. Unpublished report to the Environmental Evaluation Unit, University of Cape Town, Cape Town.


Appendix 1: Figures

Figure 2. The location of the proposed Kangnas WEF site (in the south) and SEF site (in the north), near Springbok, Northern Cape. The envisaged turbine layout is shown for the WEF (blue circles). The Quarter-Degree Grid Cells are overlain; most of the sites are encompassed in the grid 2918CB. The black line is the proposed transmission line connecting the sites to the national grid.
**Figure 3.1** Bushmanland Arid Grassland within the WEF and SEF development zones.

**Figure 3.2** Typical Bushmanland Inselberg Shrubland vegetation. Picture taken in SEF site.

**Figure 3.3** Granite rocky koppies/outcrops in the southern sections of the WEF site
Figure 3.4 Cliff faces of the inselbergs showing guano marks, evidence of raptor activity. This picture was taken along the ridgeline in the SEF where the Verreaux’s Eagle pair was observed.

Figure 3.5 Goebeesvlei (granite pan) located to the north of the WEF site. One of two wetlands within the study area. Namaqua Sandgrouse frequented this pan as a drinking spot.

Figure 3.6 A Martial Eagle perched on the 220 kV transmission line along the N14. These structures provide perching and nesting opportunities for raptors and crows.
Figure 4. Locations of important bird species at the proposed Kangnas WEF and SEF sites. BC = Burchell’s Courser, DBC = Double-banded Courser, JB = Jackal Buzzard, LB = Ludwig’s Bustard, KB = Kori Bustard, KK = Karoo Korhaan, M = Martial Eagle, SEO = Spotted Eagle Owl, PCG = Southern Pale-chanting Goshawk, RK = Rock Kestrel, SEC = Secretarybird nest, SW = Sociable Weaver colonies (1–6). W = wetlands (Granite Pan and Steenbok Pan).
Figure 5. Observed flight paths of eight priority bird species at the proposed Kangnas WEF and SEF sites as observed during a field survey from 24-28 June 2012. Red = Ludwig’s Bustard, Pink = Southern Pale Chanting Goshawk, Yellow = Karoo Korhaan, Orange = Jackal Buzzard, Dark Orange = South African Shelduck, Light Green = Rock Kestrel, Dark Green = Namaqua Sandgrouse, Bright Green = Verreaux’s Eagle. Location of the wind turbines are indicated by the blue circles.
Figure 6. Proposed development exclusion zones (red circles) based on the activity associated around wetland sites in the WEF and in relation to the layout of turbines. No exclusion zones are currently proposed for the SEF.
**Appendix 2.** Annotated list of bird species likely to occur within the development area of the proposed Kangnas WEF and SEF development areas. Species marked in the WEF and SEF columns were those recorded during the site visit (24-28 June 2012). S1 = SABAP1 data and S2 = SABAP2 data. WEF and SEF = species seen in the wind energy and solar energy development areas respectively. Grey shaded species are red-listed endemics. Species marked with an asterisk were not recorded during SABAP1.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Conservation status</th>
<th>Regional endemicity</th>
<th>S1</th>
<th>S2</th>
<th>WE</th>
<th>SE</th>
<th>Habitat</th>
<th>Susceptibility to</th>
<th>Comments</th>
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<td>Karoid shrublands</td>
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<td>Bee-eater, European</td>
<td>Merops apiaster</td>
<td>X</td>
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<td>Bulbul, Cape</td>
<td>Pycnonotus capensis</td>
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Annexure F2
Hi Cornelia

Based on the new SEF layout we envisage that there will be no changes to the significance of the impacts on the avifauna. We are still of the opinion that the bird monitoring will determine any changes to the impact and significance on the avifauna. The avifaunal assessment surveys (EIA) have only provided a first look at the occurrence of birds on site; we will need the monitoring to provide more details in order to make better assessments and provide further and improved mitigation proposals.

Regards
Doug

On 08/11/2012 02:27 PM, Cornelia Steyn wrote:

Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON'T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Corlie Steyn I Environmental Management
Environmental Practitioner I Aurecon
T +27 44 805 5421  I  M +27 82 575 7415
E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George I South Africa
aurecongroup.com
Annexure G
Specialist EIA Assessment with regards to bat (Chiroptera) sensitivity

- For the proposed Kangnas Wind Energy Facility, near Springbok, Northern Cape
Scope of the Study

- A brief description of the existing land use of the site and its associated impacts.
- The vegetation units of the site will be described with regards to their respective bat roosting and foraging potentials.
- An explanation of South African bats and the effects of wind turbines on bats as well as a literature based table of species probability of occurrence on the site.
- Spatial representation of bats that were detected on the site during field work.
- Indication of the possible roosting and foraging habitats/areas on site.
- Indication of the bat sensitive areas.
- Discussion of the foreseen impacts of the development and their suggested mitigation measures or recommendations.

Appointment of Specialist

Animalia Zoological & Ecological Consultation CC was appointed by Aurecon South Africa (Pty) Ltd to undertake a specialist EIA phase bat sensitivity study for the proposed Kangnas Wind Energy Facility in the Northern Cape. The fieldwork data gathering component was conducted by Monika Moir and overseen and reviewed by Werner Marais, the report was also compiled by Werner Marais (CV’s available on request).

Independence:

Animalia Zoological & Ecological Consultation CC has no connection with the developer. Animalia Zoological & Ecological Consultation CC is not a subsidiary, legally or financially, of the developer; remuneration for services by the developer in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorization of this project.

Applicable Legislation:

Legislation dealing with mammals applies to bats and includes the following:

- NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; section 97): THREATENED OR PROTECTED SPECIES REGULATIONS: All bats enjoy protection under this act. This act also calls for an environmental impact assessment for threatened and protected species.
- NORTHERN CAPE NATURE CONSERVATION ACT: SCHEDULE 1 & 2 (ACT 9 OF 2009): Schedule 1 lists Specially Protected species in the Province, with no bats listed. Schedule 2 lists Protected species which includes very common and general bat species as well as species not occurring within the Northern Cape.
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8. **Appendix B - Specialist declaration of interest**
1. INTRODUCTION

1.1 Study Area

South Africa Mainstream Renewable Power Developments (Pty) Ltd (MRP) proposes to construct a 750 MW wind energy facility and a 250 MW solar photovoltaic energy facility on farms near Springbok in the Northern Cape (Kangnas site). The proposed project would take place on Farm Kangnas (Farm No. 77 Portion 3 and the Remainder), Farm Koeris (Farm No. 78 Portion 1), Farm Areb (Farm No. 75 Portion 0 and Remainder) and Farm Smorgenschaduwe (Farm No. 127 Portion 0 and Remainder) in the Northern Cape. These farms are located approximately 48 km east of Springbok and are accessed via the N14(Figure 1). The five farms cover an area of approximately 46 535 ha (Aurecon, 2012).

The site is 89.5km and 86.7km north-east of the Namaqua National Park and Skilpad and Namaqua National Park, respectively, and approximately 22 km east of the Goegap Nature Reserve. The terrain consists of relatively flat terrain with rocky elevations and mountainous areas in the north-west of the site. These rocky elevations reach the highest elevation of approximately 180m in comparison to most of the surrounding flat terrain. Gulleys and drainage channels are relatively absent from the site and vegetation is sparse (Figure 2). Sustainable water sources are not evident.

Figure 1: Map with an indication of the Kangnas site (red outline).
Satellite image of the Kangnas site; the site perimeter is indicated in red, approximate proposed turbine locations as black dots and
1.2 Land use and existing impacts on the study area

There are no direct impacts on the study site apart from some farm buildings. The impacts on the natural vegetation for all four sites is predominantly limited to livestock grazing as no agricultural fields were observed.

1.3 Vegetation units, geology and climate

Majority of the Kangnas site occupies the vegetation unit of Bushmanland Arid Grassland within the Nama Karoo biome (Figure 3). The site occupies the western part of the vegetation unit, characterized by extensive plains on a slightly sloping plateau interspersed with few rocky outcrops. These rocky outcrops may prove useful as bat roosting sites. The substrate ranges from sandy to stony and sparsely-vegetated sand dunes. The Bushmanland Arid Grassland is sparsely dominated by “white” grasses such as Stipagrostis spp. and Salsola shrub, giving it a semi desert character. In years of high precipitation rates, rich displays of annual herbs appear. Mean monthly maximum and minimum temperatures are 40.6°C and -3.7°C in January and July, respectively. The minimum monthly amount of precipitation has been recorded at around 6 mm in January and a high of 54 mm in July. The area has a low agricultural potential due to low rainfall and limited grass cover. This unit has been categorized as Least Threatened with 0.4% currently protected in the Augrabies Falls National Parks and Goegap Nature Reserve. 99.4% of the vegetation unit remains such that very little of the unit has been transformed by anthropogenic activities. This unit has a low potential of being utilised by bats for foraging and a very low potential for providing roosting space (Table 1).

The west and north-west section of the Kangnas site falls on the Bushmanland Inselberg Shrubland vegetation unit within the Richtersveld bioregion of the Succulent Karoo biome. The area is dominated by a plain of desert grasslands spotted with inselbergs (an isolated hill or mountain, often heavily eroded on its lower slopes). These Inselbergs can prove useful as roosting sites. The area is considered to be of a non-soil land class due to the substrate consisting of rock with limited soils. These substrate characteristics restrict land-use options. The unit possesses a rich composition of succulent plant taxa of the families Mesembryanthemaceae, Asphodelaceae, Crassulaceae, Euphorbiaceae and Zygophyllaceae. These plants may provide limited foraging areas suitable for insectivorous bats. The vegetation unit has been categorized as Least Concern as 99.8% of the unit has remained unchanged. This unit has a moderate potential of being utilised by bats for foraging and roosting (Table 1).

South and south west of the site boundary is the Platbakkies Succulent Shrubland vegetation unit of the Namaqualand Hardeveld bioregion. Platbakkies Shrubland supports at least five endemic succulents (Lithops and Conophytum spp) and two endemic geophytes (Helme & Desmet, 2006). This unit may support limited foraging areas suitable for insectivorous bats. The soil is porous with a high drainage capacity. The area was classed as a Least Concern conservation category as 99.3% of the unit remains unchanged.
(Mucina & Rutherford, 2006). This unit has a low potential of being utilised by bats for foraging and roosting (Table 1).

South west of the site an area is occupied by the Namaqualand Klipkoppe Shrubland vegetation unit of the Namaqualand Hardeveld bioregion. This vegetation unit occurs at an altitude of 300m to 800 m. The landscape consists of large granite and gneiss domes, boulder koppies and valleys. The Klipkoppe Shrubland vegetation unit possesses shallow soils covering hard rock. The vegetation consists of a mix of succulent and woody shrubs. The dominant succulent species include *Ruschia viridifolia* and *Leipoldtia laxa* while woody shrubs include *Zygophyllum morgsana* and *Lycium fercissimum* (Helme & Desmet, 2006). This area experiences high precipitation rates during winter while dry summer months are characteristic of the Succulent Karoo. The unit is classed as Least Concern with 95% of the unit remaining. Currently 5.8% of the unit is protected. The geological formations and vegetation may provide roosting and foraging sites, although only a small portion is located 5km from the site (*Figure 3*). This unit has a moderate potential of being utilised by bats for foraging and a high potential for providing roosting space (Table 1).

*Figure 3*: Vegetation units present on the Kangnas site (Mucina & Rutherford, 2006).
Table 1: The roosting and foraging potential of the vegetation units present on the Kangnas site.

(This table serves as an indicator of the likelihood of use of each vegetation unit by bats. The potential was graded based on observations and findings on site).

<table>
<thead>
<tr>
<th>Vegetation Unit</th>
<th>Roosting Potential</th>
<th>Foraging Potential</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushmanland Arid Grassland</td>
<td>Very Low</td>
<td>Low</td>
<td>Vegetation and geology mostly unsuitable for roosting and foraging, however man – made structures (buildings) and planted trees may provide roosting space. These structures are very limited on site.</td>
</tr>
<tr>
<td>Bushmanland Inselberg Shrubland</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Rocky outcrops with crevices can offer roosting space for crevice dwelling species. The two small caves can offer some additional roosting space, or can be utilised as night roosts.</td>
</tr>
<tr>
<td>Platbakkies Succulent Shrubland</td>
<td>Low</td>
<td>Low</td>
<td>Vegetation unsuitable for foraging, geology and vegetation mostly not ideal for roosting.</td>
</tr>
<tr>
<td>Namaqualand Klipkoppe Shrubland</td>
<td>High</td>
<td>Moderate</td>
<td>Granite geology can provide suitable roosting spaces and offer sheltered foraging environments.</td>
</tr>
</tbody>
</table>

1.4 The bats of South Africa

Bats form part of the Order Chiroptera and are the second largest group of mammals after rodents.

Bats are the only mammals to have developed true powered flight and have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are compact and light, thereby reducing the total body weight. This unique wing profile allows for the manipulation wing camber and shape, exploiting functions such as agility and maneuverability. This adaption surpasses the static design of the bird wings in function and enables bats to utilise a wide variety of food sources, including a large diversity of insects (Neuweiler 2000). Species based facial features may differ considerably as a result of differing life styles, particularly in relation to varying feeding and echolocation navigation strategies. Most South African bats are insectivorous and are capable of consuming vast numbers of insects on a nightly basis (Taylor 2000, Tuttle and Hensley 2001) however, they have also been found to feed on amphibians, fruit, nectar and other invertebrates. As a result, insectivorous bats are the predominant predators of nocturnal flying insects in South Africa and contribute greatly to the
suppression of their numbers. Their prey also includes agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and limited knowledge of the ecological importance of bats. Some species also roost in domestic residences, causing disturbance and thereby decreasing any popularity bats may have. Other species may occur in large communities in buildings, posing as a potential health risk to the residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which is actually to the benefit of humans.

Many bat species roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas can adversely impact individuals of different communities within the same population concurrently (Hester and Grenier 2005). Secondly, natality (birth) rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum and according to O’Shea et al. (2003), bats may live for up to 30 years and so limit the amount of pups born due to this increased life expectancy. Under natural circumstances, a populations numbers can accumulate over long periods of time. This is due to the longevity and the relatively low predation of bats when compared to other small mammals. Therefore, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

1.5 Bats and wind turbines

Although most bats are highly capable of advanced navigation, through the use of echolocation and excellent sight, they are still at risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines in Minnesota, USA, and, in this case study conducted by Johnson et al. (2003) were found to be directly related to collisions. The incident of bat fatalities for migrating species has been found to be directly related to turbine height, increasing exponentially with altitude, as this disrupts the migratory flight paths (Howe et al. 2002, Barclay et al. 2007). Although the number of fatalities of migrating species increased with turbine height, this correlation was not found for increased wing sweep (Howe et al. 2002, Barclay et al. 2007) at night. In the United States of America this was thought to be due to the fact that migrating bats may navigate without the use of echolocation, rather using vision as its main sense for long distance orientation (Johnson et al. 2003, Barclay et al. 2007). Despite the high incidence of deaths caused by direct impact with the blades, most bat mortalities have been found to be caused by barotrauma (Baerwald et al. 2008). This is a condition where low air pressure found around the moving blades of wind turbines, causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz et al. 2007). Baerwald et al. (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma. A study conducted by Arnett (2005) recorded a total of 398
and 262 bat fatalities in two surveys at the Mountaineer Wind Energy Centre in Tucker County, West Virginia and at the Meyersdale Wind Energy Centre in Somerset County, Pennsylvania, respectively. These surveys took place during a 6 week study period from 31 July 2004 to 13 September 2004. In some studies, such as that taken in Kewaunee County (Howe et al. 2002) bat mortalities were found to be 3 times higher than bird mortalities in the area.

Although bats are predominately found in areas near trees, human dwellings and water, in conditions where valleys are foggy, warmer air is drawn to hilltops through thermal inversion which may result in increased concentrations of insects and subsequently bats at hilltops, where wind turbines are often placed (Kunz et al. 2007). Some studies (Horn et al. 2008) suggest that bats may be attracted to the large turbine structure as roosting spaces or that swarms of insects may get trapped in low pressure air pockets around the turbine, thus attracting bats to the area. The presence of lights on wind turbines have also been identified as possible causes for increased bat fatalities. This is thought to be due to increased foraging activity of bats at lighted turbines, as a result of higher insect densities, opposed to non-lit turbines (Johnson et al. 2003). Clearings around wind turbines may also improve conditions for insects, thereby attracting bats to the area and the swishing sound of the turbine blades could confuse bats (Kunz et al. 2007). Electromagnetic fields generated by the turbine may also affect bats who are sensitive to magnetic fields (Kunz et al. 2007). It could also be hypothesized, that under natural circumstances, the echolocation capabilities of bats are designed to locate smaller insect prey or avoid stationary objects, and may not be primarily focused on the detection of unnatural objects moving sideways across the flight path.

Whatever the reason for bat mortalities around wind turbines, the facts remain that this could be a very serious ecological problem when turbines are located in high risk habitat intensively utilised by bats. During a study by Arnett et al. (2009), 10 turbines monitored over a period of 3 months showed 124 bat fatalities in South-central Pennsylvania (America), which can cumulatively have a catastrophic long term effect on bat populations this rate of fatality continues. Most bat species only reproduce once a year, bearing one young per female, therefore their numbers are slow to recover from mass mortalities. It is very difficult to assess the true number of bat deaths as a result of the presence of wind turbines, due to the fact that many of the carcasses will be removed through predation, where the rate of removal differs as a function of habitat type (Howe et al. 2002, Johnson et al. 2003). Mitigation measures are being researched and experimented with globally.

The first option for effective and the most economical mitigation is the correct placement and layout of turbines on a site, avoiding high risk areas/habitats utilised by bats. The implementation of curtailment processes, where the turbine cut-in speed is raised to a higher wind speed, is a very aggressive and expensive mitigation measure only required if turbines are placed in sensitive areas where proof exists of high bat activity and numbers. Less aggressive curtailment processes entails the turbine blades to be stationary up to the manufacturer's recommended cut-in speed. This relies on the principle that the prey of bats will be less in areas of strong winds and more energy is required for the bats to fly under these conditions. It is thought, that by the implementation of such a measure, that bats in the area are not likely to be as impacted as when the turbine blades move slowly in low wind speeds.
2. ASSESSMENT METHODOLOGY

Three factors need to be present for most South African bats to be prevalent in an area: availability of roosting space, food (insects/arthropods or fruit), and accessible open water sources. However, the dependence of a bat on each of these factors depends on the species, its behaviour and ecology. Nevertheless if all three of these factors are common in an area the bat activity, abundance and diversity will also most likely be high.

Concerning species of bats that may be impacted by wind turbines, the Kangnas site was evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water). These comparisons were done chiefly by studying the geographic literature of each site, available satellite imagery and observations during the site visit. Species probability of occurrence based on the above mentioned factors were estimated for the site and the surrounding larger area.

The site was visited from the 18th to the 22th of July 2012. It was inspected during the day for any possible roosting and foraging sites. At dusk and during the night, the sky was monitored for visual observation of bats and bat activity.

The main method of bat detection involved the use of a bat detector to record bat echolocation calls on a continuous basis throughout most of the night while traversing the study area. Only sections of the farm that were accessible by vehicle were traversed. Refer to Table 2 for sampling effort in terms of time and distance traversed with the bat detector and Figure 4 for areas traversed.

A bat detector is a device capable of detecting and recording the ultrasonic echolocation calls of bats. These calls were then analyzed with the use of computer software. A time expansion type bat detector was utilised for the study, a time expansion detector effectively slows an ultrasonic bat call down 10 times such that bat calls become audible to the human ear, but still retain all of the harmonics and characteristics of the call. Although this type of bat detection equipment is advanced technology, it is not necessarily possible to identify all bat species by just their echolocation calls. Recordings of bat calls may be negatively affected by the weather conditions (i.e. high humidity) and openness of the terrain. The range of detecting a bat is also dependent on the volume of the bat call.

Positive bat calls were analysed for species identification and are represented spatially in Figure8.
### Table 2: Details of bat detector transect sampling effort.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time spent traversing site</th>
<th>Distance covered (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 July 2012</td>
<td>6 hrs 10 min</td>
<td>96.1</td>
</tr>
<tr>
<td>19 July 2012</td>
<td>4 hrs 41 min</td>
<td>69</td>
</tr>
<tr>
<td>20 July 2012</td>
<td>6 hrs 17 min</td>
<td>93.4</td>
</tr>
<tr>
<td>21 July 2012</td>
<td>6 hrs 45 min</td>
<td>123</td>
</tr>
<tr>
<td>22 July 2012</td>
<td>5 hrs 14 min</td>
<td>135</td>
</tr>
</tbody>
</table>

**Figure 4:** Extent of the site traversed for bat detection
2.1 Assumptions and Limitations

Distribution maps of South African bat species still require further refinement such that the bat species proposed to occur on the site (that were not detected) are assumed accurate. If a species has a distribution marginal to the site it was assumed to occur in the area. The literature based table of species probability of occurrence may include a higher number of bat species than actually present. The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large scale effect on migratory species. This limitation however will be overcome with a long-term sensitivity assessment.

The satellite imagery partly used to develop the sensitivity map may be slightly imprecise due to land changes occurring since the imagery was taken. Satellite imagery from Google Earth for 2012 was utilized to minimize this limitation.

Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence.
3. RESULTS

3.1 Species probability of occurrence

“Probability of Occurrence” is assigned based on consideration of the presence of roosting sites and foraging habitats on the site, compared to literature described preferences. The probability of occurrence is described by a percentage indicative of the expected numbers of individuals present on site and the frequency at which the site will be visited by the species. Bat species that were positively detected on the site are noted as Confirmed in the “Probability of Occurrence” column.

The column of “Likely risk of impact” describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by Sowler & Stoffberg (2012) based on species distributions, altitudes at which they fly and distances they travel.

Table 3: Table of species that may be roosting or foraging on the study area, the possible site specific roosts, and their probability of occurrence based on literature (Monadjem et al., 2010).

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Probability of occurrence (%)</th>
<th>Conservation status</th>
<th>Possible roosting habitat to be utilized on study area</th>
<th>Foraging Habits (indicative of possible foraging sites in study area)</th>
<th>Likely Risk of Impact (Sowler &amp; Stoffberg, 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinolophus clivosus</td>
<td>Geoffroy’s horseshoe bat</td>
<td>20 - 30</td>
<td>Least Concern</td>
<td>Roosts in caves and rocky hollows, associated with arid savanna, woodland and riparian forest. The mountainous terrain in the area may provide rocky hollows, two small caves present.</td>
<td>Clutter forager, may possibly utilise sheltered rocky outcrop areas.</td>
<td>Low</td>
</tr>
<tr>
<td>Rhinolophus darlingi</td>
<td>Darling’s horseshoe bat</td>
<td>20 - 30</td>
<td>Least Concern</td>
<td>Roosts in caves and mine adits associated with arid savannah. Mountainous characteristics of the area do provide small caves.</td>
<td>Clutter forager, may possibly utilise sheltered rocky outcrop areas.</td>
<td>Low</td>
</tr>
<tr>
<td>Nycteris thebaica</td>
<td>Egyptian slit-faced bat</td>
<td>40 - 50</td>
<td>Least Concern</td>
<td>Roosts in caves, aardvark burrows, road culverts, and trunks of large trees. It appears to occur throughout savannah and Karoo biomes.</td>
<td>Clutter forager, may possibly utilise sheltered rocky outcrop areas.</td>
<td>Low</td>
</tr>
<tr>
<td>Sauromys petrophilus</td>
<td>Roberts’s flat-headed bat</td>
<td>70 - 80</td>
<td>Least Concern</td>
<td>Roost in narrow cracks and under slabs of exfoliating rock. Species is closely associated with rocky habitats in drywoodland, mountain fynbos and arid scrub.</td>
<td>Open air forager.</td>
<td>High</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Conservation Status</td>
<td>Range</td>
<td>Diet Model</td>
<td>Diet Model Details</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------</td>
<td>-----------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><em>Tadarida aegyptiaca</em></td>
<td>Egyptian freetailed bat</td>
<td>Least Concern</td>
<td>Roost in caves, rock crevices, under exfoliating rocks, in hollow trees, behind the bark of dead trees, and in roofs of houses.</td>
<td>Open空气 forager.</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td><em>Miniopterus natalensis</em></td>
<td>Natal long-fingered bat</td>
<td>Near threatened</td>
<td>Cave-dependent. May use small caves on site for night stops. Current caves too small for day roosting, but possibility remains for larger unknown chambers.</td>
<td>Clutter-edge forager, may possibly forage along edges of rocky outcrops.</td>
<td>Medium - High</td>
<td></td>
</tr>
<tr>
<td><em>Cistugo seabrae</em></td>
<td>Angolan wing-gland bat</td>
<td>Near threatened</td>
<td>It is restricted to the arid western parts of southern Africa, typically in desert and semi-desert conditions. Not a common bat.</td>
<td>Not well known, once netted at a dry stream bed in 2006 close to Vredesvallei.</td>
<td>Not well known.</td>
<td></td>
</tr>
<tr>
<td><em>Eptesicus hottentotus</em></td>
<td>Long-tailed serotine</td>
<td>Least Concern</td>
<td>Roosts in caves and rock crevices, usually netted near rocky outcrops.</td>
<td>Clutter-edge forager, may possibly forage along edges of rocky outcrops.</td>
<td>Medium - High</td>
<td></td>
</tr>
<tr>
<td><em>Myotis tricolor</em></td>
<td>Temminck’s myotis</td>
<td>Least Concern</td>
<td>Cave-dependent. May use small caves as day roost.</td>
<td>Clutter-edge forager, may possibly forage along edges of rocky outcrops.</td>
<td>Medium - High</td>
<td></td>
</tr>
<tr>
<td><em>Neoromicia capensis</em></td>
<td>Cape serotine</td>
<td>Least Concern</td>
<td>Roosts under bark of trees, at the base of aloe leaves and under the roofs of houses.</td>
<td>Clutter-edge forager, may possibly forage along edges of rocky outcrops.</td>
<td>Medium - High</td>
<td></td>
</tr>
</tbody>
</table>
3.2 Surface rock, topography, climate, surface water and vegetation

Precipitation in the site area is very low, and channels or streams of any kind cannot be regarded as sustainable, such that surface water on this site is very limited. This reduces the sites’ probability of use as a foraging area.

The site is found at a relatively high altitude with rocky outcrops in the north-west corner of the site (Figure 5). These will support bat roosts, the two small caves found (Figure 6) can offer some additional roosting space. Apart from the outcrops the terrain is relatively flat and featureless in the south eastern regions (Figure 7). The farm buildings can also provide suitable roosting spaces.

Figure 5: Typical rocky outcrops found in the north west of the site.
Figure 6: Small cave A (top) and small cave B (bottom).
Figure 7: The flat and relatively featureless terrain of the south eastern part of the site.
3.3 Bat detection

Figure 8: Spatial presentation of bats detected on site by means of transects.
3.4 Sensitivity map

These sensitivities are based on the findings of bat detection during the site visit and the probability of certain features and habitats to be utilised for roosting foraging purposes (see Table 1).

The High Bat Sensitivity areas are expected to have elevated levels of bat activity and possibly support greater bat diversity. High Bat Sensitivity areas are ‘no – go’ areas due to expected elevated rates of bat fatalities due to wind turbines. These areas were designated 500m radial buffer zones due to the open terrain and therefore larger expected foraging ranges.

Proposed turbines located within Moderate Bat Sensitivity areas and their respective buffer must receive special attention and preference with regards to bat monitoring and implementation of mitigations during the operational phase. These turbines within Moderate Bat Sensitivity areas and buffer zones must thus be prioritised for mitigation.

No proposed turbines are located within any High Bat sensitivity areas.

The possible *Cistugo seabrae* or *Miniopterus natalensis* call was one single bat call with a dominant frequency of approximately 49.4 and a short duration of 4.7ms, rendering it uncertain between the two species. Although *Cistugo seabrae* is endemic to South Africa it is considered to have a low threat from Wind Energy Facilities by Sowler & Stoffberg (2012) and was found within a high sensitivity area.

**Table 4:** Description of sensitivity categories utilized in the sensitivity map

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate Sensitivity</td>
<td>Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology. Turbines within these areas must acquire priority for post-construction monitoring and mitigation measures.</td>
</tr>
<tr>
<td>High Sensitivity</td>
<td>Areas that are deemed critical for resident bat populations. These areas are ‘no-go’ areas and turbines or solar panels must not be placed in these areas.</td>
</tr>
</tbody>
</table>
Site boundary
- Proposed turbine locations
- High bat sensitivity

Tracks traversed
- Solar focus area
- High bat sensitivity 500m buffer

Tadarida aegyptiaca
- Possibly Cistugo seabrae or Miniopterus natalensis

Figure 9: Bat sensitivity map.
Figure 9: Bat sensitivity map of the north western part of the study site.
4. FORESEEN IMPACTS OF THE PROPOSED OPERATION and PROPOSED TERMS OF REFERENCE FOR ASSESSING/ADDRESSING THE ISSUES

4.1 Construction phase

4.1.1 Destruction of foraging habitat

Limited foraging habitat will be destroyed by the construction of the turbines and solar panels. This impact will be effective during the lifespan of the wind farm.

Proposed mitigation measures and recommendations

The placement of turbines or solar panels within areas identified as having a High Bat Sensitivity (Figures 8 - 9) should be avoided.

These areas must be avoided when the placement of associated infrastructure is considered. If possible, underground cabling should not be laid in these areas. If cabling is located within these areas, vegetation rehabilitation can be carried out to rectify this impact.

Significance Statement

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Total Score</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporal Scale</td>
<td>Spatial Scale</td>
<td>Severity of Impact</td>
<td></td>
</tr>
<tr>
<td>Without mitigation</td>
<td>Long Term</td>
<td>3</td>
<td>Study Area</td>
<td>2</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Long Term</td>
<td>3</td>
<td>Study Area</td>
<td>2</td>
</tr>
<tr>
<td>No-go option</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

4.2 Operational phase

4.2.1 Bat mortalities due to blade collisions and barotrauma during foraging

In section 1.5 the concern of bats and possible wind turbine blade collisions/barotrauma have been mentioned, but yet international research and experiments are unable to suggest sustainable large scale mitigation measures that can move this threat to a category of no concern.

Proposed mitigation measures and recommendations

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area. Therefore areas designated as having a High Bat Sensitivity (Figures 8 – 9) must be avoided in turbine placement; additionally areas of Moderate Bat Sensitivity must receive special attention and be prioritised in post construction monitoring and implementation of mitigation measures.
Curtailment is an operational phase mitigation measure that can be implemented to lessen bat mortalities caused by direct collisions with turbine blades. Curtailment is the practice of maintaining the turbine blades stationary or ‘locked’ at low wind speeds, and once the wind exceeds a specified speed the blades are then allowed to rotate normally. The theory behind curtailment is that there exists a negative correlation between bat activity and wind speed, causing bat activity to decline as wind speed increases.

Baerwald et al. (2008) carried out a study wherein the wind speed trigger of 15 turbines, on an operational wind farm in south-western Alberta, was altered. Under normal circumstances the turbine blades turn slowly in low wind speeds, however they only begin to generate electricity when the wind speed reaches 4 m/s. During the experiment, the Vestas V80 type turbines were kept stationary during low wind speeds and only allowed to start turning and generating electricity at a cut-in speed of 5.5 m/s. During the peak bat fatality period, curtailment showed a reduction of bat fatalities by 60%.

Another strategy (used in the same experiment) involved altering blade angles to reduce rotor speed in low wind speed conditions, such that the blades were near motionless. This resulted in a significant 57.5% reduction in bat fatalities.

Long term field experiments and studies done by Arnett et al. (2010) in Somerset County, Pennsylvania, showed a 44 – 93% reduction in bat fatalities, with marginal annual power generation loss, when curtailment was implemented. Their study concluded that curtailment can be used as an effective mitigation measure to reduce bat fatalities at wind energy facilities. However, when using a cut-in speed of 6.5 m/s the annual power loss was 3 times higher than when implementing a 5.0 m/s cut-in speed.

It is important to note that the above mentioned experiments were applied only during peak bat activity periods, such as migratory seasons, which explains the resulting low annual energy production loss measured.

No such peak periods are predicted for this site, which would result in a higher annual energy production loss if curtailment is applied throughout most of the year. Therefore correct placement of turbines are crucial and the recommended mitigation measure, which means that no turbines should be placed in areas of High bat sensitivity identified during the EIA phase as well as the pre-construction monitoring phase. The pre-construction monitoring would inform if any additional mitigation measures (e.g. acoustic bat deterrents) may be required on any other turbines, especially those located within areas of Moderate bat sensitivity.

A further mitigation measures involves the use of ultrasonic deterrent devices to repel bats from wind turbines. The device emits ultrasonic sound in a broad range that is inaudible to humans. This ultrasonic sound repels bats from wind turbines by creating a disorientating or irritating airspace around the turbine. Research in the field of ultrasonic deterrent devices is progressing and yielding some promising results, although controversy about the effectiveness and a lack of large scale experimental evidence exists.

Szewczak & Arnett (2008) performed a study involving the comparison of bat activity in the presence of an acoustic deterrent device and without the deterrent. The study showed that when ultrasound was broadcasted, only 2.5-10.4% of the control activity rate was observed. Other studies demonstrating the usefulness of the deterrent devices were carried out by Spanjer (2006) and Horn et al. (2008).

It may be feasible to install such devices on selected functional turbines within the Moderate Bat Sensitivity areas, with the results being monitored by an appropriately qualified researcher. Progression in the technology of such devices can possibly yield favourable results.
Pre-construction monitoring is recommended for at least four seasons at the proposed wind energy facility, focusing efforts on the Moderate bat sensitivity areas and the two small caves on site. Post-construction monitoring is optional for this site, and the need for it as well as the methodologies can be informed by the pre-construction assessment results. The results of these monitoring studies should inform mitigation measures, if any, should be implemented.

### Significance Statement

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Total Score</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Go ahead option</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without mitigation</td>
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<td></td>
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<tr>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
</tr>
<tr>
<td>With mitigation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 4.2.2 Bat mortalities due to blade collisions and barotrauma during migration

The migration paths of South African bats in the Cape Provinces are virtually unknown. Cave dwelling species like *Miniopterus natalensis* and *Myotis tricolor* undertake annual migrations, the caves on the Kangnas site can possibly provide roosting space for the above mentioned bat species. Although it is unlikely that these caves can support large migratory colonies, and no signs of bats were found in these caves.

**Proposed mitigation measures and recommendations**

It will be beneficial to collaborate with academic institutions to promote research on the subject, post construction monitoring, focusing on these caves, is recommended.

### Significance Statement

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Total Score</th>
<th>Overall Significance</th>
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<tr>
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<td>Regional</td>
<td>Moderate</td>
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<td>9</td>
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<tr>
<td>With mitigation</td>
<td>Long Term</td>
<td>Regional</td>
<td>Slight</td>
<td>Unlikely</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td><strong>No-go option</strong></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Without mitigation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>With mitigation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 4.3 Decommissioning phase

No impacts identified.
5. CONCLUSION

The Kangnas site does not display a high potential to support a high diversity or abundance of bats. Roosting space are moderately available, but the lack of open water sources and relatively low insect food abundance, does not allow for the support of large bat colonies.

No proposed turbines fall within a high bat sensitivity area or the associated buffer, proposed turbines within Moderate Bat Sensitivity areas should be prioritized in post-construction monitoring and implementation of possible mitigation measures that may possibly follow from post-construction monitoring.

Pre-construction monitoring is recommended for at least four seasons at the proposed wind energy facility, focusing efforts on the Moderate bat sensitivity areas and the two small caves on site. Post-construction monitoring is optional for this site, and the need for it as well as the methodologies can be informed by the pre-construction assessment results. The results of these monitoring studies should inform mitigation measures, if any, should be implemented.

Possible mitigations that may follow post-construction monitoring may include a curtailment method which entails the blades to be stationary only at low wind speeds (below manufacturer’s recommended cut in speed), and using the manufacturer’s recommended cut in speed. This will be more economical and may be sufficient for this site.
6. REFERENCES


iii) BAERWALD EF, D’AMOURS GH, KLUG BJ & BARCLAY RMR, 2008, Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology Vol 18 No 16.


7. APPENDIX A

**Animalia methodology for assessing the significance of impacts**

To ensure a direct comparison between various specialist studies, a standard rating scale has been defined and will be used to assess and quantify the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. Five factors need to be considered when assessing the significance of impacts, namely:

1. Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
2. Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.
3. The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system. The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word ‘mitigation’ means not just ‘compensation’, but also the ideas of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.
4. The **likelihood** of the impact occurring - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur, and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Each criterion is ranked with scores assigned as presented in Table 1-1 to determine the overall **significance** of an activity. The criterion is then considered in two categories, viz. effect of the activity and the likelihood of the impact. The total scores recorded for the effect and likelihood are then read off the matrix presented in Table 1-2, to determine the overall significance of the impact (Table 1-3). The overall significance is either negative or positive.

The **environmental significance** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgement.

Negative impacts that are ranked as being of “**VERY HIGH**” and “**HIGH**” significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. lots of **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of “**MODERATE**” significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as “**LOW**” significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.
### Table 1-1: Criterion used to rate the significance of an impact

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td>Short term</td>
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</tr>
<tr>
<td>Medium term</td>
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<tr>
<td>Long term</td>
<td>3</td>
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<tr>
<td>Permanent</td>
<td>4</td>
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<table>
<thead>
<tr>
<th>Spatial Scale</th>
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<tr>
<td>Localised</td>
<td>1</td>
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<tr>
<td>Study area</td>
<td>2</td>
</tr>
<tr>
<td>Regional</td>
<td>3</td>
</tr>
<tr>
<td>National</td>
<td>3</td>
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<tr>
<td>International</td>
<td>4</td>
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**Effect**

<table>
<thead>
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<td>May Occur</td>
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<tr>
<td>Probable</td>
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</tr>
<tr>
<td>Definite</td>
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</table>

<table>
<thead>
<tr>
<th>Severity</th>
<th>If Beneficial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight / Slightly Beneficial</td>
<td>Slightly beneficial to the affected system(s) or party (ies)</td>
</tr>
<tr>
<td>Moderate / Moderately Beneficial</td>
<td>An impact of real benefit to the affected system(s) or party (ies)</td>
</tr>
<tr>
<td>Severe / Beneficial</td>
<td>A substantial benefit to the affected system(s) or party (ies)</td>
</tr>
<tr>
<td>Very Severe / Very Beneficial</td>
<td>A very substantial benefit to the affected system(s) or party (ies)</td>
</tr>
</tbody>
</table>

### Table 1-2: The matrix that will be used for determining SIGNIFICANCE by using the EFFECT and the LIKELIHOOD of occurrence; EFFECT is the sum of the spatial, temporal and severity factors.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Effect</th>
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<tr>
<td></td>
<td>3 4 5 6 7 8 9 10 11 12 13 14 15 16</td>
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<td>7 8 9 10 11 12 13 14 15 16 17 18 19 20</td>
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Table 1-3: The significance rating scale

<table>
<thead>
<tr>
<th>Significance</th>
<th>Description</th>
<th>Positive Score</th>
<th>Negative Score</th>
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<tr>
<td>Low</td>
<td>An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects on the social and/or natural environment.</td>
<td>4-7</td>
<td>4-7</td>
</tr>
<tr>
<td>Moderate</td>
<td>An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.</td>
<td>8-11</td>
<td>8-11</td>
</tr>
<tr>
<td>High</td>
<td>A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the (natural &amp;/or social) environment and result in severe effects or beneficial effects.</td>
<td>12-15</td>
<td>12-15</td>
</tr>
<tr>
<td>Very High</td>
<td>A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are unmitigable and usually result in very severe effects, or very beneficial effects.</td>
<td>16-20</td>
<td>16-20</td>
</tr>
</tbody>
</table>
8. **APPENDIX B - Specialist declaration of interest**

![Environmental Affairs Logo]

---

**DETAILS OF SPECIALIST AND DECLARATION OF INTEREST**

<table>
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<tr>
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<td>DEAT/EIA/</td>
</tr>
<tr>
<td>Date Received:</td>
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**PROJECT TITLE**

*Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape*

<table>
<thead>
<tr>
<th>Specialist:</th>
<th>Werner Marais</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person:</td>
<td>Werner Marais</td>
</tr>
<tr>
<td>Postal address:</td>
<td>P.O. Box 6892, Weltevredenpark, Gauteng</td>
</tr>
<tr>
<td>Postal code:</td>
<td>1715</td>
</tr>
<tr>
<td>Telephone:</td>
<td>078 190 3316</td>
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<td>Cell:</td>
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</tr>
<tr>
<td>Fax:</td>
<td></td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:werner@animalia-consult.co.za">werner@animalia-consult.co.za</a></td>
</tr>
<tr>
<td>Professional affiliation(s) (if any)</td>
<td>Pr.Sci.Nat. (Zoological Science), SACNASP, reg nr: 400169/10</td>
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**Project Consultant:**

*Aurecon South Africa (Pty) Ltd*

<table>
<thead>
<tr>
<th>Contact person:</th>
<th>Louise Corbett / Cornelia Steyn</th>
</tr>
</thead>
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</tr>
<tr>
<td>Postal code:</td>
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<td>Fax:</td>
<td>021-526-9400</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:Louise.corbett@aurecongroup.com">Louise.corbett@aurecongroup.com</a> / <a href="mailto:cornelia.steyn@aurecongroup.com">cornelia.steyn@aurecongroup.com</a></td>
</tr>
</tbody>
</table>
4.2 The specialist appointed in terms of the Regulations...

I, Werner Marais, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):
Animalia Zoological & Ecological Consultation CC

Date: 31 August 2012
Compiled by:

Werner Marais
Zoologist and Ecologist
MSc (Biodiversity & Conservation, UJ)
Pr.Sci.Nat. – SACNASP
(Zoological Science)
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Annexure G2
Hi Corlie,

The new layout is considerate towards areas of bat sensitivity and no turbines are in High or moderate bat sensitivity areas or their buffers. So therefore the negative impact significance is lowered as follows:

Without mitigation:         Low -
With mitigation:                Low -

This applies to both operational, and construction phases as well as foraging and migration impacts.

Best regards

Werner Marais
Pr.Sci.Nat. (Zoological Science)
MSc (Biodiversity & Conservation)
Animalia Zoological & Ecological Consultation CC
(+27) 78 190 3316
www.animalia-consult.co.za

Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON’T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Corlie Steyn | Environmental Management
Environmental Practitioner | Aurecon
T +27 44 805 5421  | M +27 82 575 7415
Annexure H1
EXECUTIVE SUMMARY

ACO Associates cc was contracted by Aurecon South Africa (Pty) Ltd to assess the impact to heritage resources that might occur through construction of a wind energy facility (WEF) and a photo-voltaic solar energy facilities (PV) and/or concentrating photo-voltaic CPV on farms between Springbok and Aggeneys in the Northern Cape Province (Figure 1). The following farm portions are affected:

- Farm Areb 75/remainder;
- Farm Kangnas 77/remainder;
- Farm Kangnas 77/portion 3;
- Farm Koeris 78/portion 1; and
- Farm Smorgen Schaduwe 127/remainder.

No layouts were provided as the proponent wishes to design a layout that will have the least impacts to the environment based on specialist studies and, as such, only focus areas were provided for assessment. However, the solar facility would cover approximately 1000 ha and the wind facility would have between 185 and 500 turbines.

A literature survey set the heritage context for the development, while a six day field survey aimed to record as many heritage resources as possible so as to understand the heritage landscape well. Sites were photographed and their locations taken by means of a GPS.

The environment consists of two strongly contrasting landforms; flat open grasslands and rocky hills. Several pans also occur in the area.

A large number of heritage resources were found, some of which were deemed highly significant. These resources varied from background scatters of stone artefacts (very low significance) to rock art and graves (very high significance) to farm werfs and historical features (generally medium to high significance). The majority of resources occurred in clusters such that buffer zones could be proposed to ensure their protection. Five areas have buffer zones suggested, while one further site should be excluded from development but does not warrant a buffer around it. All of these lie within the wind focus area.

Overall it is found that the site is suitable for the proposed developments, so long as the suggested buffers are implemented. The solar energy facility will likely have very low impacts to archaeology and medium significance impacts to the landscape and scenic resources. The wind energy facility could result in archaeological impacts of high significance, but with the suggested buffers being implemented then these will be reduced to very low. Landscape and scenic impacts will be of medium significance. The grid connection power line from the wind focus area will need rerouting to avoid one of the sensitive archaeological areas.

It is recommended that the proposed developments should be allowed to proceed but subject to the following conditions:

- All buffers and no-go areas stipulated in this report must be adhered to for both the facilities and all roads and power lines;
- Should any human remains be uncovered during development they must be immediately protected in situ and reported to the heritage authorities or to an archaeologist. The remains will need to be exhumed at the cost of the developer;
• All construction and maintenance crew and vehicles (except small vehicles which may use existing farm tracks) should be kept out of the buffer zones.
• The final layout should be shown to the appointed archaeologist before implementation to confirm that all significant heritage resources have been adequately protected.

Declaration of independence:

I, Jayson Orton, am an independent specialist consultant who is in no way connected with the proponent, other than in terms of the delivery of consulting services.

I hold a Masters degree in archaeology and have been consulting since 2004 in the Northern, Eastern and Western Cape Provinces. I am an accredited Principal Investigator with the Association of Southern African Professional Archaeologists (ASAPA, member No. 233).
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1. INTRODUCTION

ACO Associates cc was contracted by Aurecon South Africa (Pty) Ltd to assess the impact to heritage resources that might occur through construction of a wind energy facility (WEF) and a photovoltaic (PV) and/or concentrating photovoltaic (CPV) solar energy facility (PV) on farms between Springbok and Aggeneys in the Northern Cape Province (Figure 1). The following farm portions are affected:

- Farm Areb 75/remainder;
- Farm Kangnas 77/remainder;
- Farm Kangnas 77/portion 3;
- Farm Koeris 78/portion 1; and
- Farm Smorgen Schaduwe 127/remainder (Figure 1).

![Map showing the location of the affected farm portions. Most lie just south of the N14 which runs from Springbok in the west to Aggeneys and Pofadder in the east.](image)

No layout for either wind or solar energy generation was provided for assessment, since the proponent wishes to produce a realistic layout after receiving all the constraints from the specialist studies. However, we were provided with areas on which to focus for each of the proposed developments (Figure 2).

The project description is also still quite broad and only the following details are as yet available from the Draft Scoping Report (Aurecon 2012):

**Wind:**
- Between 185 and 500 turbines of between 1.5 and 4 MW each;
- Maximum total generating capacity of 750 MW; and
• Turbine foundations would be approximately 20 m by 20 m and 3 m deep.

Solar:
• Total generating capacity of 250 MW;
• Either PV or CPV technology will be used; and
• Total land area will be approximately 1000 ha.

Figure 2: Aerial view of the study area showing the land available for development after the initial feasibility and scoping studies (black outlines) and the areas to be focused on for solar (yellow) and wind (blue).

1.1. Terms of reference

ACO Associates cc was asked to:

• Conduct a detailed desk-top level investigation to identify known archaeological, cultural and historic sites in the proposed development areas;
• Undertake field work to verify the results of the desktop investigation;
• Document (GPS coordinates and map) all sites, objects and structures identified;
• Compile a report which would include:
  o Identification of archaeological, cultural and historic sites within the proposed development areas;
  o Assess the sensitivity and significance of all heritage remains on the site;
o Evaluate the potential impacts of construction, operation and maintenance of the proposed development on heritage resources, in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the duration of the impact (construction, up to 10 years after construction (medium term), more than 10 years after construction (long term));

o Recommend mitigation measures to ameliorate any negative impacts on areas of heritage importance;

• Prepare a heritage resources management plan which includes recommendations on the management of the objects, sites or features, and also guidelines on procedures to be implemented if previously unidentified cultural resources are uncovered during later developments in the area;

• Consider relevant guidelines; and

• Consider the Department of Environmental Affairs and Development Planning guideline: “Guideline for involving heritage specialists in EIA processes” (Winter & Baumann 2005).

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources including palaeontological, prehistoric and historical material (including ruins) more than 100 years old (Section 35), human remains older than 60 years and located outside of a formal cemetery administered by a local authority (Section 36) and non-ruined structures older than 60 years (Section 34). Landscapes with cultural significance are also protected under the definition of the National Estate: Section 3 (3.2d). Section 38 (2a) states that if there is reason to believe that heritage resources will be affected then an Impact Assessment Report must be submitted. This report fulfils that requirement.

Since the project is subject to an Environmental Impact Assessment (EIA), Heritage Northern Cape and the South African Heritage Resources Agency are required to provide comment on the proposed project in order to facilitate final decision making by the Department of Environmental Affairs (DEA).

3. METHODS

3.1. Literature survey

A survey of available literature was carried out to assess the general heritage context into which the development was to be set. This literature included published material, unpublished commercial reports, a desktop fatal flaw analysis done by ACO and online material, and helped focus the field survey.

3.2. Field survey

The site was subjected to a combination of driving and walking surveys, during which the positions of finds were recorded on a hand-held GPS receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape settings of the proposed developments. Due to the immense size of the study area, focus was placed on understanding the archaeological landscape so as to be able to effectively predict where archaeological resources would most
likely be found. The survey was carried out between 23\textsuperscript{rd} July and 28\textsuperscript{th} July 2012 inclusive. It should be noted that the use of binoculars at regular intervals was a key factor in locating parts of the landscape that were likely to be more sensitive and it is believed that no highly significant heritage resources would have been missed. Figure 3 shows the coverage of the survey.

Site names were allocated to all important heritage finds and these are based on three components: (1) a three letter acronym for the farm, a year to allow extension of the system into the future, and a consecutive number for the site for that year. So SMS2012/003 is the third site found in 2012 on Smorgen Schaduwe.

![Figure 3: Aerial view of the study area showing the tracks (blue lines) created during the survey.](image)

### 3.3. Impact assessment

The impact assessment ratings were estimated using a scale supplied by Aurecon as per their Draft Scoping Report. Criteria for each rating were described and the significance is worked out based on various combinations of the magnitude, extent and duration of impacts.

### 3.4. Limitations

The sheer immensity of the site precluded a detailed examination of the entire layout but it is anticipated that, through the survey methodology outlined above, we have gained a good understanding of the site and have located all the most important heritage resources.
4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The landscape on and around the study area is dominated by two strongly contrasting characters: low rocky inselbergs and ranges of hills dot the landscape, while in between them the land is very flat grassland (Figures 4 & 5). Within the latter, however, are several low rocky outcrops, sometimes heavily weathered and gravel-coated (Figures 6 & 7) and a number of pans (Figures 8 & 9), some of which also have exposed bedrock within them. The open areas are covered in grass and small shrubs and many farm tracks criss-cross the area (Figure 10).

Figure 4: View towards the southeast across the centre of Smorgen Schaduwe. Note the small orange-coloured hill (“Orange Hill” as referred to in Section 7.1) in the middle which is a very sensitive area for heritage. The rocky hills and open, very flat grasslands are obvious.

Figure 5: View towards the southeast across the centre of Smorgen Schaduwe and taken from the summit of the orange hill in Figure 3.

Figure 6: View towards the southwest near the south-western boundary of Kangnas showing a granite outcrop in the middle of the grassland. For scale, the white spot to the right of the hill is the vehicle.
Figure 7: View towards the southwest across Kangnas from a rocky hill in the far north of Kangnas. The extensive flat grasslands across the eastern part of the study area is evident.

Figure 8: One of the many small pans, this one in the southern part of Kangnas.

Figure 9: Exposed bedrock in the largest pan at Kangnas.

Figure 10: Open plains and farm tracks on Kangnas.
5. HERITAGE CONTEXT

5.1. Palaeontology

The farm Kangnas is believed to be the original discovery site of the dinosaur known as *Kangnasaurus coetzeei*. The fossil was named by Sidney Haughton in 1915, the generic name referring to the farm and the specific name to the farmer, Coetzee. It is based on holotype SAM 2732, a tooth found at a depth of 34 m in a well on the farm (Haughton 1915, cited in Wikipedia 2011). The age of the rocks, which are conglomerates in an ancient crater lake, is unclear but they are thought to be from the Early Cretaceous (Ruiz-Omeñaca et al. 2007, cited in Wikipedia 2011). Haughton considered the tooth an iguanodontid, but later reassessment considers it to be a more basal ornithopod, such as a Dryosaurus (Cooper 1985). Haughton also described several other fossils possibly also belonging to Kangnasaurus, and these included several partial thigh bones, etc. Some of these bones came from other deposits and Haughton was not sure that they all belonged to the new genus. Kangnasaurus is regarded as a dubious specimen by some (Sues & Norman 1990, Norman 2004, both cited in Wikipedia 2011), Ruiz-Omeñaca et al. (2007, cited in Wikipedia 2011) still thought it potentially valid.

Another potentially significant palaeontological/geological feature relates to the unconfirmed reports that a meteorite impact crater exists near Kangnas, to the south of the present site. This was reported by the landowner, but consultation with various geologists has failed to yield any further information in this regard. None had heard of the possibility. Those consulted by us include:

- Dr John Rogers (retired, UCT);
- Associate Professor John Compton (UCT);
- Professor David Reid (UCT);
- Mr Greg Moseley (private geological consultant); and
- Dr Chris Hartnady (consultant, Umvoto).

In addition, Aurecon (2012) consulted with:
- Mr Hendrik Minnaar (Council for Geoscience in Upington); and
- Professor Chris Harris (UCT), who produced a report based on a site visit.

Harris (2012) suggested that the crater may have been the result of the eruption of an olivine melilitite pipe, of which several are known from an area some 10-30 km to the east. He considered it also possible, though less likely, that the crater was the result of a meteorite impact.

5.2. Archaeology

Although little archaeological research has been conducted in the general area around Kangnas, several impact assessment studies have been conducted in recent years. These form the basis of the present background review.

Early (ESA) and Middle Stone Age (MSA) material, including manufacturing sites, have been found on the northern slopes of the Gamsberg, probably positioned so as to gain easy access to a source of stone material on the mountain. Suitable flaking rock is apparently not easily available on the plains (D. Morris 2010). Pelser (2011) reported MSA and Later Stone Age (LSA) material in an area around the Paulputs substation near Pofadder, although his
illustrations appear to be of LSA artefacts made on quartz. He also mentions the presence of ostrich eggshell. East of Aggeneys, Webley and Halkett (2012) found a background scatter of predominantly quartz, and some quartzite artefacts. The material is particularly prevalent in those areas where the soil surface is covered in quartz pebbles and cobbles. The size of the artefacts suggests that they pertain to the Middle Stone Age but diagnostic MSA features were absent. In general, the scatter of stone tools is very widely distributed and does not appear to be concentrated in any specific location.

According to D. Morris (2011a) LSA sites are the predominant archaeological trace noted in surveys in the Aggeneys-Pofadder region, although his survey of the northern slopes of the Gamsberg identified very few isolated LSA flakes (D. Morris 2010). However, on the plains below the mountain he did find three LSA settlements. To the northwest of the Gamsberg, he located two stone cairns which could represent graves, as well as a ceramic LSA site. These sites all lie at least 50 km away to the northwest and probably represent transient settlement by transhumant hunter-gatherers or herders that moved through the area. Beaumont et al. (1995:263) noted that most LSA sites then known in Bushmanland appeared to be ephemeral occupations by small groups of people in the hinterland both north and south of the Orange River. This was in sharp contrast to the substantial herder encampments along the Orange River floodplain itself. Away from the river, LSA material, mainly quartz flakes, appears to often be focused around the base of granite hills (D. Morris 2011a, b & c; Pelser 2011; Webley & Halkett 2011). Beaumont et al. (1995) agree and add that red dunes and the margins of seasonal pans also served as foci for LSA occupation.

Webley (pers. comm. 2012) visited Kangnas in 1987. The first cave with rock art (described below) had many grinding grooves in the bedrock nearby. The back of one cave had been used as a lair, but part of it contained a very shallow ashy deposit, with ostrich eggshell fragments and one bead, stone artefacts, and some black glass artefacts on the talus slope. The floor of the second shelter was covered in gravel brought in by the farmer who used to barbecue in the shelter. It too contained grinding grooves in the bedrock, some stone artefacts, ostrich eggshell and a trade bead. The stony ridges contained “klipbakke” which retained water in summer, making this an attractive location of prehistoric settlement. Webley observed fragments of ostrich eggshell, stone artefacts and bottle glass artefacts as well as a few potsherds around the ridges.

Despite the above observations, archaeological remains are likely to be patchy since, in a 15 km linear survey between Pofadder and Pella, Halkett (2010) failed to record any archaeological material. In general, D. Morris (2011c) notes that archaeological finds around Aggeneys and Pofadder are sparse.

Rock art is known from the region. Rudner and Rudner (1968) note the scarcity of suitable rock canvases and that art is sparsely distributed through the region. Engravings occur along the Orange River (D. Morris 1998) where suitable rock exists, while in the rocky areas away from the river there are rare rock paintings. Rudner and Rudner (1968:80-81) described the paintings on the farm Kangnas as follows:

“The paintings on this farm on the road to Pofadder are in a quartzite cave on the northern side of a ravine; on the sooty roof of the cave are crude black handprints and double-headed axe-like designs made in what appears to be black (burnt?) wax, which, when scratched, turned white. Where the pictures had weathered off, a greyish-white image remained. Grey designs are superimposed on red geometric designs.

“In a cave on the opposite side of the ravine are designs in white superimposed by red-brown ones. In this cave there is also an engraving of a wheel, which is probably of European origin as there are initials
engraved next to it. A few stone implements were found in these caves, including a crescent in clear quartz, a few potsherd s of thin Hottentot ware and some flakes in glass. (SAM 6753.) These caves were mentioned by W. C. Scully (Wilman, 1933), who stated that Bushmen were known to have lived there.

Further to the east, rock art occurs near the pan of Gobees. Rudner and Rudner (1968:81) described the art:

“The in southern corner of this farm near a small pan a large east-facing shelter contains paintings-crude gemsbok in faded red and some shield-like designs in maroon superimposed by white designs. The names of early visitors are pecked across the maroon pictures with the date 1879, providing us with an upper date for these paintings. Inside and outside this shelter we found a rich Wilton industry containing one large crescent and many small side-scrapers, some of them on reworked Middle Stone Age tools, two thumbnail scrapers, two small bead borers and a few potsherd s of Hottentot-type, one with signs of an external lug (Namaqua pot?). (SAM 6751-2.) Some of this pottery has a coarse sand admixture (Rudner, in press).”

Historical accounts of travels through southern Africa frequently provide clues to the pre-colonial occupation of the land. In this case, two travellers, John Barrow and George Thompson, passed through this area leaving observations on the local population.

Barrow (1801:387) wrote of the plains between the Kamiesberg Mountains and the Orange River that:

“These plains are now desolate and uninhabited. All those numerous tribes of Namaaquas, possessed of vast herds of cattle, are, in the course of less than half a century, dwindled away to four hordes, which are not very numerous, and in a great measure subservient to the Dutch peasantry, who dwell among them.”

Thompsom (1824:288) noted the following:

“The extensive plains, lying between the Gariep and the Kamiesberg, are represented, by old writers, as occupied by a numerous race of people, possessed of large flocks and herds, and living in ease and abundance. Of these, the tribe now resident at Pella and its vicinity, is the only one remaining.”

Both texts show that the area was well inhabited in the past but that colonial expansion was taking its toll on the indigenous inhabitants. Nevertheless, these observations suggest that archaeological remains, at least pertaining to the more recent prehistoric period, should be abundant on the landscape.

5.3. History

The nearest towns to the west of the study area are Springbok, O’Kiep, Concordia and Carolusberg. These owe their origins primarily to the 19th century copper mining industry and preserve extensive mining and Anglo-Boer War heritage. To the east Aggenys is a modern mining town and Pofadder and Pella are 19th century mission settlements (Northern Cape Tourism Board 2007).

A close examination of the 1906 map in Figure 11 shows how scarce water is on the landscape. This and the fact that the area is so remote probably led to the area being surveyed so late. The four adjoining farms of Areb 75, Kangnas 77, Karas 76 and Smorgen Schaduwe 127, were all surveyed in 1893. However, European graffiti (1879) is present at Kangnas testifying to the earlier use of the area by colonial settlers (Aurecon 2012). Interestingly Kangnas is labelled as Kannas near the centre of the map. This point marks Kangas Poort.
Figure 11: Military Map of 1906 showing the position of wagon tracks and sources of water around Kangnas and Smorgen Schaduwe. Note that there are water holes on the top of the Karas Berg. Goubies Vlei (Goobees) was reported to contain “small quantity of water obtained by digging, after rain”. There are also the icons for huts, positioned to the north of the Karas Berg, above the phrase “wells, occasional water”. The red dashed line shows the present position of the N14 and the small yellow dot the location of the Anglo-Boer War remains discussed in Section 6.3 below.

Very few records pertaining to Kangnas were available from the Cape Archives. A lease was held over the farm in 1987 by WC Dixon and it was owned by DJ Coetzee between 1914 and 1916. The road through Kangnas Poort, where Figure 11 shows water to have been available, was closed in 1918. According to Nienaber & Raper (1977) the name Kangnas is derived from the Nama word !gai!na which means “string a bow”. This is in line with the explanation by a local farmer (1973) that Bushmen hunters used to ambush the game in the narrow passage between the mountains. The name of Goobies (or Goubies) is associated with Kangnas. The –bie- refers to a fountain or well. Together, the two names may be translated as “where with strung bow, game is shot”.

6. FINDINGS

A large number of occurrences were recorded. The sections below highlight examples of each of the different types of heritage resources, while the table in Appendix A lists every occurrence individually and Appendix B provides mapping. It should be noted that many of the occurrences were not worthy of being listed as archaeological or heritage sites. These were retained in the appendix but not allocated site numbers or rated for significance – they can all be assumed to be of very low significance.

6.1. Pre-colonial archaeology

The best pre-colonial sites are often found in caves. These are very rare in the Bushmanland landscape with only four being located in the study area. Two contain rock art and will be
discussed below and one had just two quartz artefacts in it and was not listed as a site (point 154). The last one, SMS2012/010, was located in a small rocky valley and seemed to contain only light traces of occupation (Figure 12). These consisted of fragments of burnt bone, some fragments of ostrich eggshell and pottery and a few quartz flaked stone artefacts. A lower grindstone was found on the talus slope. The dearth of occupation debris was surprising, especially given that the nearby river contained potholes that retained water.

Figure 12: Site SMS2012/010 (point 035).

The majority of archaeological sites recorded contained scatters of stone artefacts, predominantly in quartz (milky and clear) and cryptocrystalline silica (CCS) with silcrete, quartzite and other rocks more rarely represented. Several examples occurred near the base of a hill in the western part of the study area. SMS2012/034 is one such example (Figure 13). Many eroded/denuded areas revealed scatters of stone artefacts. Usually these were very ephemeral and were regarded as background scatter. However, in some areas there were denser concentrations that might well be representative of camp sites, such as at KNG2012/002 (Figure 14).

Figure 13: Stone artefacts from SMS2012/034 (point 073).

Figure 14: Stone artefacts from KNG2012/002 (point 157).

Around the few large pans, particularly those with bedrock exposures, many archaeological occurrences were recorded. No doubt the proximity to water, particularly after rains, served as the main attraction. The occurrences around the large ‘Gobees se Pan’ were grouped as one very large site, named KNG2012/011. More than 70 individual archaeological
occurrences of varying nature were located with point 180 being one of the most interesting because it included a large horizontally pierced and internally reinforced lug (Figure 15). Site KNG2012/010 is an artefact scatter located alongside a smaller pan very close to the large Gobees se Pan. This proximity no doubt resulted in the good artefact collection found there (Figure 16).

Sometimes European colonial artefacts can make their way into Stone Age contexts, either through reuse of the site by colonists, or perhaps through use of European artefacts by indigenous people. Several possible examples of either case were found with one example possibly suggested the latter, at point 089. Here a piece of the base of an old wine bottle appears to have been deliberately shaped for use as a tool (Figures 17 – 19). The sandy context and shape of artefact suggests it to have been flaked rather than trampled into shape.

Many sites contained pottery, but usually only a very few sherds. One small site was peculiar in that it contained only pottery and nothing else, in all ten sherds were located (Figure 20). Some of the sites in the study area contained pottery with fibre temper (Figure 21), although the vast majority of sherds were tempered with mineral grains. The significance of the temper lies in the fact that fibre (grass) tempered sherds have been directly associated with Bushmen groups rather than the Khoekhoen (Bollong et al. 1993). Such sherds are identified through the elongated spaces in the fabric where the grass has burned up during firing.
Large, heavy artefacts such as grindstones are usually not considered readily portable. However, we found isolated grindstones in a few locations. The large lower grindstone at point 044 is an example where it was entirely alone (Figure 22), while at ARB2012/010 there was a lower grindstone, two upper grindstones and several other rocks that may have functioned as weights for the ropes that are used to hold down a matjieshuis (Figure 23).

Particularly in/near pans, but also on a low hill in the middle of Smorgen Schaduwe, we found areas where people had used patches of exposed bedrock as lower grindstones. These areas manifested in two ways. Some were broad smooth areas, typical of many lower grindstones, while many others had formed clear grooves from repeated grinding in the same plane. The examples in Figures 24 and 25 come from KNG2012/011 at a point where 23 grinding hollows were found on the same rock (point 215). The photographs show a section where four grooves were placed one beside the other, reminiscent of a portable grindstone from coastal Namaqualand where the same was done. One groove at this same site (point 215) had a second and deeper groove placed over it at right angles.
6.2. Pre-colonial rock art

Rock art in the study area took two forms. The first was painting which was located at four sites. The two painted rock shelters in Kangnas Poort were first described by Rudner and Rudner (1968) and are reasonably well known. The Rudners also described a third site from the same area, this one located at the junction of Kangnas, Koeris and Goinoep with the paintings actually on Koeris (Figure 26). The site is locally known as Kromneus and was incorrectly listed as Gobees se Pan by the Rudners. All three of these rock art sites contain paintings thought by their style and imagery to have been made by Khoekhoen herders rather than Bushmen hunter-gatherers (Eastwood & Smith 2005; Smith & Ouzman 2004). The imagery includes shapes listed as typical of ‘herder art’ such as circles, and grids (Figure 27). Two gemsbok (Figure 28) and a third unidentifiable animal are also present but importantly, all paintings are finger-painted.

Figure 26: Panoramic view of the entire painted rock face at Kromneus (KOE2012/001; point L056). The fence separating Koeris from Kangnas can be seen at the far right hand side.
One new painted site was discovered. It was found in a small crevice between two boulders on the farm Areb (Figure 29). It consists of just two semi-circular shapes with their straight sides adjacent to one another (Figure 30). It is unclear what the images represent but they are probably also part of the herder art tradition. A few ostrich eggshell fragments and quartz artefacts were found in front of the boulders.

The second type of rock art takes the form of small hollows or ‘cupules’ pecked and ground into the surface of the rock face. In total eight such localities were found, all on Smorgen Schaduwe. This form of art is very rare outside of the Iron Age and David Morris, an expert on Northern Cape rock art, knows of only a handful of similar occurrences stretching from Nieuwhoudtville in the south to north of the Orange River (D. Morris, pers. comm. 2012). Most of the new examples were on vertical rock faces with a small overhanging roof, but not all. They were all at or very close to ground level with just one example being about 3 m above the sandy plains (Figures 31 – 32). Five were on one small and slightly orange-coloured hill (SMS2012/054 to SMS2012/058 inclusive; see Figure 4 for a distant view of the hill) and a sixth was immediately north of this hill (SMS2012/036). All of these faced either
south or south-east. Two more were located on low rock outcrops on the low hill 4 km ESE of the one just mentioned (SMS2012/027 and SMS2012/019). Both face southeast and are different to the other six sites for different reasons. SMS2012/019 was the only site to have ‘cupules’ deeper than about 3 mm. Here three were deeper than 20 mm with the deepest being ground about 35 mm into the rock surface (Figures 33 & 34). The second ‘cupule’ site on the hill was distinguished by having just a single hollow ground into a low, overhanging boulder at about knee-height.

Figures 31 & 32: View of the ‘cupule’ site at SMS2012/058 (point L017), the only one to be a few metres above natural ground level.

Figure 33: The ground ‘cupule’ site at SMS2012/019 (point 048).

Figure 34: Close-up of some of the deep ‘cupules’ at SMS2012/109 (point 048).

That the hollows were started by chipping the surface of the rock is exemplified at SMS2012/036 where about 27 ‘cupules’ were found (Figures 35 & 36). Two, on a separate face just to the right of the main panel were not ground at all and presented only a rough concavity (Figure 37).
6.3. Historical archaeology (Anglo-Boer War)

Informal and formal Anglo-Boer War fortifications and related structures are common throughout north-western South Africa. In the present study area several examples of informal type structures pertaining to the war (according to the Kennedys who own the farm)
were located. None of the structures on Smorgen Schaduwe were fortifications in the traditional sense and there were no gun ports in the walls, which, in turn, were all relatively low and made of roughly packed rocks collected from the immediate vicinity (Figures 41 & 42). Most of the structures were perched on the northern edge of a hill with a commanding view across the plains to the north (Figure 43). What the function of these structures were is unknown, especially since the main road through the area in fact passed to the south of this hill and could not have been seen from this location (Figure 11). Two larger structures were located further back, more on top of the hill, and must have served different functions given their restricted views (Figures 44 & 45). The presence of a number of old tin cans and other similar metal items supports this claim, since such items are frequently found on known Anglo-Boer War sites (Figures 46 – 48).

Figure 41: Stone enclosure at SMS2012/002 (point 027).

Figure 42: Close-up of the packed stone wall at SMS2012/002 (point 027).

Figure 43: View of SMS2012/005 (point 030) showing its location on the edge of the mountain overlooking the plains.
Several other informally built, piled stone structures were also present on the landscape and these likely all pertain to the historical use of the landscape for livestock grazing. It should be emphasised that with the very late granting of farms in this area and its great remoteness from the Cape Colony, practices that seem very antiquated would likely have continued on into the 20th century and all the features described here likely date to the very late 19th century or early 20th century. The structures consist of small circular features and kraals with walls up to one metre high and single stone high alignments of rocks. The first example highlighted here is a set of low features of stones and earth that have been packed into the low points on a granite outcrop to increase the volume of the natural ‘klipbakke’ that occur there (Figure 49). Small informal kraals were also noted in a number of areas. That at SMS2012/026 was a fine example of about 7 m diameter and 0.3 m to 0.8 m height and contained a small (c. 140 mm long) early-mid 20th century clear glass bottle (Figure 50).
Even less formal structures also occur. At SMS2012/045 we found a low semi-circular stone alignment some 23 m long running along the base of a hill with a rectangular enclosure of 5.5 m by 7.0 m sticking out from it (Figure 51). Nearby was a small semi-circular feature, perhaps for anchoring the base of a wind break structure made from matting. These no doubt relate to a historical stock post.
A large kraal at ARB2012/007 may have been in use until fairly recently but still no doubt dates back to at least the early 20th century. It is well built of packed stone and approximately 10 m by 31 m in size (Figures 52 & 53). The walls were about 1 m high. A small (c. 3 m diameter) circular structure was found some 60 m to the northwest. This too may have served as shelter for a shepherd. A large area in front of the kraal was heavily overgrazed and, despite not having been used in very recent decades, the ground has not recovered (Figure 54). Many historical artefacts typical of the late 19th and early 20th centuries (Figures 55 & 56) and even a probable grave are associated with this site (see below).

Figure 52: Large historical kraal built against the side of a rocky ridge at ARB2012/007 (point 105).

Figure 53: Floor plan of the kraal at ARB2012/007 (point 105).
One outcrop of granite boulders seems to have been used both in pre-colonial and historical times. Pre-colonial artefacts were rather less frequent than might have been expected. It is thus unlikely that the site was the result of contact between indigenous and colonial people. Artefacts of glass, ceramic and metal were noted, and a number of bones were also present (Figures 57 – 59).

At ARB2012/002 (point 097A & 097B) there were crude stone walls between boulders of a granite outcrop. Their function is not evident but they are almost certainly historical and have a number of glass, ceramic and metal objects in their vicinity (point 096; Figures 60 & 61). Another area with suggestions of historical use was at SMS2012/065 where a denuded area suggested an old stock post and several historical ceramic fragments (Figure 62) and some loose rocks were found. The rocks may have been anchors for a Matjieshuis. These traditional houses were still in use until quite recently and were also used by European settlers for their versatility and convenience. The ceramics included Chinese coarse porcelain.
(ginger jars), lusterware, white refined earthenware and transfer ware. Other evidence of historical use of the area is found in the occasional isolated fragments of glass and ceramics like the pink glass found very far from any other heritage or landscape features in the northern part of Areb at point 110 (Figure 63).

Figures 60 & 61: Historical artefacts from in and around the crude stone walling at ARB2012/002 (point 096).

Figure 62: Historical ceramic fragments from SMS2012/065 (point L038).

Figure 63: Isolated find of glass on Areb (point 110).

The last type of historical archaeological resource we noted were ‘putse’ excavated by hand during the late 19th and early 20th centuries. These are essentially wells but only had the uppermost parts lined with stones. They can be very deep with three dry ‘putse’ on Areb being as much as 20 m to 25 m deep and only about 2.5 m to 3.0 m in diameter. The Areb ‘putse’ now have windmills built over the top of them. One was located on Karas, just outside the study area while two more were on Kangnas (in Gobees se Pan) and Koeris (in Springbokvlei) respectively. These two were obviously excavated in pans where water frequently collects so as to maximise their yield. During our visit both had water in them almost to the land surface (Figures 64 & 65).
At the Kromneus rock art site we also found several examples of historical graffiti. That the pan was important for water in pre-colonial and historical times is shown by the fact that an early 19th century track ran past this place (Figure 11), likely the reason for the graffiti (Figures 66 – 70). Names, initials and dates visible include:

- J.F.H. Kotzee 1879;
- C.W. Meyer 1879;
- J. v. Niekerk;
- D.J. Coetzee;
- 1900 (possibly associated with D.J. Coetzee and maybe J. v. Niekerk);
- A J v Zyl
- G.A.;
- EM;
- CM
- H;
- AE;
- ARM;
- J; and
- J9 Mo.

There was also one name engraved on the floor of the shelter but this has become to worn down to read.

**Figures 66 – 68:** Historical graffiti scratched on the rocks at Kromneus, often over pre-colonial rock art.
6.5. Built environment

The built environment, in general, is not very old in this area. Most farm buildings appear to date to the 1930s to 1960s but some on Smorgen Schaduwe appear to be older, perhaps dating to the late 9th century. They are vernacular Karoo-style buildings, now serving as farm outbuildings, although we were told that one was originally a house and the other a barn (Figures 71 & 72). The walls of these structures are very thick and they are flat-roofed.

The oldest ‘modern’ house is likely that at Areb. The present owner (who acquired the farm in 1988) claims it to have been built in about 1912/1913. It is early 20th century, built of dressed stone and the walls are thick. However, the joinery (windows and doors) appears more like joinery typical of the 1930s. The porch was enclosed during the 1950s or 1960s, judging by the bricks used (Figure 73). A ruined outbuilding shows evidence of at least early 20th century construction with more modern alteration (Figure 74). The water ‘putse’ mentioned above are located behind this building, beneath the windmills.
The Koeris farmstead has a historical component but this is only early 20th century. While the main house (now in ruin) seems to have been built in the 1960s, the single outbuilding, which is still in usable condition, is likely a bit older (Figure 75). An interesting item at this werf was an old water pump that may have predated the windmills (Figure 76). It too is regarded as a heritage object.

6.6. Graves and graveyards

Most farms have family graveyards and those under study here were no exception. With one exception (Areb), they were not visited. Of greater concern is the possibility of isolated graves occurring away from the houses. A few potential examples were encountered. At SMS2012/020 there were two small neighbouring mounds of stones that seemed like possible graves (Figures 77 – 79). At ARB2012/005 there was a pile of rocks placed in a small gully between two bulges of bedrock (Figure 80). This seemed suspiciously similar to the stone-piled graves commonly found along the Orange River, close to Augrabies Falls (Dreyer & Meiring 1937; A. Morris 1995), although the latter are generally far larger.
Figures 77 - 79: Possible graves at SMS2012/020 (point 054).

Figure 80: Possible pre-colonial grave site at ARB2012/005 (point 103).

Perhaps the clearest example of a grave is that mentioned earlier from alongside the stockpost at ARB2012/007 (point 106). It was a stone mound with one stone that was probably a headstone (Figure 81). The grave also had a small blue bottle on top of it, perhaps left in memory of the deceased (Figure 82). Unmarked pre-colonial graves can be found anywhere on the landscape where substrate suitable for burial exists. There is, however, no way of predicting the locations of such graves.
6.7. Cultural landscapes

The study area was developed for farming relatively recently when compared to, for example, the south-western Cape. As a result the cultural landscape has few layers. The landscape is dominated by vast undeveloped spaces with occasional livestock enclosures, watering points, cement dams and windmills (Figure 83). Trees are very rare. Otherwise the only other elements of cultural landscape pertain to the farm werfs which are generally 20th century. These manifest as clusters of low buildings with windmills, water tanks, bushes and fences (Figures 84 & 85).
Although the farms were surveyed relatively late, in 1893, we know that colonists were using the area earlier than this because of both the graffiti and the European and Asian ceramic fragments found from time to time. The pans were as important to the colonists as they were in pre-colonial times and each pan, mountain and hill would have been well known to those passing through the area.

7. IMPORTANT HERITAGE

Due to the large number of sites and occurrences placed on record, this section was deemed necessary so as to briefly sum up the most important heritage resources that require further action before development and during operation of the proposed facilities.

Many of the important heritage resources have already been protected through institution of buffers around farm werfs, pans and mountains. There are, however, still five areas of primary heritage concern.

7.1. ‘Orange Hill’

The fist area of concern is a small hill that we have dubbed ‘Orange Hill’ (Figure 4). From a distance it appears geologically different and has a clearly orange hue. There are a large number of archaeological sites on and around this hill, including six of the eight ground ‘cupule’ sites described above. There are many scatters of stone artefacts, including one with a preserved hearth that appears that it may be a recent Khoekhoen stockpost. There are other areas with artefacts clearly dating to 2000 to 5000 years ago as well. This entire hill and its surrounds should be considered a no-go area and a buffer as shown in Figure 86 should be implemented. The buffer is approximately 1.5 km in diameter (approximately 700 m from all recorded heritage on the side that the rock art faces and 400 m elsewhere). This whole hill currently falls outside of both development focus areas.
7.2. ‘SMS Hill’

This low rise on Smorgen Schaduwe (hence ‘SMS’) protrudes from the grasslands and has multiple low rocky outcrops on it. A large number of archaeological occurrences are present on the hill and, although none are of very high significance, the sheer number of occurrences shows the importance ascribed to this hill in both pre-colonial and historical times. This entire hill and its surrounds should be considered a no-go area and a buffer as shown in Figure 87 should be implemented. The proposed grid connection power line will need to be shifted outside of this buffer zone. The buffer is approximately 1.5 km east/west and 1.9 km north/south (approximately 450 m from all recorded heritage). This entire hill currently falls just inside the wind focus area.
Figure 87: Aerial view of ‘SMS Hill’ showing the proposed heritage buffer. The red outline denotes the edge of the archaeological site, while the straight red line is the proposed grid connection routing. The blue line represents the wind focus area (south of the line). The yellow bar for scale at lower left is 500 m long.

7.3. Gobees se Pan

This large pan with extensive granite bedrock outcrops is home to a plethora of archaeological sites and occurrences and more may well be preserved beneath the surface of the ground. The entire pan and its immediate surroundings should be considered a no-go area and a buffer as shown in Figure 88 should be implemented. The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage). This site currently falls outside of both development focus areas.
7.4. Springbokvlei

This is another large pan with some exposed bedrock. Many archaeological sites were located on the surface and some may have depth. Further sites may be fully preserved beneath the ground. The entire pan and its immediate surroundings should be considered a no-go area and a buffer as shown in Figure 89 should be implemented. The buffer is approximately 0.9 km east/west and 1.0 km north/south (approximately 200 m from all recorded heritage). The site presently falls just on the northern edge of the wind focus area.
Figure 89: Aerial view of Springbokvlei showing the proposed heritage buffer. The red outline denotes the edge of the archaeological site. The blue line denotes the wind focus area (to the south of the line). The yellow bar for scale at lower left is 500 m long.

7.5. Site KNG2012/007

This site is not of very high significance but nonetheless has value and should not be developed. Being a pan, the chances of subsurface deposits occurring around it are still relatively high. No buffer is proposed but the area within the red line should be considered off limits for development (Figure 90). The site is approximately 250 m across.
Figure 90: Aerial view of site KNG2012/007 showing the edge of the archaeological site (red outline). The yellow bar for scale is 500 m long.

7.6. Kromneus

Aside from graves, this painted rock art site and its surrounding archaeology are perhaps the most important heritage resources under threat from the proposed development, given that the other rock art sites are already protected. The entire outcrop and its immediate surroundings should be considered a no-go area and a buffer as shown in Figure 91 should be implemented. The buffer is approximately 1.0 km in radius from the rock art site.
8. ASSESSMENT OF IMPACTS

In this section the impacts are rated according to the standard criteria provided by Aurecon in their DSR. It should be noted that impacts to the majority of heritage resources occur during construction as they relate to destruction of the resource and/or degradation of its context. The latter impacts would be reversible after decommissioning but any destroyed heritage is non-recoverable. Note also that significance ratings for heritage are sometimes inflated due to the permanent nature of the impacts and the rating reflected in the table below have at times been moderated to more accurately reflect the archaeological significance. No ratings for decommissioning are provided since all impacts would revert back to the status quo.

8.1. Solar energy facility

Direct impacts to heritage resources are primarily expected to occur during the construction phase of the solar development, although indirect visual impacts will persist for the life of the project. Table 1 shows the expected impacts to archaeological resources. No mitigation is required within the present solar focus area. Table 2 shows the expected impacts to the cultural landscape and scenic value as seen from the N14. The only mitigation that can be suggested is to keep the facility as far to the northwest within the focus area as possible, but
without knowing the full extent of the layout, specific alterations to it cannot be suggested. As such, no post-mitigation ratings can be provided. Impacts to graves and built environment resources will not occur in the current solar focus area.

Table 1: Assessment of construction phase archaeological impacts for the solar energy facility.

<table>
<thead>
<tr>
<th>Before mitigation</th>
<th>After mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Site specific</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very low</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
</tr>
<tr>
<td>Probability</td>
<td>Definite</td>
</tr>
<tr>
<td>Significance</td>
<td>Very low</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
</tr>
<tr>
<td>Status</td>
<td>Negative</td>
</tr>
<tr>
<td>Reversible</td>
<td>No</td>
</tr>
<tr>
<td>Cumulative impacts</td>
<td>No similar facilities are planned within reasonable proximity of the Kangnas site and cumulative impacts cannot thus be rated. However, the archaeological material present in the immediate vicinity is of very low significance and the loss of larger areas containing such material is not significant.</td>
</tr>
</tbody>
</table>

Table 2: Assessment of construction and operational phase cultural landscape and visual impacts for the solar energy facility.

<table>
<thead>
<tr>
<th>Before mitigation</th>
<th>After mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low - Medium*</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
</tr>
<tr>
<td>Probability</td>
<td>Definite</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium**</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
</tr>
<tr>
<td>Status</td>
<td>Negative</td>
</tr>
<tr>
<td>Reversible</td>
<td>Yes</td>
</tr>
<tr>
<td>Cumulative impacts</td>
<td>No similar facilities are planned within reasonable proximity of the Kangnas site and cumulative impacts cannot thus be rated. However, the more such facilities that are built along the N14 the more its scenic value would be degraded.</td>
</tr>
</tbody>
</table>
* This would vary depending on the height of the facility.
** Most likely overall significance.

8.2. Wind energy facility

Direct impacts to heritage resources are primarily expected to occur during the construction phase of the wind development, although indirect visual impacts will persist for the life of the project. Table 3 shows the expected impacts to archaeological resources. No conventional archaeological mitigation work (i.e. excavation, recording) is required so long as the suggested buffers and no-go areas are implemented. These buffers will serve to protect all important heritage resources. The post-mitigation ratings are effectively rating the impacts that would occur to the general background scatter of archaeological artefacts that litter the landscape. Table 4 shows the expected impacts to the cultural landscape and scenic value as seen from the N14, as well as visual impacts to the contexts of the important archaeological resources. Although the facility would be further from the N14 if the present wind focus area is retained, the turbine structures are far taller than solar development so the
same magnitude has been assigned as for the solar development. Impacts to graves and built environment resources will not occur in the current wind focus area so long as the proposed buffers are implemented.

Table 3: Assessment of construction phase archaeological impacts for the wind energy facility.

|                  | Before mitigation | After mitigation |
|------------------|-------------------|----------------
| Extent           | Regional          | Site specific  |
| Magnitude        | High              | Very low       |
| Duration         | Long term         | Long term      |
| Probability      | Certain           | Definite       |
| Significance     | High              | Very low       |
| Confidence       | Certain           | Sure           |
| Status           | Negative          | Negative       |
| Reversible       | No                |                |
| Cumulative impacts | No similar facilities are planned within reasonable proximity of the Kangnas site and cumulative impacts cannot thus be rated. However, the archaeological material present within the no-go areas is of high significance and any impacts caused by further similar facilities would be considerable. |

Table 4: Assessment of construction and operational phase cultural landscape and visual impacts for the wind energy facility.

|                  | Before mitigation | After mitigation |
|------------------|-------------------|----------------
| Extent           | Local             | -              |
| Magnitude        | Low - Medium*     | -              |
| Duration         | Long term         | -              |
| Probability      | Definite          | -              |
| Significance     | Medium**          | -              |
| Confidence       | Certain           | -              |
| Status           | Negative          | Negative       |
| Reversible       | No                |                |
| Cumulative impacts | No similar facilities are planned within reasonable proximity of the Kangnas site and cumulative impacts cannot thus be rated. However, the more such facilities that are built along the N14 the more its scenic value would be degraded. |

* This would vary depending on the height of the facility.
** Most likely overall significance.

9. CONCLUSIONS

This heritage impact assessment has found a wide variety of heritage resources to be present on the landscape of the study area. However, these resources are very tightly clustered around water sources and hills and, as such are often protected by the buffers already required by natural scientists. However, certain of these buffers require extending to ensure adequate protection of heritage resources. Should such buffers be successfully implemented then the site is deemed suitable from a heritage point of view for the proposed developments. The grid connection power line will need to be shifted so as to stay out of one of the no-go areas.
It should be noted that the management plan must stipulate that construction crew and vehicles should not enter the buffer areas so as to ensure their protection at all times. Small vehicles may, however, continue to use farm roads that pass through the buffer zones. The primary concern here is with people seeing the existing historical graffiti at the rock art sites and adding their own modern graffiti.

Although Harris (2012) has concluded that the Kalkkom crater could be a meteorite impact site, he feels this to be unlikely. In any event, the crater is outside of the area to be impacted and requires no further consideration.

10. RECOMMENDATIONS

It is recommended that the proposed developments should be allowed to proceed but subject to the following conditions:

- All buffers and no-go areas stipulated in this report must be adhered to for both the facilities and all roads and power lines;
- Should any human remains be uncovered during development they must be immediately protected in situ and reported to the heritage authorities or to an archaeologist. The remains will need to be exhumed at the cost of the developer;
- All construction and maintenance crew and vehicles (except small vehicles which may use existing farm tracks) should be kept out of the buffer zones; and
- The final layout should be shown to the appointed archaeologist before implementation to confirm that all significant heritage resources have been adequately protected.

11. REFERENCES


Barrow, J. 1801. An account of travels into the interior of southern Africa, in the years 1797 and 1978: including cursory observations on the geology and geography of the southern part of that continent; the natural history of such objects as occurred in the animal, vegetable and mineral kingdoms; and sketches of the physical and moral character of the various tribes of inhabitants surrounding the settlement of the Cape of Good Hope. London: T. Cadell Jun. and W. Davies.


Halkett, D. 2010. An assessment of impact on archaeological heritage resulting from replacement of a section of the existing bulkwater supply pipeline from Pella to Pofadder, Northern Cape. Unpublished report for Van Zyl Environmental.


### APPENDIX A: List of heritage sites and other occurrences.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>GPS point</th>
<th>Co-ordinates</th>
<th>Description</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areb 75</td>
<td>094</td>
<td>S29 30 37.0</td>
<td>One shallow ground area in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/001</td>
<td>095</td>
<td>S29 30 37.9</td>
<td>Tiny stone structure 1.0 x 1.0 x 0.4 m high.</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/002</td>
<td>096</td>
<td>S29 30 40.9</td>
<td>Light scatter of pink and pale green glass, hand-painted ceramics, tin lid, quartz, OES.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>097A</td>
<td>S29 30 40.7</td>
<td>Crude walloing on granite platform. A &amp; B at two bits of walling. Tin can close to 097A.</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>097B</td>
<td>S29 30 41.4</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>098</td>
<td>S29 30 41.1</td>
<td>One shallow ground area in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>099</td>
<td>S29 30 41.3</td>
<td>Ephemeral quartz, OES and refined earthenware scatter and one granite upper grindstone on granite platform. Fragments of ?early 20th century wine bottle nearby.</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/003</td>
<td>100</td>
<td>S29 31 58.0</td>
<td>Scatter of pottery, with one having an ochred external surface. Nothing else associated.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>101</td>
<td>S29 31 44.7</td>
<td>A few green bottle fragments. One has a square edge suggesting case bottle.</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/004</td>
<td>102</td>
<td>S29 31 48.9</td>
<td>Likely rock painting in white. Two semi-circular motifs with straight sides facing one another a few cm apart. OES and quartz scatter in front of the shelter and one tin lid. The shelter is not inhabitable and is really a gap between two boulders.</td>
<td>High-Medium</td>
</tr>
<tr>
<td>ARB2012/005</td>
<td>103</td>
<td>S29 31 49.0</td>
<td>Suspicious pile of rocks filling a crevice between granite bedrock outcrops. Looks like it may be a burial.</td>
<td>High (potentially)</td>
</tr>
<tr>
<td>ARB2012/006</td>
<td>104</td>
<td>S29 31 49.9</td>
<td>Small round stone enclosure of 3.0 x 3.0 x 0.8 m high at the base of the hill. A refined earthenware fragment was found in front of it. Probably related to point 105.</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/007</td>
<td>105</td>
<td>S29 31 51.2</td>
<td>Large rectangular kraal up against a steep granite wall. Plenty of quartz and OES in front of the part that would be called a rock shelter. Near the entrance was quartz, CCS, pottery, a HS/UG fragment (quartzite cobble), and ceramic and glass fragments.</td>
<td>Medium (stock post)</td>
</tr>
<tr>
<td></td>
<td>L052</td>
<td>S29 31 54.4</td>
<td>A 20th century stockpost location? The veld is degraded and covered with invasive plants (dried Mesembryanthemum?) Some glass and a widespread distribution of European ceramics that extends all the way to the front of the stone kraal (recorded by J)</td>
<td>High (grave)</td>
</tr>
<tr>
<td></td>
<td>106</td>
<td>S29 31 50.9</td>
<td>Likely stone covered grave with informal</td>
<td>---</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Co-ordinates</td>
<td>Description</td>
<td>Significance</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>--------------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>ARB2012/008</td>
<td>107</td>
<td>S29 29 15.2 E18 13 22.3</td>
<td>Quartz artefact scatter in an eroding area at the base of the granite hill.</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/009</td>
<td>108</td>
<td>S29 28 48.5 E18 13 49.8</td>
<td>Ephemeral pan with six potsherds in it and nothing else. Next small pan to the east had one clear quartz flake in it.</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/010</td>
<td>109</td>
<td>S29 28 35.8 E18 14 36.5</td>
<td>Large ephemeral pan with two upper grindstones right alongside a lower grindstone. Also a few other rocks together here. One quartz flake and one quartz core were seen elsewhere in the same pan.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>110</td>
<td>S29 28 18.7 E18 15 37.0</td>
<td>Three purple glass fragments.</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/011</td>
<td>111</td>
<td>S29 29 32.2 E18 15 47.4</td>
<td>Quartzite block with a flaked edge in a deflated area. Also occasional quartz flakes in the area.</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/012</td>
<td>112</td>
<td>S29 30 41.0 E18 14 56.2</td>
<td>Areb farm werf. Main house built 1912 (according to farmer) although the joinery and steel windows look a bit later. The porch was enclosed and an addition made probably in the 1950s/1960s. Also a small vernacular Karoo-style cottage out the back in decorative breeze blocks.</td>
<td>High</td>
</tr>
<tr>
<td>ARB2012/013</td>
<td>113</td>
<td>S29 30 51.4 E18 14 55.6</td>
<td>Two open wells with stone walling around the top meter or so then just cut through layers of calcrete. Apparently some French palaeontologists found and published a fossil from the calcrete in one of these holes. Windmills are built over the top of the wells and one has an old iron bucket next to it from the days when there was water in the wells.</td>
<td>High</td>
</tr>
<tr>
<td>ARB2012/014</td>
<td>114</td>
<td>S29 30 50.6 E18 15 03.1</td>
<td>Farm graveyard with three graves. Van den Heever (1940), Van den Heever (1947) &amp; Dauth (1944).</td>
<td>High</td>
</tr>
<tr>
<td>---</td>
<td>L046</td>
<td>S29 30 51.2 E18 10 19.9</td>
<td>An ephemeral scatter of quartz artefacts next to a granite koppie; about 5 stone artefacts, some OES and a Chinese cracker</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L047</td>
<td>S29 30 50.0 E18 10 19.6</td>
<td>A scatter of quartz artefacts (about 5) between some granite boulders at the base of a koppie</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L048</td>
<td>S29 30 46.8 E18 10 21.8</td>
<td>An ephemeral scatter of quartz artefacts near the koppies</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L049</td>
<td>S29 32 01.7 E18 11 26.5</td>
<td>Tin cans, wire and some OES in front of a koppie</td>
<td>---</td>
</tr>
<tr>
<td>ARB2012/015</td>
<td>L050</td>
<td>S29 32 00.5 E18 11 31.9</td>
<td>A Lower Grindstone of quartzite lying in a sheltered kloof between two koppies. Associated with an ephemeral quartz scatter</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/016</td>
<td>L051</td>
<td>S29 31 59.0 E18 11 31.0</td>
<td>Stone walling in front of a small cave formed by two large granite boulders.</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>----------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The floor of the kraal is of stone. The wall is roughly packed and about 1m high. There is no associated material.</td>
<td></td>
</tr>
<tr>
<td>ARB2012/017</td>
<td>L053</td>
<td>S29 28 34.5 E18 15 12.0</td>
<td>A scatter of 9 potsherds and one quartz flake on the banks of a dried river bed. The potsherds are all very small, about 5mm thick, fine-grained temper and brown in colour.</td>
<td>Low</td>
</tr>
<tr>
<td>ARB2012/018</td>
<td>L054</td>
<td>S29 30 51.1 E18 14 55.7</td>
<td>A stone structure at the “putse”. It is located immediately next to the putse, and adjoining the reservoir. It is square (about 20m²), minus a roof, with a large doorway, supported by a more recently inserted concrete lintel and evidence of a modern sliding door. Presumably a shed. The inside stone walls have been plastered halfway up the walls. Running in front of the door, from the reservoir to the little vineyard at the putse, is a small stone-lined furrow.</td>
<td>Medium-Low</td>
</tr>
</tbody>
</table>

**Goinoep 126**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>GPS point</th>
<th>Coordinates</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNP2012/001</td>
<td>118</td>
<td>S29 39 43.1 E18 23 38.1</td>
<td>Two shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
<tr>
<td></td>
<td>119</td>
<td>S29 39 45.4 E18 23 36.7</td>
<td>Three shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>S29 39 45.9 E18 23 37.0</td>
<td>Three shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
<tr>
<td></td>
<td>121</td>
<td>S29 39 46.1 E18 23 37.5</td>
<td>At least nine shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
<tr>
<td></td>
<td>122</td>
<td>S29 39 45.7 E18 23 39.6</td>
<td>At least seven shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
<tr>
<td></td>
<td>123</td>
<td>S29 39 45.1 E18 23 40.0</td>
<td>At least seven shallow grinding grooves in bedrock on edge of pan.</td>
</tr>
</tbody>
</table>

**Kangnas 77**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>GPS point</th>
<th>Coordinates</th>
<th>Description</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>---</td>
<td>S29 37 42.0 E18 20 36.4</td>
<td>Extensive area of pans with rare quartz artefacts.</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>S29 37 57.1 E18 20 44.9</td>
<td>Pan with quartz scatter among quartz gravel.</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>S29 40 13.4 E18 28 54.7</td>
<td>North edge of so-called crater. Looks just like a very large pan and lies on the south side of the fence line. With cadastral buffer it should be protected.</td>
<td>---</td>
</tr>
<tr>
<td>KNG2012/001</td>
<td>153</td>
<td>S29 34 06.3 E18 21 11.2</td>
<td>Kangnas farm werf. Probably all mid-20th century structures.</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>156</td>
<td>S29 33 45.9 E18 19 22.6</td>
<td>Isolated granite lower grindstone and a few quartz flakes.</td>
<td>---</td>
</tr>
<tr>
<td>KNG2012/002</td>
<td>157</td>
<td>S29 33 39.4 E18 19 20.9</td>
<td>Artefact scatter of quartz in a denuded area.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>158</td>
<td>S29 33 42.4 E18 19 27.3</td>
<td>Quartzite pebble hammerstone/upper grindstone and a large piece of very nice ochre – nothing else.</td>
<td>---</td>
</tr>
<tr>
<td>KNG2012/003</td>
<td>159</td>
<td>S29 34 01.4 E18 20 19.6</td>
<td>Kangnas rock art cave on the north side of the valley. Three shelters with central one largest. Left one (about 5 m wide, 1 m high and 2 m deep) is up on a ledge and has just one white image. Central shelter (width hard to estimate due to</td>
<td>High</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td>KNG2012/004</td>
<td>160</td>
<td>S29 34 01.3</td>
<td>Stone-lined dam with the rocks probably having been raided from a kraal that used to stand in this valley. Only the ‘foundation’ remains. Dam of uncertain age but spillway was made of ‘slasto’ and probably dates to about the 1970s.</td>
<td>Low</td>
</tr>
<tr>
<td>KNG2012/005</td>
<td>161</td>
<td>S29 34 03.0</td>
<td>Kangnas rock art cave on the south side of the valley. Dome shaped shelter of about 9 m width at the mouth tapering to form two alcoves at the back (right one is a lair). Roof about 2.5 m at mouth and about 1 m at the back, depth about 10 m. Lots of geometric art, some of which may be ‘modern art’. Lots of red geometrics are clearly the oldest with white and black being over the top.</td>
<td>High</td>
</tr>
<tr>
<td>---</td>
<td>162</td>
<td>S29 35 37.9</td>
<td>System of ephemeral pans with quartz background scatter.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>163</td>
<td>S29 36 00.1</td>
<td>System of ephemeral pans with quartz background scatter.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>164</td>
<td>S29 34 21.6</td>
<td>System of ephemeral pans with quartz background scatter but there is a proper pan at this point.</td>
<td>---</td>
</tr>
<tr>
<td>KNG2012/006</td>
<td>165</td>
<td>S29 35 15.3</td>
<td>Part of above system but with more artefacts. Quartz, quartzite, CCS. One ?unifacial point in CCS. Probably MSA and LSA mixed.</td>
<td>Low</td>
</tr>
<tr>
<td>KNG2012/007</td>
<td>166</td>
<td>S29 34 52.3</td>
<td>OES scatter with massive number of fragments over a wide area. Also 2 CCS flakes. On edge of pan.</td>
<td>Medium</td>
</tr>
<tr>
<td>167</td>
<td></td>
<td>S29 34 50.6</td>
<td>Pan with granite bedrock exposure. 10 grinding hollows.</td>
<td>Medium</td>
</tr>
<tr>
<td>168</td>
<td></td>
<td>S29 34 49.6</td>
<td>Granite bedrock with 7 grinding hollows on one rock and 1 more on a second area of bedrock. One broken backed piece in CCS, looks large and weathered, ?MSA.</td>
<td>Medium</td>
</tr>
<tr>
<td>169</td>
<td></td>
<td>S29 34 47.4</td>
<td>Artefact scatter in calcrete gravel, quartz and CCS.</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>E18 28 55.1</td>
<td></td>
</tr>
<tr>
<td>170</td>
<td>S29 34 47.0</td>
<td>E18 28 54.1</td>
<td>Artefact scatter in calcrite gravel, quartz and quartzite.</td>
<td></td>
</tr>
<tr>
<td>171</td>
<td>S29 34 46.8</td>
<td>E18 28 51.8</td>
<td>Artefact scatter in ephemeral pan, quartz and CCS.</td>
<td></td>
</tr>
<tr>
<td>172</td>
<td>S29 34 52.1</td>
<td>E18 28 55.1</td>
<td>Artefact scatter, 8 potsherds (7 fibre temper, 1 mineral temper) – 1 rim, flattened and ?everted – quartz, CCS, lots of OES. Fragment of blue and white annular ware found 50 m to the southwest.</td>
<td></td>
</tr>
<tr>
<td>KNG2012/008</td>
<td>173</td>
<td>S29 34 35.5</td>
<td>Pan with artefact scatter. Quartz and CCS. MSA.</td>
<td>Low</td>
</tr>
<tr>
<td>KNG2012/009</td>
<td>174</td>
<td>S29 34 47.9</td>
<td>Pan with granite outcrop. Artefact scatter of quartz, CCS, Silcrete. MSA.</td>
<td>Low</td>
</tr>
<tr>
<td>KNG2012/010</td>
<td>179</td>
<td>S29 34 22.3</td>
<td>Pan with artefact scatter. Quartz and CCS, many artefacts.</td>
<td>Low</td>
</tr>
<tr>
<td>180</td>
<td>S29 34 10.5</td>
<td>E18 25 58.4</td>
<td>Granite bedrock outcrop away from pan with 7 grinding hollows. Artefact scatter. Quartz, CCS, OES, pottery. Internally reinforced and horizontally-pierced lug in light brown clay.</td>
<td></td>
</tr>
<tr>
<td>181</td>
<td>S29 34 09.8</td>
<td>E18 25 57.2</td>
<td>Subsidiary pan with granite bedrock patches. 8 grinding hollows. Extensive, low density artefact scatter of quartz, CCS, OES to the east.</td>
<td></td>
</tr>
<tr>
<td>182</td>
<td>S29 34 11.9</td>
<td>E18 25 55.7</td>
<td>Granite bedrock outcrop away from pan with 4 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>S29 34 12.4</td>
<td>E18 25 55.1</td>
<td>Granite bedrock outcrop in pan with 3 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>184</td>
<td>S29 34 13.6</td>
<td>E18 25 57.0</td>
<td>Granite bedrock outcrop in pan with 2 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>185</td>
<td>S29 34 14.9</td>
<td>E18 25 56.6</td>
<td>Granite bedrock outcrop in pan with 1 grinding hollow. Big waterbakke near this point and 188.</td>
<td>High (Avoid)</td>
</tr>
<tr>
<td>186</td>
<td>S29 34 15.7</td>
<td>E18 25 57.0</td>
<td>Granite bedrock outcrop in pan with 2 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>187</td>
<td>S29 34 16.3</td>
<td>E18 25 56.8</td>
<td>Granite bedrock outcrop in pan with 17 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>188</td>
<td>S29 34 15.4</td>
<td>E18 25 56.2</td>
<td>Granite bedrock outcrop in pan with 3 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>189</td>
<td>S29 34 15.6</td>
<td>E18 25 57.7</td>
<td>Granite bedrock outcrop in pan with 3 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>S29 34 16.8</td>
<td>E18 25 57.3</td>
<td>Granite bedrock outcrop in pan with 4 grinding hollows.</td>
<td></td>
</tr>
<tr>
<td>191</td>
<td>S29 34 17.3</td>
<td>E18 25 58.2</td>
<td>OES and quartz scatter.</td>
<td></td>
</tr>
<tr>
<td>192</td>
<td>S29 34 17.1</td>
<td>E18 25 56.9</td>
<td>Granite bedrock outcrop in pan with 17 grinding hollows. Two hollows have some granite flaking off from within them. Presumably people would not have worked in obviously loose areas so this may indicate some antiquity? Artefact scatter of quartz, pottery and glass.</td>
<td></td>
</tr>
<tr>
<td>193</td>
<td>S29 34 16.9</td>
<td>E18 25 58.2</td>
<td>OES and quartz scatter.</td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>
| 195       | S29 34 15.6  
 E18 26 00.6 | E18 25 58.6 | Artefact scatter. Quartz, CCS, other, OES, pottery, glass, ceramic, metal musical instrument fragment. Also a few small granite and calcrete rocks on the site. |  |
| 196       | S29 34 17.8  
 E18 26 00.1 | E18 25 59.9 | OES and quartz scatter and 1 fragment of burnt calcrete. Also a very solid metal lid of a round container of sorts. |  |
| 197       | S29 34 18.5  
 E18 26 00.1 | E18 25 60.6 | Artefact scatter. Quartz, CCS, OES. |  |
| 198       | S29 34 19.2  
 E18 26 00.6 | E18 25 58.0 | Light artefact scatter. Quartz, CCS, OES. |  |
| 199       | S29 34 12.1  
 E18 25 58.0 | E18 25 55.0 | Granite bedrock outcrop on edge of pan with 4 grinding hollows. |  |
| 200       | S29 34 16.7  
 E18 25 54.3 | E18 25 55.0 | Granite bedrock outcrop on edge of pan with 3 grinding hollows. Artefact scatter. Quartz, CCS, OES, green glass. |  |
| 201       | S29 34 17.0  
 E18 25 53.3 | E18 25 55.0 | Granite bedrock outcrop on edge of pan with 8 grinding hollows. |  |
| 202       | S29 34 20.0  
 E18 25 59.4 | E18 25 55.0 | Ephemeral artefact scatter. Granite lower grindstone fragment, quartz, quartzite, OES, clear glass. |  |
| 203       | S29 34 21.3  
 E18 25 54.7 | E18 25 55.0 | Artefact scatter. OES, quartz, fibre-tempered pottery. |  |
| 204       | S29 34 20.9  
 E18 25 54.3 | E18 25 55.0 | OES scatter on the edge of the pan. |  |
| 205       | S29 34 20.1  
 E18 25 53.7 | E18 25 55.0 | Granite bedrock outcrop in pan with 1 grinding hollow. |  |
| 206       | S29 34 19.6  
 E18 25 53.5 | E18 25 55.0 | Granite bedrock outcrop in pan with 4 grinding hollows. |  |
| 207       | S29 34 19.5  
 E18 25 54.2 | E18 25 55.0 | Granite bedrock outcrop in pan with 5 grinding hollows. |  |
| 208       | S29 34 19.1  
 E18 25 53.9 | E18 25 55.0 | Granite bedrock outcrop in pan with 1 grinding hollow. |  |
| 209       | S29 34 18.8  
 E18 25 53.5 | E18 25 55.0 | Granite bedrock outcrop in pan with 7 grinding hollows. |  |
| 210       | S29 34 18.5  
 E18 25 53.1 | E18 25 55.0 | Granite bedrock outcrop in pan with 2 grinding hollows. |  |
| 211       | S29 34 18.0  
 E18 25 52.9 | E18 25 55.0 | Granite bedrock outcrop in pan with 6 grinding hollows. |  |
| 212       | S29 34 19.3  
 E18 25 52.2 | E18 25 55.0 | Granite bedrock outcrop on edge of pan with 4 grinding hollows. |  |
| 213       | S29 34 18.3  
 E18 25 46.3 | E18 25 55.0 | Granite bedrock outcrop in pan with 3 grinding hollows. |  |
| 214       | S29 34 18.7  
 E18 25 46.8 | E18 25 55.0 | Granite bedrock outcrop in pan with 23 grinding hollows. Some hollows placed very close together with a set of 3 and 2 at 90 degrees to one another being noteworthy. Many grooves are very deep. Artefact scatter. Quartz, CCS. |  |
| 215       | S29 34 15.4  
 E18 25 51.7 | E18 25 55.0 | Light artefact scatter. OES, quartz, CCS, quartzite. |  |
| 216       | S29 34 13.4  
 E18 25 55.0 | E18 25 55.0 | Granite bedrock outcrop away from pan |  |
<table>
<thead>
<tr>
<th>Site Name</th>
<th>GPS point</th>
<th>Co-ordinates</th>
<th>Description</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>L100</td>
<td>S29 34 09.0  E18 25 59.4</td>
<td></td>
<td>Goëbees se pan (L100-L130) Flat slab of rock a distance from the pan with about 10 grinding grooves. Around this is 1 CCS and 1 Q artefact and at least 4 very small potsherds. Fine-grained temper.</td>
<td></td>
</tr>
<tr>
<td>L101</td>
<td>S29 34 07.9  E18 26 01.0</td>
<td></td>
<td>Light scatter of OES and Q artefacts located between the bushes on a slight rise above the pan</td>
<td></td>
</tr>
<tr>
<td>L102</td>
<td>S29 34 07.0  E18 26 00.5</td>
<td></td>
<td>On the edge of the pan: OES, 2 potsherds, 1 hornfels blade, Q and CCS artefacts and one fragment of European ceramic</td>
<td></td>
</tr>
<tr>
<td>L103</td>
<td>S29 34 06.2  E18 26 00.3</td>
<td></td>
<td>Open, trampled gravel soil between the flat slabs of granite on the outer margins of the pan: 1 potsherd, Q core, CCS artefacts</td>
<td></td>
</tr>
<tr>
<td>L104</td>
<td>S29 34 05.3  E18 26 00.2</td>
<td></td>
<td>At least 5 grooves in the granite bedrock. The grooves are all on the flat rocks on the outer margins of the pan.</td>
<td></td>
</tr>
<tr>
<td>L105</td>
<td>S29 34 01.9  E18 26 01.0</td>
<td></td>
<td>At least 3 grinding grooves on a flat rock some distance from the pan</td>
<td></td>
</tr>
<tr>
<td>L106</td>
<td>S29 34 07.7  E18 25 58.3</td>
<td></td>
<td>At least 2 grinding grooves on the flat rock of the pan</td>
<td></td>
</tr>
<tr>
<td>L107</td>
<td>S29 34 07.2  E18 25 58.7</td>
<td></td>
<td>At least 2 grinding areas on the flat rock at the edge of the pan</td>
<td></td>
</tr>
<tr>
<td>L108</td>
<td>S29 34 05.5  E18 25 58.8</td>
<td></td>
<td>At least 1 grinding area on the flat rock at the edge of the pan</td>
<td></td>
</tr>
<tr>
<td>L109</td>
<td>S29 34 04.8  E18 25 58.2</td>
<td></td>
<td>At least 1 grinding area on the flat rock at the edge of the pan</td>
<td></td>
</tr>
<tr>
<td>L110</td>
<td>S29 34 04.2  E18 25 58.1</td>
<td></td>
<td>At least 3 grinding areas on the flat rock of the pan</td>
<td></td>
</tr>
<tr>
<td>L111</td>
<td>S29 34 03.3  E18 25 57.4</td>
<td></td>
<td>At least 5 grinding areas on the edge of the pan</td>
<td></td>
</tr>
<tr>
<td>L112</td>
<td>S29 34 09.0  E18 26 01.3</td>
<td></td>
<td>On the outer margins of the pan: small scatter of CCS and Q artefacts: 1 potsherd. Lid of bully beef nearby as well as two fragments of European ceramic</td>
<td></td>
</tr>
<tr>
<td>L113</td>
<td>S29 34 08.0  E18 26 01.5</td>
<td></td>
<td>On the outer margins of the pan: OES; CCS chips, 1 chal core, Q flakes</td>
<td></td>
</tr>
<tr>
<td>L114</td>
<td>S29 34 05.6  E18 26 02.6</td>
<td></td>
<td>On the outer margins of the pan: OES and Q artefacts</td>
<td></td>
</tr>
<tr>
<td>L115</td>
<td>S29 34 05.7  E18 26 01.5</td>
<td></td>
<td>Possibly a 20th century ash heap of herder living on edge of pan. Lots of ash; broken glass, bits of burnt bone; iron; cigarette stub and one potsherd</td>
<td></td>
</tr>
<tr>
<td>L116</td>
<td>S29 34 01.7  E18 25 54.1</td>
<td></td>
<td>Single grinding groove on a flat rock at the edge of the pan</td>
<td></td>
</tr>
<tr>
<td>L117</td>
<td>S29 34 02.5  E18 25 53.7</td>
<td></td>
<td>Grinding area on a flat rock at the edge of the pan – next to it a cement marker with numbers</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>L118</td>
<td>L118</td>
<td>S29 34 02.7</td>
<td>One grinding groove in the granite bedrock of the pan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L119</td>
<td>S29 34 02.5</td>
<td>About 7 grinding grooves and grinding areas on a large flat rock at the edge of the pan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L120</td>
<td>S29 34 02.4</td>
<td>2 grinding areas on the flat granite bedrock at the edge of the pan. A modern concrete base of a water tank built on the rock</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L121</td>
<td>S29 34 03.1</td>
<td>2 grinding grooves on flat granite bedrock.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L122</td>
<td>S29 34 04.5</td>
<td>At least 9 grinding grooves in the granite bedrock.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L123</td>
<td>S29 34 04.6</td>
<td>One grinding groove in the granite bedrock.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L124</td>
<td>S29 34 06.7</td>
<td>At least 13 grinding grooves and grinding areas on a very flat rock on the margins of the pan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L125</td>
<td>S29 34 07.2</td>
<td>One grinding groove on the granite bedrock of the pan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L126</td>
<td>S29 34 08.4</td>
<td>At least 16 grinding grooves and grinding surfaces on the granite bedrock on the edge of the pan. There are scatters of OES, Q and CCS artefacts on the gravel nearby</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L127</td>
<td>S29 34 08.2</td>
<td>1 grinding grooves and 1 grinding surface on the granite bedrock. A CCS bladelet nearby</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L128</td>
<td>S29 34 08.3</td>
<td>At least 3 grinding grooves in a boulder projecting out of the sand at the edge of the pan (J recorded?)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L129</td>
<td>S29 34 05.2</td>
<td>A deep “puts” dug into the base of the pan and lined with rocks. It is partially full of clear water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L130</td>
<td>S29 34 06.4</td>
<td>At the edge of the one granite area, a scatter of material including: dark green and aqua bottle glass fragments; pottery and stone artefacts in a disturbed context</td>
<td></td>
</tr>
<tr>
<td>KNG2012/012</td>
<td>220</td>
<td>S29 31 37.8</td>
<td>Goebbes farm werf. Mostly modern buildings. Main house is 1960s or 1970s but a barn looks like it may be 1930s or so.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>L055</td>
<td>S29 37 35.4</td>
<td>Ephemeral scatter of quartz artefacts on a “pan” – open patch of gravel slightly lower than surrounding landscape</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L094</td>
<td>S29 33 43.9</td>
<td>In a valley, a gravel plain with a ephemeral scatter of quartz artefacts</td>
<td>---</td>
</tr>
<tr>
<td>KNG2012/013</td>
<td>L095</td>
<td>S29 34 00.9</td>
<td>A small cairn on soft sandy soil at the mouth of a valley. There is a large flat collapsed slab of rock which resembles a headstone but which has no inscription. Possible grave?</td>
<td>High (potentially)</td>
</tr>
<tr>
<td>---</td>
<td>L096</td>
<td>S29 36 05.4</td>
<td>A cleared area/pan with a single lower grindstone made on quartz</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L097</td>
<td>S29 35 11.8</td>
<td>Scatter of quartz artefacts on a open pan area; one CCS artefact with retouch along both margins</td>
<td>---</td>
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<tr>
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<td>Significance</td>
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</tr>
<tr>
<td>Karas 76</td>
<td>154</td>
<td>S29 31.04.7 E18 18.43.7</td>
<td>Good cave with just a few quartz flakes in it... Quite high in a steep kloof.</td>
<td>---</td>
</tr>
<tr>
<td>KAR2012/001</td>
<td>155</td>
<td>S29 30.49.8 E18 18.49.8</td>
<td>Water pit, 3 m deep and fully stone-lined.</td>
<td>Medium</td>
</tr>
<tr>
<td>Koeris 78</td>
<td>L056</td>
<td>S29 39.43.3 E18 23.42.2</td>
<td>Kromneus – large granite outcrop with rock art and historical graffiti dating back to 1879. Rock art consists of geometric images, circles, grids and similar shapes. Two gemsbok are also evident. All images are finger-painted. Granite floor with little deposit. Artefact scatter spread to the east of the site</td>
<td>High (Avoid)</td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L057</td>
<td>S29 39.41.9 E18 23.43.5</td>
<td>Flaked quartz scatter to the east of Kromneus as well as one small potsherd</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L058</td>
<td>S29 39.40.3 E18 23.45.4</td>
<td>Quartz and CCS artefact scatter.</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L059</td>
<td>S29 39.41.1 E18 23.43.9</td>
<td>Two bedrock quartzite grooves situated in this open gravel area. Quartzite flake nearby</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L060</td>
<td>S29 39.41.1 E18 23.43.1</td>
<td>Single bedrock grinding groove in a slab of bedrock</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L061</td>
<td>S29 39.37.2 E18 23.41.4</td>
<td>Drop in the density of quartz artefacts</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L062</td>
<td>S29 39.36.5 E18 23.38.1</td>
<td>Low density of CCS artefacts</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L063</td>
<td>S29 39.39.8 E18 23.38.7</td>
<td>Large area of grinding on granite bedrock as well as a grinding groove</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>L064</td>
<td>S29 39.44.2 E18 23.44.1</td>
<td>One weathered silcrete MSA flake amongst large scatter of quartz and CCS artefacts</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>117</td>
<td>S29 39.42.2 E18 23.40.6</td>
<td>One shallow grinding groove in bedrock.</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>124</td>
<td>S29 39.43.3 E18 23.41.2</td>
<td>Lots of ostrich eggshell in this area compared to the rest of the site.</td>
<td></td>
</tr>
<tr>
<td>KOE2012/001</td>
<td>125</td>
<td>S29 39.40.3 E18 23.39.3</td>
<td>Three shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>128</td>
<td>S29 38.51.0 E18 32.30.5</td>
<td>Area of multiple pans with ephemeral quartz scatter all around.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L066</td>
<td>S29 39.03.5 E18 32.21.6</td>
<td>Next to small sand dune, a deflated gravel area with an ephemeral scatter of CCS and quartz artefacts</td>
<td>---</td>
</tr>
<tr>
<td>KOE2012/002</td>
<td>L067</td>
<td>S29 39.00.4 E18 32.33.3</td>
<td>Next to a small second dune, many CCS artefacts as well as quartz artefacts, on a hard red ferruginous surface</td>
<td>Low</td>
</tr>
<tr>
<td>KOE2012/003 (Springbokvlei)</td>
<td>129</td>
<td>S29 36.36.0 E18 30.04.2</td>
<td>Artefact scatter on edge of pan. Quartz, CCS, OES</td>
<td></td>
</tr>
<tr>
<td>KOE2012/003 (Springbokvlei)</td>
<td>130</td>
<td>S29 36.36.3 E18 30.04.7</td>
<td>Four shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>KOE2012/003 (Springbokvlei)</td>
<td>131</td>
<td>S29 36.33.1 E18 30.04.6</td>
<td>Two shallow grinding grooves in bedrock. Ephemeral scatter of quartz, CCS and OES all over here.</td>
<td>High-Medium</td>
</tr>
<tr>
<td>KOE2012/003 (Springbokvlei)</td>
<td>132</td>
<td>S29 36.27.5 E18 30.07.8</td>
<td>Artefacts scatter. Quartz, CCS.</td>
<td></td>
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<tr>
<td>KOE2012/003 (Springbokvlei)</td>
<td>133</td>
<td>S29 36.26.3</td>
<td>One shallow grinding groove in bedrock. Scatter of quartz, CCS and pottery (2</td>
<td></td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td>134</td>
<td>E18 30 09.2</td>
<td>S29 36 27.0, E18 30 09.5</td>
<td>Two shallow grinding grooves in bedrock. Quartz, OES, pottery (very thin).</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>E18 30 10.1</td>
<td>S29 36 27.5, E18 30 10.1</td>
<td>Five shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>E18 30 10.7</td>
<td>S29 36 27.8, E18 30 10.7</td>
<td>Five shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>137</td>
<td>E18 30 11.7</td>
<td>S29 36 28.1, E18 30 11.7</td>
<td>Two shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>E18 30 12.5</td>
<td>S29 36 28.0, E18 30 12.5</td>
<td>One shallow grinding groove in bedrock.</td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>E18 30 13.3</td>
<td>S29 36 28.4, E18 30 13.3</td>
<td>One shallow grinding groove in bedrock. Artefact scatter. CCS, Lots of OES.</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>E18 30 13.9</td>
<td>S29 36 28.3, E18 30 13.9</td>
<td>Artefact scatter with quartz, CCS and coarse porcelain.</td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>E18 30 13.2</td>
<td>S29 36 29.7, E18 30 13.2</td>
<td>Nine shallow grinding grooves in bedrock. Artefact scatter. Quartz, CCS.</td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>E18 30 14.7</td>
<td>S29 36 31.0, E18 30 14.7</td>
<td>Artefact scatter. Quartz and CCS.</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>E18 30 16.3</td>
<td>S29 36 32.7, E18 30 16.3</td>
<td>Artefact scatter. Quartz, CCS, lots of OES, one grass-tempered potsherd.</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>E18 30 11.0</td>
<td>S29 36 32.4, E18 30 11.0</td>
<td>Artefact scatter. Quartz, CCS.</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>E18 30 07.7</td>
<td>S29 36 32.6, E18 30 07.7</td>
<td>Three shallow grinding grooves in bedrock.</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>E18 30 07.2</td>
<td>S29 36 34.2, E18 30 07.2</td>
<td>Two shallow grinding grooves in bedrock. Quartz, quartzite, OES.</td>
<td></td>
</tr>
<tr>
<td>147</td>
<td>E18 30 07.8</td>
<td>S29 36 34.8, E18 30 07.8</td>
<td>Artefact scatter. Quartz, CCS, OES, upper grindstone fragment in quartzite.</td>
<td></td>
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<tr>
<td>148</td>
<td>E18 30 08.8</td>
<td>S29 36 34.3, E18 30 08.8</td>
<td>Two shallow grinding grooves in bedrock. Large number of heavily weathered MSA flakes here.</td>
<td></td>
</tr>
<tr>
<td>149a</td>
<td>E18 30 10.0</td>
<td>S29 36 35.0, E18 30 10.0</td>
<td>Artefact scatter. Quartz, CCS, FGBR (mostly very weathered again).</td>
<td></td>
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<tr>
<td>149b</td>
<td>E18 30 09.9</td>
<td>S29 36 36.8, E18 30 09.9</td>
<td>Artefact scatter. Quartz, CCS, FGBR (mostly very weathered again).</td>
<td></td>
</tr>
<tr>
<td>149c</td>
<td>E18 30 11.7</td>
<td>S29 36 36.2, E18 30 11.7</td>
<td>Artefact scatter. Quartz, CCS.</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>E18 30 05.6</td>
<td>S29 36 35.3, E18 30 05.6</td>
<td>Artefact scatter. Quartz, CCS.</td>
<td></td>
</tr>
<tr>
<td>L068</td>
<td>E18 30 04.4</td>
<td>S29 36 39.5, E18 30 04.4</td>
<td>Steenbokvlei: on soft red soils on the edge of the pan, some CCS and quartz artefacts as well as OES</td>
<td></td>
</tr>
<tr>
<td>L069</td>
<td>E18 30 04.7</td>
<td>S29 36 39.4, E18 30 04.7</td>
<td>Two grooves in granite bedrock in a granite ridge on edge of pan</td>
<td></td>
</tr>
<tr>
<td>L070</td>
<td>E18 30 04.6</td>
<td>S29 36 39.7, E18 30 04.6</td>
<td>Bedrock grinding surface</td>
<td></td>
</tr>
<tr>
<td>L071</td>
<td>E18 30 05.0</td>
<td>S29 36 39.9, E18 30 05.0</td>
<td>Bedrock grinding groove; fragment of green bottle glass nearby</td>
<td></td>
</tr>
<tr>
<td>L072</td>
<td>E18 30 07.3</td>
<td>S29 36 41.2, E18 30 07.3</td>
<td>At rocky edge overlooking the pan; on soft red soils a single potsherd about 3-4mm, with grass temper</td>
<td></td>
</tr>
<tr>
<td>L073</td>
<td>E18 30 07.6</td>
<td>S29 36 42.9, E18 30 07.6</td>
<td>At least 12 grinding grooves and grinding surfaces on the granite koppie</td>
<td></td>
</tr>
<tr>
<td>L074</td>
<td></td>
<td>S29 36 43.6</td>
<td>Between the rocks at the granite koppie,</td>
<td></td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td>KOE2012/004</td>
<td>L077</td>
<td>S29 36 43.3 E18 30 10.2</td>
<td>A “puts” dug into the base of the pan next to a large granite boulder; roughly circular and lined with rocks</td>
<td>Medium</td>
</tr>
<tr>
<td>KOE2012/005</td>
<td>L065</td>
<td>S29 38 33.4 E18 26 48.4</td>
<td>Kouberg werf. A 1960s house, servants quarters, outside oven and reservoir.</td>
<td>Low</td>
</tr>
<tr>
<td>126</td>
<td>S29 38 28.7 E18 26 51.1</td>
<td>Kouberg werf. Mid-20th century shed/workshop with wool sorting table and work bench inside. Three windmills and a big iron pump wheel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>151</td>
<td>S29 36 44.4 E18 28 49.1</td>
<td>Ephemeral pans with rare quartz artefacts.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>152</td>
<td>S29 36 52.4 E18 23 29.2</td>
<td>Four wind pumps – cultural landscape.</td>
<td>---</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>KOE2012/006</td>
<td>175</td>
<td>S29 39 43.6</td>
<td>Ephemeral pan close to Kromneus. Artefact scatter. Quartz, CCS. Granite</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 23 56.0</td>
<td>probable lower grindstone.</td>
<td></td>
</tr>
<tr>
<td>KOE2012/007</td>
<td>176</td>
<td>S29 38 57.3</td>
<td>Pan with artefact scatter. Quartz, CCS, banded ironstone. MSA. Lots of</td>
<td>Medium-Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 28 11.1</td>
<td>retouched pieces.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>176b</td>
<td>S29 39 00.8</td>
<td>Shallow pan with gravel base; quartz and CCS artefacts. Spread over a wide</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 28 10.3</td>
<td>area.</td>
<td></td>
</tr>
<tr>
<td>L098</td>
<td></td>
<td>S29 39 00.5</td>
<td>Pan with artefact scatter. CCS. MSA.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 28 08.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KOE2012/008</td>
<td>177</td>
<td>S29 38 58.3</td>
<td>Shallow pan with gravel base; CCS and quartz artefacts. MSA? No distinctive</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 29 38.7</td>
<td>MSA attributes</td>
<td></td>
</tr>
<tr>
<td>L099</td>
<td></td>
<td>S29 39 00.0</td>
<td></td>
<td>Low</td>
</tr>
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<td>E18 29 39.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>178</td>
<td>S29 35 15.3</td>
<td>Pan with quartz background scatter.</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 29 59.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Smorgen Schaduwe 127</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMS2012/001</td>
<td>026</td>
<td>S29 32 21.4</td>
<td>Old house and barn. Maybe late 1800s? Also a mid-20th century labourer’s</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 14 43.6</td>
<td>cottage and the main house which is probably 1940s with a late 1950s/1960s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>enclosure of the porch.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/002</td>
<td>027</td>
<td>S29 33 12.5</td>
<td>Stone-walled structure. Boer War. Some tins around about. Circular with</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 13 57.6</td>
<td>entrance facing downslope. About 4 m diameter.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/003</td>
<td>028</td>
<td>S29 33 13.3</td>
<td>Two stone-walled structures. Boer War. One is V-shaped, 2 m deep and 3 m</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 13 58.5</td>
<td>between ends. Larger is a wide semi-circle about 9 m across. Walls are low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(c. 0.6 m high). Look like shooting hides but no gun ports. Cans and metal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>around them.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/004</td>
<td>029a</td>
<td>S29 33 19.2</td>
<td>Stone-walled structure. Boer War. Looks like a very large and oddly shaped</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 13 57.5</td>
<td>kraal. Cans found at point 29A.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>029b</td>
<td>S29 33 19.7</td>
<td></td>
<td>Medium</td>
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<tr>
<td></td>
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<td>E18 13 58.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>029c</td>
<td>S29 33 19.8</td>
<td></td>
<td>Medium</td>
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<tr>
<td></td>
<td></td>
<td>E18 13 58.8</td>
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<tr>
<td></td>
<td>029d</td>
<td>S29 33 19.1</td>
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<td>Medium</td>
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<td></td>
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<td>E18 13 59.0</td>
<td></td>
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<tr>
<td></td>
<td>029e</td>
<td>S29 33 17.7</td>
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<td>Medium</td>
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<td></td>
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<td>E18 13 57.9</td>
<td></td>
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<tr>
<td></td>
<td>029f</td>
<td>S29 33 18.1</td>
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<td>Medium</td>
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<td>E18 13 59.0</td>
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<tr>
<td></td>
<td>029g</td>
<td>S29 33 18.0</td>
<td></td>
<td>Medium</td>
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<td>E18 14 00.9</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>029h</td>
<td>S29 33 18.4</td>
<td></td>
<td>Medium</td>
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<tr>
<td></td>
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<td>E18 14 00.7</td>
<td></td>
<td></td>
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<tr>
<td>SMS2012/005</td>
<td>030</td>
<td>S29 33 16.9</td>
<td>Stone-walled structure. Boer War. Circular enclosure with entrances at SE</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 14 00.9</td>
<td>and W. 6.5 m x 7.5 m. Tin cans and a yellow bottle neck fragment found inside.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/006</td>
<td>031</td>
<td>S29 33 19.6</td>
<td>Stone-walled structure. Boer War. Wide semi-circle 11 m across with walls</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E18 14 03.5</td>
<td>partly tumbled. Highest walls currently about 0.8 m high. Built between rocky</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>outcrops.</td>
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</table>

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<thead>
<tr>
<th>Site Name</th>
<th>GPS point</th>
<th>Coordinates</th>
<th>Description</th>
<th>Significance</th>
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<tbody>
<tr>
<td>SMS2012/007</td>
<td>032</td>
<td>S29 33 21.4</td>
<td>Stone-walled structure. Boer War. Two-sided structure with walls downslope. North end has a cleared path leading westwards down the hill.</td>
<td>Medium</td>
</tr>
<tr>
<td>SMS2012/008</td>
<td>033</td>
<td>S29 33 37.3</td>
<td>Stone-walled structure. Single row of stones against a cliff.</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>033b</td>
<td>S29 33 37.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMS2012/009</td>
<td>034</td>
<td>S29 33 37.4</td>
<td>LSA artefact scatter with lots of quartz, CCS and pottery.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/010</td>
<td>035</td>
<td>S29 33 40.5</td>
<td>Small rock shelter in kloof. Animal lair in the back with lots of bone out front. There is also some burnt bone, quartz, OES and pottery. A broken lower grindstone lies on the talus. Two large blocks in the shelter are very worn on top as if they have been sat on/used extensively. Most artefacts on the terrace out front of the cave.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>036</td>
<td>S29 33 41.3</td>
<td>Two ‘klipbak’ pools in the river: estimated capacities: 0.6 m$^3$ and 1.0 m$^3$.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>037</td>
<td>S29 33 40.9</td>
<td>A large pool just downstream another rock pool with capacity c. 7-8 m$^3$.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>038</td>
<td>S29 33 35.6</td>
<td>An isolated and out of context (in a cairn) lower grindstone and one quartz flake nearby.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/011</td>
<td>039</td>
<td>S29 32 21.2</td>
<td>Old kraal, mostly broken down. It comes right to the edge of the access road.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/012</td>
<td>040</td>
<td>S29 33 58.5</td>
<td>Rock wall with a large lower grindstone at the base. Also an endscraper/thumbnail scraper on crystal. One tine can and a few flakes (1 definite MSA) on the talus slope away from the wall.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/013</td>
<td>041</td>
<td>S29 34 03.6</td>
<td>LSA artefact scatter of probably mixed age. Includes Quartz, CCS and fine-grained black rock. 1 CCS backed scraper. Pottery is very thin-walled. Probably same site as 41B.</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>041B</td>
<td>S29 34 02.4</td>
<td>Centre-point of huge scatter of quartz and CCS with occasional other stone types. (A bit like JKB N without the OES and pottery.)</td>
<td></td>
</tr>
<tr>
<td>SMS2012/014</td>
<td>042</td>
<td>S29 34 00.4</td>
<td>Quartz and OES scatter at the base of rocky ridge. Quartz, CCS, OES. Lots of CCS including 1 segment. One cluster of rocks. Alongside a decent river channel.</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>042b</td>
<td>S29 34 00.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>042c</td>
<td>S29 34 02.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMS2012/015</td>
<td>043</td>
<td>S29 34 04.8</td>
<td>Large artefact scatter. Quartz, CCS, OES, pottery. 1 large thumbnail scraper. Site runs for 100 m along the mountain and extends out about 30 m.</td>
<td>Medium</td>
</tr>
<tr>
<td>---</td>
<td>044</td>
<td>S29 34 05.6</td>
<td>Isolated grooved lower grindstone in the middle of the veld.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/016</td>
<td>045</td>
<td>S29 35 29.5</td>
<td>Small stone enclosure against the cliff. Old can nearby and another about 70 m</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Coordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td>SMS2012/017</td>
<td>046</td>
<td>S29 35 29.4 E18 15 25.8</td>
<td>Scatter of quartz and 1 banded ironstone flake.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/018</td>
<td>047</td>
<td>S29 34 40.2 E18 17 50.5</td>
<td>Historical stone enclosure built as 2 skins with a rubble fill. One side of the wall is a low row of stones on a bedrock outcrop and wall continues along on sand. 5 m long along rock and extends out for 3 m.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/019</td>
<td>048</td>
<td>S29 34 41.5 E18 17 49.0</td>
<td>Small koppie with an overhang containing 7 “cupules”. Some are very deep which is unusual. 2 about 20 mm and one at 35 mm deep. Rock wall only about 1.8 m high above a ledge and entire koppie is about 2.5 m high.</td>
<td>High</td>
</tr>
<tr>
<td>---</td>
<td>049</td>
<td>S29 34 41.8 E18 17 49.4</td>
<td>Single shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>050</td>
<td>S29 34 42.2 E18 17 49.6</td>
<td>Single shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>051</td>
<td>S29 34 42.5 E18 17 50.1</td>
<td>Single shallow grinding groove in bedrock. Very rare quartz flakes in the area.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>052</td>
<td>S29 34 44.9 E18 17 50.1</td>
<td>One shallow grinding groove in bedrock and one open grinding area.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>053</td>
<td>S29 34 45.9 E18 17 48.3</td>
<td>Single shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/020</td>
<td>054</td>
<td>S29 34 48.6 E18 17 48.7</td>
<td>Two low stone mounds (suspiciously grave-like). Occasional quartz and OES around the area.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/021</td>
<td>055</td>
<td>S29 34 48.5 E18 17 47.4</td>
<td>Area with quartz, one thin-walled potsherd, glass and metal scattered about.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/022</td>
<td>056</td>
<td>S29 34 50.2 E18 17 47.1</td>
<td>Stone enclosure against a boulder. Enclosure about 3 m by 7 m.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/023</td>
<td>057</td>
<td>S29 34 50.4 E18 17 46.2</td>
<td>Light scatter of quartz and OES.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>058</td>
<td>S29 34 54.6 E18 17 50.1</td>
<td>Single shallow ground area.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>059</td>
<td>S29 34 54.9 E18 17 50.1</td>
<td>Two shallow grinding grooves in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/024</td>
<td>060</td>
<td>S29 34 55.3 E18 17 50.2</td>
<td>Eighteen shallow grinding grooves and open grinding areas in bedrock.</td>
<td>Medium-Low</td>
</tr>
<tr>
<td>---</td>
<td>061</td>
<td>S29 34 56.2 E18 17 50.5</td>
<td>One shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/025</td>
<td>062</td>
<td>S29 34 56.3 E18 17 50.3</td>
<td>At least eight shallow grinding grooves and open grinding areas in bedrock.</td>
<td>Medium-Low</td>
</tr>
<tr>
<td>SMS2012/026</td>
<td>063</td>
<td>S29 34 57.2 E18 17 49.8</td>
<td>Semi-circular stone enclosure against a boulder and with a glass bottle inside. Enclosure about 7 m by 7 m.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>064</td>
<td>S29 34 58.3 E18 17 50.9</td>
<td>One shallow grinding groove in bedrock and one open grinding area.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/027</td>
<td>065</td>
<td>S29 35 00.3 E18 17 49.8</td>
<td>Single shallow cupule on a 1.2 m high overhanging boulder. A few quartz flakes present out the front.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/028</td>
<td>066</td>
<td>S29 34 59.9 E18 17 48.3</td>
<td>Straight stone alignment running away from a rock outcrop.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/029</td>
<td>067</td>
<td>S29 34 59.5</td>
<td>Small possible enclosure with 5 quartz</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Co-ordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td></td>
<td></td>
<td>E18 17 49.1</td>
<td>flaks inside. There are a few other patches of possible piled stones around here on a small rocky koppie.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/030</td>
<td>068</td>
<td>S29 35 04.4, E18 17 43.1</td>
<td>Good quartz scatter in front of a boulder.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/031</td>
<td>069</td>
<td>S29 35 05.7, E18 17 42.7</td>
<td>One shallow grinding groove in bedrock and an upper grindstone fragment lying nearby. Also a stone and soil feature here to dam water in the ‘klipbakke’.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/032</td>
<td>070</td>
<td>S29 35 06.5, E18 17 40.9</td>
<td>Multiple stone and soil features making small dams in the bedrock. The ‘dam walls’ block of narrow channels in the rock.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>071</td>
<td>S29 35 03.8, E18 17 41.5</td>
<td>One shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/033</td>
<td>072</td>
<td>S29 32 11.5, E18 14 44.3</td>
<td>Family graveyard – not visited.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/034</td>
<td>073</td>
<td>S29 34 00.1, E18 15 07.9</td>
<td>Light quartz and CCS scatter in a sandy area.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/035</td>
<td>074</td>
<td>S29 34 00.0, E18 15 09.3</td>
<td>Light quartz and CCS scatter in a sandy area.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/036</td>
<td>075</td>
<td>S29 33 58.8, E18 15 11.7</td>
<td>Rock wall 5 m high with c. 27 cupules on it. Off to the right two of the cupules are only pecked and have not been ground at all. In general the cupules at this site are rougher and may be older? There is no associated archaeology out front at all.</td>
<td>High</td>
</tr>
<tr>
<td>---</td>
<td>076</td>
<td>S29 34 26.7, E18 16 47.8</td>
<td>Example of a deflated open area with rare quartz artefacts (background scatter) amongst the ubiquitous quartz gravel.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>077</td>
<td>S29 36 06.0, E18 18 10.4</td>
<td>Light, widespread scatter of quartz, silcrete and quartzite (1) in deflated area – area is an ephemeral pan.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>077b</td>
<td>S29 36 11.2, E18 18 11.7</td>
<td>Light quartz and one silcrete flakes in an open gravel area</td>
<td>---</td>
</tr>
<tr>
<td>L031</td>
<td></td>
<td>S29 36 09.6, E18 18 12.4</td>
<td>Quartz flakes and one silcrete flakes in a open gravel area</td>
<td>---</td>
</tr>
<tr>
<td>L032</td>
<td></td>
<td>S29 38 05.7, E18 18 13.7</td>
<td>Extension of same site as L031</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>078</td>
<td>S29 38 02.4, E18 18 14.4</td>
<td>Another ephemeral pan with occasional quartz, silcrete and CCS artefacts, mostly all very weathered.</td>
<td>---</td>
</tr>
<tr>
<td>L033</td>
<td></td>
<td>S29 38 13.5, E18 18 13.3</td>
<td>Extension of site recorded by J. Large gravel area with quartz artefacts and occasional silcrete cores and flakes – widespread but ephemeral</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>079</td>
<td>S29 38 14.5, E18 18 14.1</td>
<td>Another ephemeral pan but with bedrock exposures in it. Occasional quartz, silcrete and CCS artefacts, mostly all very weathered.</td>
<td>---</td>
</tr>
<tr>
<td>L034</td>
<td></td>
<td>S29 38 36.3, E18 17 29.5</td>
<td>Bedrock present – surrounded by some silcrete flakes</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>080</td>
<td>S29 38 36.7, E18 17 30.6</td>
<td>One shallow grinding groove in bedrock.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/037</td>
<td>081</td>
<td>S29 38 37.0, E18 17 30.0</td>
<td>Granite boulder with quartz, CCS, OES, glass, coarse porcelain and bone.</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Co-ordinates</td>
<td>Description</td>
<td>Significance</td>
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<tr>
<td>SMS2012/038</td>
<td>082</td>
<td>S29 38 38.0  E18 17 29.9</td>
<td>Artefact scatter among boulders alongside granite koppie. Quartz, silcrete, CCS, glass, coarse porcelain, bone.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/039</td>
<td>083</td>
<td>S29 38 37.0  E18 17 28.7</td>
<td>8 mm thick pot sherd with ochred outer wall, clear quartz backed piece fragment nearby. On neighbouring terrace below koppie there are several other potsherd with 6-7 mm thick walls, a CCS flake and some OES.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/040</td>
<td>084</td>
<td>S29 38 36.4  E18 17 25.2</td>
<td>Scatter of quartz, silcrete, OES and pottery at the base of the granite koppie.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>085</td>
<td>S29 38 36.0  E18 17 25.2</td>
<td>Widespread quartz scatter among klipbakke away from the koppie.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>086</td>
<td>S29 38 36.0  E18 17 25.2</td>
<td>One shallow grinding groove in bedrock. Plenty of artefacts all over this area but low density scatter. Quartz, CCS and silcrete. Silcrete looks mostly MSA.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/041</td>
<td>087</td>
<td>S29 32 37.7  E18 15 45.7</td>
<td>Light quartz scatter 50 m from the rocks.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/042</td>
<td>088</td>
<td>S29 35 44.2  E18 15 38.8</td>
<td>Widespread light quartz scatter in sandy area in front of rocky hills.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>089</td>
<td>S29 35 44.1  E18 15 36.9</td>
<td>Three items only. 1 OES, 1 coarse porcelain fragment and one ?flaked green bottle base in a sandy area in front of the rocks.</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/043</td>
<td>090</td>
<td>S29 35 45.5  E18 15 33.9</td>
<td>Light quartz scatter 50 m from the rocks.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/044</td>
<td>091</td>
<td>S29 35 48.3  E18 15 33.9</td>
<td>Quartz and CCS artefact scatter on raised flat platform between the rocky hills. Extensive scatter about 50 m wide.</td>
<td>Medium-Low</td>
</tr>
<tr>
<td>SMS2012/045</td>
<td>092</td>
<td>S29 35 57.9  E18 15 28.9</td>
<td>Large semi-circular stone wall of 23 m length along the rocky hill with a rectangular enclosure of 5.5 m by 7.0 m within it. Close by was a small semi-circular enclosure. Some bits of plastic here and a large tin about 30 m away to the east.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/046</td>
<td>093</td>
<td>S29 35 56.8  E18 15 22.9</td>
<td>Artefact scatter on a flat area on top of the hill. Quartz and CCS.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/047</td>
<td>L003</td>
<td>S29 33 11.8  E18 13 39.5</td>
<td>Very large cairn made of quartz blocks, 50 or more stones, forming a rough circle 2m x 2m. On a sandy patch on the slopes of the little koppie.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/047</td>
<td>L004</td>
<td>S29 33 37.2  E18 13 35.4</td>
<td>Site near the stone walling (only single course of stones) in the kloof. 5 potsherd, about 4-5 mm thick, some evidence of grass temper. One has some red ochre staining inside (not burnish). 1 ccs thumbnail scraper, 2 flakes on fine-grained material, OES.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/048</td>
<td>L005</td>
<td>S29 33 37.9  E18 13 35.5</td>
<td>Three pieces of pottery on the opposite site of the kloof, about 5mm, black outside and reddish inside. Also OES.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/049</td>
<td>L006</td>
<td>S29 34 01.9  E18 15 13.1</td>
<td>At foot of reddish koppie. Some stone features? Nearby 3 potsherd, 5mm thick, fine temper, black colour. 1 ccs</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
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<td>Description</td>
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<tr>
<td>SMS2012/050</td>
<td>L007</td>
<td>S29 34 02.1 E18 15 14.0</td>
<td>Around corner of koppie, large cairn of flat granite (sandstone?) slabs. Covered with small quartz pebbles.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/051</td>
<td>L008</td>
<td>S29 34 01.5 E18 15 14.3</td>
<td>A background of fine-grained ccs/sil as well as quartz (milky and clear) flakes and cores. Widespread. In this cleared area, occasional slab of rock suggests they are for securing matjies houses.</td>
<td>High-Medium</td>
</tr>
<tr>
<td></td>
<td>L009</td>
<td>S29 34 01.5 E18 15 13.8</td>
<td>A hearth consisting of a number of fragments of charcoal and oes. Possibly related to a stockpost in the area.</td>
<td></td>
</tr>
<tr>
<td>SMS2012/052</td>
<td>L010</td>
<td>S29 34 03.4 E18 15 17.2</td>
<td>Spread of stone artefacts including 2 fine-grained red sil/ccs flakes and 1 qzte upper grindstone. Some aqua glass nearby. 1 ccs bladelet, large silcrete core, one “green” flake.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/053</td>
<td>L011</td>
<td>S29 34 05.3 E18 15 17.0</td>
<td>More flakes on fine-grained yellow ccs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L012</td>
<td>S29 34 05.7 E18 15 17.3</td>
<td>A cairn of small stones, about 1m². Possible grave?</td>
<td>High (cairn)</td>
</tr>
<tr>
<td></td>
<td>L030</td>
<td>S29 36 07.0 E18 18 11.6</td>
<td>A potsherd amongst the widespread scatter of artefacts at the foot of the koppie. About 6-7mm thick, fine grained temper and black in colour</td>
<td>Low (artefacts)</td>
</tr>
<tr>
<td>SMS2012/054</td>
<td>L013</td>
<td>S29 34 07.7 E18 15 13.9</td>
<td>A rock art panel (2-3m) comprising about 30 ground cupules, ranging in size from 2-5cm in diameter. Arranged more or less in rows. There is a large flat rock in front of panel, with 4-5 grinding surfaces (usual boat shape). Cartridge case in front of site, and tin can lid. Scatter of quartz flakes in the area.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/055</td>
<td>L014</td>
<td>S29 34 08.2 E18 15 13.3</td>
<td>A rock art panel comprising about 70 ground cupules, a crack separates them from 2 more. Arranged in rows, small top and large below. 7 rows of small cupules, 1 row of large cupules. No deposit in front of the site.</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/056</td>
<td>L015</td>
<td>S29 34 08.1 E18 15 12.9</td>
<td>Large rock panel about 4m long, but surface partly obscured by water streaks. Rows of ground cupules. About 30 cupules, 2-5cm in size. Floor is sandy and has limited archaeological potential. There are 3 stones placed in a semi-circle angling away from rock. 7 pieces of ceramic (one base, one brown sponge ware and one annular ware). Base of dark green bottle</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/057</td>
<td>L016</td>
<td>S29 34 05.4 E18 15 16.4</td>
<td>Rock art panel on a large vertical slab (about 2m long and 80cm wide) of rock close to the ground. 35 ground cupules in about two rows. Small hollows, about 2cm diameter. No floor and no artefacts</td>
<td>High</td>
</tr>
<tr>
<td>SMS2012/058</td>
<td>L017</td>
<td>S29 34 04.3 E18 15 16.0</td>
<td>Rock art panel on a projecting rock outcrop against the side of the koppie. Under the projected rock is a further area of ground cupules. There are about 80 cupules at the top and 10 cupules below.</td>
<td>High</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
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<tr>
<td>L029</td>
<td>S29 34 05.7 E18 15 16.8</td>
<td>The top appear to be arranged in diagonal lines. No archaeology.</td>
<td>---</td>
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</tr>
<tr>
<td>---</td>
<td>L018</td>
<td>S29 34 44.4 E18 17 42.1</td>
<td>Five roughly chipped areas on a boulder next to L017 (possibly natural exfoliation). No floor or deposit and no associated remains.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L019</td>
<td>S29 34 46.5 E18 17 43.4</td>
<td>2 bedrock grooves</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L020</td>
<td>S29 34 46.9 E18 17 44.4</td>
<td>A large grinding surface</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L021</td>
<td>S29 34 48.7 E18 17 44.0</td>
<td>A bedrock groove</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/059</td>
<td>L022</td>
<td>S29 34 48.9 E18 17 41.5</td>
<td>A spread of OES and some quartz artefacts in a small area of red soil on one of the highest stone koppies. 1 piece of pottery, 5mm thick, fine grained temper.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/060</td>
<td>L023</td>
<td>S29 34 51.1 E18 17 42.0</td>
<td>On a little terrace overlooking the plains, a scatter of OES, quartz (both milky and clear) artefacts in an area around 2m x 5m.</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/061</td>
<td>L024</td>
<td>S29 34 52.1 E18 17 41.6</td>
<td>Extension of the same terrace, sheltered by the koppie. More OES and quartz artefacts</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/062</td>
<td>L025</td>
<td>S29 34 53.4 E18 17 39.8</td>
<td>Short section of rough stone walling forming a small kraal against the koppie. About 3m x 2m. Lots of broken glass around</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/063</td>
<td>L026</td>
<td>S29 34 51.3 E18 17 45.1</td>
<td>A spread of OES and quartz artefacts</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/064</td>
<td>L027</td>
<td>S29 34 47.2 E18 17 48.2</td>
<td>OES, quartz artefacts and one potsherd, 5mm thick, fine grained temper</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>L028</td>
<td>S29 34 04.3 E18 15 15.9</td>
<td>Broken granite lower grindstone on a ledge on the side of the koppie.</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L035</td>
<td>S29 38 31.5 E18 17 24.0</td>
<td>Koppie at the corner of farm. Grinding groove in granite bedrock</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L036</td>
<td>S29 38 36.4 E18 17 22.1</td>
<td>Silcrete flakes around granite bedrock with “klipbakke”</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>L037</td>
<td>S29 32 37.1 E18 15 46.5</td>
<td>Spread of silcrete flakes and cores between the granite bedrock</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/065</td>
<td>L038</td>
<td>S29 33 24.0 E18 15 52.6</td>
<td>Possible old stockpost on degraded area of veld in front of mountain. Few loose stones – with 9 ceramic fragments: 3 pieces of white refined earthenware; coarse glazed Chinese porcelain (ginger jar), 2 pieces of lusterware, one white plate fragment with moulded rim; one white fragment with black transfer decoration</td>
<td>Low</td>
</tr>
<tr>
<td>SMS2012/066</td>
<td>L039</td>
<td>S29 35 51.1 E18 15 43.7</td>
<td>Single row of rocks forming rough semi-circle in front little stone koppie associated with 20th century glass</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>L040</td>
<td>S29 35 46.3 E18 15 37.0</td>
<td>Dark green and blue bottle glass fragments in front of two small shelters</td>
<td>---</td>
</tr>
<tr>
<td>SMS2012/067</td>
<td>L041</td>
<td>S29 35 46.3</td>
<td>Large koppie – a little sandy patch of soil</td>
<td>Low</td>
</tr>
<tr>
<td>Site Name</td>
<td>GPS point</td>
<td>Co-ordinates</td>
<td>Description</td>
<td>Significance</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>L042</td>
<td>E18 15 36.7</td>
<td>(2m²) containing about 7 quartz flakes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>S29 35 45.7</td>
<td>E18 15 36.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A small collection of about 20 quartz flakes in a 5m² area. Also one quartzite flake</td>
<td></td>
</tr>
<tr>
<td>SMS2012/068</td>
<td>L043</td>
<td>S29 35 53.7</td>
<td>E18 15 29.1</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A collection of quartz artefacts between granite boulders</td>
<td></td>
</tr>
<tr>
<td>SMS2012/069</td>
<td>L044</td>
<td>S29 36 00.4</td>
<td>E18 15 19.6</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scatter of quartz artefacts next to a koppie</td>
<td></td>
</tr>
<tr>
<td>SMS2012/070</td>
<td>L045</td>
<td>S29 34 51.3</td>
<td>E18 17 45.1</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OES and quartz flakes on a sandy terrace on top of the koppie.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: Mapping of all heritage occurrences.

In the maps that follow:

- White numbered circles represent heritage occurrences as documented in Appendix A;
- Thin blue lines denote GPS tracks created during the survey;
- The black lines show the development area as identified after the scoping study;
- The yellow outlined area is the solar focus area;
- The turquoise outlined area is the wind focus area;
- The red line shows the proposed power line route; and
- The yellow bar for scale represents 2.5 km
North-western part of the study area.
South-western part of the study area.
South-eastern part of the study area.
North-eastern part of the study area.
APPENDIX C: DEA specialist declaration

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape</td>
</tr>
</tbody>
</table>

| Specialist: | ACO Associates cc |
| Contact person: | Jayson Orton |
| Postal address: | 8 Jacob’s Ladder, St James |
| Postal code: | 7945 |
| Telephone: | 021 706 4104 |
| E-mail: | Jayson.Orton@aco-associates.com |
| Professional affiliation(s) (if any): | Association of Southern African Professional Archaeologists (ASAPA) member No. 233 |

| Project Consultant: | Aurecon South Africa (Pty) Ltd |
| Contact person: | Louise Corbett / Cornelia Steyn |
| Postal address: | PO Box 494, Cape Town |
| Postal code: | 8000 |
| Telephone: | 021-526-6027 |
| E-mail: | Louise.corbett@aurecongroup.com / cornelia.steyn@aurecongroup.com |

4.2 The specialist appointed in terms of the Regulations

I, JAYSON ORTON, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of company (if applicable): ACO ASSOCIATES

Date: 21 AUGUST 2012
Dear Corlie

Thanks for this. I see no issues with this revised Solar layout area except perhaps for its proximity to the national road as a scenic route. But visual will probably raise this issue as well.

all the best
Jayson

On 8 November 2012 14:27, Cornelia Steyn <Cornelia.Steyn@aurecongroup.com> wrote:

Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON’T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Corlie Steyn Environmental Management

Environmental Practitioner I Aurecon

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Postal address: 8 Jacobs Ladder, St James, 7945
Office: 021 706 4104
Cell: 083 272 3225
Fax: 086 603 7195
Annexure H1a
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Fax: 086 603 7195
Annexure H2
PALAEONTOLOGICAL SPECIALIST STUDY: DESKTOP ASSESSMENT

Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape

John E. Almond PhD (Cantab.)
Natura Viva cc, PO Box 12410 Mill Street,
Cape Town 8010, RSA
naturaviva@universe.co.za

August 2012

SUMMARY

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) is proposing to develop a 750 MW generating capacity wind energy facility as well as a 250 MW generating capacity photovoltaic (PV) and/or concentrated photovoltaic (CPV) solar energy facility on adjacent sites near Kangnas in the Bushmanland region of the Northern Cape (Nama Khoi Local Municipality). The study area is situated some 50 km east of Springbok and straddles the N14 tar road between Springbok and Pofadder. It comprises five portions of four farms: Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77), Farm Koeris (Portion 1 of Farm No. 78), Farm Areb (remaining portion of Farm No. 75) and Farm Smorgenschaduwe (Portion 0 of Farm No. 127).

The Mainstream wind energy and solar energy facility project areas are largely underlain by ancient Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province that crop out as low, rocky inselberge and are entirely unfossiliferous. In the intervening flatter, low-lying areas where the wind and solar energy facilities are likely to be constructed these older basement rocks are extensively mantled with geologically young superficial deposits (Quaternary to Recent sandy alluvium, colluvium, soils, wind-blown sand, calcrete hardpans etc) that are generally of low to very low palaeontological sensitivity.

Small but significant areas of older fossiliferous sediments have been recorded subsurface within the Kangnas study area and have yielded scientifically important vertebrate and plant fossil material. These include (1) rare dinosaur remains (Kangnasaurus), petrified woods and non-marine crustaceans (ostracods) from crater lake deposits of probable Late Cretaceous age at Goebes in the northeast, as well as (2) Late Tertiary (Miocene) three-toed horses (Hipparion) from palaeochannel river deposits at Areb in the north. Neither of these fossil sites is likely to be directly affected by the proposed developments. However, it is quite possible that further, hitherto undiscovered fossiliferous deposits of this nature lie buried beneath the superficial sediment cover elsewhere within the broader study area. Fossils exposed at the surface or underground may be damaged, disturbed or sealed-in during the construction phase of the proposed wind and solar energy facilities near Kangnas. However, these deposits are unlikely to be directly affected except by deeper excavations (> 3m) that penetrate the generally unfossiliferous superficial deposits overlying them. Both the proposed wind energy facility and solar energy facility developments are inferred to be of LOW overall impact significance in terms of palaeontological heritage resource conservation.

Given the low overall palaeontological sensitivity of the basement rocks and superficial deposits within the Kangnas study area, the successive or concurrent development here of the proposed...
wind and solar energy facilities is not considered to pose a significant cumulative impact on local fossil heritage. Future changes in infrastructure layout for the wind or solar energy projects will not materially affect the conclusions and recommendations made in this palaeontological report.

In view of the overall low impact significance of the proposed developments on palaeontological heritage resources, it is concluded that no further palaeontological heritage studies or specialist mitigation are required for these alternative energy projects, pending the discovery or exposure of any substantial fossil remains (e.g. vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) during the construction phase. The Environmental Control Officer (ECO) responsible for these developments should be alerted to the two known fossil sites as well as the possibility of fossil remains being found either on the surface or exposed by fresh excavations during construction. Should fossil remains be discovered during construction, these should be safeguarded (preferably in situ) and the ECO should alert the South African Heritage Resources Authority (SAHRA) so that appropriate mitigation (e.g. recording, sampling or collection) can be undertaken by a professional palaeontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved repository (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

These recommendations should be incorporated into the Environmental Management Programme (EMP) for the two Mainstream alternative energy developments near Kangnas.

1. INTRODUCTION & BRIEF

The company South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) is proposing the development of (1) a 750 MW generating capacity wind energy facility as well as (2) a 250 MW generating capacity photovoltaic (PV) and/or concentrated photovoltaic (CPV) solar energy facility on adjacent sites near Kangnas in the Bushmanland region of the Northern Cape (Nama Khoi Local Municipality). The study area of about 46 535 hectares extent is situated some 48 km east of Springbok and straddles the N14 tar road between Springbok and Pofadder (Figs. 1 to 3). It comprises five portions of four farms that are currently zoned for agriculture and used for grazing (Fig. 2), namely:

- Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77);
- Farm Koeris (Portion 1 of Farm No. 78);
- Farm Areb (Remaining portion of Farm No. 75);
- Farm Smorgenschaduwe (Remaining portion of Farm No. 127).

The main infrastructural components of the proposed wind energy facility of relevance to the present fossil heritage study are:

- 185 to 500 wind turbines of 1.5-4 MW capacity each, giving a total generation capacity of up to 750 MW. The turbine foundations would be approximately 20 m x 20 m and an average of 3 m deep;
- A permanent hard standing area for the crane of compacted gravel of approximately 20 m x 50 m adjacent to each turbine location;
- Gravel surface access roads of approximately 6-10 m width between each turbine;
- Underground cables connecting the turbines with each other and a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible;
- Electricity distribution network consisting of up to four satellite substations, a main substation and a new 132 or 220 kV overhead transmission line connecting to the existing 220 kV Eskom power line that crosses the northern part of the study site (Fig. 3).
The preferred location for the wind turbines will be largely south of the N14. The main infrastructural components of the proposed solar energy facility of relevance to the present fossil heritage study are:

- Numerous PV / CPV arrays of up to 250 MW total generation capacity combined as tables (c. 40 m x 5 m) mounted on racks that are fixed to the ground via concrete, screw or pile foundations. Tracking systems may also be installed;
- Gravel access roads of approximately 6 to 10 m width;
- Cables connecting the arrays with a single 220 kV overhead transmission line crossing the site to an onsite substation. This substation will connect to the existing 220 kV Eskom power line that crosses the northern part of the study site.

The total footprint of the solar energy facility will be approximately 1000 hectares. The preferred location is north of the N14 tar road near Areb (see Fig. 3).

The present fossil heritage desktop assessment forms part of the combined EIA process for both the wind energy facility and solar energy facility at Kangnas that is being co-ordinated by Aurecon South Africa (Pty) Ltd, Cape Town (Aurecon project no: 108495) (DEA ref. no. 14/12/16/3/3/2/346 (Wind); NEAS ref. no. DEA/EIA/0001222/2012; DEA ref.no. 14/12/16/3/3/2/342 (PV); NEAS ref. no. DEAT/EIA/0001217/2012).

In accordance with the National Heritage Resources Act, 1999, a palaeontological heritage assessment is required as part of a Heritage Impact Assessment for these projects since important fossil material (Cretaceous dinosaurs and Tertiary mammals) has previously been recorded in the Kangnas area. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

The Terms of Reference for the present palaeontological heritage draft scoping report, as specified by Aurecon South Africa (Pty) Ltd, are briefly to undertake a Paleontological Impact Assessment in relation to the proposed wind and solar energy facilities, Kangnas, near Springbok in the Northern Cape. A desktop study should be conducted to determine the likelihood and need for detailed palaeontological assessment.
Fig. 1. Extract from 1: 250 000 topographical sheet 2918 Pofadder showing the approximate location (black rectangle) of the proposed wind and solar energy facilities near Kangnas, approximately 50 km east of Springbok and close to the eastern edge of the Goegap Nature Reserve, Northern Province (Courtesy of the Chief Directorate: National Geospatial Information, Mowbray). Important vertebrate fossil sites at Areb (Miocene river deposits) and Goebees (Late Cretaceous crater lake sediments) are circled.
Fig. 2. Map showing the land parcels concerned in the proposed wind energy and solar energy facilities near Kangnas, Northern Cape (Image kindly provided by Aurecon South Africa (Pty) Ltd).
Fig. 3. Google Earth© satellite image of the Kangnas study area straddling the N14 tar road between Springbok and Pofadder. The flatter-lying buildable areas are shown in grey-green. The preferred route for the new overhead transmission line is indicated by the red line. The focus area for the proposed solar energy facility is outlined in yellow. The focus area for the WEF lies south of the N14.
1.1 Approach used for this specialist palaeontological study

This palaeontological report provides an assessment of the recorded or inferred palaeontological heritage within the Kangnas wind and solar energy facility study areas, with recommendations for specialist palaeontological mitigation where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, including a palaeontological assessment for a wind farm project near Springbok (Almond 2010); (2) published geological maps and accompanying sheet explanations, and (3) relevant geological data provided in the Draft Scoping Report for these projects produced by Aurecon (Report No. 6205, June 2012) including a useful report on a geological site visit by Professor Chris Harris of UCT.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations etc) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author’s field experience (Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following scoping during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by J. Almond and colleagues; e.g. Almond & Pether 2008). The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field-based assessment by a professional palaeontologist is usually warranted.

On the basis of the desktop and any recommended follow-up field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (e.g. sedimentological data) – is usually most effective during the construction phase when fresh fossiliferous bedrock has been exposed by excavations, although pre-construction recording of surface-exposed material may sometimes be more appropriate. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority (i.e. SAHRA, Cape Town). It should be emphasized that, providing appropriate mitigation is carried out, the majority of developments involving bedrock excavation can make a positive contribution to our understanding of local palaeontological heritage.

1.2 Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant (“mappable”) bedrock units as well as major areas of superficial “drift” deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major
influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological “grey literature” - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

(b) overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of palaeontological field studies in the Springbok region, the main limitations are the high levels of bedrock cover by alluvial and colluvial soils as well as extensive calcrete hardpans. These younger sandy and gravelly deposits may conceal scientifically important buried fossiliferous sediments associated with ancient (Tertiary) drainage courses and volcano crater lake deposits (Late Cretaceous), such as have been described near Kangnas and elsewhere in the Bushmanland region.
Fig. 4. Geological map of the Kangnas region c. 50 km east of Springbok, Northern Cape, showing the outcrop areas of the main rock units represented within the wind energy facility and solar energy facility study areas, outlined in dark red (Map abstracted from 1: 250 000 geology sheet 2918 Pofadder, Council for Geoscience, Pretoria). The red triangle indicates the site of the Kangnasaurus Cretaceous dinosaur fossil site at the Goebbees farmstead and the blue triangle the Miocene fossil horse locality at Areb (approximate position only).

The following rock units are mapped at surface within the Kangas study area:
Precambrian metamorphic and intrusive igneous rocks of the Namaqua-Natal Metamorphic Province:
Ksg, Kwr, Kkop, Kld = Mid Proterozoic (Mokolian / Kheisian) metamorphic rocks of the Bushmanland Group and Gladkop Metamorphic Suite
Nml, Nky, Nab, Nkf – Early to Mid Proterozoic (Mokolian / Namaquan) metamorphic and intrusive igneous rocks of the Little Namaqualand Suite, Korridor Suite
T-c (yellow) = Tertiary / Quaternary calcrite (pedogenic limestone)
Q-s1 (pale yellow) = Quaternary aeolian (wind-blown) sands, probably equivalent to the Gordonia Formation (Kalahari Group)
Q-s2 (v. pale yellow) = Quaternary sand, scree, rubble, sandy soils of alluvial and colluvial origin
small black diamond symbol (K-k) = kimberlite volcanic pipe
small black triangular symbol (K-om) = olivine melilitite volcanic pipe
Grey area in bottom RHS corner = Permo-carboniferous Mbizane Formation (Dwyka Group, Pmb).
2. GEOLOGICAL BACKGROUND

The Kangnas study area is situated within the arid Bushmanland region between Springbok and Pofadder (Fig. 3). The rugged mountainous terrain of the Namaqualand klipkoppe (e.g. Goegap Nature Reserve) lies some ten km to the west. Much flatter-lying, sandy terrain predominates around Kangnas, where the ground slopes northwards from around 1100m amsl in the south down to c. 900m amsl in the north. Numerous small koppies and ridges of ancient basement rocks (gneisses, granites etc) emerge abruptly above the sand cover as isolated Inselberge, reaching elevations of some 1200m amsl or slightly more (e.g. Karasberg, Areb se Berg, Koumoesnaab se Berg). The flatter areas feature several shallow, intermittent-flowing drainage channels; many of these trend southwest in the southern part of the study area and northwards in the northern part of the area. There are also numerous depressions or pans, the most prominent among which are Steenbok Pan and Kalkom pan, the latter situated towards the southern margin of the area (Draft Scoping Report 2012, Aurecon Report No. 6205, geological site report by Harris 2012) (Fig. 4). These pans, often associated with thick development of calcrete (pedogenic limestone), are variously related to depressions in the underlying basement rocks as well as possible buried ancient water courses and volcanic pipes.

The geology of the Kangnas study area is shown on 1: 250 000 geology sheet 2912 Pofadder (Council for Geoscience, Pretoria; Fig. 4) and described in the accompanying sheet explanation by Agenbacht (2007). Also relevant are the explanations to the adjoining Springbok and Loeriesfontein sheets by Marias et al. (2001) and Macey et al. (2011) respectively since the terrain and rocks concerned show a high level of overlap. Most of the study area is mantled by unconsolidated Quaternary to Recent superficial sediments. These include a range of quartz-rich alluvial sands and gravels, skeletal soils, colluvial deposits such as bouldery or blocky scree, sandy, arkosic (feldspar-rich) and gravelly sheet wash and slope deposits derived from weathering of the surrounding granite-gneiss terrain (Q-s2), and wind-blown (aeolian) sands (Q-s1). These last may probably be equated with the Quaternary Gordonia Formation of the Kalahari Group whose main outcrop area lies to the north of the Pofadder sheet area. Pans and water courses are often associated with thick developments of calcrete (pedogenic limestone). Calcrete hardpans (T-c) of probable Late Tertiary (Neogene) to Quaternary or Recent age also occur subsurface and extensive surface exposures are mapped at the south-eastern and south-western edges of the study area. Calcrete thicknesses of 10m are apparently typical for the study area but a succession up to 80m thick occurs in association with the Kalkkom pan in the south (Van Niekerk, pers. comm. in Harris 2012).

Relict patches of ancient Tertiary alluvial sediments dating back to at least the Neogene (Late Tertiary), and possibly older, are preserved in the Bushmanland interior, as shown by sparse fossil mammal and petrified wood evidence (Section 4; see review in Macey et al. 2011). The best known is the Koa River Valley, a defunct south bank tributary of the Orange River situated some 50 km northeast of the Kangnas study area, that enters the main Orange River valley at Henkries (De Wit 1990, 1993, 1999, De Wit et al. 2000) (Figs. 5, 6.1). Rogers (1915) postulated the existence within the study area of a western tributary of this palaeo-drainage system termed the Kangnas Valley, but this has been largely discounted by more recent work (De Wit et al., 1992).
Fig. 5. Traces of post-Gondwana drainage systems in the Namaqualand – Bushmanland region (modified from De Wit 1999). Note the extinct Koa Valley palaeodrainage system draining into the Orange River between Pofadder and Springbok, north and east of Kangnas. Important crater lake fossil sites in the Northern Cape (red circles) include Late Cretaceous assemblages at Kangnas (KAN) and Stompoor (STO) and the Late Cretaceous / early Palaeocene assemblage at Banke (BAN). Miocene vertebrate remains and petrified woods are recorded from Bosluis Pan (BOS) and Brandvlei (BR) (blue circles).

Several **kimberlite and olivine melilitite volcanic pipes** of Cretaceous age are mapped just to the east of the Kangnas study area (black triangle and diamond symbols on geological map Fig. 4). The melilitite pipes belong to the “Bushmanland pipe swarm” of the Gamoep Melilitite Suite, dated 59 to 77 Ma (Late Cretaceous Period) (Verwoerd & De Beer 2006). Some of these pipes are still associated with fossiliferous crater lake deposits whose preservation reflects the low levels of landscape denudation since Late Cretaceous times in the Bushmanland region. Of particular interest for the present fossil heritage study is the buried double feeder pipe olivine-melilitite system with a footprint of some one to two hectares that has been inferred on geophysical as well as geological grounds at Goebees in the north-eastern portion of the study area (red triangle in Fig. 4, also Figs. 6.1, 6.2) (De Wit et al. 1992). Here melilitite-rich volcaniclastic breccias are associated with laminated fossiliferous mudrocks that are interpreted respectively as debris flow and lacustrine deposits within a crater lake of probable Late Cretaceous age. It is quite possible that other potentially-fossiliferous crater lake deposits are hidden beneath the Late Cenozoic superficial sediments elsewhere within the Kangnas study area (e.g. calcrete-capped pans), but these are difficult to detect without geomagnetic surveys or borehole coring. For example, the Kalkkom pan on the southern margin of the study area may also overlie an olivine melilitite pipe, although there is currently no convincing geological data to confirm this (Harris 2012).

Beneath the superficial sediment cover the study area is almost entirely underlain by Mid Proterozoic (Mokolian) basement rocks of the **Namaqua-Natal Metamorphic Province**. The basement rocks build the numerous isolated inselberge and ridges scattered across the Bushmanland landscape (Fig. 3). These rocks, primarily highly metamorphosed sediments and volcanic rocks (e.g. gneisses, schists, quartzites, amphibolites) **plus** major granitic and gabbroic
(norite) intrusions, are dated between 2050 and 1000 Ma (million years ago; Cornell et al., 2006). They have been assigned to several rock successions such as the intrusive Korridor Suite and Little Namaqualand Suite as well as the metamorphic crustal rocks of the Gladkop Metamorphic Suite and Bushmanland Group. Since these ancient Precambrian rocks are entirely unfossiliferous, they will not be treated further here.

Glacial tillites of Permo-Carboniferous age (Dwyka Group) crop out extensively in the eastern half of the Pofadder sheet area. Small Dwyka Group inliers (Mbizane Formation, Pmb) are mapped just to the southeast of the Kangnas study area (bottom right corner of map Fig. 4), but none are recorded within the study area itself (pace the Draft Scoping Report by Aurecon 2012). Downwasted and reworked weathering products of pre-existing Dwyka sediments, such as erratic boulders of various exotic lithologies, might be represented in local surface or subsurface gravels.

Figure 6 (following page): Late Cretaceous dinosaur fossils from Kangnas, Bushmanland.

6.1. Location of fossil site at farmstead Goebees on Farm Kangnas 77, c. 50 km east of Springbok, Northern Cape (From De Wit et al. 1992).

6.2. Inferred double volcanic pipe overlain by fossiliferous crater lake deposits at Goebees (From De Wit et al. 1992).

6.3. Sketch plan of fossil site at Goebees farmstead (From De Wit et al. 1992).

6.4. Right femur of Kangnasaurus (From Cooper 1985).

6.5. Vertebrae (centra) of Kangnasaurus (From Cooper 1985).

6.6. Tooth of Kangnasaurus – this is the holotype specimen, c. 18 mm long (From Cooper 1985).
3. PALAEOONTOLOGICAL HERITAGE

3.1 Precambrian basement rocks

The ancient Precambrian basement rocks underlying the entire Kangnas study area at depth are entirely unfossiliferous (highly metamorphosed sediments, igneous intrusions) and are therefore not of palaeontological heritage significance (Almond & Pether 2008). They are therefore not considered further here.

Fig. 7. Reconstruction of a bipedal iguanodontian dinosaur similar to Kangnasaurus from the Late Cretaceous Bushmanland

3.2 Cretaceous crater lake deposits

The Kangnas area of Bushmanland is of special geological and palaeontological interest because sediments and fossils of probable Late Cretaceous age have been recorded here, representing some of the oldest remnants of post-Gondwana rocks and fossils from South Africa (De Wit et al. 1992). The fossil material largely comprises the teeth and disarticulated post-cranial skeletal elements (leg bones, vertebrae, ribs) of the ornithischian dinosaur Kangnasaurus (Figs. 6.4 to 6.6). Associated fossils include calcified and silicified wood, lignite, leaf fragments and aquatic ostracods (microscopic seed shrimps) (Rogers 1915, De Wit et al. 1992). The dinosaur remains were first recorded from quartzofeldspathic grits, breccias and laminated calcareous mudrocks in a well and associated spoil heap at Goebees farmstead (Farm Kangnas 77) at a depth of some 34m by Rogers (1915) and were described in some detail by Haughton (1915) (Figs. 6.1 & 6.2). The dinosaur material was subsequently revised by Cooper (1985), who considers the remains to belong to a single individual, but to the author’s knowledge the fossil wood remains unstudied (N.B. The locality map of Cooper (1985, his. Fig. 1), placing the Kangnas fossil site near Goodhouse on the River Orange, is incorrect). Nevertheless, the taxonomic validity, age and systematic position of Kangnasaurus remain uncertain, with some workers regarding the genus as of dubious status. According to the most recent review, it was probably a basal bipedal, herbivorous iguanodontian related to Dryosaurus (Ruiz-Omeñaca et al. 2007) (Fig. 7).

Rogers (1915) interpreted the fossiliferous sediments at Goebees as infilling a buried palaeochannel (Kangnas Valley) that formed a tributary of the Koa River system (Figs. 5, 6.1). However, the fossil bones show no evidence of transport and subsequent geological and palaeomagnetic studies have demonstrated the presence of paired olivine melilitite (volcanic) feeder pipes at Goebees overlain by bedded sediments (Fig. 6.2; De Wit et al. 1992). The fossil vertebrate and plant remains are therefore considered to lie within a crater lake infill comparable to those described at Stompoor and Banke elsewhere in Bushmanland and Namaqualand respectively (Fig. 6.2; Haughton 1931, De Villiers 1999, Smith 1986a, 1986b, 1988, 1995, Macey.
Cooper (1985) suggests an Early Cretaceous age for Kangnasaurus, while De Wit et al. (1992) prefer a younger, Late Cretaceous age based on that of other olivine melilitite pipes in the region (cf Verwoerd & De Beer 2006).

There is a significant possibility that other small patches of fossiliferous crater lake sediments lie buried beneath the superficial sediment cover (sands, calcrete etc) within the Kangnas study area (See discussion on Kalkom Pan in Harris 2012). Any such sediments are only likely to be intersected by deeper excavations – i.e. those exceeding a few meters below surface (cf 35m depth for material from the well at Goebees, 80m thickness for calcretes at Kalkkom).

3.3 Late Tertiary to Recent superficial deposits

The overall palaeontological sensitivity of the sandy and calcretised superficial deposits in the Bushmanland region is low. The predominantly porous, sandy superficial deposits in the study area, including the Quaternary alluvial and aeolian sands and gravels, are unlikely to contain substantial fossil remains (De Beer et al., 2002, Almond & Pether 2008, Almond in Macey et al. 2008). Fossil land snails have been recorded from yellowish to reddish terrestrial sands and overlying calcrites in the Springbok sheet area (Marais et al., 2001, p70). Among the limited range of other fossils that might be encountered within Late Cenozoic surface sediments in the study area are calcretized rhizoliths (root casts), termitaria and other burrows, freshwater molluscs, ostrich egg shells, sparse bones, teeth and horn cores of mammals, and tortoise remains. Finer-grained river and pan sediments may contain fossils of fish, frogs, molluscs, crustaceans (crabs, ostracods, phyllopods such as conchostracans) as well as microfossils such as diatoms, palynomorphs and macroplant remains (e.g. wood, peats).

Fig. 8. Reconstruction of an extinct Miocene three-toed horse, Hipparion. Fossil remains or related fossil horses are recorded from Areb in Bushmanland (Northern Cape) as well as Langebaanweg (West Coast Fossil Park, W. Cape).

Relict patches of Neogene (Late Tertiary) river, pan and lake sediments in the Northern Cape interior, including Bushmanland, have yielded a small range of terrestrial and freshwater vertebrates (fish, reptiles, mammals) as well as freshwater molluscs, petrified wood and trace fossils from localities such as Bosluis Pan and Brandvlei (See review in Macey et al. 2011 and references therein, including De Beer et al., 2002, Agenbacht 2007). Skeletal remains of a Pliocene three-toed horse, Hipparion, have been recorded from a well at Areb, 65km east of Springbok and within the northern part of the present study area, close to the proposed solar
energy facility development area (Haughton 1932, Hendey 1984) (Figs. 1, 4, 5 and 8). The rare vertebrate fossils are probably associated with buried Late Tertiary river deposits comparable to those in the Koa River palaeochannel to the east. These deposits are likely to be narrow, linear, perhaps branching, in geometry and may well occur elsewhere within the Kangnas study area, as originally suggested by Rogers (1915).

4. ASSESSMENT OF SIGNIFICANCE OF PALAEOONTOLOGICAL HERITAGE IMPACTS

The construction phase of the Kangnas alternative energy developments will entail numerous, but mostly shallow (< 3m), excavations into the superficial sediment cover and in some areas into the underlying bedrock as well. These include, for example, excavations for the wind turbine and solar panel foundations, underground cables, new electricity transmission line pylons and substations, as well as new gravel access roads and any control / administrative buildings. In addition, substantial areas of bedrock will be sealed-in or sterilized by infrastructure such as lay-down and standing areas for the wind turbines as well as new access roads. All these developments may adversely affect fossil heritage within the development footprint by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good.

The significance of expected impacts on palaeontological heritage resources within the combined wind energy and solar energy facility study areas at Kangnas are assessed together for the construction phase in Table 1 below, according to the scheme specified by Aurecon. Given the uncertainties concerning the patchy distribution of buried fossil heritage, predicted impacts for the wind and solar energy facilities are not significantly different, and are considered unsure. Please note that:

- the operational and decommissioning phases of the wind and solar energy facilities will not involve further significant adverse or other impacts on palaeontological heritage;

- impacts from the construction of associated new road infrastructure and transmission lines is treated as part of the overall impact of each PV development, and have not been considered separately.
Table 1: Evaluation of impacts of the proposed Kangnas Wind Energy Facility and Solar Energy Facility on fossil heritage resources (construction phase)

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<tr>
<th>CRITERIA</th>
<th>CATEGORY</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>Extent</td>
<td>Site specific</td>
<td>Limited to development footprint</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Generally low (but locally high)</td>
<td>Most surface rocks within study area are unfossiliferous but highly significant fossil material (e.g. dinosaur and mammal remains) occurs at small, localized sites (buried crater lake and alluvial deposits) within the study area.</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Loss of fossils and contextual geological data is generally permanent.</td>
</tr>
<tr>
<td>Significance</td>
<td>Generally low (but locally high)</td>
<td>Specialist monitoring or mitigation measures therefore not proposed for this project unless new fossil sites are encountered during development.</td>
</tr>
<tr>
<td>Probability</td>
<td>Unlikely</td>
<td>Buried fossiliferous deposits probably occupy only a small fraction of the study area.</td>
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<tr>
<td>Confidence</td>
<td>Unsure</td>
<td>Limited by low levels of fossiliferous rock exposure within the study area (Covered by extensive mantle of unfossiliferous superficial sediments)</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
<td>Loss of fossil heritage is generally permanent.</td>
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6. CONCLUSIONS & RECOMMENDATIONS

The proposed Mainstream wind energy and solar energy facility project areas near Kangnas, Bushmanland, are largely underlain by ancient Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province that crop out as low, rocky inselberge and are entirely unfossiliferous. In the intervening flatter, low-lying areas where the wind and solar energy facilities are likely to be constructed these older basement rocks are extensively mantled with geologically young superficial deposits (Quaternary to Recent sandy alluvium, soils, wind-blown sand, calcrete hardpans etc) that are generally of low to very low palaeontological sensitivity. However, small but significant areas of older fossiliferous sediments have been recorded subsurface within the Kangnas study area since the early twentieth century and have yielded scientifically important vertebrate and plant fossil material. These include (1) rare dinosaur remains (*Kangnasaurus*), petrified woods and non-marine crustaceans (ostracods) from crater lake deposits of probable Late Cretaceous age at Goebbees in the northeast, as well as (2) Late Tertiary (Miocene) three-toed horses (*Hipparion*) from palaeochannel river deposits near Areb in the north. Both these fossil sites are unlikely to be directly affected by the proposed developments. It is quite possible that further, hitherto undiscovered fossiliferous deposits of this nature lie buried beneath the surface elsewhere within the broader study area. Fossils exposed at the surface or underground may be damaged, disturbed or sealed-in during the construction phase of the proposed wind and solar energy facilities near Kangnas. However, these deposits are unlikely to be directly affected except by deeper excavations (> 3m) that penetrate the generally unfossiliferous superficial deposits overlying them. Both the proposed wind energy facility and solar energy facility developments are inferred to be of LOW overall impact significance in terms of palaeontological heritage resource conservation.

Given the low overall palaeontological sensitivity of the basement rocks and superficial deposits within the Kangnas study area, the successive or concurrent development here of the proposed wind and energy energy facilities is not considered to pose a significant cumulative impact on local fossil heritage. Future changes in infrastructure layout for the wind or solar energy projects will not materially affect the conclusions and recommendations made in this palaeontological report.

In view of the overall low significance of the proposed developments on palaeontological heritage resources, it is concluded that no further palaeontological heritage studies or specialist mitigation are required for these alternative projects, pending the discovery or exposure of any substantial fossil remains (*e.g.* vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) during the construction phase. The ECO responsible for these developments should be alerted to the two known fossil sites within the study area as well as possibility of fossil remains being found either on the surface or exposed by fresh excavations during construction. Should fossil remains be discovered during construction, these should be safeguarded (*preferably in situ*) and the ECO should alert SAHRA so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved repository (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

These recommendations should be incorporated into the EMP for the two Mainstream alternative energy developments near Kangnas.

7. ACKNOWLEDGEMENTS

Ms Cornelia Steyn of Aurecon South Africa (Pty) Ltd and and her colleagues Tanya Farber and Louise Corbett are thanked for commissioning this desktop study, for commenting on the draft report, and for providing the necessary background information.

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8. REFERENCES


9. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1:250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company Natura Viva cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed alternative energy projects, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond (2012) 21 Natura Viva cc
### DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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### PROJECT TITLE

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

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4.2 The specialist appointed in terms of the Regulations

I, John E. Almond, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Natura Viva cc

Date:

1 August 2012
Annexure I
DRAFT 2
VISUAL IMPACT ASSESSMENT
PROPOSED KANGNAS ALTERNATIVE
ENERGY PROJECTS

KANGNAS SOLAR ENERGY

AND

KANGNAS WIND FARM PROJECTS

August 2012

Prepared for:
Aurecon South Africa
PO Box 509
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South Africa
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This document was completed by Silver Solutions 887 cc trading as VRM Africa, a Visual Impact Study and Mapping organisation located in George, Western Cape. VRM Africa cc was appointed as an independent professional visual impact practitioner to facilitate the VIA.

Stephen Stead has 12 years’ experience in the field of GIS mapping and 3D modelling through his work as a GIS consultant and visual impact practitioner. He is accredited by the Association of Professional Heritage Practitioners (APHP) as a Visual Impact Assessment Specialist.

I, Stephen Stead, principle author of the Visual Impact specialist report, hereby declare that I am an independent consultant appointed to provide specialist input on the proposed project. I hereby confirm that I have no business, financial, personal or other, interest in the activity, application or appeal in respect of which I have been appointed, other than fair remuneration for work performed in connection with the activity and application. All opinions expressed in this specialist report are my own.

Stephen Stead
Association of Professional Heritage Practitioners (APHP) accredited VIA Specialist
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ACRONYMS

ACEC  Areas of Critical Environmental Concern
APHP  Association of Professional Heritage Practitioners
BLM  Bureau of Land Management (United States)
BPEO  Best Practicable Environmental Option
CALP  Collaborative for Advanced Landscape Planning
CBA  Critical Biodiversity Areas
DEA&DP Department of Environmental Affairs and Development Planning
DEM  Digital Elevation Model
DoC  Degree of Contrast
EIA  Environmental Impact Assessment
EMP  Environmental Management Plan
GIS  Geographic Information System
IAIAsa International Association of Impact Assessment, South African Affiliate
I&APs Interested and Affected Parties
IEMA Institute of Environmental Management and Assessment (United Kingdom)
KOP  Key Observation Point
ROD  Record of Decision
VAC  Visual Absorption Capacity
VE  Visual Envelope
VIA  Visual Impact Assessment
VRM  Visual Resource Management
ZVI  Zone of Visual Influence

GLOSSARY

**Best Practicable Environmental Option (BPEO)**
This is the option that provides the most benefit, or causes the least damage, to the environment as a whole, at a cost acceptable to society, in the long, as well as the short, term.

**Cumulative Impact**
The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

**Impact (visual)**
A description, within a defined time and space, of the effect of an aspect of the development on a specified component of the visual, aesthetic or scenic environment.

**Issue (visual)**
Issues are concerns related to the proposed development, generally phrased as questions, taking the form of “what will the impact of some activity be on some element of the visual, aesthetic or scenic environment?”.

**Key Observation Points (KOPs)**
Receptors refer to the people located in the most critical locations, or key observation points, surrounding the landscape modification, which make consistent use of the views associated with the site where the landscape modifications are proposed. KOPs can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or a linear view along a roadway, trail or river corridor.

**Management Actions**
Actions that enhance benefits of a proposed development, or avoid, mitigate, restore or compensate for, negative impacts.
Receptors
Individuals, groups or communities who would be subject to the visual influence of a particular project.

Sense of Place
The unique quality or character of a place, whether natural, rural or urban.

Scenic Corridor
A linear geographic area that contains scenic resources, usually, but not necessarily, defined by a route.

Scoping
The process of determining the key issues, and the space and time boundaries, to be addressed in an environmental assessment.

Viewshed
The outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed. This reflects the area in which, or the extent to which, the landscape modification is likely to be seen.

Zone of Visual Influence (ZVI)
The ZVI is defined as ‘the area within which a proposed development may have an influence or effect on visual amenity.’
1 EXECUTIVE SUMMARY

1.1 PV Component

<table>
<thead>
<tr>
<th>Extent</th>
<th>Geographical area of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Related (S)</td>
<td>extending only as far as the activity</td>
</tr>
<tr>
<td>Local (L)</td>
<td>limited to immediate surroundings</td>
</tr>
<tr>
<td>Regional (R)</td>
<td>affecting a larger metropolitan or regional area</td>
</tr>
<tr>
<td>National (N)</td>
<td>affecting large parts of the country</td>
</tr>
<tr>
<td>International (I)</td>
<td>affecting areas across international boundaries</td>
</tr>
</tbody>
</table>

**Regional**
The viewshed from the 16m PV will be widespread and cover a large area to the north-west and the east. The viewshed will be restricted to the south-west by the mountains adjacent to the site, as well as to the north. The open plain to the west offers little topographic screening. Located within the viewshed are the N14 receptors, as well as one farmstead located at a distance of 4 km.

**Visual Exposure**

<table>
<thead>
<tr>
<th>Degree of exposure to receptors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>Dominant or clearly noticeable (&lt;2 km)</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>Recognisable to the viewer (2 – 6 km)</td>
</tr>
<tr>
<td>Low (L)</td>
<td>Minimally visible areas in the landscape (&gt;6 km)</td>
</tr>
</tbody>
</table>

**Moderate to High**
The proposed PV project would be located within 2 km from the N14 receptors and would be defined as having high visual exposure, and the PVs would be dominant or clearly noticeable. The farmstead is located in the 2 – 6 km range and, with the distance, there is some screening from the small trees scattered between the dwelling and the project site. This would only offer some screening for the 10 m height PV option but less for the 16 m height option.

**Visual Absorption Capacity**

<table>
<thead>
<tr>
<th>Potential of landscape to conceal</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>effective screening</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>partial screening</td>
</tr>
<tr>
<td>Low (L)</td>
<td>little screening</td>
</tr>
</tbody>
</table>

**Low**
Other than the small hills to the south-west of the site, the terrain is mainly flat and offers little topographic screening. The limited vegetation of the Nama Karoo landscape offers no screening.

**Site Scenic Quality**

<table>
<thead>
<tr>
<th>The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>highly visible and potentially sensitive areas in the landscape.</td>
</tr>
<tr>
<td>Moderate</td>
<td>moderately visible areas in the landscape.</td>
</tr>
<tr>
<td>Low</td>
<td>minimally visible areas in the landscape.</td>
</tr>
</tbody>
</table>

**Moderate to high**
The vast plain of the Nama Karoo does add value, but this type of landscape is fairly common in the region. The range of low hills to the south-west in contrast to the flat plains adds value to the landscape character. This is further enhanced by the limited development/settlement, which creates a moderate to high scenic quality value.

**Receptor Sensitivity**

<table>
<thead>
<tr>
<th>The level of visual impact considered acceptable is dependent on the type of receptors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>e.g. residential areas, nature reserves and scenic routes or trails</td>
</tr>
<tr>
<td>Moderate</td>
<td>e.g. sporting or recreational areas, or places of work</td>
</tr>
<tr>
<td>Low</td>
<td>e.g. industrial, mining or degraded areas</td>
</tr>
</tbody>
</table>

**Moderate to high**
The receptors include some isolated agricultural farmsteads that could be more sensitive to a change in the sense of place. However, due to the isolation of the site and lower levels of exposure to receptors, sensitivity to landscape change would be moderate to high. The N14 also carries tourist traffic and these receptors would be more sensitive to landscape modification.
### Congruence of the project with the particular qualities of the area, or its 'sense of place'

<table>
<thead>
<tr>
<th>Visual Intrusion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>Noticeable change</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>Partially fits into the surroundings, but clearly noticeable</td>
</tr>
<tr>
<td>Low (L)</td>
<td>Blends in well with the surroundings</td>
</tr>
</tbody>
</table>

**Moderate to high**

The size and scale of the project, which includes approximately 4288 PV panels located in a predominantly flat landscape, does create a large viewshed and the dark colour of the PV panels increases the intrusion. However, the area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the solar farm would be in the distant and they require moderate levels of visual contrast required for the Class III visual objective would be met with mitigation of excluding the drainage lines from development. With mitigations, lights at night can be contained, but they will result in a change in the night-time sense of place.

### Visual Significance

<table>
<thead>
<tr>
<th>Visual Significance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (L):</td>
<td>Will not have an influence on the decision.</td>
</tr>
<tr>
<td>Moderate (M):</td>
<td>Should have an influence on the decision unless it is mitigated.</td>
</tr>
<tr>
<td>High (H):</td>
<td>Would influence the decision regardless of any possible mitigation.</td>
</tr>
</tbody>
</table>

**Moderate**

The significance of the surrounding landscape was defined as high as it includes the Klein Koperberge to the west of the site as well as the Goegap Nature Reserve which increase the regional landscape scenic quality and receptor sensitivity. The uniform nature of the flat Nama Karoo plains can be fairly monotonous, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.

It is the conclusion of the assessment that the impact to the site and surrounding visual resources of the area will be of moderate significance as the area is remote and views of the PV installation will be mainly contained within a two to three kilometre zone of visual influence. Low hills to the west would result in no views of the proposed landscape modifications being visible from the Goegap National Park located to the west. Views for the N14 receptors would be clear but intrusion would be reduced by the 750 m buffer and the location of the existing 132 kVA power line in the foreground. Mitigation would be required which would include the avoidance of the washes and the rocky outcrops. The preferred alternative is the 10 m height as this would reduce the visual intrusion and allow for the low trees to the east of the site to offer partial visual screening to the adjacent farmstead. Cumulative impacts need to be taken into consideration as should the solar farm be approved the development may attract similar wind and PV developments to the area which could limit local eco / farm-tourism possibilities.
1.2 Wind Component

<table>
<thead>
<tr>
<th>Extent</th>
<th>Geographical area of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Related (S)</td>
<td>extending only as far as the activity</td>
</tr>
<tr>
<td>Local (L)</td>
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<tr>
<td>International (I)</td>
<td>affecting areas across international boundaries</td>
</tr>
</tbody>
</table>

Regional

Due to the flat terrain of the site, the viewshed is widespread and covers a large area around the site, but is constrained to the west by the higher elevated areas of the Klein Koperberg Mountains. Although the viewshed does extend into the Goegap Nature Reserve area, only the upper section of the hills will have distant views of the proposed project. From the Goegap Nature Reserve activity map obtained from the Reserve, it is apparent that the main activities take place in the valleys where there are no views of the project. The main receptors are the N14 national road to the north and the R355 to the south, as well as only a few isolated farmsteads as the area is very remote.

Visual Exposure

<table>
<thead>
<tr>
<th>Degree of exposure to receptors</th>
<th>High (H)</th>
<th>Moderate (M)</th>
<th>Low (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dominant or clearly noticeable (&lt;2 km)</td>
<td>Recognisable to the viewer (2 – 6 km)</td>
<td>Minimally visible areas in the landscape (&gt;6 km)</td>
</tr>
</tbody>
</table>

Moderate to Low

As indicated in the viewshed comment, due to the remoteness of the location, there are very few receptors. Most of these would be moderately exposed to the proposed wind farm, with views of the site forming part of the background context. One section of the N14 will have moderate exposure with all the other receptors viewing the turbines in the background at low exposure.

Visual Absorption Capacity

<table>
<thead>
<tr>
<th>Potential of landscape to conceal</th>
<th>High (H)</th>
<th>Moderate (M)</th>
<th>Low (L)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>effective screening</td>
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<td>little screening</td>
</tr>
</tbody>
</table>

Low

Other than the small hills to the north-west of the site, the terrain is mainly flat and offers little topographic screening. The limited vegetation of the Nama-Karoo landscape offers no screening.

Site Scenic Quality

<table>
<thead>
<tr>
<th>The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>highly visible and potentially sensitive areas in the landscape.</td>
<td>moderately visible areas in the landscape.</td>
<td>minimally visible areas in the landscape.</td>
</tr>
</tbody>
</table>

Moderate to high

The vast plain of the Nama Karoo does add value, but this type of landscape is fairly common in the region. The Klein Koperberg Mountain in the background and the low levels of development / settlement create a moderate to high scenic quality value.

Receptor Sensitivity

<table>
<thead>
<tr>
<th>The level of visual impact considered acceptable is dependent on the type of receptors</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>e.g. residential areas, nature reserves and scenic routes or trails</td>
<td>e.g. sporting or recreational areas, or places of work</td>
<td>e.g. industrial, mining or degraded areas</td>
</tr>
</tbody>
</table>

Moderate

The receptors include some isolated agricultural farmsteads that could be more sensitive to a change in the sense of place. However, due to the isolation of the site and lower levels of exposure to receptors, sensitivity to landscape change would be moderate.
## Visual Intrusion

<table>
<thead>
<tr>
<th></th>
<th>Congruence of the project with the particular qualities of the area, or its 'sense of place'</th>
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</thead>
<tbody>
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<td><strong>High (H)</strong></td>
<td>noticeable change</td>
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<tr>
<td><strong>Moderate (M)</strong></td>
<td>partially fits into the surroundings, but clearly noticeable</td>
</tr>
<tr>
<td><strong>Low (L)</strong></td>
<td>blends in well with the surroundings</td>
</tr>
</tbody>
</table>

**Moderate to High**

The size and scale of the project, located in a predominantly flat landscape, does create a large viewshed and the white colour of the turbines and movement of the blades increases the intrusion. The area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the wind farm would be in the background and the require moderate levels of visual contrast required for the Class III visual objective would be met with mitigation. With mitigations, lights at night can be contained, but they will result in a change in the night-time sense of place. However it must be noted that the area is remote and is not used by many people or tourist related activities (other than the N14).

## Visual Significance

<table>
<thead>
<tr>
<th></th>
<th>A synthesis of nature, duration, intensity, extent and probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low (L)</strong></td>
<td>will not have an influence on the decision.</td>
</tr>
<tr>
<td><strong>Moderate (M)</strong></td>
<td>should have an influence on the decision unless it is mitigated.</td>
</tr>
<tr>
<td><strong>High (H)</strong></td>
<td>would influence the decision regardless of any possible mitigation.</td>
</tr>
</tbody>
</table>

**Moderate**

The significance of the surrounding landscape was defined as high as it includes the Klein Koperberge to the west of the site as well as the Goegap Nature Reserve which increase the regional landscape scenic quality and receptor sensitivity. The uniform nature of the flat Nama Karoo plains can be fairly monotonous, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.

The size and scale of the project, located in a predominantly flat landscape, does create a large viewshed, and the white colour of the turbines and movement of the blades increases the intrusion. However the area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the wind farm would be in the background. The required moderate levels of visual contrast of the Class III visual objective would therefore be met for most of the receptors with mitigation. Mitigation would include using white colours only for the turbines and location off the rocky outcrop as well as not locating turbines in the river washes / water holes buffer areas. With mitigation, lights at night can be contained but they will result in a change in the night-time sense of place but this would be visible to very few receptors.

It is the conclusion of the assessment that the significance of the impacts to the visual resources of the area will be moderate as the area is remote and views of the wind farm will be mainly located in the background for all receptors. The scenic resources of the Goegap Nature Reserve will not be impacted. However, cumulative impacts need to be taken into consideration for later projects as, should the wind farm be approved, other types of development opportunities could be restricted and this development could attract other wind and photovoltaic developments to the area, as the landscape in the vicinity of the wind farm will be transformed.
SECTION A: SCOPE OF WORK

2 SUMMARY OF VISUAL IMPACT ASSESSMENT METHODOLOGY

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

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

This emotional enrichment that people experience is a non-material benefit that people obtain from cultural ecosystems services, as described by The Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis report: “Cultural ecosystems services: the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.”

The above includes the following, amongst others:

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

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

VRM Africa’s methodology of assessing potential impacts on the visual resources of an area earmarked for a proposed development, and recommending avoidance/mitigation/compensation measures, meets the three IFC Performance Standards applicable to the field of visual assessment, i.e. PS 1, PS 6 and PS8. Below follows a brief summary of this assessment method.

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

These people are referred to as receptors and are identified early on in the VIA process. Only those sensitive receptors who are qualify as Key Observation Points (KOPs) by applying certain criteria, are used to measure the amount of contrast that would be generated by the changes caused by the project activities, against the existing landscape (the visual impact).

The landscape character of the proposed project site is then surveyed to identify areas of similar landuse and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels, called VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be “absorbed” or “disappear”, into the landscape). The areas identified on site are categorised into these Classes by using a matrix from the BLM Visual Resource Management method, which is then represented in a visual sensitivity map.

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

The proposed project activities are then finally assessed from the KOPs around the site to see whether the visual objectives (VRM Classes) defined for the site, are met in terms of measuring the potential change to the site’s form, line, colour and texture visual elements, as a result of the proposed project (i.e., are the expected changes within acceptable parameters to ensure that the visual character of the landscape is kept intact and, if not, what can be done by the project to ensure that it is). Photo montages are generated to represent the expected change in the views, as seen from each KOP and, if Class objectives are not met, to also show how proposed mitigation measures could improve the same views.

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

This report uses the impact criteria supplied by Aurecon South Africa’s standardised and internationally recognised methodology which has been applied to assess the significance of the potential environmental impacts of the proposed development, outlined as follows:

- For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) are described.
- These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

Refer to Annexure 2 for a detailed description of the applied VIA methodology.
From each of the Key Observation Points, assess if the visual contrast generated by the proposed project is suited to the visual objective defined for each of the Classes.

Classification of the site where the project is proposed into one of four VRM Classes which define the suitability of the existing landscape to accommodate change.

Identification of Key Observation Points making use of the views where the proposed project is located.

Generation of a viewshed from proposed project height to determine probable visibility to the surrounding region.

Generation of a terrain model in order to understand the lie of the land where the project is proposed.

Identification of significant features/landuses in the region which define the regional landscape character and sense of place.
3 INTRODUCTION

VRM Africa was appointed by Aurecon South Africa (Pty) Ltd to undertake a Visual Impact Assessment (VIA) for the proposed Kangnas Alternative Energy Project. Aurecon South Africa has been sub-contracted by Mainstream Renewable Power South Africa (Pty) to undertake the Scoping/EIA process for this project. The two projects that fall within the reports scope of work are:

- Proposed Kangnas Photovoltaic Site (See full assessment in Section B)
- Proposed Kangnas Windfarm Site (See full assessment in Section C)

As indicated on the map in the following chapter, the proposed project is situated on Farm Kangas RE 75, Farm Kangas (3/77) and the Remainder of Farm 77 and Farm Koeris (1/78) near Springbok in the Northern Cape Province.

Figure 2: Regional locality map

TERMS OF REFERENCE

- The scope of the study is to cover the entire affected project area: This includes the full site extent, and where potential impacts may occur beyond the site boundaries, such as cumulative impacts.
- Identify issues relating to visual, aesthetic and scenic resources through a desktop study of existing literature and a site visit;
- Describe the receiving environment and the proposed projects in terms of landscape types, landscape character and land use patterns;
- Establish the view catchment area, view corridors, viewpoints and receptors;
- Indication of all potential visual impacts using established criteria
- Inclusion of potential lighting impacts at night
- Undertake an assessment of the visual impacts at the site in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the duration of the impact (construction, up to 10 years after construction, more than 10 years after construction). The assessment is to indicate the potential cumulative impacts;
- Describe potential mitigation measures to reduce or eliminate the potential visual impacts identified;
Assessments must take into account the expected community response as well as the applicable South African standards; and

Cognisance must be taken of the Department of Environmental Affairs and Development Planning guideline: “Guideline for involving visual and aesthetic specialists in EIA processes”

Specific attention will be given to the following:
- Quantifying and assessing the existing scenic resources/visual characteristics on, and around, the proposed site.
- Evaluating and classifying the landscape in terms of its sensitivity to a changing land use.
- Determining viewsheds, view corridors and important viewpoints in order to assess the visual impacts of the proposed project.
- Determining visual issues, including those identified in the public participation process.
- Reviewing the legal framework that may have implications for visual/scenic resources.
- Assessing the significance of potential visual impacts resulting from the proposed project for the construction, operational and decommissioning phases of the project.
- Identifying possible mitigation measures to reduce negative visual impacts, for inclusion into the project design, including input into the Environmental Management Plan (EMP).

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

In terms of best practice, the following guidelines will be used to measure adherence to best practice:
- Internationally, the U.K Institute of Environmental Management and Assessment’s (IEMA) ‘Guidelines for Landscape and Visual Impact Assessment’; and
- From a Southern African perspective, the ‘Guideline for Involving Visual and Aesthetic Specialists in EIA Processes generated by South Africa’s Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning.

‘Principles that influence (development)…within a receiving environment include the following:
- The need to maintain the overall integrity (or intactness) of the particular landscape or townscape;
- The need to preserve the special character or 'sense of place' of a particular area; and
• The need to minimize visual intrusion or obstruction of views within a particular area.’ (Oberholzer, B., 2005).
4  **REGIONAL LANDSCAPE CONTEXT**

Landscape character is defined by the U.K. Institute of Environmental Management and Assessment (IEMA) as the ‘distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, landuse and human settlement.’ It creates the specific sense of place or essential character and ‘spirit of the place’. (Spon Press, 2002)

As indicated in the Google Earth locality map below, the proposed projects are located approximately 35 km to the west of the town of Springbok which is set in a narrow valley bisecting the granite domes of the Klein Koperberge (small copper mountains). Springbok is the capital of the Namaqua District within the Northern Cape province, and the administrative, commercial, farming and industrial centre of the district. Situated close to the intersection of the N7 and N14 national roads, the town is 550 km from Cape Town. Springbok is a town of historical importance in the Northern Cape and was built around the copper mining industry. Copper was discovered on the farm Melkboschkuil in 1850. The resulting Cape Copper Company mine became the first commercial mine in South Africa. Springbok lies in a deep, low plain between rugged mountains and is located on the N7 that connects the Cape and the Namibian capital Windhoek. Springbok is a prosperous town with 15000 inhabitants. The main income is generated from tourism, mining activities, commerce and farming. Namaqualand is famous for its wildflower display in spring and for the tremendous variety of succulents that can be seen in the Goegab Nature Reserve, located in a hilly area approximately 11 to 15 km due West of the proposed wind and solar farm sites.

The predominant land use for the general area in which the project is proposed is livestock grazing. However, formal agricultural fields are limited to specific nodes, none of which occur within the study area. Another important sector is tourism, especially during spring, when flower tourists visit the area for an eight to ten week period. The nearest large power line to the site is approximately 7 km away and the Aggenys substation is approximately 53 km to the east. (Aurecon, 2012)

![Google Earth map of Kangnas focus areas](image)

**Figure 3: Proposed regional locality of Kangnas focus areas**

As indicated in the terrain map below, the main topographic feature is the Koperberg mountain range to the east of the site and some isolated hills to the south-west, which range in height from approximately 1016 to 1205 metres above mean sea level (MSMSL). The majority of the site, and
the eastern, northern areas, is a vast open and flat plain, typical of the Nama Karoo. The site where the project is proposed is regionally prominent, at a dominant level.

Figure 4: Approximate project areas overlay onto Regional Terrain Model Map

A vegetation study for the area was conducted by Dr Dave McDonald of Bergwind Botanical Tours & Surveys for the Aurecon South Africa. According to the study (and as indicated on the map below), the general matrix is Bushmanland Arid Grassland (uncoloured); the yellow area is a botanically important area which includes Bushmanland Inselberg Shrubland (areas outlined in red). The mauve areas indicate ‘biodiversity corridors’ as mapped by Desmet & Marsh (2008); the pink areas are Platbakkies Succulent Shrubland within the Kangnas study area and the green area is Platbakkies Succulent Shrubland as mapped by Mucina et al. (2005). The survey track is shown as light blue lines with waypoints indicated as red dot icons with KTS# labels. The white dots represent the proposed locations of wind turbines and the cyan line represents the proposed route for overhead transmission lines. The ‘Solar Focus Area’ is outlined in white in the northeastern corner of Areb 75/RE within the Kangnas study area. Note the dark blue lines in the latter area indicating seasonal drainage lines. (McDonald, 2012).
The first step in the VIA process is determining the existing landscape context of the surrounding area to determine what scenic resources around the proposed site are being utilised for. The significant surrounding landscape features identified during the field survey undertaken between 25 and 27 June 2012 are listed below:

- Klein Koperberge
- Tourist View Corridors
- Nama Karoo open plains
- Goegap Nature Reserve

**Klein Koperberge and surrounding Hills**

As indicated earlier, surrounding the local town of Springbok and located to approximately 15 km to the east of the proposed site is the Klein Koperberge range of low hills which range in height from
1000 to 1300 mamsl. Due to rugged and rocky terrain create a scenic element but also assist in reducing the visibility of the proposed projects. Due north of the proposed wind farm site and south-west of the PV site are some small hills also of similar height to the Klein Koperberge range which would further reduce visibility in these directions.

**Tourist View Corridors**

![Figure 7: Photograph depicting the N14 road adjacent the Goegap Nature Reserve approximately 10 km west of the PV site.](image)

![Figure 8: View from R355 used by tourists depicting sense of place of the Nama Karoo](image)

View corridors are roads which are utilized by tourists to access tourist related areas of areas of high scenic quality. In the surrounding areas, the main tourist view corridor would be the N14. A Wikipedia search revealed that this National Road runs from Springbok in the Northern Cape to Pretoria and passes through Upington, Kuruman, Vryburg and Krugersdorp. Tourist traffic from Cape Town would access the Augrabies Falls and the Kadagadi Transfrontier National Park via this road turning off the N7 at Springbok.
Agricultural Nama Karoo Open Plains

The photograph above is taken on the proposed wind site looking south. The dominant landscape feature is the Nama Karoo flat open plains with isolated mountain outcrops surrounding the plain. Land use is agricultural sheep farming in pockets, on typical farmsteads that comprise a cluster of agricultural dwellings and structures. In terms of scenic quality, the wide open spaces of this Nama Karoo landscape increases the value of the landform. Vegetation is moderate to low due to the agricultural grazing impact and typically there is little presence of water. The significance of this landscape relates to the limited man made modifications which generate a strong wilderness sense of place. However, this lack of variation and uniformity of these landscapes can reduce visual appeal.

Goegap Nature Reserve

Figure 9: Reservoir, windmills and fences typically associated with Northern Cape agricultural landscapes

Figure 10: View of Goegap Nature Reserve in the flower season (Source: S. van Vuurven, www.panoramio.com)
The Goegap Nature Reserve, with its granite peaks and sandy plains, are dominated by Carolusberg, the highest point in the area. This reserve features most of the Namakwa District’s natural riches, supporting 600 indigenous flower species, 45 mammal species and 94 bird species. It includes the Hester Malan Wild Flower Garden that showcases many Namaqua succulents and a rock garden (http://www.sa-venues.com). The nearest Goegap Nature Reserve boundary is located 11 km from the proposed wind site however there are no current tourist related activities taking place at this point (see map of Nature Reserve on the following page). The nearest tourist activity on the reserve is the Ja-leegte drive located in the south-eastern corner of the park which is located 18 km from the wind farm but as this drive is located in a valley, views of the proposed turbines would not be visible. Due to the rugged and undulating terrain, most of the tourist activities of the park would not see the turbines. Due to topographic screening to the east of the proposed PV site, no visibility of the proposed PV would be seen from the park. The only activity that would seen the turbines would be the Blou-myn 4 * 4 route, but at a distance of 26 km and with the very rugged and rocky terrain at the location of the 4 * 4 route impairing clear views to the east, it is highly unlikely that the distant views of the turbines would impact the local sense of place.

![Figure 11: Tourist map of Goegap Nature Reserve](image)

The significance of the surrounding landscape was defined as high as it includes the the Klein Koperberge lies to the west of the site as well as the Goegap Nature Reserve which increase the regional landscape scenic quality and receptor sensitivity. The uniform nature of the flat Nama Karoo plains can be fairly monotonous, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.
SECTION B: KANGNAS PV VISUAL ASSESSMENT

5 PROJECT DESCRIPTION AND VISIBILITY

The objective of this section is to describe the character of the project activities and to define the extent to which they will be visible to the surrounding areas. The extent of the visibility of the project can be seen in the viewshed maps on the following pages.

The photograph below shows views of existing solar energy photovoltaic (PV) projects.

The project will comprise the following: *(to be confirmed)*

- Structure height:
  - Alternative 1: PV panel height of 10m
  - Alternative 2: PV trackers with a height of up to 16m
  - Electrical infrastructure – height of 16m
  - Number of panels: up to 4000 Panels/MW
Figure 12: Example generic layout generate for the site
5.1 Project Visibility and Exposure

Making use of SA Survey General 20m contours data, a terrain model was generated for an area of approximately 24 km around the proposed project area indicated in the map in Figure 2. The terrain in the area ranges from a minimum of 28 m to a maximum height of 1089 m on the site, as can be seen in the Site Elevation Maps in Figure 15. Making use of the average height of the proposed PV Panels (Siemens type) above ground level, the viewsesh of each of the alternatives was modelled.

### Visibility

<table>
<thead>
<tr>
<th>Proposed Activities</th>
<th>PV Structures</th>
<th>Structures (unknown location)</th>
<th>Transmission Line</th>
<th>Lights at Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>10 – 16 m</td>
<td>8 m</td>
<td>30m</td>
<td>Security</td>
</tr>
<tr>
<td>Extent (Construction)</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Extent (Operation)</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Key: H = High, M = Moderate, L = Low

![Figure 13: Regional area elevation map from Springbok to the site](image)
Figure 14: Viewshed of proposed PV panels with offset of 16m above ground level
A viewshed was generated for the proposed PV Panels with an offset above the ground of 10m and 16m. There was no difference in the viewshed size. The viewshed extends to the north-east and north-west, as can be seen in the map on the previous page. Due to the elevation level of the mountainous area between Springbok and the site, Springbok does not fall within the project viewshed and the viewshed for both the 10m and 16m heights are fairly directional.

The following receptors were identified during the field survey as having views which are shared with the area where the development is proposed:
- Local farmstead
- N14 north and south

### 5.2 Project Visibility Findings

<table>
<thead>
<tr>
<th>Extent</th>
<th>Geographical area of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Related (S)</td>
<td>extending only as far as the activity</td>
</tr>
<tr>
<td>Local (L)</td>
<td>limited to immediate surroundings</td>
</tr>
<tr>
<td>Regional (R)</td>
<td>affecting a larger metropolitan or regional area</td>
</tr>
<tr>
<td>National (N)</td>
<td>affecting large parts of the country</td>
</tr>
<tr>
<td>International (I)</td>
<td>affecting areas across international boundaries</td>
</tr>
</tbody>
</table>

#### Regional

The viewshed from the 16m PV will be widespread and cover a large area to the north-west and the east. The viewshed will be restricted to the south-west by the mountains adjacent to the site, as well as to the north. The open plain to the west offers little topographic screening. Located within the viewshed are the N14 receptors, as well as one farmstead located at a distance of 4 km.

#### Visual Exposure

<table>
<thead>
<tr>
<th>Degree of exposure to receptors</th>
<th>High (H)</th>
<th>Moderate (M)</th>
<th>Low (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dominant or clearly noticeable (&lt;2 km)</td>
<td>Recognisable to the viewer (2 – 6 km)</td>
<td>Minimally visible areas in the landscape (&gt;6 km)</td>
</tr>
</tbody>
</table>

#### Moderate to High

The proposed PV project would be located within 2 km from the N14 receptors and would be defined as having high visual exposure, and the PVs would be dominant or clearly noticeable. The farmstead is located in the 2 – 6 km range and, with the distance, there is some screening from the small trees scattered between the dwelling and the project site. This would only offer some screening for the 10 m height PV option but less for the 16 m height option.
6 PROJECT SITE LANDSCAPE SURVEY

The project site was assessed for scenic quality and sensitivity in order to define the VRM visual objective for the project location. In the VRM methodology, receptor sensitivity levels are a measure of public concern for scenic quality. Public lands are assigned high, medium or low sensitivity levels by analysing the various indicators of public concern. In the visual resource inventory process, public lands are given a rating based on the apparent scenic quality, which is determined using seven key factors. During the rating process, each of these factors is ranked on a comparative basis with similar features in the region (USA Bureau of Land Management, 2004). (Refer to Methodology in Annexure 2 for further details.)

Six points were surveyed during the site visit to determine the status of the landscape character where the proposed activities would be located, as indicated in the map below. The points, and the associated landscape feature at their locations, are listed below:

- S1: Agricultural Karoo scrub
- S2: Agricultural Karoo scrub
- S3: Non perennial wash drainage area
- S4: Non perennial wash drainage area
- S5: Karoo grasses
- S6: Nama Karoo rocky outcrop
Figure 15: Site elevation map of solar energy site
Figure 16: Solar energy site survey reference points (S1 – S6) overlaid onto aerial survey
6.1 S1: Karoo scrub

The dominant landscape feature is the open plains of the Karoo scrub and the Nama Karoo. Land use is agricultural sheep farming. Prominence of the site is low, as the topography is uniform. The visual absorption capacity for the PV installation would be low as the flat terrain and low vegetation offer limited screening of the proposed PV structures. Receptors are located approximately 4 km away in the foreground zone, as well as on the N14 view corridor.

Land form at this survey point was slightly undulating and rated moderate to low. Vegetation has a low rating as it has been fairly heavily impacted on by grazing and offers only one or two main species. There is no presence of water at the survey point. The grasses and slight reddish colour of the soils provide some colour, with dark grey-brown mountains in the background. Adjacent scenery, consisting of rocky mountains to the west, adds scenic value and was rated moderate to high. Scarcity is rated low, as this type of landscape is fairly common in the area. Other than fences and farm tracks, there are no dominant cultural modifications and they neither detract nor add to the sense of place. The overall score for scenic quality at this location was defined as moderate to low.

The isolated farmsteads of the region would have fairly high sensitivity to landscape modification due to their isolation and association with a particular sense of place. Amount of use and public interest are low, as the site location is fairly remote. Adjacent land users would have moderate levels of sensitivity due to the reduced zone of visual influence of the activity. Special areas category is rated moderate as the area has wide open spaces, typical of the Nama Karoo. The overall receptor sensitivity to this location was rated moderate.

The moderate to low scenic quality, with moderate sensitivity and foreground distance zone, results in a Class III visual objective. This allows for moderate levels of landscape modification.
6.2  S2: Karoo Scrub

Figure 18: Photograph of the open plains of the Karoo scrub at point S2

Comments for S2 are the same as for S1.
6.3 S3: Non-Perennial Wash and Drainage Area

The feature at this survey point is a dry river bed (wash). Land use in the area is agricultural and prominence is low due to the flat terrain. Land form is typically flat Karoo with a rating of moderate to low. Vegetation is sparse and fairly impacted on by agricultural activities and the rating was moderate to low. Water is rated moderate as the topography defines a water channel and in this arid region, water areas are important and add value. There are one or two main colours: the light, sandy-orange of the sands, and the scrub with the darkened greys of the mountains in the background. Adjacent scenery is typically Nama Karoo and is rated as high due to the close proximity of the low hills to the west which is accentuated in contrast to the open vistas of the plains. The type of scenic landscape is fairly common in the area and rated moderate for scarcity. There are no cultural modifications apparent at the location which neither add nor detract from the sense of place. The overall scenic quality rating for this location is moderate to high.

The type of users would be agricultural, as well as tourists travelling along the N14 view corridor. Due to the overall scenic qualities of the surrounding areas, it is likely that receptor sensitivity would be moderate to high. The amount of use is moderate due to the closer proximity to the N14. Public interest would be moderate to low, as views of the area are also associated with manmade infrastructure, which includes the road and the 132KVA transmission line.

Adjacent land user’s sensitivity to landscape change was rated moderate as the visibility of the proposed project would be buffered by the approximate one kilometre distance from the N14. The visual significance of the locations as a special areas category was rated high due to the fact that this area is considered sensitive in the Vegetation study. This study states that ‘In addition to the pans, there is also a drainage area in the north-western portion of the inselberg complex on Kangnas that is considered to be sensitive, especially in terms of botany (McDonald, 2012).
Overall sensitivity for this location was rated *high* and it is recommendations are that development should be excluded within the draining lines and drainage channels on the property to allow for continued hydrological integrity of the area.

### 6.4 S4: Non-Perennial Wash and Drainage Area

![Figure 20: Photograph of the non-perennial wash and drainage areas](image)

Comments for S4 would be the same as for S3.
6.5 **S5: Karoo Grasses**

![Image: Photograph of the open plains of the Nama Karoo](image)

**Figure 21:** Photograph of the open plains of the Nama Karoo

Comments for S5 are the same as for S1.
6.6 S6: Nama Karoo Rocky outcrop

The main landscape feature is a rock outcrop indicated by the red dotted oval in the top-left photograph. Prominence is moderate to high as the site is raised above the surrounding terrain. The surrounding land use is agricultural. Distance to the nearest receptor is over 6 km, which places S6 in the background zone. Land form has a high rating due to the uniqueness of the feature. There is no presence of water. Colours are interesting within close proximity to the red rocks, hence the common site name of “Rooikop”, and were rated moderate to high. Adjacent scenery was rated high with the close proximity to the surrounding mountains located in an open Nama Karoo landscape. Scarcity was rated moderate to high, also due to the uniqueness of the rock outcrop feature. Cultural modifications are agricultural and they neither detract nor add to the landscape. The overall score was defined as moderate to high for scenic quality of this location.

Types of users are predominantly farming in nature, and the amount of use is moderate. Due to the uniqueness of the landscape and the close proximity to the mountains, the sensitivity is expected to be moderate to high. Public interest would be low, due to the approximately six kilometres distance to the nearest receptor. The importance of maintaining visual quality for adjacent land users would be moderate to high as the area is remote and with the higher levels of scenic quality of the regions, does have a unique sense of place and does have special visual qualities. The overall sensitivity for this location was rated high with the recommendation that only low levels of landscape modification are allowed in this area and within a 50m surround.
### 6.7 Site Landscape Significance Findings

#### 6.7.1 Site Scenic Quality Summary Table

<table>
<thead>
<tr>
<th>ID</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Karoo scrub</td>
<td>Karoo scrub</td>
<td>Wash</td>
<td>Wash</td>
<td>Karoo grasslands</td>
<td>Rocky outcrop</td>
</tr>
<tr>
<td>Visual Absorption Capacity</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
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<td>2</td>
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<td>2</td>
<td>2</td>
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<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Adjacent scenery</td>
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<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Scarcity</td>
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<td>1</td>
<td>1</td>
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<td>14</td>
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<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

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

#### Sensitivity

<table>
<thead>
<tr>
<th>Type of user</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of use</td>
<td>L</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>Public interest</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Adjacent land users</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Special areas</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>M</td>
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<tr>
<td>Score</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>H</td>
</tr>
</tbody>
</table>

(H = High, M = Moderate, L = Low sensitivity)

#### Distance Zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>FG</th>
<th>FG</th>
<th>FG</th>
<th>FG</th>
<th>FG</th>
<th>BG</th>
</tr>
</thead>
</table>

(FG = Foreground, BG = Background, SS = Seldom Seen)

#### VRM Class

<table>
<thead>
<tr>
<th>Class</th>
<th>3</th>
<th>3</th>
<th>2</th>
<th>2</th>
<th>3</th>
<th>2</th>
</tr>
</thead>
</table>
### 6.7.2 Site Visual Absorption Capacity

<table>
<thead>
<tr>
<th>Rating</th>
<th>Potential of landscape to conceal</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>effective screening</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>partial screening</td>
</tr>
<tr>
<td>Low (L)</td>
<td>little screening</td>
</tr>
</tbody>
</table>

**Low**

Other than the small hills to the south-west of the site, the terrain is mainly flat and offers little topographic screening. The limited vegetation of the Nama Karoo landscape offers no screening.

### 6.7.3 Site Scenic Quality

<table>
<thead>
<tr>
<th>Rating</th>
<th>The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>highly visible and potentially sensitive areas in the landscape.</td>
</tr>
<tr>
<td>Moderate</td>
<td>moderately visible areas in the landscape.</td>
</tr>
<tr>
<td>Low</td>
<td>minimally visible areas in the landscape.</td>
</tr>
</tbody>
</table>

**Moderate** to **high**

The vast plain of the Nama Karoo does add value, but this type of landscape is fairly common in the region. The range of low hills to the south-west in contrast to the flat plains adds value to the landscape character. This is further enhanced by the limited development/settlement, which creates a moderate to high scenic quality value.

### 6.7.4 Visual Sensitivity of Receptors

<table>
<thead>
<tr>
<th>Rating</th>
<th>The level of visual impact considered acceptable is dependent on the type of receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>e.g. residential areas, nature reserves and scenic routes or trails</td>
</tr>
<tr>
<td>Moderate</td>
<td>e.g. sporting or recreational areas, or places of work</td>
</tr>
<tr>
<td>Low</td>
<td>e.g. industrial, mining or degraded areas</td>
</tr>
</tbody>
</table>

**Moderate** to **high**

The receptors include some isolated agricultural farmsteads that could be more sensitive to a change in the sense of place. However, due to the isolation of the site and lower levels of exposure to receptors, sensitivity to landscape change would be moderate to high. The N14 also carries tourist traffic and these receptors would be more sensitive to landscape modification.
7 VRM Sensitivity Mapping

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

- **Classes I and II** are the most valued;
- **Class III** represent a moderate value; and
- **Class IV** is of least value.

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

**Class I**
- No Class I areas were identified on the site.

**Class II**
- Class II was assigned to the river washes and the single rock outcrop. In this area it is recommended that only low levels of landscape modifications take place on the area and within a 50m surround.

**Class III**
- A Class III visual objective was assigned to the areas falling within the foreground/middle ground six kilometre area from the N14 receptor as this area is more exposed to the N14 receptors which would also carry tourist traffic. The Class III visual objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate.

**Class IV**
- No Class IV areas were identified on the site.
Figure 23: VRM Sensitivity Map of solar energy site
8 KEY OBSERVATION POINT CONTRAST RATING

The assessment of the Degree of Contrast (DoC) is a systematic process undertaken from Key Observation Points (KOPs) surrounding the project site and is used to evaluate the potential visual impacts associated with the proposed landscape modifications. Key Observation Points (KOPs) are defined by the Bureau of Land Management as the people (receptors) located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. These locations are important in terms of the VRM methodology which requires that the degree of contrast that the proposed landscape modifications will make to the existing landscape is measured from these most critical locations, or receptors, surrounding the property. The degree of contrast generated by the proposed landscape modifications are measured against the existing landscape context in terms of the elements of form, line, colour and texture. Each alternative activity is then assessed in terms of whether it meets the objectives of the established class category, and whether mitigation is possible (USA Bureau of Land Management, 2004).

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

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

As indicated in the map below, four receptor locations were identified as Key Observation Points. These locations were used to assess the suitability of the proposed landscape modifications.

<table>
<thead>
<tr>
<th>Map ID</th>
<th>KOP</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Varsputs residential dwelling</td>
<td>Farmstead</td>
</tr>
<tr>
<td>R2</td>
<td>N14 East eastbound</td>
<td>National road</td>
</tr>
<tr>
<td>R3</td>
<td>N14 West westbound</td>
<td>National road</td>
</tr>
</tbody>
</table>
Figure 24: Solar energy site receptor (KOP) locality points overlaid onto aerial survey
8.1 R1: Varsputs Residential Dwelling

Figure 25: Existing view from Varsputs residential dwelling

Figure 26: 10 m PV panel 3D Model of R1  
Blue colour for modelling purposes only

Figure 27: 16 m PV panel 3D Model of R1  
Blue colour for modelling purposes only
Land use at this KOP is rural agricultural residential. The receptor consists of a farmstead with a cluster of agricultural dwellings and structures. The distance to the proposed landscape modification is 2.5 km, which places it outside the high exposure zone. VRM Class III was defined for the property due to the moderate to high levels of scenic quality, the moderate sensitivity levels and there being foreground receptors. This allows for moderate levels of contrast to be generated, whilst partially retaining the existing character of the landscape. The PV panels are massed together, creating a rectilinear, clustered, flat form. From a distance they appear to be a simple, dark mass, dominant and highly visible in an otherwise complex, irregular landscape. However, the form contrast would be weak due to the fact that the low height of the proposed PV structures would be partially obscured by the low bushes and small trees which are located between the receptor and the site. This would break up the massing effect of the form, as the receptor and the PV site are on the same elevation.

The predominant lines of the landscape are horizontal, reflecting the wide open expanse of the plain. There are some small vertical lines within the view, created by fence posts and other farm infrastructure. The far horizon line is irregular and wavy, contrasting with the horizontality of the fore and middle ground. At this distance, the PV panels read together as a wide, flat, horizontal linear form. Hence, line contrast created by the proposed modification with the natural landscape would be moderate. The mountain in the background would reduce the line contrast. The black and grey shadow hues from the proposed PV site would generate moderate levels of contrast to the grey-brown hues and colours of the background scenery. The site will be read as a total form from this distance. Texture contrast would be moderate as textures of the landscape are irregular and complex, whilst those of the PV panels are regular, smooth and clean. The massing of the structure’s textures would be reduced by vegetation screening and the 2.5 km distance would push it into the middle ground zone which would reduce the clarity of the PV views.

The overall degree of contrast generated by the proposed modification is moderate. The potential reflectivity of the panels must also be taken into consideration, as this would increase the overall degree of contrast. In the second alternative, if tracking panels are used they pivot to follow the sun, and different levels of contrast will be generated at different times of the day. The receptor is due east of the proposed development and would hence be particularly susceptible to glare in the mornings.

Visual objectives for the PV would be met with a reduction in height of the PV. For the transmission line, the visual objectives would be met without mitigation as there is already an existing precedence for power lines created by the 132KVA line routed along the N14. Visual objectives for structures would be met with mitigation in terms of colour, site selection and height. Height of structures should preferably be limited to 10 m. Preferred colours for the structure are mid grey-brown and should not be prominently located.
8.2 R2: N14 travelling east

Figure 29: Existing view from N14

Figure 30: 10 m PV panel 3D Model of R2  Blue colour for modelling purposes only

Figure 31: 16 m PV panel 3D Model of R2  Blue colour for modelling purposes only
This KOP is from the N14, travelling in a north-east direction. The N14 is an important access road in the area and carries moderate amounts of traffic receptors. The road serves as an infrastructure corridor for the telephone and power lines. Land use in the surrounding areas is agricultural. Distance to the proposed landscape modification is 1 km and the proposed PV site runs parallel to the N14 at a distance of 1 km for approximately 3 km. The area was defined as VRM Class III due to the moderate to high scenic qualities. Receptors will be in the foreground zone of the proposed modifications and their sensitivity to the proposed change will be moderate. The Class III objective is to partially retain the existing character of the landscape, allowing for a moderate level of change.

The PV panels are massed together, creating a rectilinear, clustered, flat form. From a distance they appear to be a simple, dark mass, dominant and highly visible in an otherwise complex, irregular landscape. The form contrast potentially generated will be moderate, due to the 1 km buffer, which places the PVs behind the transmission line. The predominant lines of the landscape are horizontal, reflecting the wide, open expanse of the plain. There are some vertical lines within the view, created by fence posts and telephone poles. The far horizon line of the hills is irregular and wavy, contrasting with the horizontality of the fore and middle ground. At this distance, the PV panels read together as a wide, flat, horizontal linear form, with interspersed, receding, diagonal, parallel lines (linear perspective). Hence, line contrast between the proposed modification and the natural landscape would be moderate. The mountain in the background would reduce the line contrast.

The back of the PVs would be facing towards the receptor, which would create a grey shadow effect. Very little, if any, of the dark reflective surface of the PVs will be seen. The existing colour on the landscape is grey-brown, which would result in moderate levels of contrast. Texture contrast would be strong as there are no other metallic-type textures in the landscape other than the power lines. Textures of the natural landscape are irregular and complex, whilst those of the PV panels are regular, smooth and clean, and are seen in the foreground, with no softening effect of atmospheric perspective. Foreground vegetation is low, and does not offer any screening potential. The overall degree of contrast generated by the proposed landscape modification, as seen from this receptor point, is defined as moderate to strong.

Objectives are met for the PV installation, without mitigation. Management activities repeat the basic horizontal and colour elements found in the predominant natural features of the characteristic landscape. Objectives from this receptor were met for the transmission line and infrastructure, without mitigation. However, the objectives for structures were met with mitigation, which requires that the structures have colour mitigation to reduce contrasts. The colour must therefore be mid-grey or brown-grey. In addition, the structures should be located in clusters and not within 2 km of the receptor, to reduce visibility and the effects of lights at night.

Figure 32: Photograph of R2 sense of place
8.3 R3: N14 travelling west

Figure 33: Existing view from N14

Figure 34: 10 m PV panel 3D Model of R3  Blue colour for modelling purposes only

Figure 35: 16 m PV panel 3D Model of R3  Blue colour for modelling purposes only
Figure 36: Photograph of receptor sense of place

Comments for R3 are the same as for R2.
8.4 Contrast Rating Findings

8.4.1 Contrast Rating Summary Table

<table>
<thead>
<tr>
<th>GPS ID</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Varsputs</td>
<td>N14 travelling east</td>
<td>N14 travelling west</td>
</tr>
<tr>
<td>Land use</td>
<td>Residential</td>
<td>View corridor</td>
<td>View corridor</td>
</tr>
<tr>
<td>Distance</td>
<td>2.5 km</td>
<td>1 km</td>
<td>1 km</td>
</tr>
<tr>
<td>Class</td>
<td>II / III</td>
<td>II / III</td>
<td>II / III</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Weak</th>
<th>Moderate</th>
<th>Moderate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lines</td>
<td>Moderate</td>
<td></td>
<td>Weak</td>
</tr>
<tr>
<td>Colour</td>
<td>Moderate</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Texture</td>
<td>Moderate</td>
<td></td>
<td>Strong</td>
</tr>
<tr>
<td>DoC</td>
<td>Moderate</td>
<td>Moderate Strong</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visual Objectives Met</th>
<th>PV (with mitigation)</th>
<th>Infrastructure (with mitigation)</th>
<th>Lights at Night (with mitigation)</th>
<th>DoC with mitigation (with mitigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lights at Night</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DoC with mitigation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

8.4.2 Visual Intrusion

<table>
<thead>
<tr>
<th>Rating</th>
<th>Congruence of the project with the particular qualities of the area, or its 'sense of place'</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>: noticeable change</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>: partially fits into the surroundings, but clearly noticeable</td>
</tr>
<tr>
<td>Low (L)</td>
<td>: blends in well with the surroundings</td>
</tr>
</tbody>
</table>

Moderate

The size and scale of the project, which include PV panels located in a predominantly flat landscape, does create a large viewshed and the dark colour of the PV panels increases the intrusion. However, the area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the solar farm would be in the distant and they require moderate levels of visual contrast required for the Class III visual objective would be met with mitigation of excluding the drainage lines from development. With mitigations, lights at night can be contained, but they will result in a change in the night-time sense of place.
9 IMPACTS PER PROPOSED ACTIVITY

Impact as defined by the DEA&DP Guideline for involving Visual and Aesthetic Specialists in EIA processes (2005) is: ‘A description of the effect of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space’ (Oberholzer. 2005).

Based on the contrast rating which was undertaken from each of the surrounding receptors, an assessment was made on whether the proposed activities met the recommended visual objectives defined in order to protect the landscape character of the area.

9.1 PV Panels: Alternative 16 m height

9.1.1 Impacts per phase table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Long term</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Recommendations
- Development should remain outside of wash areas and the small rocky outcrop and preference is for containing the heights of the PV structures to 10 metres.

9.1.2 Mitigations

Construction
- All topsoil must be stockpiled in a suitable location and re-utilised for landscaping/rehabilitation. Plant rescue needs to be undertaken.
- Litter must be strictly controlled.
- Lighting should be kept to an efficient minimum, while still keeping within the safety norms.
- Fencing should be a grey chain link fence, or similar, that will blend with the agricultural landscape context and should encircle the development footprint and not the perimeter.
- Signage must be constrained.

Operation
- LED directional lighting, with no overhead lighting, should be used to prevent light spillage.
- Lighting should be kept to an efficient minimum while still keeping within the safety norms.
- As explanation, and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility, a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corporation has been included (see Annexure 3).
- Rehabilitation of previously modified areas should be continually undertaken.

Deconstruction
- Removal of infrastructure, recycling of materials and rehabilitation of the area.
9.2 PV Panels: Alternative 10 m height

9.2.1 Impacts per phase table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation Without</th>
<th>Mitigation With</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Regional</td>
<td>Regional</td>
<td>Within the province/recognised region</td>
</tr>
<tr>
<td>Magnitude</td>
<td>High</td>
<td>Medium</td>
<td>High magnitude where social, natural functions and process severely altered and medium notably altered</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Long term</td>
<td>More than 10 years after construction</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>High</td>
<td>Medium</td>
<td>High = High magnitude and regional extent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium</td>
<td>Medium = medium magnitude with regional extent</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
<td>Estimate 5 – 95% chance of impact occurring</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
<td>Reasonable information and relatively sound understanding of environmental factors influencing impact</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible within a period of 10 years</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Yes</td>
<td>Yes</td>
<td>A development of this nature would restrict development options</td>
</tr>
</tbody>
</table>

Recommendations
- Preference is for the 10 m PV panels as they are lower in height and less dominating.

9.2.2 Mitigations

Construction
As for Alt 1

Operation
As for Alt 1

Deconstruction
As for Alt 1

9.3 Roads and Infrastructure

9.3.1 Impacts per phase table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation Without</th>
<th>Mitigation With</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Local</td>
<td>Local</td>
<td>Within 1 km of the impact site</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium</td>
<td>Low</td>
<td>Medium is where social, natural functions and process notably altered and low, slightly altered</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Medium term</td>
<td>More than 10 years after construction if bright colours are utilised and structures located in close proximity to the N14. With colour mitigation and location two kilometres from receptors, the duration of the visual impact would be less.</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>Medium</td>
<td>Low</td>
<td>Medium magnitude with regional extent without mitigations and low should mitigation be implemented.</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
<td>Estimate 5 – 95% chance of impact occurring</td>
</tr>
<tr>
<td>Confidence</td>
<td>Unsure</td>
<td>Unsure</td>
<td>Limited useful information on and understanding of the environmental factors potentially influencing this impact</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible within a period of 10 years</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Yes</td>
<td>No</td>
<td>Precedent would be set for development in washes</td>
</tr>
</tbody>
</table>
9.3.2 Mitigations

**Construction**
- All topsoil must be stockpiled in a suitable location and re-utilised for landscaping / rehabilitation. Plant rescue needs to be undertaken.
- Litter must be strictly controlled.
- Lighting should be kept to an efficient minimum, while still keeping within the safety norms.
- Fencing should be a grey chain link fence, or similar, that will blend with the agricultural landscape context and should encircle the development footprint and not the perimeter.
- Signage must be constrained.
- Colours for the buildings should be RAL 1011 or RAL 8001. *(Source: Classic RAL colour chart www.ralcolor.com)*

**Operation**
- LED directional lighting, with no overhead lighting, should be used to prevent light spillage.

**Deconstruction**
- Removal of infrastructure, recycling of materials and rehabilitation of the area.

### 9.4 Visual Impact Summary Table

<table>
<thead>
<tr>
<th>Extent</th>
<th>PV Panels 16 m</th>
<th>PV Panels 10 m</th>
<th>Roads and Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Mit</td>
<td>With Mit</td>
<td>Without Mit</td>
</tr>
<tr>
<td>Extent</td>
<td>Regional</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Long term</td>
<td>Long term</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
10 **PV Project Conclusion**

The significance of the surrounding landscape was defined as high as it includes the Klein Koperberge to the west of the site as well as the Goegap Nature Reserve which increase the regional landscape scenic quality and receptor sensitivity. The uniform nature of the flat Nama Karoo plains can be fairly monotonous, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.

It is the conclusion of the assessment that the impact to the site and surrounding visual resources of the area will be of moderate significance as the area is remote and views of the PV installation will be mainly contained within a two to three kilometre zone of visual influence. Low hills to the west would result in no views of the proposed landscape modifications being visible from the Goegap National Park located to the west. Views for the N14 receptors would be clear but intrusion would be reduced by the 750 m buffer and the location of the existing 132 kVA power line in the foreground. Mitigation would be required which would include the avoidance of the washes and the rocky outcrops. The preferred alternative is the 10 m height as this would reduce the visual intrusion and allow for the low trees to the east of the site to offer partial visual screening to the adjacent farmstead. Cumulative impacts need to be taken into consideration as should the solar farm be approved the development may attract similar wind and PV developments to the area which could limit local eco / farm-tourism possibilities.
11 GENERAL MITIGATIONS

Construction Phase
The following mitigations would be necessary:
- Mitigation measures need to be set in place to ensure that dust generated during construction is kept to a minimum.
- Litter needs to be strictly controlled.
- All topsoil needs to be stockpiled in a suitable location and re-utilised for landscaping/rehabilitation.
- Excess material from construction of infrastructure and roads should be disposed of offsite or through natural landscaping of areas. No dumping or piling should be allowed.
- Fencing should be a grey chainlink fence, or similar, that will blend with the agricultural landscape context and should encircle the development footprint and not the perimeter.
- Activities should be situated off the rocky outcrop and remain outside of washes.

Operational Phase
- LED directional lighting, with no overhead lighting, should be used to minimise light spillage.
- Rehabilitation of previously modified areas should be continually undertaken.
- Colours for the buildings should be RAL 1011 or RAL 8001.

Deconstruction Phase
- Site rehabilitation must be implemented as per the specifications of the vegetation specialist.
- Deconstruction activities would include removal and recycling of project infrastructure.

11.1.1 Mitigation of Night-Lighting
'As explanation and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corp. has been included in Annexure 3.
SECTION C: KANGNAS WINDFARM VISUAL ASSESSMENT

12 PROJECT DESCRIPTION AND VISIBILITY

The objective of this section is to describe the character of the project activities and to define the extent to which it will be visible to the surrounding areas. The extent of the visibility of the project can be seen in the viewshed maps on the following pages.

The photographs below show views of existing wind turbines.

Figure 37: Photograph of Nevada Desert Wind Farm
(Source: www.globalinvcorp.com)

Figure 38: Lights at night from Vienna wind turbines
(Source: www.freewheelercampers.com)

Figure 39: 3D model of wind turbine with red-tipped blades for aircraft warning

The project will comprise of the following activities: *(to be confirmed)*
- 350 x 3 - blade wind turbines (approximate height of 120 – 180 m) with a maximum 60% of those turbines with aircraft warning lighting;
- Circular foundations and transformers at the base of each turbine;
- A cleared, compacted area for positioning the crane next to each turbine foundation;
- A proposed 132 kV and 220 kV overhead transmission power line. The grid connection is 132, 220 or 400 kV;
- Permanent internal roads (approximately 4.5 m wide) and infrastructure.

Two alternatives will be assessed:
- Alternative 1 (Alt 1): Average turbine height of 180 m,
- Alternative 2 (Alt 2): Average turbine height of 120 m.

*(See comparative diagram below)*
Due to the white colour and reflective nature of the turbine in relation to the height (required to harness the stronger winds), this type of project tends to generate higher levels of visual contrast. Visual contrast can also be further exacerbated by the required aircraft warning colours and lights. The space required for construction covers an area of less than 1% of the site. This would depend on how many turbines built, which will only be finalised much later. Very large cranes are required to construct the turbines, which also generate higher levels of visual contrast during construction. Once constructed, the movement associated with the turning blades becomes a focal point for the casual observer. However, the turbines can also become sculptural if located in the correct setting and can merge into background views.
Figure 40: Proposed site assessment plan of 350 turbines overlaid onto aerial survey
12.1 Project Visibility and Exposure

Making use of SA Survey General 20 m contours data, a terrain model was generated for an area of approximately 50 km around the proposed project area indicated in the map on the following page. The terrain in the area ranges from a minimum of 28 m to a maximum height of 1089 m on the site, as can be seen in the site elevation map. Making use of the average height of the proposed turbine type of 180 m above ground level, the viewshed of each of the alternatives was modelled.

<table>
<thead>
<tr>
<th>Proposed Activities</th>
<th>Visibility</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turbines</td>
<td>Structures (unknown location)</td>
<td>Transmission line</td>
<td>Lights at Night</td>
</tr>
<tr>
<td>Height (m)</td>
<td>120 - 180</td>
<td>4</td>
<td>35</td>
<td>120 - 180</td>
</tr>
<tr>
<td>Extent (Construction)</td>
<td>H</td>
<td>M</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Extent (Operation)</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
</tbody>
</table>

Key: H = High, M = Moderate, L = Low
Figure 41: Viewshed of proposed wind turbines with offset of 180 m above ground
A viewshed was generated for the proposed wind turbines, with an offset above the ground of 180 m, making use of ASTGTM data (ASTER GDEM). As indicated in the map above, due to the flat terrain, the viewshed is widespread and covers a large area around the site but is constrained to the west by the higher elevated areas of the Klein Koperberg Mountains. Within the six kilometre buffer zone, all areas would view the proposed turbines except for a few areas were the N14 receptors would be screened from the wind farm by the low hills which offer topographic screening. At an approximate distance of 15 km, the viewshed begins to fragment at all compass points. As the surrounding terrain is uniform, only the maximum height was utilised in the viewshed, as the slightly lower height of the alternative turbines would represent a very similar distribution pattern. The following receptors were identified during the field survey as having views which are shared with the area where the development is proposed:

- **R355**
- **N14**
- Aggeneys town servicing Black Mountain Mine (site not likely to be visible due to topographical screening)

Of the above receptors located within the viewshed, the isolated farmsteads are the only ones who would have higher levels of exposure, but even these receptors would mainly be located at the outer extents of the foreground / middle ground distance zone. An approximate 3 km section of the N14 is located in the foreground / middle ground, with most of the views of the site forming part of the background views.

### 12.2 Project Visibility Findings

<table>
<thead>
<tr>
<th>Extent</th>
<th>Geographical area of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Related (S)</td>
<td>extending only as far as the activity</td>
</tr>
<tr>
<td>Local (L)</td>
<td>limited to immediate surroundings</td>
</tr>
<tr>
<td>Regional (R)</td>
<td>affecting a larger metropolitan or regional area</td>
</tr>
<tr>
<td>National (N)</td>
<td>affecting large parts of the country</td>
</tr>
<tr>
<td>International (I)</td>
<td>affecting areas across international boundaries</td>
</tr>
</tbody>
</table>

**Regional**

Due to the flat terrain, the viewshed is widespread and covers a large area around the site, but is constrained to the west by the higher elevated areas of the Klein Koperberg Mountains. Although the viewshed does extend into the Goegap Nature Reserve area, only the upper section of the hills will have distant views of the proposed project. From the Goegap Nature Reserve activity map obtained from the Reserve, it is apparent that the main activities take place in the valleys where there are no views of the project. The main receptors are the N14 national road to the north and the R355 to the south, as well as only a few isolated farmsteads as the area is very remote.

<table>
<thead>
<tr>
<th>Visual Exposure</th>
<th>Degree of exposure to receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>Dominant or clearly noticeable (&lt;2 km)</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>Recognisable to the viewer (2 – 6 km)</td>
</tr>
<tr>
<td>Low (L)</td>
<td>Minimally visible areas in the landscape (&gt;6 km)</td>
</tr>
</tbody>
</table>

**Moderate to Low**

As indicated in the viewshed comment, due to the remoteness of the location, there are very few receptors. Most of these would be moderately exposed to the proposed wind farm, with views of the site forming part of the background context. One section of the N14 will have moderate exposure with all the other receptors viewing the turbines in the background at low exposure.
13 PROJECT SITE LANDSCAPE SURVEY

The project site was assessed for scenic quality and sensitivity in order to define the VRM visual objective for the project location. In the VRM methodology, receptor sensitivity levels are a measure of public concern for scenic quality. Public lands are assigned high, medium or low sensitivity levels by analysing the various indicators of public concern. In the visual resource inventory process, public lands are given a rating based on the apparent scenic quality, which is determined using seven key factors. During the rating process, each of these factors is ranked on a comparative basis with similar features in the region (USA Bureau of Land Management, 2004). *(Refer to Methodology in Annexure 2 for further details.)*

Seven points were surveyed during the site visit to determine the status of the landscape character on site, where the proposed activities would be located (see map on the following page). The points, and the associated landscape feature at their locations, are listed below:

- S1: Nama Karoo / mountain outcrops
- S2: Agricultural Karoo scrub
- S3: Eastern Agricultural Karoo scrub on small hill
- S4: Agricultural Karoo scrub (Central)
- S5: Agricultural Karoo scrub (Eastern)
- S6: Waterhole
- S7: Nama Karoo landscape
Figure 42: Site elevation map of wind energy site

Site elevation profile from west to east

Site elevation profile from north to south
Figure 43: Windfarm site survey reference points (S1 – S7) overlaid onto aerial survey
13.1 **S1: Nama Karoo flat open plains**

The flat open plains with isolated mountain outcrops of the Nama Karoo dominate the landscape. Land use is agricultural sheep farming with limited presence. Visibility is high and extends across the plain, exceeding 24 km. The Visual Absorption Capacity (VAC) is low due to the uniformity of the landscape and flat plain, in relation to the height of the turbines. The scenic quality is moderate due to the wide open spaces increasing the value of the land form. Vegetation is moderate to low due to the impact from agricultural grazing on indigenous vegetation and is limited in variation. There is no evidence of the presence of water. Colours comprise one or two different colour hues, mainly grey-browns. Adjacent scenery is rated moderate to high due to the rocky outcrops and the hills to the west in the background. Scarcity of this landscape is rated low, as this landscape is fairly widespread in the region. Other than the road and fences, there are no dominating cultural modifications or agricultural activities that either add or detract from the sense of place. The overall score for scenic quality is moderate to low due to the wide open spaces which is fairly widespread in the region.

The type of user would predominantly be agricultural or residential farmers and they would, unless associated with the project, be sensitive to landscape change due to the remoteness of the landscape and their historic association with the open space of the plain. Amount of use and public interest is very low due to the remoteness and this area is therefore categorized as “seldom seen” or “background”. Adjacent land users would be farmers and their sensitivities would be expected to be moderate to high, depending on distance from the site. In terms of any surrounding areas with visual significance, the site was rated moderate to high as it is in a large Nama Karoo landscape, which has a special sense of place. The overall sensitivity rating given is moderate due to the remoteness and monotony of the open plains. The VRM class visual objective for the area is Class III due to moderate scenic qualities of the landscape and receptor sensitivity being moderate to low, with receptor location falling into the background distance zone. The recommendation is that the site is suitable for landscape modification but that visual mitigation would be required to ensure that the regional moderate to high scenic quality is protected.
13.2 S2: Karoo Scrub

Figure 45: Photograph of Karoo Scrub at point S2

Comments for S2 are the same as for S1.
This site (S3) is located to the north-east of the project area. The proposed activity in the area is for turbines as well as for the transmission line. Features are Karoo scrub, but this area is closest to the mountainous region to the east of the site and is located on a small rocky outcrop. The land use is also agricultural sheep farming. Due to the elevation of this location, the view prominence is slightly higher than the surrounds. Visual absorption capacity is low as the terrain is fairly flat. In terms of receptors, the location is closer to the receptors on the N14. In terms of landform, comments would be the same as for Point S1. Scenic quality is moderate to high due to the rocky outcrop within the wide open spaces which increases the value of the land form.

The types of users are rural residential and agricultural receptors, as well as the receptors making use of the N14. Sensitivity to landscape modification would probably be high for the farmers and moderate for the road receptors as they are exposed to existing manmade modifications which include the road and the transmission line. Amount of use is moderate, as the N14 is the main road in the area. Public interest would be moderate as it falls within the foreground region and is also in closer proximity to the Goegap Nature Reserve to the east, although not falling within the reserve visibility area. For the special or visually significance category, the site was defined as moderate to high due to the slightly prominent topography in relation to the flat surrounds of the open plains, with the overall receptor sensitivity being defined as moderate mainly due to remoteness and the uniformity of the landscape. Due to the foreground distance zones to the receptors, the moderate to high scenic qualities, as well as the moderate receptor sensitivities, a Class III is recommended where moderate levels of contrast should be generated by the proposed project elements, as seen from surrounding receptors.
13.4 S4: Agricultural Karoo Scrub (Central)

Figure 47: Photograph of Karoo scrub from Point S4

Comments for S4 are the same as for S1.
13.5 S5: Agricultural Karoo Scrub (Eastern)

Figure 48: Photograph of eastern agricultural Karoo scrub

Comments for S5 are the same as for S1.
13.6  S6: Waterhole

Figure 49: Photograph of waterhole and surrounding landscape

Landscape features at this site comprise a natural water hole, rocky outcrop area and associated low-lying wash area. Land use is agricultural and visual prominence of the area is low. Vegetation is more abundant due to the natural presence of water and, as such, is rated as moderate. Colours are moderate to low, with one or two main colours provided by the vegetation, rock and sand. Adjacent scenery being similar open plains is fairly uniform in character and rated as moderate. Scarcity has a moderate to high value from a biodiversity perspective due to the importance of water within the dry landscape. Cultural modifications associated with agricultural land uses neither add nor detract from the sense of place. The scenic quality is moderate to high due to the high value from a biodiversity perspective due to the importance of water within the dry landscape.

The type of users would be the local farmers who would be sensitive to the landscape modification in the area due to the importance of water. However, the amount of use is very low due to the remoteness of the location. Public interest would be low as this area is not within any public visual corridors. Adjacent land users would also be sensitive to landscape modification in this area as the downstream water users would potentially be affected. This is an important water source with high significant special areas rating with an overall high receptor sensitivity rating. Although visibility of this feature is limited due to the remoteness of the location, the water feature does have landscape value and the DEA&DP visual guidelines require that all scenic resources be taken into account and not only those which are visible.

The VRM rating was defined as Class II with a visual objective to allow for only low levels of landscape change. Landscape modifications within these types of features should not be
undertaken. The turbines, or development within a 50m buffer area from the waterholes and major river washes, should be avoided, as it is likely that they will not meet the visual objective for the site.

13.7 S7: Nama Karoo from N14

Figure 50: Photograph of Nama Karoo landscape from N14

The proposed activity is the transmission line at the location of the N14. The main feature at this survey point is the N14 road which dominates the landscape context. Also located at the site are the telephone poles and lines to the site, as well as a 132kVa power line to the north of the road, which all increase the visual absorption capacity of this area. Land form is fairly uniformly flat at the site, with vegetation being limited to one or two main types and therefore rated as low. There is no evidence of water, and colours are moderate with mainly reds and ochre's provided by the rock and sand, with khaki colours of the grasses. These views are fairly common in the area and scarcity was rated low. Cultural modifications are rated as low due to the power line and road infrastructure. The overall scenic quality of the site is rated as moderate to low.

In terms of receptor sensitivity, the type of user would include tourists who would be more sensitive to landscape change, but the area is remote and amount of use would be moderate to low. The landscape is fairly common in the area but is typically Nama Karoo and, as such, public interest would be moderate. Adjacent users are mainly farmers and their sensitivity to landscape change would be moderate to high as the open spaces of the Nama Karoo would be strongly associated with their cultural heritage. As the N14 would carry tourist traffic, it would have a higher landscape significance or special area rating.

In order to protect the landscape character associated with the N14 view corridor, the Class III visual objective is recommended, with moderate levels of landscape change being acceptable in order to protect the visual resources.
13.8 Site Landscape Significance Findings

The landscape character of the proposed project site is surveyed to identify areas of common landuse and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels, called VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be “absorbed” or “disappear” into the landscape). The areas identified on site are categorised into these Classes by using a matrix from the BLM Visual Resource Management method, which is then represented in a visual sensitivity map. (See Annexure 2 for further details)

13.8.1 Site Scenic Quality Summary Table

<table>
<thead>
<tr>
<th>ID</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Nama Karoo/mountain outcrops</td>
<td>Karoo scrub</td>
<td>Eastern Karoo scrub on small hill</td>
<td>Agricultural Karoo scrub</td>
<td>Agricultural Karoo scrub</td>
<td>Waterhole</td>
<td>Nama Karoo landscape at the N14</td>
</tr>
<tr>
<td>Visual Absorption Capacity</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>Land Form</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Vegetation</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
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<td>Colour</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Adjacent scenery</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Scarcity</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Cultural modifications</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-2</td>
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<tr>
<td>Score</td>
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<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Category</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Type of user</th>
<th>Amount of use</th>
<th>Public interest</th>
<th>Adjacent land users</th>
<th>Special areas</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>M</td>
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<td>M</td>
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<td>M</td>
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</tr>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>H</td>
</tr>
</tbody>
</table>

PROPOSED KANGNAS ALTERNATIVE ENERGY PROJECT VIA
(H = High, M = Moderate, L = Low sensitivity)

<table>
<thead>
<tr>
<th>Distance Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
</tr>
</tbody>
</table>

(FG = Foreground, BG = Background, SS = Seldom Seen)

### VRM Class

<table>
<thead>
<tr>
<th>Class</th>
<th>IV * (III)</th>
<th>IV * (III)</th>
<th>III</th>
<th>IV * (III)</th>
<th>IV * (III)</th>
<th>III</th>
<th>III</th>
</tr>
</thead>
</table>

* Class IV amended to Class III in order to offer some protection of the surrounding visual resources.

13.8.2 Site Visual Absorption Capacity

<table>
<thead>
<tr>
<th>Rating</th>
<th>Potential of landscape to conceal</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (H)</td>
<td>effective screening</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>partial screening</td>
</tr>
<tr>
<td>Low (L)</td>
<td>little screening</td>
</tr>
</tbody>
</table>

Low

Other than the small hills to the north-west of the site, the terrain is mainly flat and offers little topographic screening. The limited vegetation of the Nama-Karoo landscape offers no screening.

13.8.3 Site Scenic Quality

<table>
<thead>
<tr>
<th>Rating</th>
<th>The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>highly visible and potentially sensitive areas in the landscape.</td>
</tr>
<tr>
<td>Moderate</td>
<td>moderately visible areas in the landscape.</td>
</tr>
<tr>
<td>Low</td>
<td>minimally visible areas in the landscape.</td>
</tr>
</tbody>
</table>

Moderate to high

The vast plain of the Nama Karoo does add value, but this type of landscape is fairly common in the region. The Klein Koperberge Mountain in the background and the low levels of development / settlement create a moderate to high scenic quality value.

13.8.4 Visual Sensitivity of Receptors

<table>
<thead>
<tr>
<th>Rating</th>
<th>The level of visual impact considered acceptable is dependent on the type of receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>e.g. residential areas, nature reserves and scenic routes or trails</td>
</tr>
<tr>
<td>Moderate</td>
<td>e.g. sporting or recreational areas, or places of work</td>
</tr>
<tr>
<td>Low</td>
<td>e.g. industrial, mining or degraded areas</td>
</tr>
</tbody>
</table>

Moderate

The receptors include some isolated agricultural farmsteads that could be more sensitive to a change in the sense of place. However, due to the isolation of the site and lower levels of exposure to receptors, sensitivity to landscape change would be moderate.
14 VRM Sensitivity Mapping

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

- Classes I and II are the most valued;
- Class III represent a moderate value; and
- Class IV is of least value.

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

Class I
- No Class I areas were identified on the site.

Class II
- Class II was assigned to the S6 waterhole survey point. In this area it is recommended that development does not take place as the degree of contrast associated with the project would exceed the low levels of contrast required to maintain the visual integrity of these areas.

Class III
- A Class III visual objective was assigned to the areas falling within the foreground / middle ground six kilometre areas from the N14 receptor. This area is more exposed to the N14 receptors which include tourist traffic. The Class III visual objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. A Class IV visual objective was assigned to the Karoo open plains in the background area. However, the Class IV objective is to provide for management activities which require major modifications of the existing character of the landscape. As this would negatively affect the surrounding Nama Karoo landscape which has value as a visual resource, it was adjusted to Class III in order to offer some protection of the surrounding visual resources.

Class IV
- No Class IV areas were identified on the site.
Figure 51: VRM Class Map for the wind focus area
15 **KEY OBSERVATION POINT CONTRAST RATING**

The assessment of the Degree of Contrast (DoC) is a systematic process undertaken from Key Observation Points (KOPs) surrounding the project site and is used to evaluate the potential visual impacts associated with the proposed landscape modifications.

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

The proposed project activities are then finally assessed from the KOPs around the site to see whether the visual objectives (VRM Classes) defined for the site, are met in terms of measuring the potential change to the site’s form, line, colour and texture visual elements, as a result of the proposed project (i.e., are the expected changes within acceptable parameters to ensure that the visual character of the landscape is kept intact and, if not, what can be done by the project to ensure that it is).

To define the KOPs, potential receptor locations are identified in the viewshed analysis, which are screened based on the following criteria:
- Angle of observation
- Number of viewers
- Length of time the project is in view
- Relative project size
- Season of use
- Critical viewpoints, e.g. views from communities, road crossings
- Distance from property

As indicated in the map below, four receptor locations were identified as Key Observation Points. These locations were used to assess the suitability of the proposed landscape modifications.

<table>
<thead>
<tr>
<th>Map ID</th>
<th>KOP</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>N14 Foreground</td>
<td>National road</td>
</tr>
<tr>
<td>R2</td>
<td>N14 East Background</td>
<td>National road</td>
</tr>
<tr>
<td>R3</td>
<td>N14 West Background</td>
<td>National road</td>
</tr>
<tr>
<td>R4</td>
<td>R355</td>
<td>District road</td>
</tr>
</tbody>
</table>
Figure 52: Windfarm site receptor (KOP) locality points overlaid onto aerial survey
15.1 R1: N14 Foreground

Figure 53: Existing view from N14 foreground

Figure 54: Photomontage of proposed wind turbines FOR ILLUSTRATIVE PURPOSES ONLY
The land use surrounding this KOP is road infrastructure surrounded by rural agricultural. Exposure to the proposed modifications is moderate as it is 3.25 km to the nearest turbine. At this distance, the vertical lines of the turbines are clearly visible, reading visually together and creating a regular, linear, textured mass across the landscape, extending above the horizon line. Textures of the landscape, mostly created by the vegetation, are irregular. They lie evenly across the view. The predominant natural line in the landscape is that of the flat horizon. Hence, line and texture contrast are both strong.

The tall, narrow, linear forms will not dominate individually, hence form contrast is weak. The overall tones of the landscape are light to medium, creating irregular textures across the flat landscape. The turbines are a regular white colour, smoothly textured. Hence, the colour contrast between the existing landscape and the white turbines will be moderate to strong. It is strongly recommended that the turbine blades do not have red tips, as this will increase colour contrast significantly. The white of the turbine will soften visually with atmospheric perspective, reducing contrast; this will not occur with red, which is visible from great distances.

**Visual objectives:**
- For the background turbines, the visual objectives of a Class III would be met with mitigation, which would include:
  - Certain areas within the project boundary, i.e. the washes and water areas, would need to be excluded from the development footprint.
  - The exclusion of red tips must be considered, as well as careful consideration of lighting.
- The foreground turbines are relatively close and the movement of the turbine blades will generate the most visual contrast as there is no movement in the existing landscape other than that of intermittently passing cars. These turbines would not meet the Class III visual objective.
- Transmission lines and structures would not be visible at this distance, but colour mitigations would be required and it is recommended that they are located outside of the N14 view corridor.

![Photograph of N14 sense of place](image)
15.2  **R2: N14 West Background**

Figure 56: Existing view from N14 westbound

Figure 57: Photomontage of proposed wind turbines **FOR ILLUSTRATIVE PURPOSES ONLY**
The proposed modification is seen in the background (9.18 km away) from this receptor point, the N14 national road and an agricultural farmstead. Current land use is infrastructure, residential and surrounding agricultural. The VRM class defined for the area is Class III due to the moderate levels of scenic quality, the moderate to high levels of receptor sensitivity and the proposed modification being in the background.

The form contrast generated by the turbines as seen from this distance would be neutral, as there is little form to the turbine structures; they are mainly a series of predominantly vertical lines, with smaller blade diagonals. Line contrast to the dominating flat horizon would be moderate, as at this distance the contrast would be limited due to the atmospheric influence. However, the movement of the turbine blades would demand more attention from the casual observer, but not be dominating at this distance.

Colour contrast would be moderate to weak. Against the grey background atmospheric haze, the white of the structures would not contrast strongly. Texture contrast would be moderate to strong as the structures are fairly reflective and smooth, whilst the existing landscape is coarser and rougher, resulting in a stronger texture contrast. The overall degree of contrast is defined as moderate to strong. This increase is due to the large number of turbines, creating stronger line and texture contrasts.

**Visual objectives:**
- For the turbines, the visual objectives of a Class III would be met with mitigation which would include:
  - Certain areas within the project boundary, i.e. the washes and water areas, would need to be excluded from the development footprint.
  - The exclusion of red tips must be considered, as well as careful consideration of lighting.
- Transmission lines and structures would not be visible at this distance.
15.3 R3: N14 East Background

**Figure 59:** Existing view from N14 eastbound

**Figure 60:** Photomontage of proposed wind turbines FOR ILLUSTRATIVE PURPOSES ONLY
The proposed modification is seen in the background (7.36 km away) from the N14 national road. Current land use includes infrastructure (road, fencing and power lines) and surrounding agricultural. The VRM class defined for the area is Class III due to the moderate levels of scenic quality, the moderate to high levels of receptor sensitivity and the proposed modification being in the background.

The form contrast generated by the turbines as seen from this distance would be neutral, as there is little form to the turbine structures. They are mainly a series of predominantly vertical lines, with smaller blade diagonals. Line contrast to the dominating flat horizon would be moderate, reduced to moderate to weak by the verticals of the raised ground to the left of the view. At this distance, all contrast would be reduced by atmospheric perspective. However, the movement of the turbine blades would demand more attention from the casual observer, but would not dominate at this distance.

Due to the distance, colour contrast would be moderate to weak as against the grey background atmospheric haze; the white of the structures would not contrast strongly. Texture contrast would be moderate to weak, as the structures are fairly reflective and smooth, whilst the existing landscape is coarser and rougher, increasing contrast. The overall degree of contrast is therefore defined as moderate to weak. From this receptor point, only a few of the turbines are seen in the left of the view. They would be partially screened by the horizon line and together with the vertical, linear precedent of the transmission line and pylon in the foreground.

**Visual objectives:**
- For the turbines, the Class III visual objectives would be met with mitigation which would include:
  - Certain areas within the project boundary, i.e. the washes and water areas, would need to be excluded from the development footprint.
  - The exclusion of red tips must be considered, as well as careful consideration of lighting.
- Transmission lines and structures would not be visible at this distance.
15.4 R4: R355 District Road

Figure 62: Existing view from R355 district road

Figure 63: Photomontage of proposed wind turbines

FOR ILLUSTRATIVE PURPOSES ONLY
The R355 is a district road to the south of the property which runs between Springbok and the R358. The land use is a road and telephone line corridor and it is located in a rural agricultural setting. Distance to the proposed landscape modification is 17 km.

The VRM class defined for the area is Class III. There would be no form contrast generated by the turbines due to the distance. Due to the very thin nature of the structure, form or massing would also not be generated at this distance. Line contrast would be weak as mainly the upper half of the turbine would be seen. The receptor is also located to the south of the property and, as such, for most of the day the receptor would be looking towards the sun, reducing the line, colour and texture contrast.

Colour contrast would be weak as at this distance, the white of the turbines would ‘grey out’ and would blend more with the greyish areas at the outer extent of the viewshed. Texture contrast would be weak as very little detail would be seen at this distance. The total degree of visual contrast generated will be moderate to weak, the slight increase being created by the movement of the turbines. This would still be noticeable, but without significantly changing the sense of place of the current locality.

**Visual objectives are met:**
- For the turbines from this location, without mitigation.
- Transmission line would not be visible
- Structures would not be visible.
15.5 Contrast Rating Findings

The proposed project activities are assessed from the KOPs around the site to see whether the visual objectives (VRM Classes) defined for the site, are met in terms of measuring the potential change to the site’s form, line, colour and texture visual elements, as a result of the proposed project (i.e., are the expected changes within acceptable parameters to ensure that the visual character of the landscape is kept intact and, if not, what can be done by the project to ensure that it is). Photo montages are generated to represent the expected change in the views, as seen from each KOP and, if Class objectives are not met, to also show how proposed mitigation measures could improve the same views.

15.5.1 Contrast Rating Summary Table

<table>
<thead>
<tr>
<th>GPS ID</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>N14 foreground</td>
<td>N14 West background</td>
<td>N14 East background</td>
<td>R355</td>
</tr>
<tr>
<td>Land Use</td>
<td>Infrastructure</td>
<td>Infrastructure</td>
<td>Infrastructure</td>
<td>Infrastructure / rural</td>
</tr>
<tr>
<td>Distance</td>
<td>3.25 km</td>
<td>9.18 km</td>
<td>7.36 km</td>
<td>17.26 km</td>
</tr>
<tr>
<td>VRM Class</td>
<td>III</td>
<td>III</td>
<td>III</td>
<td>III</td>
</tr>
</tbody>
</table>

**Contrast**

<table>
<thead>
<tr>
<th></th>
<th>Form</th>
<th>Lines</th>
<th>Colour</th>
<th>Texture</th>
<th>DoC</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>W</td>
<td>S</td>
<td>M/S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>N</td>
<td>M</td>
<td>M/W</td>
<td>M/S</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>W</td>
<td>M/W</td>
<td>M/W</td>
<td>M/W</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>N</td>
<td>W</td>
<td>W</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

Key: N = Neutral, S = Strong, M = Moderate, W = Weak

**Visual Objectives Met**

<table>
<thead>
<tr>
<th></th>
<th>Wind Turbines (Alt 1: 150m height)</th>
<th>Wind Turbines (Alt 2: 120m height)</th>
<th>Transmission Lines</th>
<th>Structure</th>
<th>Lights at Night</th>
<th>DoC with mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Yes (with mitigation)</td>
<td>Yes</td>
<td>Yes</td>
<td>No (with mitigation)</td>
</tr>
<tr>
<td></td>
<td>Yes (with mitigation)</td>
<td>Yes (with mitigation)</td>
<td>No Visibility</td>
<td>No Visibility</td>
<td>No Visibility</td>
<td>Yes (with mitigation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No Visibility</td>
<td>No Visibility</td>
<td>No Visibility</td>
<td>Yes (with mitigation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes (with mitigation)</td>
<td></td>
</tr>
</tbody>
</table>

15.5.2 Visual Intrusion

**Congruence of the project with the particular qualities of the area, or its 'sense of place'**

**Rating**

- High (H): noticeable change
- Moderate (M): partially fits into the surroundings, but clearly noticeable
- Low (L): blends in well with the surroundings

**Moderate to High**

The size and scale of the project, located in a predominantly flat landscape, does create a large viewshed and the white colour of the turbines and movement of the blades increases the intrusion. The area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the wind farm would be in the background and the require moderate levels of visual contrast required for the Class III visual objective would be met with mitigation. With mitigations, lights at night can be contained, but they will result in a change in the night-time sense of place. However the area is remote and is not used by many people.
16   IMPACTS PER PROPOSED ACTIVITY

Impact is defined by the DEA&DP Guideline for involving Visual and Aesthetic Specialists in EIA processes (2005) as: ‘A description of the effect of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space’ (Oberholzer, 2005). Using the impact assessment method provided by the environmental consultant, each project activity is assessed for its visual impact. This is based on the contrast rating which was undertaken from each of the surrounding receptors on whether the proposed activities meet the recommended visual objectives defined to protect the landscape character of the area. Recommendations are made and mitigations are provided.

16.1  350 Wind Turbines: Alt 1 – 180m height

16.1.1 Impacts per phase table
Construction activities for wind energy projects typically include land clearing for site preparation and access routes; excavation, possible blasting if founded on rock, and filling; transportation of supply materials and fuels; construction of foundations involving excavations and placement of concrete; operating cranes for unloading and installation of equipment; and commissioning of new equipment.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Long term</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With or without mitigation the zone of geographical extent is regional and the view is widespread.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The magnitude of the impact would be low and very low with mitigation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration of the predicted lifespan would be long term.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The significance would be medium and low with mitigation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probable with and without mitigation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Confidence would be sure for the project.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reversible post deconstruction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Precedent may attract other wind farms to the area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May limit some land use / tourism activities</td>
</tr>
</tbody>
</table>

Recommendations
- Preference would be for the larger turbines. The larger scale would require more spacing, there would be less clustering in views and the turbines would be more spread out.

16.1.2 Mitigations

Planning and Construction
The following mitigations would be necessary to maintain the existing sense of place:
- Exclude turbines located in the foreground zone to N14, the rocky outcrop at Survey Point S3 as well as from the water holes and drainage channels.
- Use only white colour for the turbines.
- Turbines should be situated off the rocky outcrop with a uniform height.
- Mitigation measures need to be set in place to ensure that dust generated during construction is kept to a minimum.
- Litter needs to be strictly controlled.
- The labour camp for construction workers should be located outside of the N14 view corridor.
- All topsoil (if any) needs to be stockpiled in a suitable location and re-utilised for landscaping / rehabilitation.
• Excess material from earthworks of infrastructure and roads should be disposed of offsite or through natural landscaping of areas. No dumping or piling should be allowed.
• Fencing should be a grey chain link fence, or similar, that will blend with the agricultural landscape context and should not extend up to the N14.
• Rehabilitation of foundation area must be commenced once construction phase has been completed.
• Signage (if any) should be constrained.

**Operation**

• LED lighting should be used.
• Lighting should be kept to an efficient minimum while still keeping within the safety norms.

As explanation, and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility, a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corporation has been included (see Annexure 3).
• Rehabilitation of previously modified areas should be continually undertaken.
• No branding on the turbines.
• No lights on the blade tips (within safety limits).

**Deconstruction**

• Decommissioning activities would include removal of project infrastructure and site rehabilitation.

### 16.2 350 Wind Turbines: Alt 2 - 120m height

#### 16.2.1 Impacts per phase table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term</td>
<td>Long term</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*With or without mitigation the zone of geographical extent is regional and the view is widespread.*

*The magnitude of the impact would be low and very low with mitigation.*

*Duration of the predicted lifespan would be long term.*

*The significance would be medium and low with mitigation.*

*Probable with and without mitigation.*

*Confidence would be sure for the project.*

*Reversible post deconstruction.*

*Precedent may attract other wind farms to the area*

*May limit some land use/tourism activities*

**Recommendations**

• Preference would be for the larger 180m turbines. Due to the large scale there would be less clustering in views and the turbines would be more spread out.

#### 16.2.2 Mitigations

**Construction**

As for Alt 1.
**Operation**
As for Alt 1.

**Decommissioning**
As for Alt 1.

### 16.3 Transmission Lines

#### 16.3.1 Impacts per phase table

Construction activities for transmission lines typically include road access, and construction of towers and lines. Operation includes maintenance activities creating tracks and potential soil erosion.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mitigation</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td><strong>Extent</strong></td>
<td>Local</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>Due the low hills on either side of the proposed transmission line, the extent of the visibility would be contained within the local valley. Mitigation would not influence this decision.</td>
</tr>
<tr>
<td><strong>Magnitude</strong></td>
<td>Very Low</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>The power line is proposed to link to the existing power line where the visual context is already associated with a modified infrastructure corridor.</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>Long term</td>
<td>NA</td>
</tr>
<tr>
<td><strong>SIGNIFICANCE</strong></td>
<td>Very Low</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>There is an existing context of power lines and telecommunications towers in the area.</td>
</tr>
<tr>
<td><strong>Probability</strong></td>
<td>Probable</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>It is probable that the visual impact will occur</td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
<td>Sure</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Reversibility</strong></td>
<td>Reversible</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>The transmission lines can be removed and the ground rehabilitated.</td>
</tr>
<tr>
<td><strong>Cumulative</strong></td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>Potential new substation in the area which would create further visual intrusion in the area (further details are required).</td>
</tr>
</tbody>
</table>

**Recommendations**

It is likely that the project would require new substation and it is recommended that the proposed substation be located outside the visual influence of the N14. Should the substation be located within 2 km of the N14, it is recommended that further visual assessment be undertaken to assess the suitability of the proposed landscape modification.

#### 16.3.2 Mitigations

**Construction**
Limit tracks to existing tracks as far as possible.

**Operation**
Not applicable

**Deconstruction**
Remove during deconstruction and rehabilitate modified ground.

### 16.4 Lights at Night

#### 16.4.1 Impacts per phase table

Lights at night would create increased security on the ground, at the fence line and the structures. Red aviation warning lights are required on the top of the tower.


### Criteria | Mitigation | Motivation
--- | --- | ---
**Without** | **With** | **With**

### Extent
- Regional
- Regional

**Motivation**
- With or without mitigation the zone of geographical extent is regional and the view is widespread.

### Magnitude
- High
- Low

**Motivation**
- Utilisation of LED directional lighting as opposed to overhead lighting would reduce the magnitude of the light pollution.

### Duration
- Long term
- Long term

**Motivation**
- If not properly managed, light spillage would take place for the extent of the project.

### SIGNIFICANCE
- High
- Low

**Motivation**
- Lights at night would be potentially intrusive and has the potential to change the current dark sky sense of place which has value for agri-tourism in the area.

### Probability
- Definite
- Probable

### Confidence
- Sure
- Sure

### Reversibility
- Reversible
- Reversible

**Motivation**
- The light spillage can be reversed.

### Cumulative
- Yes
- Probable

**Motivation**
- As mentioned for significance, lights at night would be potentially intrusive and has the potential to change the current dark sky sense of place which has value for agri-tourism in the area.

### Recommendations
- As explanation, and additional information concerning the implementation of the night lighting mitigation measures for the preferred location of the facility, a copy of ‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corporation has been included (see Annexure 3).

#### 16.4.2 Mitigations

**Construction and Operation**
- LED directional lighting with no overhead lighting should be used due to light spillage.
- No lights on the blade tips (within safety limits).
- Lighting should be kept to an efficient minimum while still keeping within the safety norms.

**Deconstruction**
Not applicable

### 16.5 Roads, Infrastructure & Fencing

#### 16.5.1 Impacts per phase table

Construction activities for wind energy projects typically include road construction as well as perimeter fencing and building infrastructure.

### Criteria | Mitigation | Motivation
--- | --- | ---
**Without** | **With** | **With**

### Extent
- Regional
- Local

**Motivation**
- It may set a precedent for inappropriate colours.

### Magnitude
- Very Low
- Zero

**Motivation**
- Very low due to it being seen in the background.

### Duration
- Long term
- Short term

**Motivation**
- The roads would be permanent but with mitigation, the larger road footprint required for construction could be reduced.

### SIGNIFICANCE
- Low
- Neutral

**Motivation**
- As the roads offer little visual disturbance as seen from the distant receptors, visual significance is limited and with mitigations, possible erosion would be contained and the visual impact neutralised.

### Probability
- Probable
- Probable

**Motivation**
- It is probable that the road impact will occur.

### Confidence
- Sure
- Sure

### Reversibility
- Reversible
- Reversible

**Motivation**
- The roads impacts can be reversed with rehabilitation.
As the roads are not tarred, the cumulative impacts are limited. There are also existing farm roads in the area.

**Construction**
- Security fences should be outside the 6 km buffer from the road.
- Fencing should be a grey chainlink fence, or similar, that will blend with the agricultural landscape context.

**Operation**
- Colours for the buildings should be RAL 1011 or RAL 8001 (See Annexure 3).

### 16.6 Visual Impact Summary Table

<table>
<thead>
<tr>
<th></th>
<th>350 Wind Turbines Alt 180 m height</th>
<th>350 Wind Turbines Alt 120 m height</th>
<th>Transmission Lines</th>
<th>Lights at Night</th>
<th>Roads and Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Mit</td>
<td>With Mit</td>
<td>Without Mit</td>
<td>With Mit</td>
<td>Without Mit</td>
</tr>
<tr>
<td>Extent</td>
<td>Reg</td>
<td>Reg</td>
<td>Reg</td>
<td>Reg</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Low</td>
<td>Very Low</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Prob</td>
<td>Prob</td>
<td>Prob</td>
<td>Prob</td>
<td>Prob</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
<td>Sure</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>SIGNIFICANCE</td>
<td>Medium</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

*Key: Reg = Regional; Prob = Probable; Rev=Reversible*

### 17 Conclusion

The significance of the surrounding landscape was defined as high as it includes the the Klein Koperberge to the west of the site as well as the Goegap Nature Reserve which increase the regional landscape scenic quality and receptor sensitivity. The uniform nature of the flat Nama Karoo plains can be fairly monotonous, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.

The size and scale of the project, located in a predominantly flat landscape, does create a large viewshed, and the white colour of the turbines and movement of the blades increases the intrusion. However the area is very remote and isolated with limited receptors where, except for one section of the N14 national road, views of the wind farm would be in the background. The required moderate levels of visual contrast of the Class III visual objective would therefore be met for most of the receptors with mitigation. Mitigation would include using white colours only for the turbines and location off the rocky outcrop as well as not locating turbines in the river washes / water holes buffer areas. With mitigation, lights at night can be contained but they will result in a change in the nighttime sense of place but this would be visible to very few receptors.

It is the conclusion of the assessment that the significance of the impacts to the visual resources of the area will be moderate as the area is remote and views of the wind farm will be mainly located in the background for all receptors. The scenic resources of the the Goegap Nature Reserve will not be impacted. However, cumulative impacts need to be taken into consideration for later projects as, should the wind farm be approved, other types of development opportunities could be restricted and this development could attract other wind and photovoltaic developments to the area, as the landscape in the vicinity of the wind farm will be transformed.
18 GENERAL MITIGATIONS

Construction Phase

- Mitigation measures need to be set in place to ensure that dust generated during construction is kept to a minimum.
- Litter needs to be strictly controlled.
- The labour camp for construction workers should not be housed on site.
- All topsoil needs to be stockpiled in a suitable location and re-utilised for landscaping/rehabilitation.
- Excess material from construction of infrastructure and roads should be disposed of offsite or through natural landscaping of areas. No dumping or piling should be allowed.
- Security fences should go around the turbine area and fall outside the 6 km buffer from the road, near the mountain.
- Fencing should be a grey chainlink fence, or similar, that will blend with the agricultural landscape context.
- Rehabilitation of foundation area should be commenced once construction phase has been completed.
- Colour turbines white only.
- Project elements should be situated off the rocky outcrop with a uniform height.

Operational Phase

- Lighting should be kept to an efficient minimum while still keeping within the safety norms.
- LED directional lighting with no overhead lighting should be used due to light spillage.
- Limit tracks to existing tracks as much as possible.
- Rehabilitation of previously modified areas should be continually undertaken.
- No branding on the turbines.
- No red tips on the blades.
- No lights on the blade tips (within safety limits).
- Colours for the buildings should be RAL 1011 or RAL 8001. (see Annexure 3)

Deconstruction Phase

- Site rehabilitation as per vegetation specialist specifications.
- Deconstruction activities would include removal of project infrastructure.
SECTION D: ANNEXURES

19 ANNEXURE 1: MODEL PROOF

Figure 65: 3D Model of photovoltaic panel utilised in the project 3D modelling for 10 m alternative

Figure 66: Example of a 180 m 3D Model of turbine
Figure 67: Example of a 180 m 3D Model of turbine utilised in the project 3D modelling
20     ANNEXURE 2: METHODOLOGY

Visual impact is defined as ‘the effect of an aspect of the development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.’ (Oberholzer, B., 2005). As identified in this definition, ‘landscapes are considerably more than just the visual perception of a combination of landform, vegetation cover and buildings, as they embody the history, landuse, human culture, wildlife and seasonal changes to an area.’ (U.K IEMA, 2002). These elements combine to produce distinctive local character that will affect the way in which the landscape is valued and perceived.

VRM Africa’s objective is to provide Interested and Affected Parties (I&APs) and decision-makers with sufficient information to take “early opportunities for avoidance of negative visual effects.” This is based on the U.K. Institute of Environmental Management and Assessment’s (IEMA), and South Africa’s Western Cape Department of Environmental Affairs and Development Planning’s (DEA&DP), guidelines:

- “The ideal strategy for each identifiable, negative effect is one of avoidance. If this is not possible, alternative strategies of reduction, remediation and compensation may be explored. If the consideration of mitigation measures is left to the later stages of scheme design, this can result in increased mitigation costs because early opportunities for avoidance of negative visual effects are missed.” (U.K IEMA, 2002).
- “In order to retain the visual quality and landscape character, management actions must become an essential part of the guidelines throughout construction and operation...Proper management actions ensure that the lowest possible impact is created by the project...
- Ongoing monitoring programmes, with regard to the control of aesthetic aspects, for all stages of the project, are a vital component, ensuring that the long-term visual management objectives are met.” (Oberholzer, B., 2005).

The impact assessment methodology that VRM Africa uses is based on the VRM methodology developed by the United States Bureau of Land Management (BLM) in that the study involves the measurement of contrast in the form, line, texture and colour of the proposed landscape modification, against the same elements found in the natural landscape. The contrast rating is a systematic process undertaken from KOPs surrounding the project site, and the assessment of the degree of contrast (DoC) is used to evaluate the potential visual impacts associated with the proposed landscape modifications. The method is based on the premise that the degree to which a proposed landscape modification affects the visual quality of a landscape depends on the visual contrast created between a project and the existing landscape (USA Bureau of Land Management, 2004).

**Landscape Significance**

Landscape significance is assessed in order to highlight the nature and degree of significance of the landscape context by differentiating between those landscapes of recognized or potential significance or sensitivity to modification to those landscape contexts that have low sensitivity and scenic value. ‘Different levels of scenic values require different levels of management. For example, management of an area with high scenic value might be focused on preserving the existing character of the landscape, and management of an area with little scenic value might allow for major modifications to the landscape. Determining how an area should be managed first requires an assessment of the area’s scenic values. Assessing scenic values and determining visual impacts can be a subjective process. Objectivity and consistency can be greatly increased by using standard assessment criteria to describe and evaluate landscapes, and to also describe proposed projects.’ (USA Bureau of Land Management, 2004).

**Viewshed Analysis**

A viewshed is ‘the outer boundary defining a view catchment area, usually along crests and ridgelines’ (Oberholzer, B., 2005). This reflects the area within which, or the extent to which, the landscape modification is likely to be seen. It is important to assess the extent to which the proposed landscape modifications are visible in the surrounding landscape, as a point of departure for defining the shared landscape context, and to identify the receptors making use of the common views. Viewshed analyses are not absolute indicators of the level of significance, but an indication of
potential visibility (Centre for Advanced Spatial Analysis, 2002). Once the sites and heights of the proposed activities have been finalised, the viewshed analysis will be undertaken.

**Key Observation Points (KOPs)**
KOPs are defined by the BLM Visual Resource Management as the people located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. These locations are used to assess the suitability of the proposed landscape modifications by means of assessing the degree of contrast of the proposed landscape modifications to the existing landscape, taking into consideration the visual management objectives defined for the area. The following selection criteria were utilised in defining the KOPs:

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

**Visual Sensitivity of Receptors Criteria**
The level of visual impact considered acceptable is dependent on the types of receptors.

- **High sensitivity**: e.g. residential areas, nature reserves and scenic routes or trails
- **Moderate sensitivity**: e.g. sporting or recreational areas, or places of work
- **Low sensitivity**: e.g. industrial, mining or degraded areas

**Receptor Exposure**
The area where a landscape modification starts to influence the landscape character is termed the Zone of Visual Influence (ZVI) and is defined by the U.K. Institute of Environmental Management and Assessment’s (IEMA) ‘Guidelines for Landscape and Visual Impact Assessment’ as ‘the area within which a proposed development may have an influence or effect on visual amenity (of the surrounding areas).’

The inverse relationship of distance and visual impact is well recognised in visual analysis literature (Hull, R.B. and Bishop, I.E., 1988). According to Hull and Bishop, exposure, or visual impact, tends to diminish exponentially with distance. The areas where most landscape modifications would be visible are located within 2 km from the site of the landscape modification. Thus the potential visual impact of an object diminishes at an exponential rate as the distance between the observer and the object increases due to atmospheric conditions prevalent at a location, which causes the air to appear greyer, thereby diminishing detail. For example, viewed from 1000 m from a landscape modification, the impact would be 25% of the impact as viewed from 500 m from a landscape modification. At 2000m it would be 10% of the impact at 500 m. The relationship is indicated in the following graph generated by Hull and Bishop.

The VRM methodology also takes distance from a landscape modification into consideration in terms of understanding visual resource. Three distance categories are defined by the Bureau of Land Management (BLM) Visual Resource Management (VRM) program.
The distance zones are:
1. Foreground / Middle ground, up to approximately 6 km, which is where there is potential for the sense of place to change;
2. Background areas, from 6 km to 24 km, where there is some potential for change in the sense of place, but where change would only occur in the case of very large landscape modifications; and
3. Seldom seen areas, which fall within the Foreground / Middle ground area but, as a result of no receptors, are not viewed or are seldom viewed.

In order to determine the level of exposure to receptors, the following criteria were utilised, and the receptors located within each distance zone were identified:

Visual Exposure Criteria (Oberholzer, B., 2005)
- **High**: Dominant or clearly noticeable (<2 km)
- **Moderate**: Recognisable to the viewer (2 – 6 km)
- **Low**: Minimally visible areas in the landscape (>6 km)

Receptor Sensitivity
Sensitivity levels are a measure of public concern for scenic quality. Public lands are assigned high, medium or low sensitivity levels by analysing the various indicators of public concern. The following criteria were used to assess the sensitivity of each of the communities:
- **Public Interest**: The visual quality of an area may be of concern to local, state, or national groups. Indicators of this concern are usually expressed in public meetings, letters, newspaper or magazine articles, newsletters, landuse plans, etc. Public controversy, created in response to proposed activities that would change the landscape character, should also be considered.
- **Special Areas**: Management objectives for special areas such as natural areas, wilderness areas or wilderness study areas, wild and scenic rivers, scenic areas, scenic roads or trails, and Areas of Critical Environmental Concern (ACEC), frequently require special consideration for the protection of visual values. This does not necessarily mean that these areas are scenic, but rather that one of the management objectives may be to preserve the natural landscape setting. The management objectives for these areas may be used as a basis for assigning sensitivity levels.
- **Adjacent Land Uses**: The interrelationship with land uses in adjacent land can affect the visual sensitivity of an area. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive.
- **Type of User**: Visual sensitivity will vary with the type of users. Recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
- **Amount of Use**: Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase (USA Bureau of Land Management, 2004).

Scenic Quality
In the VRM methodology, scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are given a rating based on the apparent scenic quality, which is determined using seven key factors. During the rating process, each of these factors is ranked on a comparative basis with similar features in the region (USA Bureau of Land Management, 2004). These seven elements are:
1. **Landform**: Topography becomes more interesting as it gets steeper, or more massive, or more severely or universally sculptured.
2. **Vegetation**: Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Also consider smaller-scale vegetation features which add striking and intriguing detail elements to the land.
3. **Water:** That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration.

4. **Colour:** Consider the overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "colour" are variety, contrast and harmony.

5. **Scarcity:** This factor provides an opportunity to give added importance to one, or all, of the scenic features that appear to be relatively unique or rare within one physiographic region.

6. **Adjacent Land Use:** Degree to which scenery, outside the scenery unit being rated, enhances the overall impression of the scenery within the rating unit. The distance at which adjacent scenery will start to influence scenery within the rating unit ranges, depending upon the characteristics of the topography, the vegetative cover, and other such factors.

7. **Cultural Modifications:** Cultural modifications in the landform, water, and vegetation, and addition of structures, should be considered, and may detract from the scenery in the form of a negative intrusion, or complement or improve the scenic quality of a unit.

**Visual Sensitivity Rating Criteria**

This is the inherent sensitivity of the landscape, which is usually determined by a combination of topography, landform, vegetation cover and settlement pattern.

- **High visual sensitivity**: highly visible and potentially sensitive areas in the landscape;
- **Moderate visual sensitivity**: moderately visible areas in the landscape; and
- **Low visual sensitivity**: minimally visible areas in the landscape.

**Photo Montages and 3D Visualisation**

As a component in this contrast rating process, visual representation, such as photo montages are vital in large-scale modifications, as this serves to inform I&APs and decision-making authorities of the nature and extent of the impact associated with the proposed project/development. There is an ethical obligation in this process, as visualisation can be misleading if not undertaken ethically. In terms of adhering to standards for ethical representation of landscape modifications, VRM Africa subscribes to the Proposed Interim Code of Ethics for Landscape Visualisation developed by the Collaborative for Advanced Landscape Planning (CALP) (July 2003) (Sheppard, S.R.J., 2005). This code states that professional presenters of realistic landscape visualisations are responsible for promoting full understanding of proposed landscape changes, providing an honest and neutral visual representation of the expected landscape, by seeking to avoid bias in responses and demonstrating the legitimacy of the visualisation process. Presenters of landscape visualisations should adhere to the principles of:

- Access to Information
- Accuracy
- Legitimacy
- Representativeness
- Visual Clarity
- Interest

The Code of Ethical Conduct states that the presenter should:

- Demonstrate an appropriate level of qualification and experience.
- Use visualisation tools and media that are appropriate to the purpose.
- Choose the appropriate level of realism.
- Identify, collect and document supporting visual data available for, or used in, the visualisation process.
- Conduct an on-site visual analysis to determine important issues and views.
- Seek community input on viewpoints and landscape issues to address in the visualisations.
- Provide the viewer with a reasonable choice of viewpoints, view directions, view angles, viewing conditions and timeframes appropriate to the area being visualised.
- Estimate and disclose the expected degree of uncertainty, indicating areas and possible visual consequences of the uncertainties.
• Use more than one appropriate presentation mode and means of access for the affected public.
• Present important non-visual information at the same time as the visual presentation, using a neutral delivery.
• Avoid the use, or the appearance of, ‘sales’ techniques or special effects.
• Avoid seeking a particular response from the audience.
• Provide information describing how the visualisation process was conducted and how key decisions were taken (Sheppard, S.R.J., 2005).

**VRM Classes**

The landscape character of the proposed project site is surveyed to identify areas of common landuse and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape’s integrity, but this can be achieved at varying levels, called VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be “absorbed” or “disappear” into the landscape). The areas identified on site are categorised into these Classes by using a matrix from the BLM Visual Resource Management method as seen below, which is then represented in a visual sensitivity map.

The BLM has defined four Classes that represent the relative value of the visual resources of an area:

1. **Classes I and II** are the most valued
2. **Class III** represent a moderate value
3. **Class IV** is of least value

### VISUAL SENSITIVITY LEVELS

<table>
<thead>
<tr>
<th>SCENIC QUALITY</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (High)</td>
<td>II</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>B (Medium)</td>
<td>III</td>
<td>III/ IV*</td>
<td>IV</td>
</tr>
<tr>
<td>C (Low)</td>
<td>III</td>
<td>IV</td>
<td>IV</td>
</tr>
</tbody>
</table>

**DISTANCE ZONES**

- Fore/middle ground
- Background
- Seldom seen

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

* If adjacent areas are **Class III** or lower, assign **Class III**, if higher, assign **Class IV**

Evaluation of the suitability of a proposed landscape modification is undertaken by means of assessing the proposed modification against a predefined management objective assigned to each class. The VRM class objectives are defined as follows:

1. **The Class I** objective is to preserve the existing character of the landscape, where the level of change to the characteristic landscape should be very low, and must not attract attention. **Class I** is assigned to those areas where a **specialist decision** has been made to maintain a natural landscape.
2. **The Class II** objective is to retain the existing character of the landscape and the level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer, and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.
3. The **Class III** objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

4. The **Class IV** objective is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the landscape can be high, and these management activities may dominate the view and be the major focus of the viewer’s (s’) attention.

**Contrast Rating Stage**
The contrast rating, or impacts assessment phase, is undertaken after the inventory process has been completed. The suitability of landscape modification is assessed by measuring the Degree of Contrast (DoC) of the proposed landscape modification to the existing contrast created by the existing landscape. This is done by evaluating the level of change to the existing landscape in terms of the line, colour, texture and form, in relation to the visual objectives defined for the area. The following criteria are utilised in defining the DoC:

- **None**: The element contrast is not visible or perceived.
- **Weak**: The element contrast can be seen but does not attract attention.
- **Moderate**: The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- **Strong**: The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

As an example, in a Class I area, the visual objective is to preserve the existing character of the landscape, and the resultant contrast to the existing landscape should not be notable to the casual observer and cannot attract attention. In a Class IV area example, the objective is to provide for management activities which require major modifications of the existing character of the landscape. Based on whether the VRM objectives are met, mitigations, if required, are defined to avoid, reduce or mitigate the proposed landscape modifications so that the visual impact does not detract from the surrounding landscape sense of place.
20.1 Specialist Impact Methodology (Aurecon)

A standardised and internationally recognised methodology has been applied to assess the significance of the potential environmental impacts of the proposed development, outlined as follows:

For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) are described. These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

Assessment criteria for the evaluation of impacts

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent or spatial influence of impact</td>
<td>National</td>
<td>Within the country</td>
</tr>
<tr>
<td></td>
<td>Regional</td>
<td>Within the province/recognised region</td>
</tr>
<tr>
<td></td>
<td>Local</td>
<td>On site or within 1000 m of the impact site</td>
</tr>
<tr>
<td>Magnitude of impact (at the indicated spatial scale)</td>
<td>High</td>
<td>Social and/or natural functions and/or processes are severely altered</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Social and/or natural functions and/or processes are notably altered</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Social and/or natural functions and/or processes are slightly altered</td>
</tr>
<tr>
<td></td>
<td>Very Low</td>
<td>Social and/or natural functions and/or processes are negligibly altered</td>
</tr>
<tr>
<td></td>
<td>Zero</td>
<td>Social and/or natural functions and/or processes remain unaltered</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
<td>Up to 7 years</td>
</tr>
<tr>
<td></td>
<td>Medium Term</td>
<td>Up to 10 years after construction</td>
</tr>
<tr>
<td></td>
<td>Long Term</td>
<td>More than 10 years after construction</td>
</tr>
</tbody>
</table>

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. Such significance is also informed by the context of the impact, i.e. the character and identity of the receptor of the impact. The means of arriving at the different significance ratings is explained in the following table, developed by Ninham Shand in 1995 as a means of minimising subjectivity in such evaluations, i.e. to allow for replicability in the determination of significance.

Definition of significance ratings

<table>
<thead>
<tr>
<th>SIGNIFICANCE RATINGS</th>
<th>LEVEL OF CRITERIA REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>• High magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with either a regional extent and medium term duration or a local extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Medium</td>
<td>• High magnitude with a local extent and medium term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with a regional extent and construction period or a site specific extent and long term duration</td>
</tr>
<tr>
<td></td>
<td>• High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term</td>
</tr>
<tr>
<td></td>
<td>• Low magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Low</td>
<td>• High magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Medium magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term</td>
</tr>
<tr>
<td></td>
<td>• Very low magnitude with a regional extent and long term duration</td>
</tr>
<tr>
<td>Very low</td>
<td>• Low magnitude with a site specific extent and construction period duration</td>
</tr>
<tr>
<td></td>
<td>• Very low magnitude with any combination of extent and duration except regional and long term</td>
</tr>
<tr>
<td>Neutral</td>
<td>• Zero magnitude with any combination of extent and duration</td>
</tr>
</tbody>
</table>
Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact has been determined using the rating systems outlined in the following two tables. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring.

**Definition of probability ratings**

<table>
<thead>
<tr>
<th>PROBABILITY RATINGS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite</td>
<td>Estimated greater than 95% chance of the impact occurring.</td>
</tr>
<tr>
<td>Probable</td>
<td>Estimated 5 to 95% chance of the impact occurring.</td>
</tr>
<tr>
<td>Unlikely</td>
<td>Estimated less than 5% chance of the impact occurring.</td>
</tr>
</tbody>
</table>

**Definition of confidence ratings**

<table>
<thead>
<tr>
<th>CONFIDENCE RATINGS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certain</td>
<td>Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.</td>
</tr>
<tr>
<td>Sure</td>
<td>Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.</td>
</tr>
<tr>
<td>Unsure</td>
<td>Limited useful information on and understanding of the environmental factors potentially influencing this impact.</td>
</tr>
</tbody>
</table>

Lastly, the REVERSIBILITY of the impact has been estimated using the rating system outlined in the following table.

**Definition of reversibility ratings**

<table>
<thead>
<tr>
<th>REVERSIBILITY RATINGS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irreversible</td>
<td>The activity will lead to an impact that is permanent.</td>
</tr>
<tr>
<td>Reversible</td>
<td>The impact is reversible, within a period of 10 years.</td>
</tr>
</tbody>
</table>

**Subjectivity in assigning significance**

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, environmental assessment processes can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity of that impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can

**Consideration of cumulative impacts**

The following questions must be considered when addressing the cumulative impacts for each specialist study.

1. Are there key valued ecosystem vectors (VEC) of importance in the region (e.g. air quality, water quality, aquatic resources, agricultural areas, important biodiversity areas, visual resources etc)? Each specialist to identify as relevant to his/her field of expertise;
2. How will the project impact on this VEC when considered in conjunction with other activities currently occurring in the area, and those known to be imminent? Assess significance thereof.

**20.2 DEA&DP Nature of the visual impacts for the total project with mitigation**
### Extent

<table>
<thead>
<tr>
<th>Site Related (S):</th>
<th>extending only as far as the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local (L):</td>
<td>limited to immediate surroundings.</td>
</tr>
<tr>
<td>Regional (R):</td>
<td>affecting a larger metropolitan or regional area</td>
</tr>
<tr>
<td>National (N):</td>
<td>affecting large parts of the country</td>
</tr>
<tr>
<td>International (I):</td>
<td>affecting areas across international boundaries</td>
</tr>
</tbody>
</table>

### Duration

<table>
<thead>
<tr>
<th>Short term (S):</th>
<th>duration of the construction phase.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium term (M):</td>
<td>duration for screening vegetation to mature.</td>
</tr>
<tr>
<td>Long term (L):</td>
<td>lifespan of the project.</td>
</tr>
<tr>
<td>Permanent (P):</td>
<td>where time will not mitigate the visual impact.</td>
</tr>
</tbody>
</table>

### Intensity

<table>
<thead>
<tr>
<th>Low (L):</th>
<th>where visual and scenic resources are not affected.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate (M):</td>
<td>where visual and scenic resources are affected</td>
</tr>
<tr>
<td>High (H):</td>
<td>where scenic and cultural resources are significantly affected.</td>
</tr>
</tbody>
</table>

### Probability

<table>
<thead>
<tr>
<th>Improbable (I):</th>
<th>possibility of the impact occurring is very low.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable (P):</td>
<td>distinct possibility that the impact will occur.</td>
</tr>
<tr>
<td>Highly probable (HP):</td>
<td>most likely that the impact will occur.</td>
</tr>
<tr>
<td>Definite (D):</td>
<td>impact will occur regardless of any prevention measures.</td>
</tr>
</tbody>
</table>

### Significance

- **Low (L):** will not have an influence on the decision.
- **Moderate (M):** should have an influence on the decision unless it is mitigated.
- **High (H):** would influence the decision regardless of any possible mitigation.

### Confidence Levels

Key uncertainties and risks in the VIA process, which may influence the accuracy of, and confidence in, the VIA process.

*Source: DEA&DP Guideline for involving Visual and Aesthetic Specialists in EIA Processes, page 29*
20.3 **Visual Resource Management Criteria**

1. **Scenic Quality Rating Questionnaire**

<table>
<thead>
<tr>
<th>KEY FACTORS</th>
<th>RATING CRITERIA AND SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCORE</strong></td>
<td><strong>5</strong></td>
</tr>
<tr>
<td><strong>Land Form</strong></td>
<td>High vertical relief as expressed in prominent cliffs, spires or massive rock outcrops, or severe surface variation or highly eroded formations including dune systems: or detail features that are dominating and exceptionally striking and intriguing.</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>A variety of vegetative types as expressed in interesting forms, textures and patterns.</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>Clear and clean appearing, still or cascading white water, any of which are a dominant factor in the landscape.</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>Rich colour combinations, variety or vivid colour: or pleasing contrasts in the soil, rock, vegetation, water.</td>
</tr>
<tr>
<td><strong>Adjacent Scenery</strong></td>
<td>Adjacent scenery greatly enhances visual quality.</td>
</tr>
<tr>
<td><strong>Scarcity</strong></td>
<td>One of a kind: unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing etc.</td>
</tr>
<tr>
<td><strong>SCORE</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td><strong>Cultural Modification</strong></td>
<td>Modifications add favourably to visual variety, while promoting visual harmony.</td>
</tr>
</tbody>
</table>
2. Sensitivity Level Rating Questionnaire

The following VRM questionnaire was completed for general receptors in the area:

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Users</td>
<td>Maintenance of visual quality is:</td>
</tr>
<tr>
<td></td>
<td>A major concern for most users</td>
</tr>
<tr>
<td></td>
<td>A moderate concern for most users</td>
</tr>
<tr>
<td></td>
<td>A low concern for most users</td>
</tr>
<tr>
<td>Amount of use</td>
<td>Maintenance of visual quality becomes more important as the level of use increases:</td>
</tr>
<tr>
<td></td>
<td>A high level of use</td>
</tr>
<tr>
<td></td>
<td>Moderately level of use</td>
</tr>
<tr>
<td></td>
<td>Low level of use</td>
</tr>
<tr>
<td>Public interest</td>
<td>Maintenance of visual quality:</td>
</tr>
<tr>
<td></td>
<td>A major concern for most users</td>
</tr>
<tr>
<td></td>
<td>A moderate concern for most users</td>
</tr>
<tr>
<td></td>
<td>A low concern for most users</td>
</tr>
<tr>
<td>Adjacent land Users</td>
<td>Maintenance of visual quality to sustain adjacent land use objectives is:</td>
</tr>
<tr>
<td></td>
<td>Very important</td>
</tr>
<tr>
<td></td>
<td>Moderately important</td>
</tr>
<tr>
<td></td>
<td>Slightly important</td>
</tr>
<tr>
<td>Special Areas</td>
<td>Maintenance of visual quality to sustain Special Area management objectives is:</td>
</tr>
<tr>
<td></td>
<td>Very important</td>
</tr>
<tr>
<td></td>
<td>Moderately important</td>
</tr>
<tr>
<td></td>
<td>Slightly important</td>
</tr>
</tbody>
</table>

3. Distance Zones

Landscapes are subdivided into four distance zones, based on relative visibility from travel routes or observation points. The four zones are:

<table>
<thead>
<tr>
<th>DISTANCE ZONES</th>
<th>DISTANCE ZONES DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreground</td>
<td>The foreground (FG) zone includes areas seen from highways, rivers, or other viewing locations that are less than 1 kilometres away.</td>
</tr>
<tr>
<td>Middle ground</td>
<td>The middle ground (MG) zone includes areas seen from highways, rivers, or other viewing locations that are greater than 1 kilometre but less than 2 kilometres away.</td>
</tr>
<tr>
<td>Background</td>
<td>Seen areas beyond the foreground-middle ground zone greater than 2 kilometres away are in the background (BG) zone.</td>
</tr>
<tr>
<td>Seldom seen</td>
<td>Areas not seen as foreground-middle ground or background (i.e. hidden from view) are in the seldom-seen (SS) zone.</td>
</tr>
</tbody>
</table>
4. VRM Terminology

The following terms were used in the Contrast Rating Tables to help define Form, Line, Colour, and Texture. The definitions were a combination of Microsoft Word Dictionary and simple description.

<table>
<thead>
<tr>
<th>FORM</th>
<th>LINE</th>
<th>COLOUR</th>
<th>TEXTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>Horizontal</td>
<td>Dark</td>
<td>Smooth</td>
</tr>
<tr>
<td>Weak</td>
<td>Vertical</td>
<td>Light</td>
<td>Rough</td>
</tr>
<tr>
<td>Strong</td>
<td>Geometric</td>
<td>Mottled</td>
<td>Fine</td>
</tr>
<tr>
<td>Dominant</td>
<td>Angular</td>
<td></td>
<td>Coarse</td>
</tr>
<tr>
<td>Flat</td>
<td>Acute</td>
<td></td>
<td>Patchy</td>
</tr>
<tr>
<td>Rolling</td>
<td>Parallel</td>
<td></td>
<td>Even</td>
</tr>
<tr>
<td>Undulating</td>
<td>Curved</td>
<td></td>
<td>Uneven</td>
</tr>
<tr>
<td>Complex</td>
<td>Wavy</td>
<td></td>
<td>Complex</td>
</tr>
<tr>
<td>Plateau</td>
<td>Strong</td>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Ridge</td>
<td>Weak</td>
<td></td>
<td>Stark</td>
</tr>
<tr>
<td>Valley</td>
<td>Crisp</td>
<td></td>
<td>Clustered</td>
</tr>
<tr>
<td>Plain</td>
<td>Feathered</td>
<td></td>
<td>Diffuse</td>
</tr>
<tr>
<td>Steep</td>
<td>Indistinct</td>
<td></td>
<td>Dense</td>
</tr>
<tr>
<td>Shallow</td>
<td>Clean</td>
<td></td>
<td>Scattered</td>
</tr>
<tr>
<td>Organic</td>
<td>Prominent</td>
<td></td>
<td>Sporadic</td>
</tr>
<tr>
<td>Structured</td>
<td>Solid</td>
<td></td>
<td>Consistent</td>
</tr>
</tbody>
</table>

Simple: Basic, composed of few elements
Organic: Derived from nature; occurring or developing gradually and naturally

Complex: Complicated; made up of many interrelated parts
Structure: Organised; planned and controlled; with definite shape, form, or pattern

Weak: Lacking strength of character
Regular: Repeatedly occurring in an ordered fashion

Strong: Bold, definite, having prominence
Horizontal: Parallel to the horizon

Dominant: Controlling, influencing the surrounding environment
Vertical: Perpendicular to the horizon; upright

Flat: Level and horizontal without any slope; even and smooth without any bumps or hollows
Geometric: Consisting of straight lines and simple shapes

Rolling: Progressive and consistent in form, usually rounded
Angular: Sharply defined; used to describe an object identified by angles

Undulating: Moving sinuously like waves; wavy in appearance
Acute: Less than 90°; used to describe a sharp angle

Plateau: Uniformly elevated flat to gently undulating land bounded on one or more sides by steep slopes
Parallel: Relating to or being lines, planes, or curved surfaces that are always the same distance apart and therefore never meet

Ridge: A narrow landform typical of a highpoint or apex; a long narrow hilltop or range of hills
curved: Rounded or bending in shape

Valley: Low-lying area; a long low area of land, often with a river or stream running through it, that is surrounded by higher ground
Wavy: Repeatedly curving forming a series of smooth curves that go in one direction and then another

Plain: A flat expanse of land; fairly flat dry land, usually with few trees
Feathered: Layered; consisting of many fine parallel strands

Steep: Sloping sharply often to the extent of being almost vertical
Indistinct: Vague; lacking clarity or form

Prominent: Noticeable; distinguished, eminent, or well-known
Patchy: Irregular and inconsistent;

Solid: Unadulterated or unmixed; made of the same material throughout; uninterrupted
Even: Consistent and equal; lacking slope, roughness, and irregularity

Broken: Lacking continuity; having an uneven surface
Uneven: Inconsistent and unequal in measurement irregular

Smooth: Consistent in line and form; even textured
Stark: Bare and plain; lacking ornament or relieving features

Rough: Bumpy; knobbly; or uneven, coarse in texture
Clustered: Densely grouped

Fine: Intricate and refined in nature
Diffuse: Spread through; scattered over an area
ANNEXURE 3: GENERAL MITIGATIONS

‘Good Neighbour – Outdoor Lighting’ by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corp. has been included below.

---

**What is good lighting?**

Good outdoor lights improve visibility, safety, and a sense of security, while minimizing energy use, operating costs, and ugly, dazzling glare.

**Why should we be concerned?**

Many outdoor lights are poorly designed or improperly aimed. Such lights are costly, wasteful, and distractingly glaring. They harm the nighttime environment and neighbors’ property values. Light directed uselessly above the horizon creates murky skylight — the “light pollution” that washes out our view of the stars.

- **Glare:** Here’s the basic rule of thumb: If you can see the bright bulb from a distance, it’s a bad light. With a good light, you see lit ground instead of the dazzling bulb. “Glare” is light that beams directly from a bulb into your eye. It hampers the vision of pedestrians, cyclists, and drivers.

- **Light Trespass:** Poor outdoor lighting shines onto neighbors’ properties and into bedroom windows, reducing privacy, hindering sleep, and giving the area an unattractive, trashy look.

- **Energy Waste:** Many outdoor lights waste energy by spilling much of their light where it is not needed, such as up into the sky. This waste results in high operating costs. Each year we waste more than a billion dollars in the United States needlessly lighting the night sky.

- **Excess Lighting:** Some homes and businesses are flooded with much stronger light than is necessary for safety or security.

**How do I switch to good lighting?**

1. Provide only enough light for the task at hand; don’t over-light, and don’t spill light off your property. Specifying enough light for a job is sometimes hard to do on paper. Remember that a full Moon can make an area quite bright. Some lighting systems illuminate

---

**Some Good and Bad Light Fixtures**

- **Typical “Wall Pack”**
  - BAD
  - Waste light goes up and sideways

- **Typical “Shoe Box” (forward throw)**
  - GOOD
  - Directs all light down

- **Typical “Yard Light”**
  - BAD
  - Waste light goes up and sideways

- **Opaque Reflector (lamp inside)**
  - GOOD
  - Directs all light down

- **Area Flood Light**
  - BAD
  - Waste light goes up and sideways

- **Area Flood Light with Hood**
  - GOOD
  - Directs all light down
areas 100 times more brightly than the full Moon! More importantly, by choosing properly shielded lights, you can meet your needs without bothering neighbors or polluting the sky.

2. Aim lights down. Choose “full-cutoff shielded” fixtures that keep light from going uselessly up or sideways. Full-cutoff fixtures produce minimum glare. They create a pleasant-looking environment. They increase safety because you see illuminated people, cars, and terrain, not dazzling bulbs.

3. Install fixtures carefully to maximize their effectiveness on the targeted area and minimize their impact elsewhere. Proper aiming of fixtures is crucial. Most are aimed too high. Try to install them at night, when you can see where all the rays actually go. Properly aimed and shielded lights may cost more initially, but they save you far more in the long run. They can illuminate your target with a low-wattage bulb just as well as a wasteful light does with a high-wattage bulb.

4. If color discrimination is not important, choose energy-efficient fixtures utilizing yellowish high-pressure sodium (HPS) bulbs. If “white” light is needed, fixtures using compact fluorescent or metal-halide (MH) bulbs are more energy-efficient than those using incandescent, halogen, or mercury-vapor bulbs.

5. Where feasible, put lights on timers to turn them off each night after they are no longer needed. Put home security lights on a motion-detector switch, which turns them on only when someone enters the area; this provides a great deterrent effect!

Replace bad lights with good lights. You’ll save energy and money. You’ll be a good neighbor. And you’ll help preserve our view of the stars.

Presented by the New England Light Pollution Advisory Group (NELPAG) (http://www.nelpag.org) and Sky & Telescope (http://SkyandTelescope.com/).

NELPAG and Sky & Telescope support the International Dark-Sky Association (IDA) (http://www.darksky.org/).

We urge all individuals and groups interested in the problems of light pollution and obtrusive lighting to support the IDA and subscribe to its newsletter. IDA membership costs $30 per year; send your check to IDA, 3225 N. First Avenue, Tucson, AZ 85719, U.S.A.
21.1 Glint and Glare
Diagram illustrating the potential effect of Glint and Glare from ‘Sacramento Solar Highways Initial Study and Mitigated Negative Declaration.’ (Sacramento Municipal Utility District. 2011)
# 21.2 RAL Colour Chart

![RAL Colour Chart](image)

---

**PROPOSED KANGNAS ALTERNATIVE ENERGY PROJECT VIA**

114
22 REFERENCES

2. ASTER GDEM, METI and NASA, Source: https://lpdaac.usgs.gov

PROJECT TITLE
Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

Specialist: Visual Impact
Contact person: Stephen Stead
Postal address: P.O Box 7233
Postal code: 6531
Telephone: 044-876 0020
E-mail: steve@vma.co.za
Professional affiliation(s) (if any)
Association of Professional Heritage Practitioners  http://aphp.org.za

Project Consultant: Aurecon South Africa (Pty) Ltd
Contact person: Louise Corbett / Cornelia Steyn
Postal address: PO Box 494, Cape Town
Postal code: 8000
Telephone: 021-526-6027
E-mail: Louise.corbett@aurecongroup.com / cornelia.steyn@aurecongroup.com
4.2 The specialist appointed in terms of the Regulations, Stephen Stead, declare that

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Visual Resource Management Africa

Date: 5 Aug 2012
Annexure I1
Hi Corlie,

The amendments to the PV layout align with the visual mitigations / recommendations of the VIA report that would result in the project having a Moderate Visual Significance. The distance buffer from the N14 remains, the washes / drainage channels and the area around the rock outcrop to the north-east of the site have been excluded as per the recommendations.

Kind regards,

Stephen Stead
Director: Visual Resource Management Africa
Cell: +27(83)560 9911
Tel: +27(44)876 0020

On 8 Nov 2012, at 14:27, Cornelia Steyn wrote:

Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON’T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Cornelia Steyn
Environmental Management Practitioner I Aurecon
T +27 44 805 5421  M +27 82 575 7415
E Cornelia.Steyn@aurecongroup.com
Suite 201, 2nd Floor Bloemhof Building, 65 York St, George I South Africa
aurecongroup.com
<Kangnas solar areas 3 x 75MW.KMZ><buffer_infra_updNov.jpg>
Annexure J
Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok

August 2012

Prepared for:
South Africa Mainstream Renewable Power Developments (Pty) Ltd

Environmental Consultants:
Aurecon South Africa (Pty) Ltd
PO Box 509, George, 6530
Tel: +27 044 805 5410 Fax: +27 044 805 5454

Prepared By:
Toni Belcher
Cell: 082 883 8055
Email: toni.b@iburst.co.za
Executive Summary

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) proposes to develop a 750 MW wind energy facility and a 250 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility on the farms approximately 48km east of Springbok in the Northern Cape. The study area is situated on a watershed between the Orange River and the Buffels River with the main freshwater features being a number of small ephemeral streams that drain the inselbergs for a short period following rainfall events, two small springs/well points and some ephemeral pans at Kangnas and Koeris farms. The ephemeral tributaries of the Buffels and Orange rivers within the study area are considered to be in a largely natural to moderately modified ecological state. The springs and pans are in a similar ecological state, however the pans are relatively small and insignificant in terms of their ecological importance.

Overall, the expected impacts of the proposed activities without mitigation are likely to be of a low to very low significance and mostly limited to the proposed solar and wind energy facility sites, access roads and transmission line routes. The expected impacts on the identified freshwater features are likely to mostly occur while construction activities are taking place. The primary negative impacts are the result of direct and indirect factors. Direct impacts include loss of natural vegetation associated with the ephemeral systems as a result of construction activities as well as longer term disturbance of these features by machinery utilised during the operational phase. Indirect factors include altered surface water runoff and water quality modification, erosion and invasive plant growth. All of these impacts can however be mitigated.

Thus, provided that the following recommended mitigation measures are implemented, the significance of the impact is expected to be very low:

- Solar panel arrays should be located outside of any of the identified drainage channels.
- Construction activities should as far as possible be limited to the identified sites for the proposed wind energy and solar facilities and the identified access routes.
- Where transmission lines need to be constructed over/through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete.
- Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed projects. Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited.
- All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded.
- Road infrastructure and power transmission lines should coincide as much as possible to minimize the impact. Maintenance of transmission lines should only take place via the designated access routes.
- Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.
- All crossings over drainage channels or stream beds after the construction phase should be rehabilitated such that the flow within the drainage channel is not impeded.
- A buffer of 30m (measured from top of bank) should be maintained adjacent to the identified ephemeral streams and 500m from the springs.
- All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from any drainage areas/ephemeral streams and regularly serviced. These measures should be addressed, implemented
and monitored in terms of the EMP for the construction phase.

- Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes.

- Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants.

- Any septic tanks constructed for the project should be located at least 100m (measured from top of bank) from the ephemeral streams and at least 1000m away from the springs or any boreholes/wellpoints.

- Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

- Maintenance of infrastructure related to the project should only take place via the designated access routes. Disturbed areas along the access routes should be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.

The Department of Water Affairs Northern Cape Regional Office should be approached for approval of any water use aspects of the proposed activities.
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1. BACKGROUND

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) proposes to develop a 750 MW wind energy facility and a 250 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility on the farms approximately 48km east of Springbok in the Northern Cape. Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the requisite environmental process on behalf of Mainstream. This freshwater assessment is intended to inform the environmental authorisation process on the possible impact of the proposed activities, due to the fact that there are a number of ephemeral streams within the proposed development area.

![Locality map of the proposed wind and solar energy facilities](Google maps, 2012)

2. TERMS OF REFERENCE

The scope of works for the freshwater assessment is as follows:

- A situation assessment, based on existing information for the area as well as site assessments, will be undertaken consisting of a survey of the available information and the site visit/field assessments.
- This will include mapping and describing the freshwater areas, as well as an assessment of the importance, conservation value, sensitivity and current state of the freshwater system.
- The proposed site will be evaluated in terms of freshwater opportunities and constraints.
The findings and recommendations, including mitigation measures to assist in the long-term management of the remainder of the site will be written up into a report.

A Water Use Licence Application will be compiled relating to groundwater abstraction and any change to the bed, bank and characteristics of the water features on the site.

All relevant information for the water use authorisation application will be collected and the licence application forms will be completed to include any additional supporting documentation to the freshwater assessment that would be required for the water use application.

Time is allowed for liaison with DWA and the client.

Undertake the requisite field work;

Summarise the available information pertaining to surface water (streams, dams and wetlands) in close vicinity to the sites;

Undertake water quality and biotic assessments/sampling for stream, wetland and dam condition assessments;

Describe and determine importance, functionality and trophic state of the water resources;

Assess the potential impact of the change in site hydrology (quantity) and water chemistry (quality) on any streams, dams and wetlands during the construction and operational phases;

Evaluate (a) magnitude, frequency of occurrence, duration and probability of impacts, (b) the local, regional, and national significance of predicted impacts, (c) the level of confidence in findings relating to potential impacts, (d) the degree to which the impact can be reversed, and (e) cumulative impacts that may occur as a result of the activities which include mining and associated overburden dumping;

Recommend mitigation measures aimed at minimising the potential negative impacts and enhancing potential positive impacts while retaining reasonable operational efficiencies;

List additional or required permitting and/or licensing requirements; and

Take cognisance of the Wetland Delineation Guideline Document of the Department of Water, and if applicable the DEA&DP draft guideline: “Guideline for involving biodiversity specialists in EIA processes.

3. APPROACH TO THE STUDY AND STUDY LIMITATIONS AND ASSUMPTIONS

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as by a more detailed assessment of the freshwater features at the various proposed sites. Aquatic Ecosystem Health assessments were carried out to provide information on the ecological condition and ecological importance and sensitivity of the river and wetland systems to be impacted. The river health and wetland health assessments were carried out using South African Department of Water Affairs (DWA) developed methodologies.

The site was visited on 14 July 2012. During the field visit, the characterisation, mapping and integrity assessments of the freshwater features were undertaken. This information/data was used to inform the potential impact of the proposed activities as well as the recommended mitigation measures.
Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. An analysis of the freshwater ecosystems was however undertaken according to nationally developed methodologies and was undertaken at a rapid level which was considered a suitable level of evaluation for this freshwater impact assessment.

4. **USE OF THIS REPORT**

This report reflects the professional judgment of its author. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the author.

5. **OVERVIEW OF THE PROPOSAL**

5.1. **Overview of the Study Area**

The proposed project is to take place on Farm Kangnas (Farm No. 77 Portion 3 and the Remainder), Farm Koeris (Farm No. 78 Portion 1), Farm Areb (Farm No. 75 Portion 0 and Remainder) and Farm Smorgenschaduwe (Farm No. 127 Portion 0 and Remainder) in the Northern Cape (Figure 2). These farms are located approximately 48 km east of Springbok, along the N14. The five farms cover an area of approximately 46 535 ha.

![Figure 2. Locality map for the study area where the polygons indicate the preferred sites for the solar and wind energy projects and the rivers are indicated by blue lines (Google Earth, 2012)](image-url)
5.2. Activity Description

The proposed activities consist of two aspects, a wind energy facility south of the N14 highway and a solar energy facility north of the highway.

Wind Energy Facility:
The proposed wind energy facility would consist out of approximately 185 – 500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW. The turbine tower comprises of sections, the first is bolted to the concrete foundation and subsequent sections are lifted on site by a crane, manoeuvred into position and bolted together. The foundations would be approximately 20m x 20m and an average of 3m deep. A permanent hard standing made of compacted gravel of approximately 20m x 50m would be constructed adjacent to each turbine location for the crane. The preliminary area within which turbines of the proposed wind energy facility would be located is indicated in Figure 3.

Figure 3. Layout of the proposed wind energy facility indicating the preliminary focus area for the project

Gravel surface access roads of approximately 6-10 m wide would also be required between each turbine. Cables connecting each turbine would interconnect and ultimately become a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible.

Each turbine would have a transformer that steps up the voltage from 690 Volt to a medium voltage +/- 33 kilovolt (kV). This transformer is housed within each turbine tower or immediately outside the turbine.
electricity distribution infrastructure would comprise of one transmission line (132, 220 or 400 kV). The proposed project could connect to the grid via up to four satellite substations that would link sectors of the facilities to a main substation which would connect to an overhead line. The proposed route to the substation is approximately 0.5 - 20 km long, depending on the final location of the main wind and solar energy facilities. At the substation (200 m x 100 m) the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site (Figure 3).

A preliminary approximation of the water requirements for the construction phase of the proposed wind energy facility is 1500 cubic meters (m$^3$) of water per month. Mainstream has indicated that water could be sourced from underground sources (if available) depending on legal agreements and compensation with the landowners.

Turbines are designed to operate continuously, unattended and with low maintenance for more than 20 years or greater than 120 000 hours of operation. Once operating, the proposed wind energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. There would be basic operation and maintenance including storage facilities on site.

The construction period is anticipated to last 18 – 36 months. Only Security and key staff will be housed on site. Electricity for construction would be obtained from temporary diesel generators and possibly small scale mobile PV units. Drinking water and basic sanitation will be provided during construction and septic tanks during operation.

The proposed projects have a project lifespan of approximately 20 - 35 years, based on the mechanical characteristics of the turbines. However, as the infrastructure, such as roads, transmission, substations and foundations would already be established, and the energy source (wind) is a renewable one the proposed projects would continue to be operated after 20 years (Aurecon 2012)

**Solar Energy Facility**

The proposed solar energy facility (250 MW of PV and/or CPV) would have an approximate footprint of 1000 ha. The preliminary focus area of the proposed solar energy facility is shown in Figure 4. The arrays are arranged into rows that form the solar field. The arrays and racks are founded into the ground through either concrete, screw or pile foundations. The arrays are wired to inverters that convert direct current (DC) into alternate current (AC) that can be fed into a national grid system. A gravel surface access road of approximately 6-10 m wide would also be required to reach the array. Cables connecting the arrays would interconnect with overhead transmission lines that will follow the route of the access roads.

Inverters located at nodes of PV strings will convert the Direct Current to Alternating Current. The electricity distribution infrastructure would comprise of one transmission line (220 kV) traversing the site. The proposed project would connect to the grid via an onsite substation. The proposed route to the substation is approximately 1 km long. At the substation the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site.
Mainstream has indicated that water could be obtained from underground water sources depending on the legal agreements and compensation with the landowners. Water might also have to be abstracted and may require authorisation by DWA. Apart from security and key staff housing there will be no other housing components. Electricity during construction will be obtained from temporary diesel generators and possibly small scale mobile PV units. Drinking water and basic sanitation will be provided during construction and septic tanks during operation.

The construction period is anticipated to last 24 months for the solar energy facility and 36 months for the wind energy facility months. The facility would be designed to operate continuously, unattended and with low maintenance for more than 20 years. Once operating, the proposed solar energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. Regular cleaning of the panels to remove dust, dirt, pollen, and bird excretions would be required to ensure that the maximum quantity of sunrays can be captured by the PV panels. The frequency of panel cleaning would depend on the site conditions. Panels would be washed with water and a mild, organic, and non-abrasive detergent.

The decommissioning is expected to take 6 months for the solar energy facility and 12 months for the wind energy facility. The module components would be removed and recycled as the silicon and aluminum can be re-used in the production of new modules (Aurecon 2012).
5.3. Legal Requirements

The following Acts, regulations and ordinances are applicable to the development:

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

Chapter Seven of the NEMA states that:

“Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”.

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

“(a) investigate, assess and evaluate the impact on the environment;
(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:
(c) cease, modify or control any act, activity or process causing the pollution or degradation:
(d) contain or prevent the movement of pollutants or degradation: or
(e) eliminate any source of pollution or degradation: or
(f) remedy the effects of the pollution or degradation.”

**NEMA EIA Assessment Regulations, GN R543 of 2010**

Activities listed in terms of Chapter 5 of NEMA in Government Notice No. R. 544, 5 and 6 trigger a mandatory Basic Assessment, or even a full scoping EIA process, prior to development.

The National Environmental Management Second Amendment Act (Act No.8 of 2004) provided for formal procedures for offenders in terms of Section 24G to apply for rectification of the unlawful commencement of listed activities.


The purpose of the National Water Act is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

**Regulations Requiring that a Water User be Registered, GN R.1352 (1999)**

Regulations requiring the registration of water users were promulgated by the Minister of the Department of Water Affairs (DWA) in terms of provision made in section 26(1)(c), read together with section 69 of the
National Water Act, 1998. Section 26(1)(c) of the Act allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

**General Authorisation in terms of s. 39 of the National Water Act, GN R 1199 of 2009**

Government Notice R1199 was issued as a revision of the General Authorisations (No. 1191 of 1999) for Section 21 (c) and (i) water uses as defined under the National Water Act (Act 36 of 1998). The revision was published and came into effect on 2009/12/18. According to the preamble to Part 6 of the National Water Act, “This Part establishes a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette…” “The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary…”

The authorisation of water use activities for Sections 21 (c) - change to the bed, banks and characteristics of a water course and 21 (i)- impeding and diverting the flow, may need to be applied for should access roads or any of the other activities associated with the project occur within the drainage channels. It is likely that the proposed activities will fall within the listed activities that can be Generally Authorised at the Northern Cape Regional Office of the Department of Water Affairs; however they will need to be approached for confirmation that this is the case.

6. **AQUATIC SYSTEMS IN THE STUDY AREA**

6.1. **Description of the Study Site**

a. **Physical Characteristics**

The topography of the area is relatively flat, although a few ridges “granite inselbergs” are present in the landscape (Figure 5). The site is largely spread over the watershed between minor, northward flowing, tributaries of the Orange River (quaternary catchments D82C & D) and tributaries of the south and westward flowing Buffels River (quaternary catchment F30B). See Figure 6.
b. Climate

Springbok has a Mediterranean climate and normally receives about 106mm of rain per year, mostly during winter. The lowest rainfall (0mm) occurs in January and the highest (23mm) in June. The average midday temperatures for Springbok range from 16.5°C in July to 28.3°C in February. The region is the coldest during July when the mercury drops to 3.8°C on average during the night.
c. **Geology and Soil**

The geology of the study area can be described as being underlain by bedrock of the Namaqua-Natal Metamorphic Province. Tertiary to recent sand deposits and tillite primarily covers the area. The overlying soils on the plains are freely drained structure-less soils with excessive drainage, high erodibility and low fertility. The higher lying areas of the plateau are shallow with rock. These areas are water recharge areas.

![Average monthly rainfall for the area (SA Explorer, 2012)](image1.png)

**Figure 7.** Average monthly rainfall for the area (SA Explorer, 2012)

![Soil map for the area (Biodiversity GIS, 2012)](image2.png)

**Figure 8.** Soil map for the area (Biodiversity GIS, 2012), general site area encircled

d. **Flora**

The study area lies within the Nama Karoo biome, and is mapped according to the national vegetation types (2006) as being predominantly of the vegetation types Bushman Arid Grassland (Figure 9) which is

Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok August 2012
considered to be least threatened. The higher lying, rocky outcrops are covered by Bushmanland Inselberg Shrubland which is also considered to be least threatened. At the south western extent of the study area is Platbakkies Succulent Shrubland (Least threatened). Portions of the area are in a disturbed condition, mostly as a result of livestock grazing. There is however little presence of invasive alien plants. The ephemeral streams have no visible aquatic vegetation.

![Vegetation map for the area (SANBI Biodiversity GIS), general site area encircled](image)

**Figure 9.** Vegetation map for the area (SANBI Biodiversity GIS), general site area encircled

e. **Aquatic features and fauna**
The study area is situated on a watershed between the Orange River and the Buffels River (Figure 10). The main freshwater features within the study area consist of a number of small ephemeral streams that drain the inselbergs for a short period following rainfall events. These small drainage channels are discernible only as slightly shallow depressions with no clear associated vegetation and slightly clayey soils (Figures 11 and 12), which are distinct on the slopes of the inselbergs but become indistinct once the gradient of the slope flattens out. The larger drainage channels that result from the confluence of a number of the small drainage channels are more defined and significant in terms of ecosystem functionality.

There are also two small springs/well points (Figure 13) and some ephemeral pans (Figure 14) at Kangnas and Koeris farms. The ephemeral pans within the study area are also small (a few meters in diameter) and of no great ecological significance.
The ecological condition of the ephemeral streams in the study area is described in more detail in the following section.

Figure 10. Google Earth image of rivers within the Springbok area

Figure 11. An ephemeral tributary of the Buffels River
Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok

**Figure 12.** An ephemeral tributary of the Orange River

**Figure 13.** The spring at Kangnas

**Figure 14.** An ephemeral pan at Kangnas
f. **Land use**

Much of the study area is undeveloped, with some homesteads, and the veld being used for grazing of sheep, goats and game such as springbok. The closest urban area is Springbok approximately 48km to the west of the study area.

![Figure 15. Land cover map for the area (SANBI Biodiversity GIS, 2012), general site area encircled](image)


g. **Freshwater Biodiversity and Conservation**

In the study area, the rivers in the western half of the area have been identified as having conservation importance. Figure 16 is the Freshwater Ecosystem Protected Areas (FEPA) map for the study area. FEPAs are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries. The light green areas in Figure 17 are Upstream Management Areas (areas that need to be managed to prevent degradation of downstream Fish Sanctuaries and Fish Migration Corridors). These areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.
There were no aquatic features identified as part of the Critical Biodiversity Areas mapping (Figure 16) although the Karasberg area is delineated at a terrestrial Critical Biodiversity Area where the vegetated cover should be maintained in a natural state with no further biodiversity loss (only game farms and livestock production allowed). The surrounding terrestrial landscape is seen as an ecological support area with limited loss of ecological functioning.
6.2. Freshwater Assessment of the Study Area

The Index for Habitat Integrity (IHI) and a Site Characterisation were used to provide information on the ecological condition of the more significant river systems within the study area.

a. River classification

In order to assess the condition and ecological importance and sensitivity of the rivers in the study area, it is necessary to understand how the rivers might have appeared under unimpacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification...
presented in Department of Water Affairs and Forestry\(^1\) in 1999, which divides the country’s rivers into ecoregions, was used. The river assessed lies within the Nama Karoo Ecoregion, with the characteristics as described in Table 1.

Sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 2 provides the geomorphological features of the streams assessed.

| Table 1. Characteristics of the Nama Karoo Ecoregion (Dominant Types In Bold) |
|---------------------------------|---------------------------------|
| **Main Attributes**             | **Description**                 |
| Terrain Morphology: Broad division | Plains; Low Relief; Plains Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills, Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief |
| Vegetation types                | Eastern Mixed Nama Karoo; Upper Nama Karoo; Bushmanland Nama Karoo; Orange River Nama Karoo |
| Altitude (m a.m.s.l)            | 300-1700                        |
| MAP (mm)                        | 0 to 500                        |
| Rainfall seasonality            | Late to very late summer to Winter |
| Mean annual temp. (°C)          | 12 to 20                        |
| Median annual simulated runoff (mm) for quaternary catchment | <5 to 60 |

b. **River/Site Characterisation**

All of the streams within the study area are ephemeral (only flowing for short periods of time following rainfall events) and consist of the shallow ill-defined channel with a sand/gravel substrate. The rivers drain shrubland vegetation and do not have a distinct riparian vegetation. From the Site Characterisation assessments, the geomorphological and physical characteristics of the tributaries can be classified as shown in Table 2.

<table>
<thead>
<tr>
<th>Table 2. Geomorphological and Physical features</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
</tr>
<tr>
<td>Geomorphological Zone</td>
</tr>
<tr>
<td>Lateral mobility</td>
</tr>
<tr>
<td>Channel form</td>
</tr>
<tr>
<td>Channel pattern</td>
</tr>
<tr>
<td>Channel type</td>
</tr>
<tr>
<td>Channel modification</td>
</tr>
<tr>
<td>Hydrological type</td>
</tr>
<tr>
<td>Ecoregion</td>
</tr>
<tr>
<td>DWA catchment</td>
</tr>
<tr>
<td>Vegetation type</td>
</tr>
<tr>
<td>Rainfall region</td>
</tr>
</tbody>
</table>

\(^1\) Now Department of Water Affairs (DWA)
c. **Index of Habitat Integrity**

The evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the tributaries of the Buffels and Orange rivers (Tables 3 and 4). The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the rivers, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component. The estimated impact of each criterion is calculated as follows:

**Rating for the criterion/maximum value (25) x weight (percent)**

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components respectively. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category.

**Table 3. Habitat Integrity categories (From DWAF, 1999)**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
<th>SCORE (% OF TOTAL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unmodified, natural.</td>
<td>90-100</td>
</tr>
<tr>
<td>B</td>
<td>Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.</td>
<td>80-90</td>
</tr>
<tr>
<td>C</td>
<td>Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.</td>
<td>60-79</td>
</tr>
<tr>
<td>D</td>
<td>Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.</td>
<td>40-59</td>
</tr>
<tr>
<td>E</td>
<td>The loss of natural habitat, biota and basic ecosystem functions is extensive.</td>
<td>20-39</td>
</tr>
<tr>
<td>F</td>
<td>Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In worst instances, basic ecosystem functions have been destroyed and changes are irreversible.</td>
<td>0</td>
</tr>
</tbody>
</table>

The ephemeral streams within the study area are largely natural to moderately modified, with the modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing and direct habitat disturbance as a result of roads etc.). The results from the habitat integrity assessment are shown in Table 4.
Table 4. Index of Habitat Integrity Assessment results and criteria assessed of ephemeral tributaries within the study area

<table>
<thead>
<tr>
<th>Instream Criteria</th>
<th>Weight</th>
<th>Score</th>
<th>Riparian Zone Criteria</th>
<th>Weight</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water abstraction</td>
<td>14</td>
<td>2</td>
<td>Water abstraction</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Flow modification</td>
<td>13</td>
<td>3</td>
<td>Inundations</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Bed modification</td>
<td>13</td>
<td>4</td>
<td>Flow modification</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Channel modification</td>
<td>13</td>
<td>4</td>
<td>Water quality</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Water quality</td>
<td>14</td>
<td>3</td>
<td>Indigenous vegetation removal</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Inundation</td>
<td>10</td>
<td>3</td>
<td>Exotic vegetation encroachment</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Exotic macrophytes</td>
<td>9</td>
<td>0</td>
<td>Bank erosion</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Exotic fauna</td>
<td>8</td>
<td>0</td>
<td>Channel modification</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Solid waste disposal</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>A/B</td>
<td></td>
<td>Category</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

d. Ecological Importance and Sensitivity (EIS)

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 5). The median of the resultant score is calculated to derive the EIS category (Table 6).

Table 5. Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

<table>
<thead>
<tr>
<th>Scale</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One species/taxon judged as rare or endangered at a local scale.</td>
</tr>
<tr>
<td>2</td>
<td>More than one species/taxon judged to be rare or endangered on a local scale.</td>
</tr>
<tr>
<td>3</td>
<td>One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.</td>
</tr>
<tr>
<td>4</td>
<td>One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)</td>
</tr>
</tbody>
</table>

Table 6. Ecological importance and sensitivity categories (DWAF, 1999)

<table>
<thead>
<tr>
<th>EISC</th>
<th>General description</th>
<th>Range of median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.</td>
<td>&gt;3-4</td>
</tr>
<tr>
<td>High</td>
<td>Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.</td>
<td>&gt;2≤3</td>
</tr>
<tr>
<td>Moderate</td>
<td>Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.</td>
<td>&gt;1≤2</td>
</tr>
<tr>
<td>Low/marginal</td>
<td>Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.</td>
<td>≤1</td>
</tr>
</tbody>
</table>
### Table 7. Results of the EIS assessment

<table>
<thead>
<tr>
<th>Biotic Determinants</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare and endangered biota</td>
<td>0</td>
</tr>
<tr>
<td>Unique biota</td>
<td>0</td>
</tr>
<tr>
<td>Intolerant biota</td>
<td>0</td>
</tr>
<tr>
<td>Species/taxon richness</td>
<td>1</td>
</tr>
<tr>
<td>Aquatic Habitat Determinants</td>
<td></td>
</tr>
<tr>
<td>Diversity of aquatic habitat types or features</td>
<td>1</td>
</tr>
<tr>
<td>Refuge value of habitat type</td>
<td>1</td>
</tr>
<tr>
<td>Sensitivity of habitat to flow changes</td>
<td>2</td>
</tr>
<tr>
<td>Sensitivity of flow related water quality changes</td>
<td>1</td>
</tr>
<tr>
<td>Migration route/corridor for instream and riparian biota</td>
<td>2</td>
</tr>
<tr>
<td>National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs</td>
<td>2</td>
</tr>
<tr>
<td>RATINGS</td>
<td>1.0</td>
</tr>
<tr>
<td>EIS CATEGORY</td>
<td>low</td>
</tr>
</tbody>
</table>

The ecological importance and sensitivity of the ephemeral streams are considered to be low.
## 6.3 Evaluation of Sites

The proposed sites that were assessed are discussed in the following table per farm unit and proposed activity:

**Table 8. Assessment of Proposed Activities**

<table>
<thead>
<tr>
<th>Farm</th>
<th>Google Earth image/map</th>
<th>Comment</th>
</tr>
</thead>
</table>
| *Areb (Farm 75 Portion 0 and Remainder)* | ![Google Earth image/map](image) | Solar energy facility:  
There are some drainage lines within the focus area.  

Overhead transmission lines:  
The overhead transmission lines may cross a number of ephemeral streams.  

Access routes:  
The proposed access routes are likely to cross a number of ephemeral streams.  

Summary of Impacts to freshwater features:  
- The arrays may be placed within ephemeral drainage lines or streams, while the transmission line and access roads may need to cross drainage lines in a number of places. |
Wind energy facility:
None of the locations proposed for the wind turbines are within an identified drainage line/ephemeral stream.

Overhead transmission lines:
The overhead transmission lines do not appear to cross any drainage lines.

Access routes:
The proposed access routes do not appear to cross any of the identified freshwater features.

Summary of Impacts to freshwater features:
- No impact on the identified water features on the farm is expected within the focus area.
Wind energy facility:
Some of the locations proposed for the wind turbines are within an identified drainage line/stream.

Overhead transmission lines:
The overhead transmission lines do not appear to cross any drainage lines.

Access routes:
The proposed access routes may cross some of the identified drainage lines.

Summary of Impacts to freshwater features:
- Some of the locations of the wind turbines are placed within drainage lines. Access routes to these turbines are likely to cross the drainage lines.
Wind energy facility:
None of the locations proposed for the wind turbines are within an identified drainage line/ephemeral stream.

Overhead transmission lines:
The overhead transmission lines may need to cross drainage lines.

Access routes:
The proposed access routes may need to cross drainage lines.

Summary of Impacts to freshwater features:
- A very limited impact on the identified water features on the farm is expected within the focus area as a result of access routes and transmission lines.
7. ASSESSMENT OF IMPACTS

This section provides an assessment of the overall potential impacts to freshwater ecosystems that are likely to be associated with the proposed activities. The assessment methodology as outlined in Appendix 3 was utilised to evaluate the identified potential impacts. The impact assessment and recommended mitigation measures are grouped according to the various proposed activities, that is, the proposed solar energy facilities, wind energy facilities, overhead transmission lines and access routes.

7.1. Description and assessment of Impacts of proposed activities

a. Solar Energy Facility

The arrays and racks are founded into the ground through either concrete, screw or pile foundations.

Construction Phase Activities

Nature of Impact: Activities during the construction phase of the project could thus be expected to result in the removal of vegetation cover.

Significance of impacts without mitigation: A localized shorter term impact of moderate to low intensity (depending on the distance between the construction activities and the freshwater features) that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Solar panel arrays should be located outside of any of the identified drainage channels. A buffer of 30m (measured from top of bank) should be maintained adjacent to the identified freshwater features. Any of the cleared areas that are not hardened surfaces should be rehabilitated after construction is completed. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from any drainage areas/ephemeral streams and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

Operation Phase Activities

Nature of Impact: During the operation phase the proposed solar energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. Regular cleaning of the panels to remove dust, dirt, pollen, and bird excretions would be required to ensure that the maximum quantity of sunrays can be captured by the PV panels. The frequency of panel cleaning would depend on the site conditions. Panels would be washed with water and a mild, organic, and non-abrasive detergent.

Significance of impacts without mitigation: A localized longer term impact (more than 20 years) impact of low to very low intensity (depending on the distance between the turbines and the freshwater features)
that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area as a result of on-going disturbance of the area.

**Proposed mitigation:** Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants.

Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

**Significance of impacts after mitigation:** A localized, long-term impact will still occur during the operational phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

### b. Wind Energy Facility

#### Construction Phase Activities

**Nature of Impact:** The proposed wind energy facility would consist out of approximately 185 – 500 turbines. The turbine tower comprises sections that are bolted to the concrete foundation. A permanent hard standing made of compacted gravel of approximately 20 m x 50 m would be constructed adjacent to each turbine location for a crane. Activities during the construction phase of the project could thus be expected to result in some disturbance of vegetation cover as well as the bed and banks of the drainage features.

**Significance of impacts without mitigation:** A localized shorter term impact of moderate intensity (depending on the distance between the construction activities and the freshwater features) that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

**Proposed mitigation:** Construction activities should as far as possible be limited to the identified sites for the proposed wind energy facilities and the identified access routes. A buffer of 30m (measured from top of bank) should be maintained adjacent to the identified ephemeral streams and 500m from the springs. It is important that any of the cleared areas are rehabilitated after construction is completed. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the drainage lines/ephemeral streams and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.

**Significance of impacts after mitigation:** A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

#### Operation Phase Activities

**Nature of Impact:** Turbines are designed to operate continuously, unattended and with low maintenance for more than 20 years or greater than 120 000 hours of operation. Once operating, the proposed wind energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when
required. There would be basic operation and maintenance including storage facilities on site. Septic tanks will be installed for operational staff.

**Significance of impacts without mitigation:** A localized longer term impact (more than 20 years) impact of low to very low intensity (depending on the distance between the turbines and the freshwater features) that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

**Proposed mitigation:** Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants.

Any septic tanks constructed for the project should be located at least 100m (measured from top of bank) from the ephemeral streams and at least 1000m away from the springs or any boreholes/wellpoints. Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the wind energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

**Significance of impacts after mitigation:** A localized, long-term impact will still occur during the operational phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

c. **Impact of the Overhead Transmission lines:**

**Construction Phase Activities**

**Nature of Impact:** An impact of very limited significance is expected due to possible disturbance of the ephemeral streams during the construction phase.

**Significance of impacts without mitigation:** A localized shorter term impact of low intensity that is expected to have a very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

**Proposed mitigation:** Where transmission lines need to be constructed over/through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete.

**Significance of impacts after mitigation:** A localized, short-term impact will occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

**Operation Phase Activities**

**Nature of Impact:** An impact of very limited significance is expected on the ephemeral streams after the construction phase.

**Significance of impacts without mitigation:** A localized longer term impact of low intensity that is expected to have a very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.
Proposed mitigation: All crossings over drainage channels or stream beds after the construction phase should be rehabilitated such that the flow within the drainage channel is not impeded. Maintenance of transmission lines should only take place via the designated access routes.

Significance of impacts after mitigation: A localized, long-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

d. Impact of the Access Routes:

Construction Phase Activities

Nature of Impact: An impact of limited significance is expected at the access route crossings over the ephemeral streams during the construction phase. The major impacts associated with the access roads relate to loss of habitat within streams, riparian areas and wetland/pan habitats, loss of indigenous vegetation within riparian zones and potential invasive alien plant growth as well as the potential for flow and water quality impacts and the direct impacts on the soil (erosion of drainage channels). Due to the fact that the habitat and riparian vegetation associated with the ephemeral streams is negligible, as well as the frequency of flow in the stream, the impact can be expected to be minimal.

Significance of impacts without mitigation: A localized shorter term impact of moderate to low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and power transmission lines should coincide as much as possible to minimize the impact. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.

Significance of impacts after mitigation: A localized, short-term impact can be expected to occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

Operation Phase Activities

Nature of Impact: An impact of limited significance is expected at the access route river crossings of ephemeral streams after the construction phase. The major impacts associated with the access roads during the operation phase relate to disturbance to the instream and riparian habitat of the freshwater ecosystems along the designated routes.

Significance of impacts without mitigation: A localized longer term impact of moderate to low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Maintenance of infrastructure related to the project should only take place via the designated access routes. Disturbed areas along the access routes should be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.
Significance of impacts after mitigation: A localized, longer-term impact will occur during the operation phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

e. **Cumulative impact of the activities on freshwater ecosystems:**
Land use in the study area currently consists of livestock and game farming. Due to the arid nature of the area, the carrying capacity of the land is low and livestock numbers in general are low. The land and climate are also not conducive to the cultivation of crops and pastures and the surface and groundwater tends to be brackish, with surface water only being available mostly during the wet winter months. Current land and water use impacts on the ephemeral streams are low. Due to the ephemeral character of these surface water systems, they are also slow to recover from any impacts.

The nature of the power projects allows them to have minimal impact on the surface water features with the correct mitigation measures (as are recommended in this report). Erosion and sedimentation from the project activities, together with the potential for invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats within the study area. Most of the proposed activities for this project are outside of the identified freshwater features and provided the construction and operation activities of the projects remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, the overall impact should be limited and of a low significance.

**Impact table for the cumulative impact from proposed project and other existing and future planned activities:**

<table>
<thead>
<tr>
<th>Nature</th>
<th>Loss of freshwater ecosystem functionality and habitat</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact source(s)</td>
<td>Cumulative impact of existing farming related impacts together with future proposed power projects</td>
<td></td>
</tr>
<tr>
<td>Impacted aquatic ecosystem</td>
<td>Tributaries of the Orange and Buffels rivers within the study area</td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Extent</td>
<td>Regional</td>
</tr>
<tr>
<td></td>
<td>Intensity</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>Long term</td>
</tr>
<tr>
<td></td>
<td>Reversibility</td>
<td>Reversible (medium)</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>Probable</td>
</tr>
<tr>
<td>Significance</td>
<td>Without mitigation</td>
<td>Medium to Low</td>
</tr>
<tr>
<td></td>
<td>With mitigation</td>
<td>Very low</td>
</tr>
<tr>
<td>Confidence</td>
<td>Medium/high</td>
<td></td>
</tr>
</tbody>
</table>
f. **“No Go” Alternative:**
The main activity currently taking place in the study area is low density stock and game farming. These activities are all largely at a small scale and have a low impact on the freshwater features in the study area. The tributaries of the Buffels and Orange rivers within the study area can therefore be expected to remain in their current state of largely natural under the existing land use activities.

7.2. **Summary of assessment of potential impacts of the proposed activities:**

<table>
<thead>
<tr>
<th>Construction Phase Activities:</th>
<th>Proposed solar energy facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Potential impact on freshwater features</strong></td>
<td>Limited disturbance of freshwater related habitats at the construction sites</td>
</tr>
<tr>
<td><strong>Nature of impact:</strong></td>
<td>Localised short term impacts</td>
</tr>
<tr>
<td><strong>Extent and duration of impact:</strong></td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Probability of occurrence:</strong></td>
<td>Probable as a result of construction activities in close proximity to ephemeral drainage channels</td>
</tr>
<tr>
<td><strong>Degree to which impact can be reversed:</strong></td>
<td>Medium to high</td>
</tr>
<tr>
<td><strong>Irreplaceability of resources:</strong></td>
<td>Medium to low</td>
</tr>
<tr>
<td><strong>Significance of impact pre-mitigation</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Cumulative impact prior to mitigation:</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Degree of mitigation possible:</strong></td>
<td>Very low</td>
</tr>
<tr>
<td><strong>Proposed mitigation:</strong></td>
<td>Solar panel arrays should be located outside of any of the identified drainage channels. A buffer of 30m (measured from top of bank) should be maintained adjacent to the identified freshwater features. Any of the cleared areas that are not hardened surfaces should be rehabilitated after construction is completed. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from any drainage areas/ephemeral streams and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.</td>
</tr>
<tr>
<td><strong>Significance after mitigation</strong></td>
<td>Very Low</td>
</tr>
<tr>
<td><strong>Cumulative impact post mitigation:</strong></td>
<td>Very Low</td>
</tr>
</tbody>
</table>

<p>| Proposed wind energy facilities |
|--------------------------------|----------------------------------|
| <strong>Potential impact on freshwater features</strong> | Limited disturbance of freshwater related habitats at the construction sites |
| <strong>Nature of impact:</strong> | Localised short term impacts |
| <strong>Extent and duration of impact:</strong> | Moderate |
| <strong>Probability of occurrence:</strong> | Probable as a result of construction activities in close proximity to stream beds and riparian zones |</p>
<table>
<thead>
<tr>
<th>Degree to which impact can be reversed:</th>
<th>Medium to high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation</td>
<td>Low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td><strong>Proposed mitigation:</strong></td>
<td>Construction activities should as far as possible be limited to the identified sites for the proposed wind energy facilities and the identified access routes. A buffer of 30m (measured from top of bank) should be maintained adjacent to the identified ephemeral streams and 500m from the springs. Any of the cleared areas should be rehabilitated after construction is completed. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the drainage lines/ephemeral streams and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.</td>
</tr>
<tr>
<td>Significance after mitigation:</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential impact on freshwater features</th>
<th>Proposed transmission lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact:</td>
<td>Disturbance of habitat and possibly impedance/diversion of flow at river crossings</td>
</tr>
<tr>
<td>Extent and duration of impact:</td>
<td>Localised short term impacts</td>
</tr>
<tr>
<td>Intensity of Impact</td>
<td>Low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable depending on the extent of construction activities within stream bed</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>High</td>
</tr>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation</td>
<td>Very low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td>Proposed mitigation:</td>
<td>Where transmission lines need to be constructed over/through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete.</td>
</tr>
<tr>
<td>Significance after mitigation:</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low impact</td>
</tr>
</tbody>
</table>

Potential impact on freshwater features

| Proposed access routes | Proposed access routes |

Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok  
August 2012
<table>
<thead>
<tr>
<th>Nature of impact:</th>
<th>Disturbance of habitat and possibly impedance/diversion of flow at river crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent and duration of impact:</td>
<td>Localised short term impacts</td>
</tr>
<tr>
<td>Intensity of Impact</td>
<td>Moderate to Low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>High</td>
</tr>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation</td>
<td>Low to very low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td>Proposed mitigation:</td>
<td>Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and power transmission lines should coincide as much as possible to minimize the impact. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

**Operation Phase Activities:**

<table>
<thead>
<tr>
<th>Potential impact on freshwater features</th>
<th>Maintenance of solar energy facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact:</td>
<td>Limited <em>disturbance of freshwater related habitats</em> at the river crossings for transmission lines and access roads as well as along the length of the site adjacent to any streams</td>
</tr>
<tr>
<td>Extent and duration of impact:</td>
<td>Localised longer term impacts</td>
</tr>
<tr>
<td>Intensity of Impact</td>
<td>Low to very low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable as a result of maintenance activities adjacent to stream beds and riparian zones</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation</td>
<td>Low to very low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low due to the existing disturbances within these streams</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td>Proposed mitigation:</td>
<td>Operational activities should as far as possible be limited to the delineated site for the proposed developments and the identified access routes. Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants. Storm water run-off infrastructure must be maintained to mitigate both the flow</td>
</tr>
</tbody>
</table>
and water quality impacts of any storm water leaving the energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

<table>
<thead>
<tr>
<th>Significance after mitigation</th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential impact on freshwater features</th>
<th>Maintenance of wind energy facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact:</td>
<td>Limited disturbance of freshwater related habitats at the river crossings for transmission lines and access roads as well as along the length of the site adjacent to any streams</td>
</tr>
<tr>
<td>Extent and duration of impact:</td>
<td>Localised longer term impacts</td>
</tr>
<tr>
<td>Intensity of Impact</td>
<td>Low to very low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable as a result of maintenance activities adjacent to stream beds and riparian zones</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation</td>
<td>Low to very low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low due to the existing disturbances within these streams</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td>Proposed mitigation:</td>
<td>Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants. Any septic tanks constructed for the project should be located at least 100m (measured from top of bank) from the ephemeral streams and at least 1000m away from the springs or any boreholes/wellpoints. Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the wind energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential impact on freshwater features</th>
<th>Proposed transmission lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact:</td>
<td>Disturbance of habitat and possibly impedance/diversion of flow at river crossings</td>
</tr>
<tr>
<td>Extent and duration of impact:</td>
<td>Localised longer term impacts</td>
</tr>
<tr>
<td>Intensity of Impact</td>
<td>Low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable to unlikely</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>High</td>
</tr>
</tbody>
</table>

Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok August 2012
Irreplaceability of resources: Medium to Low
Significance of impact pre-mitigation: Very low
Cumulative impact prior to mitigation: Low
Degree of mitigation possible: Very low
Proposed mitigation: All crossings over drainage channels or stream beds after the construction phase should be rehabilitated such that the flow within the drainage channel is not impeded. Maintenance of transmission lines should only take place via the designated access routes.
Significance after mitigation: Very Low
Cumulative impact post mitigation: Very Low impact

<table>
<thead>
<tr>
<th>Potential impact on freshwater features</th>
<th>Proposed access routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact:</td>
<td>Disturbance of habitat and possibly impedance/diversion of flow at river crossings</td>
</tr>
<tr>
<td>Extent and duration of impact:</td>
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</tr>
<tr>
<td>Intensity of impact:</td>
<td>Low</td>
</tr>
<tr>
<td>Probability of occurrence:</td>
<td>Probable to unlikely</td>
</tr>
<tr>
<td>Degree to which impact can be reversed:</td>
<td>High</td>
</tr>
<tr>
<td>Irreplaceability of resources:</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Significance of impact pre-mitigation:</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact prior to mitigation:</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of mitigation possible:</td>
<td>Very low</td>
</tr>
<tr>
<td>Proposed mitigation:</td>
<td>Maintenance of infrastructure related to the projects should only take place via the designated access routes. Disturbed areas along the access routes should be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.</td>
</tr>
<tr>
<td>Significance after mitigation:</td>
<td>Very Low</td>
</tr>
<tr>
<td>Cumulative impact post mitigation:</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

8. CONCLUSIONS AND RECOMMENDATIONS

The study area is situated on a watershed between the Orange River and the Buffels River with the main freshwater features being a number of small ephemeral streams that drain the inselbergs for a short period following rainfall events, two small springs/well points and some ephemeral pans at Kangnas and Koeris farms. The ephemeral tributaries of the Buffels and Orange rivers within the study area are considered to be in a largely natural to moderately modified ecological state. The springs and pans are in a similar ecological state, however the pans are relatively small and insignificant in terms of their ecological importance.
Overall, the expected impacts of the proposed activities without mitigation are likely to be of a low to very low significance and mostly limited to the proposed solar and wind energy facility sites, access roads and transmission line routes. The expected impacts on the identified freshwater features are likely to mostly occur while construction activities are taking place. The primary negative impacts are the result of direct and indirect factors. Direct impacts include loss of natural vegetation associated with the ephemeral systems as a result of construction activities as well as longer term disturbance of these features by machinery utilised during the operational phase. Indirect factors include altered surface water runoff and water quality modification, erosion and invasive plant growth. All of these impacts can however be mitigated.

The DWA Northern Cape Regional Office should be approached for approval of the water use aspects of the proposed activities.

9. REFERENCES


APPENDICES
APPENDIX 1: DECLARATION OF INDEPENDENCE BY THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I Antonia Belcher, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Signature of the specialist:

3 August 2012
Date:
APPENDIX 2: ATTACHED CURRICULUM VITAE:

Full Name       Antonia Belcher
Profession      Aquatic Ecologist and Environmental Scientist (P. Sci. Nat. 400040/10)
Contact details 60 Dummer Street, Somerset West, 7139; Telephone: 082 883 8055

Relevant work experience:
Due to my involvement in the development and implementation of the River Health Program in the Western Cape, I have been a key part of the team that has undertaken six catchment or area wide ‘state-of-river’ assessments as well as routine monitoring and specialised assessments of rivers and wetlands in all the major catchments for the Western Cape.

Relevant work experience follows:
Belcher, A. 2007. Freshwater Assessment Input into The Storm water Master Plan for the Upper Mosselbank River near Durbanville, City of Cape Town.


Belcher, A. 2009. Freshwater Assessment for the Proposed Improvement of Structures along the R27, Section 10 and 11 between Kenhardt and Keimoes.

Belcher, A. 2010. Freshwater Assessment for the Proposed Improvement of National Route 7 Section 1 between the Melkbos and Atlantis Intersections

Belcher, A. 2011. Freshwater Assessment for the Proposed Ibhubesi Power Project

Belcher, A. 2012. Freshwater Screening Assessment for the proposed solar energy facility on Portion 3 of Farm 18 (Onder Rietvlei) in the District of Aurora
APPENDIX 3: METHODOLOGY FOR IMPACT ASSESSMENT

The following convention was used for assessing the impact of the proposed upgrade and assigning significance ratings to the potential impacts. Seven rating scales considered when assessing potential impacts:

- extent;
- duration;
- intensity or magnitude;
- status of impact;
- significance;
- probability;
- degree of confidence; and
- reversibility.

In assigning significance ratings to potential impacts before and after mitigation:

- The core criteria for determining significance ratings are “extent”, “duration” and “magnitude or intensity”.
- The status of an impact is used to describe whether the impact will have a negative, positive or neutral effect on the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.
- The impact in terms of the probability of the impact occurring and the degree of confidence in the impact predictions is based on the availability of information and specialist knowledge.

Additional criteria considered, which could “increase” the significance rating were:

- Permanent / irreversible impacts;
- Potentially substantial cumulative effects; and
- High level of risk or uncertainty, with potentially substantial negative consequences.

The cumulative impacts of a project were also considered.

- The degree to which an impact may cause irreplaceable loss of a resource was also assessed.
- The significance ratings are based on largely objective criteria and inform decision-making at a project level.
DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

File Reference Number: 12/12/20/
NEAS Reference Number: DEAT/EIA/
Date Received: 


PROJECT TITLE

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

Specialist: 
Contact person: 
Postal address: 
Postal code: 
Telephone: 
E-mail: 
Professional affiliation(s) (if any): 

TONI RELLCHER
60 DUMMER STREET
SOMERSET WEST
Cell: 083-653-9055
Fax: 

SOUTH AFRICAN COUNCIL OF NATURAL SCIENTIFIC PROFESSIONS (P.Sci.Nat. 400040/10)

Project Consultant: Aurecon South Africa (Pty) Ltd
Contact person: Louise Corbett / Cornelia Steyn
Postal address: PO Box 494, Cape Town
Postal code: 8000
Telephone: 021-526-6027
E-mail: Louise.corbett@aurecongroup.com / cornelia.steyn@aurecongroup.com
I, Antonia Selchel, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Date: 10 September 2017
Annexure J2
Hi Corlie

The revised layout plan for the Kangnas energy project lies outside of any of the sensitive areas identified in the freshwater assessment for the study. It is likely that there may be a few small drainage lines within the proposed development areas. These drainage lines are however deemed to be of little significance for the larger Kirrie River system (see image below). The proposed development areas also remains outside of the recommended 30m from the more important drainage lines. The potential impact of the proposed development is thus deemed to be of a very low significance.

Kind regards

Toni

Antonia Belcher
Aquatic Scientist
P O Box 4755
Somerset West, 7137
Tel: (021)851 0555
Cell: 082 883 8055
Email: toni.b@iburst.co.za
Annexure K
South Africa Mainstream Renewable Power Developments

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

Establishment of the Kangnas Wind and Solar Energy Facilities east of the town of Springbok, Northern Cape Province

Study done for:

M² Environmental Connections cc
P.O. Box 2047
Garsfontein East
0060
Tel: 012 – 993 2165
Fax: 086 – 621 0292
E-mail: morne@menco.co.za
EXECUTIVE SUMMARY

M2 Environmental Connections was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding sound environment due to the establishment of the Kangnas Renewable Energy Facility (REF) on various farms east of the town of Springbok, Northern Cape Province. The facility is to be developed by South Africa Mainstream Renewable Power Developments (Pty) Ltd.

The facility is proposed to accommodate between 185 to 500 appropriately spaced wind turbines as well as a 250MW Photovoltaic (PV) and/or Concentrated PV (CPV). The developer has not yet identified a certain make or model of wind turbine, however they indicated that the wind turbines could be between 1.5 and 4.0 MW each with or without gearboxes. Hub height could be up to 120 meters with blade length being up to 60 meters each. Considering the uncertainty pertaining to the specifications of the wind turbine, a worst-case scenario was investigated.

This noise impact assessment mainly considered the noise impact from the development of the wind energy facility (WEF). This is because the potential noise impact of the PV section will be insignificant during the operational phase, with the only potential noise impact associated with the construction phase of the PV section.

With the input data as used, this assessment indicated that the potential noise impact would be insignificant during both the construction and operational phases.

Because of the unknown noise emission characteristics of the proposed wind turbine, it is highly recommended that the developer re-evaluate the final layout once a wind turbine make and model are selected if any wind turbines are within 2,000 meters from any Noise-Sensitive Developments (NSD);

No routine noise monitoring is recommended, yet noise monitoring should be implemented if a valid noise complaint due to the operation of the facility is registered. Feedback regarding any noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

The findings of this report should also be made available to all potentially noise-sensitive developments in the area, or the contents explained to them to ensure that they
understand all the potential risks that the development of a WEF may have on them and their families.

With its potential for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when wind farms are near to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.
Title:
Environmental Noise Impact Assessment: Establishment of the Kangnas Wind and Solar Energy Facilities east of the town of Springbok, Northern Cape Province

Client:
Aurecon South Africa (Pty) Ltd

for
South Africa Mainstream Renewable Power

Developments (Pty) Ltd

Report no:
MRP-KREF/ENIA/201208-Rev 0

Authors:
M. de Jager    (B. Ing (Chem))

Review:
Johan Maré   (Pr.Sci.Nat, M.Sc (Microbiology))

Date:
August 2012

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## GLOSSARY OF ABBREVIATIONS

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<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZSL</td>
<td>Acceptable Zone Sound Level (Rating Level)</td>
</tr>
<tr>
<td>DEADP</td>
<td>Department of Environmental Affairs and Development Planning</td>
</tr>
<tr>
<td>DEDEA</td>
<td>Department of Economic Development and Environmental Affairs</td>
</tr>
<tr>
<td>DEA</td>
<td>Department of Environmental Affairs</td>
</tr>
<tr>
<td>EAP</td>
<td>Environmental Assessment Practitioner</td>
</tr>
<tr>
<td>ECA</td>
<td>Environment Conservation Act (Act 78 of 1989)</td>
</tr>
<tr>
<td>ECO</td>
<td>Environmental Control Officer</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental Management System</td>
</tr>
<tr>
<td>FEL</td>
<td>Front End Loader</td>
</tr>
<tr>
<td>IAPs</td>
<td>Interested and Affected Parties</td>
</tr>
<tr>
<td>i.e.</td>
<td>that is</td>
</tr>
<tr>
<td>IEM</td>
<td>Integrated Environmental Management</td>
</tr>
<tr>
<td>km</td>
<td>Kilometres</td>
</tr>
<tr>
<td>LHD</td>
<td>Load haul dumper</td>
</tr>
<tr>
<td>m</td>
<td>Meters (measurement of distance)</td>
</tr>
<tr>
<td>m²</td>
<td>Square meter</td>
</tr>
<tr>
<td>m³</td>
<td>Cubic meter</td>
</tr>
<tr>
<td>mamsl</td>
<td>Meters above mean sea level</td>
</tr>
<tr>
<td>MENCO</td>
<td>M² Environmental Connections cc</td>
</tr>
<tr>
<td>NCR</td>
<td>Noise Control Regulations (under Section 25 of the ECA)</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-government Organisation</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Participation Process</td>
</tr>
<tr>
<td>REF</td>
<td>Renewable Energy Facility</td>
</tr>
<tr>
<td>SABS</td>
<td>South African Bureau of Standards</td>
</tr>
<tr>
<td>SANS</td>
<td>South African National Standards</td>
</tr>
<tr>
<td>SHEQ</td>
<td>Safety Health Environment and Quality</td>
</tr>
<tr>
<td>TLB</td>
<td>Tip Load Bucket</td>
</tr>
<tr>
<td>UTM</td>
<td>Universal Transverse Mercator</td>
</tr>
<tr>
<td>WEF</td>
<td>Wind Energy Facility</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>WTG</td>
<td>Wind Turbine Generator</td>
</tr>
</tbody>
</table>
### GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3-Octave Band</td>
<td>A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the center frequency of the band. See also definition of octave band.</td>
</tr>
<tr>
<td>A – Weighting</td>
<td>An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.</td>
</tr>
<tr>
<td>Air Absorption</td>
<td>The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no go” alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.</td>
</tr>
<tr>
<td>Ambient</td>
<td>The conditions surrounding an organism or area.</td>
</tr>
<tr>
<td>Ambient Noise</td>
<td>The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.</td>
</tr>
<tr>
<td>Ambient Sound</td>
<td>The all-encompassing sound at a point being composite of sounds from near and far.</td>
</tr>
<tr>
<td>Ambient Sound Level</td>
<td>Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.</td>
</tr>
<tr>
<td>Amplitude Modulated Sound</td>
<td>A sound that noticeably fluctuates in loudness over time.</td>
</tr>
<tr>
<td>Applicant</td>
<td>Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.</td>
</tr>
<tr>
<td>Assessment</td>
<td>The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.</td>
</tr>
<tr>
<td>Audible Frequency Range</td>
<td>Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.</td>
</tr>
<tr>
<td>Background Ambient Sound Level</td>
<td>The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.</td>
</tr>
<tr>
<td>C-Weighting</td>
<td>This is an international standard filter, which can be applied to a pressure signal or to a SPL or PWL spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.</td>
</tr>
<tr>
<td>dB(A)</td>
<td>Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.</td>
</tr>
<tr>
<td>Decibel (db)</td>
<td>A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 µ Pa.</td>
</tr>
<tr>
<td>Diffraction</td>
<td>Modification of the progressive wave distribution due to the presence of obstacles in the field. Reflection and refraction are special cases of diffraction.</td>
</tr>
<tr>
<td>Direction of Propagation</td>
<td>The direction of flow of energy associated with a wave.</td>
</tr>
<tr>
<td>Disturbing noise</td>
<td>Means a noise level that exceeds the zone sound level or, if no zone sound exists, this relates to the background ambient sound level.</td>
</tr>
</tbody>
</table>
level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.

**Environment**

The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.

**Environmental Control Officer**

Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.

**Environmental impact**

A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation’s activities or may be indirectly caused by them.

**Environmental Impact Assessment**

An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.

**Environmental issue**

A concern felt by one or more parties about some existing, potential or perceived environmental impact.

**Equivalent continuous A-weighted sound exposure level** \( (L_{Aeq,T}) \)

The value of the average A-weighted sound pressure level measured continuously within a reference time interval \( T \), which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.

**Equivalent continuous A-weighted rating level** \( (L_{Req,T}) \)

The Equivalent continuous A-weighted sound exposure level \( (L_{Aeq,T}) \) to which various adjustments has been added. More commonly used as \( (L_{Aeq,d}) \) over a time interval 06:00 – 22:00 (\( T=16 \) hours) and \( (L_{Aeq,n}) \) over a time interval of 22:00 – 06:00 (\( T=8 \) hours).

**Footprint area**

Area to be used for the construction of the proposed development, which does not include the total study area.

**Frequency**

The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.

**Green field**

A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Green field is Brown field, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brown field suggests that an investigation should be made to determine if environmental damage exists.

**G-Weighting**

An International Standard filter used to represent the infrasonic components of a sound spectrum.

**Harmonics**

Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.

**Infrasound**

Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.

**Integrated Development Plan**

A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).

**Integrated Environmental Management**

IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable
Interested and affected parties

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

Key issue

An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.

Listed activities

Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.

Magnitude of impact

Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.

Masking

The raising of a listener’s threshold of hearing for a given sound due to the presence of another sound.

Mitigation

To cause to become less harsh or hostile.

Noise

a. Sound that a listener does not wish to hear (unwanted sounds).
b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record.
c. A class of sound of an erratic, intermittent or statistically random nature.

Noise-sensitive development

Developments that could be influenced by noise such as:

a) districts (see table 2 of SANS 10103:2008)
   1. rural districts,
   2. suburban districts with little road traffic,
   3. urban districts,
   4. urban districts with some workshops, with business premises, and with main roads,
   5. central business districts, and
   6. industrial districts;
b) educational, residential, office and health care buildings and their surroundings;
c) churches and their surroundings;
d) auditoriums and concert halls and their surroundings;
e) recreational areas; and
f) nature reserves.

In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor

Octave Band

A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.

Positive impact

A change that improves the quality of life of affected people or the quality of the environment.

Property

Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon

Public Participation Process

A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development.

Reverberant Sound

The sound in an enclosure excluding that is received directly from the source.

Reverberation

The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
| **Significant Impact** | An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account. |
| **Sound Level** | The level of the frequency weighted and time weighted sound pressure as determined by a sound level meter. |
| **Sound Power** | Of a source, the total sound energy radiated per unit time. |
| **Sound Pressure Level (SPL)** | Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings. |
| **Soundscape** | Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution. |
| **Study area** | Refers to the entire study area encompassing all the alternative routes as indicated on the study area map. |
| **Sustainable Development** | Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987). |
| **Zone of Potential Influence** | The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant. |
| **Zone Sound Level** | Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS10103. |
1 INTRODUCTION

1.1 INTRODUCTION AND PURPOSE

M2 Environmental Connections was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding sound environment due to the establishment of the Kangnas Renewable Energy Facility (REF) on various farms east of the town of Springbok, Northern Cape Province.

This report describes the potential noise impact that such a facility may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

1.2 BRIEF PROJECT DESCRIPTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred as the developer) proposes the establishment of a commercial Renewable Energy Facility (REF), consisting of wind and solar energy facilities and associated infrastructure, on various farms approximately 48 km east (boundary) of the town of Springbok.

The boundary of the REF covers an area of approximately 466 km$^2$, with the study area including an area up to 2,000 meters from the Wind Energy Facility (WEF) boundary.

The facility is proposed to accommodate between 185 to 500 appropriately spaced wind turbines with a total capacity of 750 MW as well as a 250MW Photovoltaic (PV) and/or Concentrated PV (CPV). The developer has not yet identified a certain make or model, however they indicated that the wind turbines could be between 1.5 and 4.0 MW each with or without gearboxes. Hub height could be up to 120 meters with blade length being up to 60 meters each. Because of the uncertainty around specifications of the wind turbine, a worst-case scenario will be investigated.

Other infrastructure associated with the WEF is proposed to include:
- A laydown area next to the locations of the proposed wind turbines and Photovoltaic installations;
- Foundations to support the wind turbines and Photovoltaic installations;
- Cabling between the various power generation infrastructure, to be lain underground where practical, which will connect to an on-site substation;
- One or more on-site substation(s) located within the facility;
- A 220 kV overhead power line to connect the facility to the Eskom infrastructure;
• Existing roads will be used as far as possible. However, where required, internal access roads will be constructed between the turbines;

• Potentially a control building and workshop area for maintenance and storage purposes.

It should be noted that this noise impact assessment will mainly consider the noise impact from the development of the WEF. This is because the potential noise impact of the PV section will be insignificant during the operational phase, with the only potential noise impact associated with the construction phase.

1.3 TERMS OF REFERENCE

SANS 10328:2008 (Edition 3) specifies the methods to assess the noise impacts on the environment due to a proposed activity that might impact on the environment. The standard also stipulates the minimum requirements to be investigated for an EIA. These minimum requirements are:

• Undertake noise propagation modelling for both the construction and operational phases;

• Compare the calculated noise levels $L_{Aeq}$ against the measured ambient sound levels as well as the appropriate SABS rating level to determine the potential impact on the surrounding environment, focusing on potential sensitive receptors;

• Compile a report for the EIA Phase as per SANS 10328:2003 which would include:
  
  o Evaluation of the potential impacts of construction, operation and maintenance of the proposed development on the ambient noise levels, in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the likely duration of the impact.
  
  o The assessment is to indicate the potential cumulative impacts (noise impacts in context of the surroundings);
  
  o Recommendation of mitigation measures to minimise or eliminate predicted impacts on noise receptors. This will include providing input into the construction and operational phase EMP to be developed for the proposed projects.
  
  o All aspects of the investigation are to conform to the requirements of relevant environmental legislation and noise impact assessment procedure and standards.
SANS 10328:2008 (Edition 3) specifies the methods to assess the noise impacts on the environment due to a proposed activity that might impact on the environment. The standard also stipulates the minimum requirements to be investigated for an EIA. These minimum requirements are:

1. the purpose of the investigation
2. a brief description of the planned development or the changes that are being considered
3. a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements
4. the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics
5. the identified noise sources that were not taken into account and the reasons as to why they were not investigated
6. the identified noise-sensitive developments and the noise impact on them
7. where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics
8. an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations
9. an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question
10. the location of measuring or calculating points in a sketch or on a map
11. quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made
12. alternatives that were considered and the results of those that were investigated
13. a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation
14. a detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them
15. conclusions that were reached
16. proposed recommendations
17. If remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority; and

18. Any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future.

1.4 STUDY AREA

The study area is described in terms of environmental components that may contribute or change the sound character in the area. A site locality map is presented in Figure 1.1.

1.4.1 Location

The study area falls within the Namakwa Local Municipality with the proposed facility being situated on the following farms:

- Kangnas (Farm No. 77 Portion 3 and the Remainder)
- Koeris (Farm No. 78 Portion 1)
- Areb (Farm No. 75 Portion 0) and
- Smorgenschaduwe (Farm No. 127 Portion 0).

1.4.2 Topography

There are a number of notable hills on the farms proposed for the REF, yet the area where the wind turbines are to be constructed is relatively flat, sloping into a southern direction. The southern area of the proposed REF is defined as plains by the Environmental Potential Atlas of South Africa (ENPAT), with the northern section being defined as low mountains.

1.4.3 Roads and rail roads

The N14 transects the area in the north. The road is generally quiet and noise due to traffic on this road is considered insignificant.
Figure 1.1: Site map indicating the Locality of the proposed REF
1.4.4 Land use
The area can be considered rural in nature.

1.4.5 Residential areas
There are no residential communities close to the proposed development.

1.4.6 Ground conditions and vegetation
The area falls within the Nama Karoo Biome. The surface area is generally flat with low growing and sparse vegetation. The northern part of the identified farms (the farm Areb) is classified as Arid Karoo and Desent False Grassveld (ENPAT) with the southern areas being False Succulent Karoo. A 25% ground attenuation factor was selected for noise propagation modelling based on the sparse vegetation conditions.

1.4.7 Existing Background Ambient Sound Levels
The study area has a rural character in terms of the ambient sound levels. Onsite measurements and the existing soundscape are discussed in more detail in section 3.

1.5 Potential sensitive receptors (Noise Sensitive Developments)
Potentially Sensitive Receptors, defined as Noise-Sensitive Developments (NSDs – SANS 10103) were initially identified using Google Earth® during the scoping noise study, supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph. The function of the dwelling needs to be defined as well, as a building can serve as a residential, commercial or industrial housing.

While there are a number of dwellings and structures in the area, the site assessment revealed only four noise-sensitive developments (refer Figure 1.2).

1.6 Comments received from Interested or Affected Parties
No comments relating to noise were received from I&AP’s during the public participation phase of this project.
Figure 1.2: Identified and confirmed Noise-sensitive Developments in the vicinity of the proposed REF
2 LEGAL CONTEXT, POLICIES AND GUIDELINES

2.1 THE REPUBLIC OF SOUTH AFRICA CONSTITUTION ACT ("THE CONSTITUTION")

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate in the particular circumstances. The subjectivity of this approach can be problematic which has led to the development of noise standards (see Section 2.7).

"Noise pollution" is specifically included in Part B of Schedule 5 of the Constitution, which means that noise pollution control is a local authority competence, provided that the local authority concerned has the capacity to carry out this function.

2.2 THE ENVIRONMENT CONSERVATION ACT

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. See also section 2.6.

2.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures which may be regarded as reasonable. They include the following measures:

1. to investigate, assess and evaluate the impact on the environment
2. to inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment
3. to cease, modify or control any act, activity or process causing the pollution or degradation
4. to contain or prevent the movement of the pollution or degradation
5. to eliminate any source of the pollution or degradation
6. to remedy the effects of the pollution or degradation
2.4 **NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT ("AQA")**

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of 2004) makes provision for:

1. the Minister to prescribe essential national noise standards -
   a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or
   b) for determining –
      i) a definition of noise
      ii) the maximum levels of noise

2. When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

This section of the Act is in force, but no such standards have yet been promulgated. Draft regulations have however, been promulgated for adoption by Local Authorities.

An atmospheric emission licence issued in terms of section 22 may contain conditions in respect of noise. This will however, not be relevant to the facility, as no atmospheric emissions will take place.

2.5 **MODEL AIR QUALITY MANAGEMENT BY-LAW FOR ADOPTION AND ADAPTATION BY MUNICIPALITIES**

Model Air Quality Management By-Laws for adoption and adaptation by municipalities was published by the Department of Water and Environmental Affairs in the Government Gazette of 2 July 2010 as Government Notice 579 of 2010.

The main aim of the model air quality management by-law is to assist municipalities in the development of their air quality management by-law within their jurisdictions. It is also the aim of the model by-law to ensure uniformity across the country when dealing with air quality management challenges. Therefore, the model by-law is developed to be generic in order to deal with most of the air quality management challenges.

- **IT IS NOT** the aim of the model by-law to have legal force and effect on municipalities when published in the Gazette; and
- **IT IS NOT** the aim of the model by-law to impose the by-law on municipalities.
Therefore, a municipality will have to follow the legal process set out in the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000) when adopting and adapting the model by-law to its local jurisdictions.

2.6 Noise Control Regulations

In terms of Section 25 of the ECA, the national noise-control regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Western Cape and Gauteng provinces. The Northern Cape Province has not yet promulgated their own Noise Control Regulations and the National Noise Control Regulations are considered to be in effect in this province.

*It should be noted that the National Noise Control Regulations defines:*

"controlled area"

means a piece of land designated by a local authority where, in the case of--

   c) industrial noise in the vicinity of an industry-

   i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or

   ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA;

"disturbing noise"

means noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

"zone sound level"

means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. *This is the same as the Rating Level as defined in SANS 10103.*
In addition:

In terms of Regulation 2 (d):
"A local authority may –
before changes are made to existing facilities or existing uses of land or buildings, or
before new buildings are erected, in writing require that noise impact assessments or tests
are conducted to the satisfaction of that local authority by the owner, developer, tenant or
occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or
(c), reports or certificates in relation to the noise impact to the satisfaction of that local
authority are submitted by the owner, developer, tenant or occupant to the local authority
on written demand";

In terms of Regulation 3 (c):
"No person shall –
make changes to existing facilities or existing uses of land or buildings or erect new
buildings, if it shall in the opinion of a local authority house or cause activities which shall,
after such change or erection, cause a disturbing noise, unless precautionary measures to
prevent the disturbing noise have been taken to the satisfaction of the local authority";

In terms of Regulation 4 of the Noise Control Regulations:
"No person shall make, produce or cause a disturbing noise, or allow it to be made,
produced or caused by any person, machine, device or apparatus or any combination
thereof".

2.7 Noise Standards

Four South African Bureau of Standards (SABS) scientific standards are considered
relevant to noise from a WEF. They are:

- SANS 10103:2008. ‘The measurement and rating of environmental noise with
  respect to annoyance and to speech communication’.
- SANS 10357:2004. ‘The calculation of sound propagation by the Concave
  method’.

The relevant standards use the equivalent continuous rating level as a basis for
determining what is acceptable. The levels may take single event noise into account, but
single event noise by itself does not determine whether noise levels are acceptable for
land use purposes. The recommendations that the standards make are likely to inform decisions by authorities, but non-compliance with the standards will not necessarily render an activity unlawful *per se*.

### 2.8 International Guidelines

While there exist a number of international guidelines and standards that could encompass a document in itself, the three mentioned below were selected as they are used by different countries in the subject of environmental noise management, with the last two documents specifically focussing on the noises associated by wind energy facilities.

#### 2.8.1 Guidelines for Community Noise (WHO, 1999)

The World Health Organization’s (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO- expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled “Community Noise” that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of WHO’s effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments.

Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.

The document uses the $L_{Aeq}$ and $L_{A,max}$ noise descriptors to define noise levels. It should be noted that a follow-up document focusing on Night-time Noise Guidelines for Europe (WHO, 2009).

#### 2.8.2 The Assessment and Rating of Noise from Wind Farms (ETSU, 1996)

This report describes the findings of a Working Group on Wind Turbine Noise, facilitated by the United Kingdom Department of Trade and Industry. It was developed as an Energy
Technology Support Unit (ETSU) project. The aim of the project was to provide information and advice to developers and planners on noise from wind turbines. The report represents the consensus view of a number of experts (experienced in assessing and controlling the environmental impact of noise from wind farms). Their findings can be summarised as follows:

1. Absolute noise limits applied at all wind speeds are not suited to wind farms; limits set relative to the background noise (including wind as seen in Figure 3.5) are more appropriate
2. $L_{A90,10\text{mins}}$ is a much more accurate descriptor when monitoring ambient and turbine noise levels
3. The effects of other wind turbines in a given area should be added to the effect of any proposed WEF, to calculate the cumulative effect
4. Noise from a WEF should be restricted to no more than 5 dBA above the current ambient noise level at a potential sensitive receptor
5. Wind farms should be limited to within the range of 35dBA to 40dBA (day-time) in a low noise environment. A fixed limit of 43 dBA should be implemented during all night time noise environments. This should increase to 45 dBA (day and night) if the potential receptor has financial investments in the WEF
7. A penalty system should be implemented for wind turbine/s that operates with a tonal characteristic

2.8.3 Noise Guidelines for Wind Farms (MoE, 2008)

This document establishes the sound level limits for land-based wind power generating facilities and describes the information required for noise assessments and submissions under the Environmental Assessment Act and the Environmental Protection Act, Canada.

The document defines:

- Sound Level Limits for different areas (similar to rural and urban areas), defining limits for different wind speeds at 10 m height, refer also Table 2.1
- The Noise Assessment Report, including;
  - Information that must be part of the report

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1 ETSU was set up in 1974 as an agency by the United Kingdom Atomic Energy Authority to manage research programmes on renewable energy and energy conservation. The majority of projects managed by ETSU were carried out by external organisations in academia and industry. In 1996, ETSU became part of AEA Technology plc which was separated from the UKAEA by privatisation.

2 The measurement of wind induced background sound level is not required to establish the applicable limit. The wind induced background sound level reference curve was determined by correlating the A-weighted ninetieth percentile sound level ($L_{90}$) with the average wind speed measured at a particularly quiet site. The applicable $L_{eq}$ sound level limits at higher wind speeds are given by adding 7 dB to the wind induced background $L_{90}$ sound level reference values.
- Full description of noise sources
- Adjustments, such as due to the wind speed profile (wind shear)
- The identification and defining of potential sensitive receptors
- Prediction methods to be used (ISO 9613-2)
- Cumulative impact assessment requirements
- It also defines specific model input parameters
- Methods on how the results must be presented
- Assessment of Compliance (defining magnitude of noise levels)

Table 2.1: Summary of Sound Level Limits for Wind Farms (MoE)

<table>
<thead>
<tr>
<th>Wind speed (m/s) at 10 m height</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Turbine Sound Level Limits, Class 3 Area, dBA</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>43</td>
<td>45</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>Wind Turbine Sound Level Limits, Class 1 &amp; 2 Areas, dBA</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>49</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

(Class 3 area is typically a rural area in Canada)

The document used the \( \mathcal{L}_{A_{eq,1h}} \) noise descriptor to define noise levels.

It should be noted that these Sound Level Limits are included for the reader to illustrate the criteria used internationally. Due to the lack of local regulations specifically relevant to wind energy facilities this criteria will also be considered during the determination of the significance of the noise impact.
Figure 2.1: Summary of Sound Level Limits for Wind Turbines (MoE Canada)
3 CURRENT ENVIRONMENTAL SOUND CHARACTER

3.1 MEASUREMENT PROCEDURE

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

It should be noted that wind-induced noises are usually seen as unwanted noises, and samples reflecting significant background interference due to wind-induced noises are normally discarded. However, for the purpose of this study, it was opted to include these samples because the typical operating noise of the facility will only be emitted during times when wind-induced noise levels are relevant.

The equipment defined in Table 3.1 was used for gathering data:

Table 3.1: Equipment used to gather data

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model</th>
<th>Serial no</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM</td>
<td>Rion NL-32</td>
<td>01182945</td>
<td>23 January 2012</td>
</tr>
<tr>
<td>Microphone*</td>
<td>Rion UC-53A</td>
<td>315479</td>
<td>23 January 2012</td>
</tr>
<tr>
<td>Preamplifier</td>
<td>Rion NH-21</td>
<td>28879</td>
<td>23 January 2012</td>
</tr>
<tr>
<td>Calibrator</td>
<td>Rion NC-74</td>
<td>34494286</td>
<td>24 January 2012</td>
</tr>
<tr>
<td>Anemometer</td>
<td>Kestrel 4000</td>
<td>587391</td>
<td>Calibrated³</td>
</tr>
<tr>
<td>SLM</td>
<td>Svan 955</td>
<td>27324</td>
<td>31 January 2012</td>
</tr>
<tr>
<td>Microphone*</td>
<td>ACO 7052E</td>
<td>49596</td>
<td>31 January 2012</td>
</tr>
<tr>
<td>Preamplifier</td>
<td>Svantek SV12L</td>
<td>25685</td>
<td>31 January 2012</td>
</tr>
<tr>
<td>Weather Station</td>
<td>WH3081PC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Microphone fitted with the appropriate windshield.

³ Certificate of Conformity issued by Nielsen-Kellerman Co.
3.2 On-site Measurements

A number of 10 minute measurements were taken over two days during 27 and 29 May 2012 respectively. The sound level meter was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA.

The measurement location was selected to be away from any potential anthropogenic activities but still to reflect the typical ambient sound levels that the NSDs may experience in the area. The location of the ambient sound measurement points are highlighted in Figure 3.2.

Both measurement locations were rural with little other noises audible (apart from some crickets, birds and wind induced noises). As can be seen from Figure 3.1 and Figure 3.3 ambient sound levels in the area are very low during periods when wind speeds are low. A potential relationship between the statistical sound level (L_{A90}) and the average wind speed is however apparent.

![Ambient Sound Levels (10 minute bins) and Wind Speeds over time - KBN01](image)

**Figure 3.1: Ambient Sound Levels at KBN01**
Figure 3.2: Ambient measurement points selected near the proposed facility
Figure 3.3: Ambient Sound Levels at KBN02

Figure 3.4 illustrates the spectral frequencies in the area with different wind speeds. This clearly indicate the high acoustic energy contained in the lower frequencies.

Figure 3.4: Ambient Sound Levels – Frequency Analysis
3.3 Influence of Wind on Ambient Sound Levels

Unfortunately, current local regulations and standards do not consider changing ambient sound levels due to natural events, such as can be found near the coast or areas where wind-induced noises are prevalent. This is unfortunately unfeasible with wind energy facilities, as these facilities will only operate when the wind is blowing. It is therefore important that the impact of wind-induced noises be considered when determining the noise impact of such a facility. However, care should be taken when taking this approach due to other factors that complicate noise propagation from wind turbines (see also section 4.2).

Figure 3.5 illustrates this situation where the sound pressure levels associated with wind action increase as wind speeds increase. Actual sound levels ($L_{A90,f}$ and $L_{Aeq,i}$) measured at various locations in South Africa are also indicated in this figure (in yellow and dark red). Also indicated are the actual measurements as measured at the two locations at the proposed REF. As can be seen from this graph the measurements collected at Kangnas are well below other measurements. This mainly relates to the location where these measurements were collected, as more than 95% of the measurements were collected in areas with significant vegetation that increases noise levels as wind speeds increase.

![Figure 3.5: Background ambient sound levels associated with increased wind speeds](image)

Due to the lack of an acceptable guidelines in South Africa, the method proposed in the ETSU R97 (1996) will be adopted in this report. The curve developed is based on the noise measurements collected at a number of (relative quiet) sites in South Africa, at the same
time presenting the sound measurements collected at the project site. While most are not site specific it still illustrates the concept that as wind speeds increase, ambient sound levels will also increase.

To develop appropriate ambient sound levels at various wind speeds, the best curve was fitted through the $L_{A90}$ measurements (see also section 5.3.3).

It should be noted that most of these sound levels were measured at least 5 m away from any dwelling (or other reflecting surface). Where possible the measurement points were selected to be away from structures (buildings, trees, etc.) that could significantly impact the ambient sound levels during periods when wind is blowing.

It should be noted that there will always be a high variability with ambient sound levels as there are a number of factors that determines ambient sound levels, such as:

- Season and meteorological conditions (temperature, humidity, wind speed and direction);
- Annual precipitation and the presence of free water;
- Whether there are any other noise sources in the vicinity (such as a wind pumps);
- Type of trees and vegetation around dwelling (different type of grasses, conifers vs. broad-leaved trees, the habitat and food that it provides to animals and insects);
- The number, type and distance between trees and other structures. This is especially relevant when trees are close to buildings or in a forest;
- The material used in the construction of the dwelling;
- How well the dwelling was maintained; and
- What type and how many farm animals are in the vicinity of the measurement location.

### 3.4 Estimated Minimum Ambient Soundscape

There are little anthropogenic noises of significance in the vicinity of the proposed development and a (likely) ambient sound map was not developed.
4 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction of the facility and related infrastructure, as well as the operational phase of the activity.

4.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

4.1.1 Construction equipment

Construction activities include:

- Establish internal access roads - the internal road alignment is governed by the positioning of the wind turbines (i.e. Figure 7.3); 
- Site preparation activities will include clearance of vegetation at the footprint of each turbine and PV infrastructure. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construct foundations – it is expected that the volume of concrete required for each turbine foundation will be in the order 200 - 400 m³. Due to the volume of concrete that will be required, an on-site batching plant could be required to ensure a continuous concreting operation. The source of aggregate is yet undefined;
- Transport of components & equipment to site – all components will be brought to site in sections by means of flatbed trucks. Additionally, components of various specialized construction and lifting equipment are required on site to erect the wind turbines and will need to be transported to site. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.). The components required for the establishment of the overhead power line (including towers and cabling) will be transported to site as required;
- Establishment of laydown & hard standing areas - laydown areas will need to be established at each turbine position for the placement of wind turbine components. Laydown and storage areas will also be required to be established for the civil engineering construction equipment which will be required on site. Hard standing areas will need to be established for operation of the crane. Cranes of the size required to erect turbines are sensitive to differential movement during lifting operations and require a hard standing area;
- Erect turbines - a crane will be used to lift the tower sections into place and then the nacelle will be placed onto the top of the assembled tower. The next step will
be to assemble or partially assemble the rotor on the ground; it will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while the large crane will be needed to put it in place;

- Erect PV section - a crane will be used to assemble and lift the PV components into place;
- Construct substation - the underground cables carrying the generated power from the individual turbines will join at the substation. The construction of the substation would require a site survey; site clearing and leveling and construction of access road/s (where required); construction of a substation terrace and foundation; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas;
- Establishment of ancillary infrastructure - A workshop as well as a contractor's equipment camp may be required. The establishment of these facilities/buildings will require the clearing of vegetation and leveling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required;
- Connection of wind turbines and PV sections to the substation – the wind turbines and PV sections will be connected to the on-site substation via electrical cables, to be lain underground where possible. The installation of these cables will require the excavation of trenches of approximately 1 m deep within which they can then be laid. The underground cables will be planned to follow the internal access roads, where possible;
- A 132, 220 or 400 kV overhead power line to connect to Eskom’s existing infrastructure; and
- Site rehabilitation - once construction is completed and once all construction equipment is removed, the site will be rehabilitated where practical and reasonable.

The equipment likely to be required to complete the above tasks will typically include:
- excavator/graders, bulldozer(s), dump truck(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.

4.1.2 Material supply: Concrete batching plants and use of Borrow Pits
There exist two options for the supply of the concrete to the development site. These options are:

1. The transport of “ready-mix” concrete from the closest centre to the development.
2. The transport of aggregate and cement from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities. This would most likely be a movable plant.

For the purpose of the EIA, Option 2 was assumed as being the preferred option. Aggregate will be sourced from existing commercial borrow pits in the area.

4.1.3 Blasting

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relatively fast, results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control.

4.1.4 Traffic

A significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).
4.2 **Potential Noise Sources: Operational Phase**

The operation of photovoltaic cells and components are generally quiet, with the only source of noise being the transformers used.

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources generally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substations themselves, traffic (maintenance) as well as transmission line noise.

### 4.2.1 Wind Turbine Noise: Aerodynamic sources

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

1. Self-noise due to the interaction of the turbulent boundary layer with the blade trailing edge
2. Noise due to inflow turbulence (turbulence in the wind interacting with the blades)
3. Discrete frequency noise due to trailing edge thickness
4. Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade)
5. Noise generated by the rotor tips

Noise due to aerodynamic instabilities (mechanisms 3 and 4) can be reduced to insignificant levels by careful design. The other mechanisms are an inescapable consequence of the aerodynamics of the turbine that produces the power and between them they will make up most, if not all, of the aerodynamic noise radiated by the wind turbine. The relative contribution of each source will depend upon the detailed design of the turbine and the wind speed and turbulence at the time.

The mechanisms responsible for tip noise (mechanism 5) are currently under investigation, but it appears that methods for its control through design of the tip shape might be available. Self-noise (mechanism 1) is most significant at low wind speeds, whereas noise due to inflow turbulence (mechanism 2) becomes the dominant source at the higher wind speeds. Both mechanisms increase in strength as the wind speed increases, particularly inflow turbulence. The overall result is that at low to moderate wind speeds, the noise from a fixed speed wind turbine increases at a rate of 0.5-1.5 dBA /m/s

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*Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*
up to a maximum at wind speeds of 7 -12 m/s (noise generated by the WTG does not increase significantly at wind speeds above 12 m/s).

Therefore, as the wind speed increases, noises created by the wind turbine also increases. At a low wind speed the noise created by the wind turbine is generally (relatively) low, and increases to a maximum at a certain wind speed when it either remains constant, increases very slightly or even drops as illustrated in Figure 4.1.

While the developer has not yet decided on a wind turbine to use at this facility, they highlighted that they could be considering a 1.5 – 4.0 MW wind turbine. This wind turbine could be at a 120 meter hub height with blades up to 60 meters. Because the developer did not provide the make and model of the likely wind turbine or octave sound power levels, octave sound power levels were obtained from the Environmental Noise Impact Assessment of the Project Blue WEF, where sound levels for a worst-case scenario wind turbine was defined. The worse-case noise curve compared to other wind turbines is illustrated in Figure 4.1. Based on these curves sound power emission levels were calculated for a worse-case conceptual wind turbine for noise modelling purposes.

![Figure 4.1: Noise Emissions Curve of a number of different wind turbines (figure for illustration purposes only)](image)

Sound power emissions (in octave sound power levels) for this worst-case conceptual noise source are presented in Table 7.3. The propagation model makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions providing a higher accuracy than models that only use the total sound power level.
4.2.2 Wind Turbine: Mechanical sources

Mechanical noise is generally perceived within the emitted noise from wind turbines as an audible tone(s) that is subjectively more intrusive than a broad band noise of the same sound pressure level. Sources for this noise are generally associated with: the gearbox and the tooth mesh frequencies of the step up stages; generator noise caused by coil flexure of the generator windings that is associated with power regulation and control; generator noise caused by cooling fans; and control equipment noise caused by hydraulic compressors for pitch regulation and yaw control.

Tones are noises with a narrow sound frequency composition (e.g. the whine of an electrical motor). Annoying tones can be created in numerous ways: machinery with rotating parts such as motors, gearboxes, fans and pumps often create tones. An imbalance or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones. Pulsating flows of liquids or gases can also create tones, which may be caused by combustion processes or flow restrictions. The best and most well-known example of a tonal noise is the buzz created by a flying mosquito.

Where complaints have been received due to the operation of wind farms, tonal noise from the installed wind turbines appears to have increased the annoyance perceived by the complainants and indeed has been the primary cause for complaint.

However, tones were normally associated with the older models of turbines. All turbine manufacturers have started to ensure that sufficient forethought is given to the design of quieter gearboxes and the means by which these vibration transmission paths may be broken. Through the use of careful gearbox design and/or the use of anti-vibration techniques, it is possible to minimise the transmission of vibration energy into the turbine supporting structure.

The benefits of these design improvements have started to filter through into wind farm developments which are using these modified wind turbines. New generation wind turbine generators should not emit any clearly distinguishable tones.

4.2.3 Transformer noises (Substations)

Also known as magnetostriction; this is when the sheet steel used in the core of the transformer tries to change shape when being magnetised. When the magnetism is taken

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away, the shape returns, only to try and deform in a different manner when the polarity is changed.

This deformation is not uniform; consequently it varies all over a sheet. With a transformer core being composed of many sheets of steel, these deformations are taking place erratically all over each sheet, and each sheet is behaving erratically with respect to its neighbour. The resultant is the “hum” frequently associated with transformers. While this may be a soothing sound in small home appliances, various complaints are logged in areas where people stay close to these transformers. At a voltage frequency of 50 Hz, these “vibrations” takes place 100 times a second, resulting in a tonal noise at 100Hz. This is normally not an issue if the substation is further than 200 meters from a potentially sensitive receptor.

**This is a relatively easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer equipment and will not be considered further in the EIA study.**

### 4.2.4 Transmission Line Noise (Corona noise)

Corona noise is caused by the partial breakdown of the insulation properties of air surrounding the conducting wires. It can generate an audible and radio-frequency noise, but generally only occurs in humid conditions as provided by fog or rain. A minimum line potential of 70 kV or higher is generally required to generate corona noise depending on the electrical design. Corona noise does not occur on domestic distribution lines.

Corona noise has two major components: a low frequency tone associated with the frequency of the AC supply (100 Hz for 50 Hz source) and broadband noise. The tonal component of the noise is related to the point along the electric waveform at which the air begins to conduct. This varies with each cycle and consequently the frequency of the emitted tone is subject to great fluctuations. Corona noise can be characterised as broadband ‘crackling’ or ‘buzzing’, but fortunately it is generally only a feature during fog or rain.

It will not be further investigated, as corona discharges results in:

- Power losses
- Audible noises
- Electromagnetic interference
- A purple glow
- Ozone production
- Insulation damage
In addition this is associated with high voltage transmission lines, and not the lower voltage distribution lines proposed for construction by the developer.

As such, Electrical Service Providers (such as Eskom) go to great lengths to design power transmission equipment to minimise the formation of corona discharges. In addition, it is an infrequent occurrence with a relative short duration compared to other operational noises. At the relative low voltages proposed for this project Corona noises would not be an issue.

4.2.5 Low Frequency Noise\(^6\)

4.2.5.1 Background and Information

Low frequency sound is the term used to describe sound energy in the region below ~200Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range. Infrasound is often used to describe sound energy in the region below 20Hz.

Almost all noise in the environment has components in this region although they are of such a low level that they are not significant (wind, ocean, thunder). See also Figure 4.2, which indicates the sound power levels in the different octave bands from measurements taken at different wind speeds with no other audible noise sources present. Sound that has most of its energy in the 'infrasound' range is only significant if it is at a very high level, far above normal environmental levels.

4.2.5.2 The generation of Low Frequency Sounds

Due to the low rotational rates of the blades of a WTG as well as the size of these blades, significant acoustic energy is radiated by large wind turbines in the infrasonic range. It should be noted that a number of studies highlighted that these sounds are below the threshold of perception (BWEA, 2005).

4.2.5.3 Detection of Low Frequency Sounds

The levels of infrasound radiated by the largest wind turbines are very low in comparison to other sources of acoustic energy in this frequency range such as sonic booms, shock waves from explosions, etc. The danger of hearing damage from wind turbine low-frequency emissions is remote to non-existent. However, sounds in a frequency range less than 100Hz can, under the right circumstances, be responsible for annoying nearby residents. However, except very near the source, most people outside cannot detect the presence of low-frequency noise from a wind turbine. It should be noted that there are people who are more sensitive to these low frequency sounds.

4.2.5.4 Measurement, Isolation and Assessment of Low Frequency Sounds

There remains significant debate regarding the noise from WTGs, public response to that noise, as well as the presence or not of low frequency sound and how it affects people.
While low frequency sounds can be measured, it is far more difficult to isolate low frequency sounds due to the numerous sources that generate these sounds.

Unfortunately, there isn’t a standardised test, nor an assessment procedure available for the assessment of low frequency sounds, neither is there an accepted methodology on how low frequency sounds can be modelled or predicted. This is because low frequency sound can travel large distances, and are present all around us, with a significant component generated by nature itself (ocean, wind, etc.).

SANS 10103 proposes a method to identify whether low frequency noise could be an issue. It proposes that if the difference between the A-frequency weighted and the C-frequency weighted equivalent continuous ($L_{Aeq} > L_{Ceq}$) sound pressure levels is greater than 10 dB, a predominant low frequency component may be present. However, in all cases existing acoustic energy in low frequencies associated with wind must be considered.

4.2.5.5 Summary: Low Frequency Noise

Low frequency noise is always present around us as it is produced by both man and nature. While problems have been associated with older downwind wind turbines in the 1980s, this has been considered by the wind industry and modern upwind turbines do not suffer from the same problems.

4.2.6 Amplitude modulation

Although very rare, there is one other characteristic of wind turbine sound that increases the sleep disturbance potential above that of other long-term noise sources. The amplitude modulation of the sound emissions from the wind turbines creates a repetitive rise and fall in sound levels synchronised to the blade rotation speed, sometimes referred to as a “swish” or “thump”.

Pederson (2003) highlighted a weak correlation between sound pressure level and noise annoyance caused by wind turbines. Residents complaining about wind turbines noise perceived more sound characteristics than noise levels. People were able to distinguish between background ambient sounds and the sounds that the blades made. The noise produced by the blades lead to most complaints. Most of the annoyance was experienced between 16:00 and midnight. This could be an issue as noise propagation modelling would

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7 BWEA, 2005
8 Renewable Energy Research Laboratory, 2006; Audiology Today, 2010; HGC Engineering, 2007; Whitford, 2008; Noise-con, 2008; DEFRA, 2007; Bowdler, 2008
be reporting an equivalent, or “average” sound pressure level, a parameter that ignores the “character” of the sound.

Unfortunately, the mechanism of amplitude modulated noises is not known although various possible reasons have been put forward. Although the prevalence of complaints about amplitude modulation is relatively small, it is not clear whether this is because it does not occur often enough or whether it is because housing is not in the right place to observe it. Furthermore, the fact that the mechanism is unknown means that it is not possible to predict when or whether it will occur.

Fortunately, even though there is thousands of wind turbine generators in the world, amplitude modulation is one subject receiving the least complaints and due to these very few complaints, little research went into this subject.

It is included in this report to highlight all potential risks, albeit extremely low risks such as this (low significance due to very low probability).
5 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

5.1 Noise Impact on Animals

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on animals. While aircraft noise have a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources.

Overall, the research suggests that species differ in their response to:

- Various types of noise
- Durations of noise
- Sources of noise

A general animal behavioural reaction to aircraft noise is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed
- whether there is one animal or a group
- whether there have been some previous exposures

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

From these and other studies the following can be concluded:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate. This is not relevant to wind energy facilities because the turbines do not generate impulsive noises close to these sound levels.
- Animals of most species exhibit adaptation with noise, including aircraft noise and sonic booms (far worse than noises associated with Wind Turbines).
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate.
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals.

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9 Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010
5.1.1 Domestic Animals
It has been observed that most domestic animals are generally not bothered by noise, excluding most impulsive noises. In the intensity range that a Wind Turbine generates noise, it should not impact on any domestic animal.

5.1.2 Wildlife
Depending on the turbine, some may create significant enough acoustic energy in the low frequency range that might impact on animals that makes use of vibrations to hunt. But in general, most anthropogenic activities have already disturbed sensitive animals that might have been impacted by the noise from a wind turbine.

Noise impacts are therefore very highly species dependent. Studies showed that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area.

Unfortunately, there are only a few specific studies discussing the potential impacts of noise associated wind turbines on wildlife. It is suspected that noises from wind turbines may mask the sounds of a predator approaching; similarly predators depending on hearing would not be able to locate their prey. However, due to significant background ambient sounds during periods when the wind turbines are operating (wind induced noises), the potential impact from a wind turbine on such animals are questioned.

5.2 Why noise concerns communities\(^\text{10}\)
Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:
- Hinders speech communication
- Impedes the thinking process
- Interferes with concentration
- Obstructs activities (work, leisure and sleeping)
- Presents a health risk due to hearing damage

\(^{10}\) World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009
However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:
- The character/nature of the noise;
- Ambient sound levels and the ambient sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor;
- The attitude of the receptor about the emitter (noise source).

### 5.3 Impact Assessment Criteria

#### 5.3.1 Overview: Common characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:
- Intensity
- Loudness
- Annoyance
- Offensiveness

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.
The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

5.3.2 Noise criteria of concern
The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the Department of Environmental Affairs (June 2006) in terms of the NEMA, SANS 10103:2008 as well as guidelines from the World Health Organization.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- **Increase in noise levels**: People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. See also Figure 5.1.

- **Zone Sound Levels**: Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also Table 5.1.

- **Absolute or total noise levels**: Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

![Figure 5.1: Criteria to assess the significance of impacts stemming from noise](image)
In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also Table 5.1). It provides the equivalent ambient noise levels (referred to as Rating Levels), \( L_{\text{req,d}} \) and \( L_{\text{req,n}} \) during the day and night respectively to which different types of developments may be exposed. For rural areas the Zone Sound Levels are:

- Day (06:00 to 22:00) - \( L_{\text{req,d}} = 45 \text{ dBA} \); and
- Night (22:00 to 06:00) - \( L_{\text{req,n}} = 35 \text{ dBA} \).

For the purpose of this Environmental Noise Impact Assessment the Zone Sound Levels as proposed in SANS 10103:2008 would be adopted to be acceptable to the noise sensitive developments in the area during periods when the wind speeds are less than 4 m/s.

However, setting a fixed rating level is seldom correct, as ambient sound levels would differ from location to location, season to season and would also depend on the time of day. As an example, seasonal variations due to insect calls is easily measurable, with summer ambient night-time sounds from insects frequently approaching 45 dBA, where typical winter night-time ambient sounds at the same point may only be 25 – 30 dBA (low wind conditions). The prevailing ambient sound levels are therefore of critical importance, allowing for additional evaluation criteria on how the intruding noise(s) may influence the ambient sound levels.

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient sound level caused by an intruding noise. If \( \Delta \) is the increase in sound level, the following criteria are of relevance:

- \( \Delta \leq 3 \text{ dBA} \): An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient sound level would not be noticeable.

- \( 3 < \Delta \leq 5 \text{ dBA} \): An increase of between 3 dBA and 5 dBA will elicit ‘little’ community response with ‘sporadic complaints’. People will just be able to notice a change in the sound character in the area.

- \( 5 < \Delta \leq 15 \text{ dBA} \): An increase of between 5 dBA and 15 dBA will elicit a ‘medium’ community response with ‘widespread complaints’. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be ‘strong’ with ‘threats of community action’.
Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National Noise Control Regulations).

Table 5.1: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

<table>
<thead>
<tr>
<th>Type of district</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent continuous rating level ($L_{eq,TA}$) for noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outdoors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day/night $L_{Req,d}$</td>
<td>45</td>
<td>45</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Daytime $L_{Req,d}$</td>
<td>50</td>
<td>50</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Night-time $L_{Req,n}$</td>
<td>55</td>
<td>55</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td><strong>Indoors, with open windows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day/night $L_{Req,d}$</td>
<td>60</td>
<td>60</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Daytime $L_{Req,d}$</td>
<td>65</td>
<td>65</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Night-time $L_{Req,n}$</td>
<td>70</td>
<td>70</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>50</td>
</tr>
</tbody>
</table>

5.3.3 Determining appropriate Zone Sound Levels

SANS 10103:2008 unfortunately does not cater for instances when background ambient sound levels change due to the impact of external forces. Locations close (more than 500 meters from coastline) from the sea for instance always has an ambient sound level exceeding 35 dBA, and, in cases where the sea is rather turbulent, it can easily exceed 45 dBA. Similarly, noise induced by high winds is not considered in the SANS standard.

Setting noise limits relative to the ambient sound level is relatively straightforward when the prevailing ambient sound level and source level are constant. However, wind turbines only start to operate when wind speeds exceed 3 m/s. Noise emissions therefore relates to the wind speed and similarly, the environment in which they are heard also depends upon the strength of the wind and the noise associated with its effects. It is therefore necessary to derive an ambient sound level that is indicative of the noise environment at the receiving property for different wind speeds so that the turbine noise level at any particular wind speed can be compared with the ambient sound level in the same wind conditions.
Therefore, when assessing the overall noise levels emitted by a WEF, it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35m/s measured at the hub height of a wind turbine. However, ETSU-R97 (1996) proposes that noise limits only be placed up to a wind speed of 12 m/s for the following reasons:

1. Wind speeds are not often measured at wind speeds greater than 12 m/s at 10m height;
2. Reliable measurements of background ambient sound levels and turbine noise will be difficult to make in high winds due to the effects of wind noise on the microphone and the fact that one could have to wait several months before such winds were experienced;
3. Turbine manufacturers are unlikely to be able to provide information on sound power levels at such high wind speeds for similar reasons; and
4. If a wind farm meets noise limits at wind speeds lower than 12m/s, it is most unlikely to cause any greater loss of amenity at higher wind speeds. Turbine noise levels increase only slightly as wind speeds increase; however, background ambient sound levels increase significantly with increasing wind speeds due to the force of the wind.

An ambient sound vs. wind speed regression curve is illustrated in Figure 3.5. For the purpose of the EIA, Figure 3.5 will be considered, the change in sound levels that the receptors may experience together with the zone sound levels as stipulated in SANS 10103:2008. Based on this the recommended ambient noise levels associated with specific wind speeds are also defined in Table 5.6.

The proposed acceptable noise levels were developed as follows:

- All data collected were analysed and the best curve fitted to the $L_{A90}$ data (minimum error – blue line). In this case a linear regression resulted in the least squares error.
- 2 db was added as recommended by ETSU-R97 to convert the $L_{A90}$ values to $L_{Aeq}$ values – red line. As can be seen from Figure 3.5 the derived ambient sound levels ($L_{Aeq}$) may be significantly less than the measured $L_{Aeq}$ values.
- As the Noise Control Regulations refers to acceptable rating levels of 35 dBA for rural areas, if the calculated ambient sound levels were less than 35 dBA, 35 dBA was selected (refer also Table 5.6).
Note that the National Noise Control Regulations defines a disturbing noise as a noise that changes the ambient sound level with more than 7 dB. As such the selected criteria are more conservative than potentially allowable in terms of the regulations. This will however be considered during the Noise Impact Assessment.

5.3.3.1 Relationship between wind speed at different levels and noise at ground level

Generally, as the height above ground level increases, wind speed also increases. For acoustical purposes prediction of the wind speed at hub height is based on the wind speed $v_{\text{ref}}$ at the reference height (normally 10 meters) for wind speed measurements, extrapolated to a wind speed $v_h$ at hub height, using the widely used formula:

$$v_h = v_{\text{ref}} \times \frac{\log\left(\frac{h}{m}\right)}{\log\left(\frac{h_{\text{ref}}}{m}\right)}$$

However, depending on topographical layout, this relationship may not be true at all times. Authors such as Van den Berg (2003) indicated that wind speeds at hub height could be significantly higher than expected, at the same time being significantly higher than ground level wind speeds. In these cases, the wind turbines are operational and emitting noise, yet the wind induced ambient sound levels is less than expected (less masking of turbine noise).

This should be considered when evaluating the significance of the impact, especially when the wind turbines are situated on a hill, with the prevailing wind direction being in the direction of potential sensitive receptors living in a valley downwind of the WEF, as well as when the facility is to be developed in an area where temperature inversions are known to occur.

In such instances it is proposed by this author that the precautionary approach be considered, and when there is one or more turbine within 1,000 metres from a downwind receptor(s), that the probability of this impact occurring be elevated with at least one step/factor (e.g. from Likely to Highly Likely).

Similarly, if the area frequently experience weather phenomena such as temperature inversion\(^{11}\), the developer should consider this. Generally, this information is site specific and not available for remote areas, and as a result it is difficult to consider in this study.

\(^{11}\) http://en.wikipedia.org/wiki/Inversion_(meteorology)
5.3.4 Annoyance associated with Wind Energy Facilities

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that non-acoustic factors play a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity.

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in Figure 5.2, are recommended in an European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance.

![Figure 5.2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling](image)

This can be used in Environmental Health Impact Assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise climate.

5.3.5 Other noise sources of significance

In addition, other noise sources that may be present should also be considered. During the day, people are generally bombarded with the sounds from numerous sources considered “normal”, such as animal sounds, conversation, amenities and appliances.
(TV/Radio/CD playing in background, computer(s), freezers/fridges, etc). This excludes activities that may generate additional noise associated with normal work.

At night, sounds that are present are natural sounds from animals, wind as well as other sounds we consider "normal", such as the hum from a variety of appliances (magnetostriction) drawing standby power, freezers and fridges.

**Figure 5.3** illustrates the sound levels associated with some equipment or in certain rooms. This is however more for illustrative purposes, as there are many manufacturers with different equipment, each with a different noise emission character.
5.3.6 Determining the Significance of the Noise Impact

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value as defined in the third column in the tables below.

The impact consequence is determined by summing the scores of Magnitude (Table 5.2), Duration (Table 5.3) and Spatial Extent (Table 5.4). The impact significance (see sections 5.3.7 and 5.3.8) is determined by multiplying the Consequence result with the Probability score (Table 5.5).

An explanation of the impact assessment criteria is defined in the following tables.

### Table 5.2: Impact Assessment Criteria - Magnitude

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Increase in average sound pressure levels between 0 and 3 dB from the expected wind induced ambient sound level (proposed rating level - Table 5.6). No change in ambient sound levels discernable. Total projected noise level is less than the Zone Sound Level in wind-still conditions.</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>Increase in average sound pressure levels between 3 and 5 dB from the (expected) ambient sound level (proposed rating level - Table 5.6). The change is barely discernable, but the noise source might become audible.</td>
<td>4</td>
</tr>
<tr>
<td>Medium</td>
<td>Increase in average sound pressure levels between 5 and 7 dB from the (expected) ambient sound level (proposed night rating level - Table 5.6). Sporadic complaints expected. Any point where the zone sound levels are exceeded during wind still conditions.</td>
<td>6</td>
</tr>
<tr>
<td>High</td>
<td>Increase in average sound pressure levels between 7 and 10 dB from the (expected) ambient sound level (proposed night rating level - Table 5.6). Medium to widespread complaints expected.</td>
<td>8</td>
</tr>
<tr>
<td>Very High</td>
<td>Increase in average sound pressure levels higher than 10 dBA from the (expected) ambient sound level (proposed night rating level - Table 5.6). Change of 10 dBA is perceived as ‘twice as loud’, leading to widespread complaints and even threats of community or group action. Any point where noise levels exceed 65 dBA at any receptor.</td>
<td>10</td>
</tr>
</tbody>
</table>

### Table 5.3: Impact Assessment Criteria - Duration

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary</td>
<td>Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.</td>
<td>1</td>
</tr>
<tr>
<td>Short term</td>
<td>Impacts that are predicted to last only for the duration of the construction period.</td>
<td>2</td>
</tr>
<tr>
<td>Long term</td>
<td>Impacts that will continue for the life of the Project, but ceases when the Project stops operating.</td>
<td>4</td>
</tr>
</tbody>
</table>
Permanent Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.

<table>
<thead>
<tr>
<th>Classification of the physical and spatial scale of the impact</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site</strong></td>
<td>The impacted area extends only as far as the activity, such as footprint occurring within the total site area.</td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td>The impact could affect the local area (within 1,000 m from site).</td>
</tr>
<tr>
<td><strong>Regional</strong></td>
<td>The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.</td>
</tr>
<tr>
<td><strong>National</strong></td>
<td>The impact could have an effect that expands throughout the country (South Africa).</td>
</tr>
<tr>
<td><strong>International</strong></td>
<td>Where the impact has international ramifications that extend beyond the boundaries of South Africa.</td>
</tr>
</tbody>
</table>

Table 5.5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improbable</strong></td>
<td>The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).</td>
<td>1</td>
</tr>
<tr>
<td><strong>Possible</strong></td>
<td>The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25 %.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Likely</strong></td>
<td>There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50 %.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Highly Likely</strong></td>
<td>It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined to be between 50 % to 75 %.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Definite</strong></td>
<td>The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100 %.</td>
<td>5</td>
</tr>
</tbody>
</table>

5.3.7 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures).

Significance without mitigation is rated on the following scale:

- **SR < 30** Low (L): Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
- **30 < SR < 60** Medium (M): Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
- **SR > 60** High (H): Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An
impact which could influence the decision about whether or not to proceed with the project.

5.3.8 Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

<table>
<thead>
<tr>
<th>SR &lt; 30</th>
<th>Low (L)</th>
<th>The impact is mitigated to the point where it is of limited importance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 &lt; SR &lt; 60</td>
<td>Medium (M)</td>
<td>Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.</td>
</tr>
<tr>
<td>SR &gt; 60</td>
<td>High (H)</td>
<td>The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.</td>
</tr>
</tbody>
</table>

5.4 Expression of the Noise Impacts

The noise impacts can be expressed in terms of total ambient noise levels as well as the increase in present background ambient sound levels caused by noise emissions from the proposed projects.

Predicted ambient sound levels as well as change in ambient sound levels will be presented in appropriate contours of constant sound pressure levels.

For modelling and assessing the potential noise impact the values as proposed in Table 5.6 as well as the MoE Noise Guidelines (see Table 2.1) will be considered.

<table>
<thead>
<tr>
<th>Table 5.6: Proposed ambient sound levels and acceptable rating levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 meter Wind Speed (m/s)</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
6 METHODS: CALCULATION OF FUTURE NOISE EMISSIONS DUE TO PROPOSED PROJECT

6.1 NOISE EMISSIONS INTO THE SURROUNDING ENVIRONMENT

The noise emissions into the environment from the various sources as defined by the project developer were calculated for the construction and operational phases in detail, using the sound propagation models described by SANS 10357 (Construction) as well as ISO 9613-2 (Operation).

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The meteorological conditions in terms of Pasquill stability (considering refraction effects due to wind direction – SANS only);
- The operational details of the proposed project, such as the location of each Wind Turbine Generator;
- Topographical layout;
- Meteorological correction of 0 dBA; and
- Acoustical characteristics of the ground. Mixed ground conditions were modelled, as the area where the facility is proposed to be constructed is well vegetated and sufficiently uneven to allow the consideration of mixed ground conditions (50% of area is soft for both the SANS and ISO models). This is also the point where the SANS and ISO model differ significantly in the method how attenuation is calculated, with the ISO model largely minimising ground attenuation due to the height of the point source \(\text{[the wind turbines in this case]}\). The result is that noises originating from noise sources situated very high would be attenuated far less due to ground effects than noises originating closer to the ground surface using the ISO model.

The noise emission into the environment due to additional traffic will be calculated using the sound propagation model described in SANS 10210. Corrections such as the following will be considered:

- Distance of receptor from the road;
- Road construction material;
- Average speeds;

• Types of vehicles used; and
• Ground acoustical conditions.
7 RESULTS AND IMPACT ASSESSMENT

7.1 CONSTRUCTION PHASE IMPACT

Construction activities are highly dependent on the final operational layout. A layout as provided by the developer is presented in Figure 7.3. As can be seen from this layout a number of different activities might take place close to a potentially sensitive receptor, each with a specific potential impact. The activities have been defined in detail in section 4.1.

The approach taken is phase independent, as the graph developed would be relevant to any of the three phases, as it relates to the distance of the construction activities from the closest potential noise-sensitive receptor.

7.1.1 Description of Construction Activities Modelled

The following construction activities are assumed to take place simultaneously:

- General work at the workshop area. This would be activities such as equipment maintenance, off-loading and material handling. All vehicles will travel to this site where most equipment and material will be off-loaded (general noise, crane). Material, such as aggregate and building sand, will be taken directly to the construction area (foundation establishment). It was assumed that activities will be taking place for 16 hours during the 16 hour day time period.

- Surface preparation prior to civil work. This could be the removal of topsoil and levelling with compaction, or the preparation of an access road (bulldozer/grader). Activities will be taking place for 8 hours during the 16 hour day time period.

- Preparation of foundation area (sub-surface removal until secure base is reached – excavator, compaction, and general noise). Activities will be taking place for 10 hours during the 16 hour day time period.

- Pouring and compaction of foundation concrete (general noise, electric generator/compressor, concrete vibration, mobile concrete plant, TLB). As foundations must be poured in one go, the activity is projected to take place over the full 16 hour day time period.

- Erecting of the wind turbine generator and PV panels (general noise, electric generator/compressor and a crane). Activities will be taking place for 16 hours during the 16 hour day time period.

- Traffic on the site (trucks transporting material, aggregate/concrete, work crews) moving from the workshop/store area to the various activity sites. All vehicles to travel at less than 60 km/h, with a maximum of five (5) trucks and vehicles per hour to be modelled travelling to the areas where work is taking place (red line).
There will be a number of smaller equipment, but the addition of the general noise source (at each point) covers most of these noise sources. It has been modelled that all equipment would be operating under full load (generate the most noise) and that atmospheric conditions would be ideal for sound propagation.

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Below is a list (and reasons) of construction activities that might occur during night time:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore it is hard to judge beforehand if a construction team would be required to work late at night.

As it is unknown where the different activities may take place, it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact) at all locations where wind turbines may be erected, calculating how this may impact on potential noise-sensitive developments (Table 7.1) as well as mapping this modelled construction activity over distance (Figure 7.1). Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated in Figure 7.2.

The various sound power levels of the equipment used can be found in Appendix A.

7.1.2 Results: Construction Phase

The scenario as defined in the previous section (section 7.1) was modelled with the output presented in Figure 7.1 and Figure 7.2. Modelled noise levels are defined for the proposed layout in Table 7.1 with the impact tables presented in Table 7.2.

Only the calculated day time ambient noise levels are presented, as construction activities that might impact on sensitive receptors should be limited to the 06:00 – 22:00 time period. The worst case scenario is presented with all activities taking place simultaneously at each proposed wind turbine location during wind-still conditions, in good sound propagation conditions (20°C and 80% humidity).
**Figure 7.1:** Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place.

**Figure 7.2:** Construction noise: Projected Road Traffic Noise Levels as distances increase between a conceptual NSD and access roads (5 LDV and 5x Trucks travelling at 50 km/hr on a gravel road).

*Figure 7.1* can also be used to estimate the potential noise impact should the developer select the development of onsite borrow-pits. If the quarrying activities take place further than 500 meters during the day from the NSD, the significance of the impact (*Table 7.1*) will remain low.
### Table 7.1: Construction: Defining noise impact on Receptor (dBA)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Estimated Daytime Ambient Sound Level</th>
<th>Day Noise Level</th>
<th>Change From ambient sound level</th>
<th>Above zone sound level of 45 dBA?</th>
<th>Defining Significance of Noise Impact (See Table 5.2 - Table 5.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Magnitude</td>
</tr>
<tr>
<td>NSD01</td>
<td>28</td>
<td>33.7</td>
<td>15.7</td>
<td>No</td>
<td>10</td>
</tr>
<tr>
<td>NSD02</td>
<td>28</td>
<td>33.7</td>
<td>15.7</td>
<td>No</td>
<td>10</td>
</tr>
<tr>
<td>NSD03</td>
<td>28</td>
<td>33.7</td>
<td>15.7</td>
<td>No</td>
<td>10</td>
</tr>
<tr>
<td>NSD04</td>
<td>28</td>
<td>40.0</td>
<td>22.0</td>
<td>No</td>
<td>10</td>
</tr>
</tbody>
</table>

7.1.3 Impact Assessment: Construction Phase

The impact assessment for the various construction activities, for both the solar and wind components, that may impact on the surrounding environment is presented in the Table 7.2.

### Table 7.2: Impact Assessment: Construction Activities without Mitigation

<table>
<thead>
<tr>
<th>Nature:</th>
<th>Numerous simultaneous construction activities that could impact on receptors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Rating Level</td>
<td>Rural district with little road traffic (excluding construction traffic): 45 dBA outside during day (refer Table 5.1). Use of $L_{eq,d}$ of 45 dBA for rural areas. Ambient sound level = 28 dBA</td>
</tr>
<tr>
<td>Extent ($\Delta L_{A_{eq,d}}$ &gt; 7dBA)</td>
<td>Regional – Change in ambient sound levels could extend further than 1,000 meters from activity (3).</td>
</tr>
<tr>
<td>Duration</td>
<td>Temporary – Noisy activities in the vicinity of the receptors would last a portion of the construction period (1).</td>
</tr>
<tr>
<td>Magnitude</td>
<td>See Table 7.1. Ambient noise levels &lt; Rating Level, however change from Ambient sound levels very high when construction activities takes place, and may be detectable at all NSDs in quiet times. Very high (10).</td>
</tr>
<tr>
<td>Probability</td>
<td>While the construction activities will be audible it is unlikely that anyone will complain. Unlikely (1).</td>
</tr>
<tr>
<td>Significance</td>
<td>Low (14).</td>
</tr>
<tr>
<td>Status</td>
<td>Negative.</td>
</tr>
<tr>
<td>Reversibility</td>
<td>High.</td>
</tr>
<tr>
<td>Irreplaceable loss of resources?</td>
<td>Not relevant.</td>
</tr>
<tr>
<td>Comments</td>
<td>-</td>
</tr>
<tr>
<td>Can impacts be mitigated?</td>
<td>Yes, though mitigation not required.</td>
</tr>
<tr>
<td>Mitigation:</td>
<td>Not required.</td>
</tr>
<tr>
<td>Effectiveness of mitigation:</td>
<td>Not applicable, mitigation not required</td>
</tr>
<tr>
<td>Cumulative impacts:</td>
<td>This impact is cumulative with existing ambient sounds and other noisy activities conducted in the same area.</td>
</tr>
<tr>
<td>Residual Impacts:</td>
<td>This impact will only disappear once construction activities cease.</td>
</tr>
</tbody>
</table>

As can be seen from Table 7.2 and Figure 7.1 the potential noise impact is considered to be insignificant. This is because of the distance of the proposed activities to the noise-sensitive developments. Figure 7.1 also shows that if any activities take place closer than 600 meters from NSDs it will exceed the rating level, increasing the probability of noise complaints be registered.

---

14 Noise level was calculated using the SANS methods discussed in this report.
7.2 OPERATIONAL PHASE IMPACT: KANGNAS WEF

7.2.1 Description of Operational Activities Modelled

Typical day time activities would include:
- The operation of the various Wind Turbines,
- Maintenance activities (relative insignificant noise source).

However, the day time period (working day) was not considered for the EIA because noise generated during the day by the WEF is generally masked by other noises from a variety of sources surrounding potentially noise-sensitive developments. The reader is also referred to Figure 5.3.

However, times when a quiet environment is desired (at night for sleeping, weekends etc.) ambient sound levels are more critical. The time period investigated therefore would be a quieter period, normally associated with the 22:00 – 06:00 timeslot. Maintenance activities would therefore not be considered, concentrating on the ambient sound levels created due to the operation of the various Wind Turbine Generators (WTGs) at night.

The developer indicated that the wind turbine to be used is yet unknown, but that the WEF would likely use 1.5 – 4.0 MW wind turbines. For the purpose of the modelling the sound emission levels of a worst-case conceptual noise source was considered. The calculated octave sound power levels of this conceptual noise source are presented in Table 7.3.

### Table 7.3: Octave Sound Power Emission Levels used for modelling

<table>
<thead>
<tr>
<th>Wind Speed at 10 m (m/s)</th>
<th>63 (dB)</th>
<th>125 (dB)</th>
<th>250 (dB)</th>
<th>500 (dB)</th>
<th>1000 (dB)</th>
<th>2000 (dB)</th>
<th>4000 (dB)</th>
<th>LWA (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>106.4</td>
<td>100.5</td>
<td>97.4</td>
<td>92.3</td>
<td>87.6</td>
<td>85.3</td>
<td>81.5</td>
<td>94.0</td>
</tr>
<tr>
<td>4</td>
<td>112.2</td>
<td>106.2</td>
<td>102.7</td>
<td>98.2</td>
<td>93.0</td>
<td>90.3</td>
<td>86.0</td>
<td>100.4</td>
</tr>
<tr>
<td>5</td>
<td>116.5</td>
<td>110.6</td>
<td>107.5</td>
<td>102.4</td>
<td>97.7</td>
<td>95.4</td>
<td>91.6</td>
<td>105.1</td>
</tr>
<tr>
<td>6</td>
<td>118.6</td>
<td>112.7</td>
<td>109.6</td>
<td>104.5</td>
<td>99.8</td>
<td>97.5</td>
<td>93.7</td>
<td>107.2</td>
</tr>
<tr>
<td>7</td>
<td>118.6</td>
<td>112.7</td>
<td>109.6</td>
<td>104.5</td>
<td>99.8</td>
<td>97.5</td>
<td>93.7</td>
<td>107.2</td>
</tr>
<tr>
<td>8</td>
<td>118.6</td>
<td>112.7</td>
<td>109.6</td>
<td>104.5</td>
<td>99.8</td>
<td>97.5</td>
<td>93.7</td>
<td>107.2</td>
</tr>
<tr>
<td>9</td>
<td>118.6</td>
<td>112.7</td>
<td>109.6</td>
<td>104.5</td>
<td>99.8</td>
<td>97.5</td>
<td>93.7</td>
<td>107.2</td>
</tr>
</tbody>
</table>

**Source:** Calculated worst-case sound power levels based on total sound level emissions as used in the Project Blue WEF Environmental Noise Impact Assessment

Potential impacts due to low frequency sounds will also be considered. For this purpose the sound power level at both the 16 and 31.5 Hz frequency band will also be estimated and used to calculate the C-Weighted Noise Levels. However, as previously highlighted, as wind speeds increase, wind induced noise levels also increases, and the associated
ambient sound levels due to wind will be considered at all times. Acoustic energy in the low frequency range due to wind will also be considered (refer Figure 4.2).

It should be noted that SANS 10357:2004 does not provide methods to estimate sound propagation below 63 Hz. While this assessment does calculate the sound power levels at lower frequency bands (to allow the calculation of the C-weighted Sound Power Levels to estimate the potential/probability for low frequency noises), the reader should realise that this is for information purposes only. In terms of accuracy, the sound power level at these frequency bands is estimated at ±5-15 dBA (due to the unknown adjustment factor for meteorological effects at the 16 and 31.5Hz octave band frequencies).

7.2.2 Results: Operational Phase for Kangnas Renewable Energy Facility

Projected Noise Levels in the area due to the operation of the WEF are illustrated in the following figures (ISO model for a 5 m/s wind).

Figure 7.4 illustrates the projected noise levels due to the operation of the proposed WEF, illustrating the cumulative impact of all wind turbines operating simultaneously. It does not consider potential cumulative impacts due to existing (increased) ambient sound levels.

Figure 7.5 illustrates the projected change in ambient sound levels (as modelled with the ISO model) with a wind blowing at 5 m/s. It considers the likely ambient sound levels (in $L_{A90}$ statistical sound level descriptor) as well as the projected total noise levels, and calculates how the operational phase may influence the ambient sound levels at night in similar conditions. Because of little vegetation, ground attenuation is minimal, and due to the very quiet ambient sound levels measured, the extent of the area where the ambient sound levels can be changed is quite extensive. The total noise levels however are far below the 35 dBA level and the possibility of complaints are highly unlikely.

Figure 7.6 presents the total noise levels as modelled using the Concae model for a southern wind. It validates the output of the ISO model.
Figure 7.3: Proposed layout of the Kangnas WEF
Figure 7.4: Projected Noise Levels (ISO model) from WEF; Contours of constant sound levels for a 5 m/s wind
Figure 7.5: Projected change in ambient sound levels (ISO model); Contours of constant sound levels for a 5 m/s wind
Figure 7.6: Projected total Noise Levels (Concawe model); Contours of constant sound levels for a 5 m/s southern wind
The preceding figures only illustrate and evaluate the potential noise impact for a 5 m/s wind speed. A more appropriate method to determine the potential noise impact would be to graph the projected noise levels at all wind speeds as illustrated in Figure 7.7 (for the ISO model). In all cases the output of both the Concawe and ISO models was considered.

![Projected Noise Levels - ISO Model](image)

**Figure 7.7: Projected noise levels at NSDs due to the operation of the WEF at different wind speeds, ISO Model**

As the ambient sound levels cannot be accurately defined without long term measurements (refer Figure 3.5) the impact assessment is quite cautious. In addition, the use of the sound power emission levels of a worst-case scenario conceptual noise source would result in modelled noise levels that could be higher than if data from a quieter wind turbine were used. However, even considering a very cautious scenario, the potential of a noise impact developing is very unlikely.

### 7.2.3 Impact Assessment: Operational Phase for Kangnas WEF – No mitigation

This Environmental Noise Impact Assessment focuses on the impacts on the surrounding sound environment during times when a quiet environment is highly desirable. Noise limits are therefore appropriate for the most noise-sensitive activity, such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc).
Appropriate Zone Sound Levels are therefore important, yet it has been shown that the SANS recommended (fixed) Night Rating Level ($L_{req,N} = 35dBA$) might be inappropriate due to the increased ambient sounds relating to wind action. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the WEF as well as the likely ambient sound levels due to wind induced noises.

**Table 7.4: Operation: Defining noise impact on Receptors (dBA) without any mitigation (at a 5 m/s wind speed)**

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Estimated ambient sound level (dBA)</th>
<th>Total Noise Level (dBA)</th>
<th>Change From ambient sound level (dB)</th>
<th>Distance between NSD and Wind Turbine (meters)</th>
<th>Defining Significance of Noise Impact (See Table 5.2 - Table 5.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Magnitude</td>
</tr>
<tr>
<td>NSD01</td>
<td>32.55</td>
<td>33.67</td>
<td>1.1</td>
<td>5,962</td>
<td>2</td>
</tr>
<tr>
<td>NSD02</td>
<td>32.55</td>
<td>34.40</td>
<td>1.8</td>
<td>4,548</td>
<td>2</td>
</tr>
<tr>
<td>NSD03</td>
<td>32.55</td>
<td>34.32</td>
<td>1.8</td>
<td>4,687</td>
<td>2</td>
</tr>
<tr>
<td>NSD04</td>
<td>32.55</td>
<td>37.52</td>
<td>5.0</td>
<td>3,777</td>
<td>6</td>
</tr>
</tbody>
</table>

Based on the preceding figures it is obvious that there exists an insignificant risk for a noise impact during the operational phase of the development.

The C-weighted sound power levels were also evaluated and calculated as 58.6 dBC at a 5 m/s wind. At this wind speed ambient C-weighted sound levels (due to wind) would exceed the projected levels with more than 10 dBC. Risk of low frequency issues is therefore very low.

**Table 7.5: Impact Assessment: Operational phase – Kangnas WEF**

<table>
<thead>
<tr>
<th>Nature:</th>
<th>Numerous turbines operating simultaneously during a period when a quiet environment is desirable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Rating Level</td>
<td>Rural district with little road traffic. Refer to Table 5.6 for the proposed Night Rating Level that varies with wind speed.</td>
</tr>
<tr>
<td>Extent ($dL_{Aeq,0}&gt; 7dBA$)</td>
<td>Local – Impact could extend further than 1,000 meters from activity. (3).</td>
</tr>
<tr>
<td>Duration</td>
<td>Long – Facility will operate for a number of years (4).</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium (6) – NSD04, due to change in ambient sound level</td>
</tr>
<tr>
<td>Probability</td>
<td>Unlikely (1)</td>
</tr>
<tr>
<td>Significance</td>
<td>13 (Low)</td>
</tr>
<tr>
<td>Status</td>
<td>Negative.</td>
</tr>
<tr>
<td>Reversibility</td>
<td>High.</td>
</tr>
<tr>
<td>Irreplaceable loss of resources?</td>
<td>Not relevant.</td>
</tr>
<tr>
<td>Comments</td>
<td>-</td>
</tr>
<tr>
<td>Can impacts be mitigated?</td>
<td>Not required</td>
</tr>
<tr>
<td>Mitigation:</td>
<td>See section 8.2.</td>
</tr>
<tr>
<td>Cumulative impacts:</td>
<td>This impact is cumulative with existing ambient sound levels.</td>
</tr>
<tr>
<td>Residual Impacts:</td>
<td>This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.</td>
</tr>
</tbody>
</table>
8 MITIGATION OPTIONS

8.1 CONSTRUCTION PHASE

The significance of noise during the construction phase is low, and no additional mitigation measures are recommended or required.

8.2 OPERATIONAL PHASE

The significance of the noise impact is considered to be of a low significance for the closest NSDs and no additional mitigation measures are required and recommended.

However:

1. Good public relations are essential. At all stages surrounding receptors should be educated with respect to the sound generated by wind turbines. The information presented to stakeholders should be factual and should not set unrealistic expectations. It is counterproductive to suggest that the wind turbines will be inaudible, or to use vague terms like “quiet”. Modern wind turbines produce a sound due to the aerodynamic interaction of the wind with the turbine blades, audible as a “swoosh”, which can be heard at some distance from the turbines. The magnitude of the sound will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the wind turbines and the ambient background sound level.

2. Community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. Wind projects offer a benefit to the environment and the energy supply for the greater population, and offer economic benefits to the land owners leasing installation sites to the wind farm. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the wind farm, to ensure they do not feel that advantage have been taken of them.

3. The developer must implement a line of communication (i.e. a help line where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The WEF should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop. For example, sudden and sharp
increases in sound levels could result from mechanical malfunctions or perforations or slits in the blades. Problems of this nature can be corrected quickly, and it is in the developer’s interest to do so.
9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 CONSTRUCTION PHASE

Projected noise levels during construction of the WEF were modelled using the methods as proposed by SANS 10357:2004. The resulting future noise projections indicated that the construction activities, as modelled for the worst case scenario, would comply with the Noise Control Regulations (GN R154) as well as the acceptable day rating levels as per the SANS 10103:2008 guidelines.

Various construction activities would be taking place during the development of the facility and may pose a noise risk to them. While this study investigated likely and significant noisy activities, it did not evaluate all potential activities that could result in a noise impact. These activities could include temporary or short-term activities where small equipment is used (such as the digging of trenches to lay underground power-lines).

Using the available information the significance of the construction noise impact was defined to be of a low significance. Mitigation measures were however proposed that would reduce the magnitude of potential noise impacts, risks and the probability of any complaints being registered.

The following measures are recommended to define the performance of the developer in mitigating the projected impacts and reducing the significance of the noise impact.

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>Control noise pollution stemming from construction activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Component(s)</td>
<td>Construction of infrastructure, including but not limited to: turbine system (foundation, tower, nacelle and rotor), substation(s), access roads and electrical power cabling.</td>
</tr>
<tr>
<td>Potential Impact</td>
<td>• Increased noise levels at potentially sensitive receptors</td>
</tr>
<tr>
<td>Activity/Risk source</td>
<td>• Potentially changing the acceptable land use capability.</td>
</tr>
<tr>
<td>Mitigation Target/Objective</td>
<td>• Any construction activities taking place within 500 meters from any potentially noise-sensitive developments (NSDs).</td>
</tr>
</tbody>
</table>

• Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors.
• Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
• Ensure acceptable noise levels at surrounding stakeholders and potentially sensitive receptors;
• Ensuring compliance with the Noise Control Regulations.
Mitigation: Action/Control | Responsibility | Timeframe
---|---|---
Establish a line of communication and notify all stakeholders and NSDs of the means of registering any issues, complaints or comments. | - Environmental Control Officer | All phases of project
Notify potentially sensitive receptors about work to take place at least 2 days before the activity in the vicinity (if work is to take place within 500 meters) of the NSD is to start. Following information to be presented in writing: - Description of Activity to take place; - Estimated duration of activity; - Working hours; - Contact details of responsible party. | - Contractor - Environmental Control Officer | At least 2 days, but not more than 5 days before activity is to commence
Ensure that all equipment is maintained and fitted with the required noise abatement equipment. | - Environmental Control Officer | Weekly inspection
Measure the peak noise levels of equipment used when operational and keep database of noise levels. | - Acoustical Consultant / Approved Noise Inspection Authority | If noise complaints are registered
When any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured. | - Acoustical Consultant / Approved Noise Inspection Authority | Within 7 days after complaint was registered
The construction crew must abide by the local by-laws regarding noise. | - Contractor - Environmental Control Officer | Duration of construction phase
Where possible construction work should be undertaken during normal working hours (06H00 – 22H00), from Monday to Saturday; If agreements can be reached (in writing) with the all the surrounding (within a 1,000 distance) potentially sensitive receptors, these working hours can be extended. | - Contractor | As required

Performance indicator
- Equivalent A-weighted noise levels below 45 dBA at potentially sensitive receptors.
- Ensure that maximum noise levels at potentially sensitive receptors are less than 65 dBA.
- No noise complaints are registered

Monitoring Monitoring to take place every time that a valid noise complaint is registered.

9.2 Operational Phase

Projected noise levels during operation of the WEF were modelled using the methodology as proposed by both SANS 10357:2004 and ISO 9613-2.

The resulting future noise projections indicated that the operation of the facility would have in insignificant noise impact and will comply with all the criteria defined in this report.

No mitigation measures were recommended, however there are a few recommendations to allow greater environmental awareness with regards to potential noise impacts.

The following measures are recommended to define the performance of the developer in mitigating the projected impacts and reducing the significance of the noise impact.
### OBJECTIVE
Control noise pollution stemming from operation of WEF

<table>
<thead>
<tr>
<th>Project Component(s)</th>
<th>Operational Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Increased noise levels at potentially sensitive receptors;</td>
</tr>
<tr>
<td></td>
<td>• Changing ambient sound levels could change the acceptable land use</td>
</tr>
<tr>
<td></td>
<td>capability;</td>
</tr>
<tr>
<td></td>
<td>• Disturbing character of noise from the wind turbines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity/Risk source</th>
<th>Simultaneous operation of a number of Wind Turbines</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Mitigation Target/Objective</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ensure that the change in ambient sound levels as experienced by Potentially Sensitive Receptors is less than 5 dBA;</td>
</tr>
<tr>
<td></td>
<td>• Prevent the generation of nuisance noises;</td>
</tr>
<tr>
<td></td>
<td>• Ensure acceptable noise levels at surrounding stakeholders and potentially sensitive receptors.</td>
</tr>
</tbody>
</table>

### Mitigation: Action/Control

<table>
<thead>
<tr>
<th>Mitigation: Action/Control</th>
<th>Responsibility</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add noise monitoring points at any complainants that registered a valid noise complaint relating to the operation of the WEF.</td>
<td>Acoustical Consultant / Approved Noise Inspection Authority</td>
<td>With quarterly monitoring</td>
</tr>
</tbody>
</table>

### Performance indicator

- Equivalent A-weighted noise levels below 45 dBA at potentially sensitive receptors.
- Ensure that the change in ambient sound levels as experienced by Potentially Sensitive Receptors is less than 5 dBA

### Monitoring

No routine noise monitoring recommended. However, if a noise complaint is registered, monitoring should take place over a 24 hour period in 10 minute bins, with the results co-ordinated with the 10 m height wind speed (as calculated from the wind mast data). Monitoring should take place when the wind turbines are operational.
10 CONCLUSIONS AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the predicted noise environment for the proposed Kangnas Wind and Solar Energy Facilities east of the town of Springbok, making use of sound propagation models to identify issues of concern.

This assessment focussed specifically on the noise that could be associated with the wind turbines, because the activities associated with solar energy generation are generally limited to the day-time period, when a quieter environment is not as critical as the night-time period. Noise generation from solar energy generation activities (whether photovoltaic cells or concentrated solar thermal) are generally not significant.

With the input data as used, this assessment indicated that the potential noise impact would be insignificant during both the construction and operational phases.

Because of the unknown noise emission characteristics of the proposed wind turbine, it is highly recommended that the developer re-evaluate the final layout once a wind turbine make and model are selected if:

- Any wind turbines are within 2,000 meters from any NSD;

No routine noise monitoring is required, yet noise monitoring should be implemented if a valid noise complaint due to the operation of the facility is registered. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 meter height. These samples should be collected when the Wind Turbines are operational at the location of complainant. Feedback regarding noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

The findings of this report should also be made available to all potentially noise-sensitive developments in the area, or the contents explained to them to ensure that they understand all the potential risks that the development of a WEF may have on them and their families.

With its potential for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when WEF’s are near to potential sensitive receptors, consideration must be given to ensuring a
compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source - but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.
11 THE AUTHOR

The author of this report, M. de Jager (B. Ing (Chem), UP) graduated in 1998 from the University of Pretoria. He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker enclosure design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. As from 2007 he has been involved with the following projects:


- Full Noise Impact Studies for a number of mining projects, including: Skychrome (Pty) Ltd (A Ferro-chrome mine), Mooinooi Chrome Mine (WCM), Buffelsfontein East and West (WCM), Elandsdrift (Sylvania), Jagdlust Chrome Mine (ECM), Der Brochen, Apollo Brick (Pty) Ltd (Clay mine and brick manufacturer), Arthur Taylor Expansion project (X-Strata Coal SA), Klipfontein Colliery (Coal mine), Imbabala Coal, AurexGold, Sephaku Limestone Mine, Sekoko Railway Siding, Verkeerdep Pan Expansion, Schoongezicht Coal, WPB Colliery, Landau Expansion project (Coal mine), Evraz Vametco, Lesego Platinum.

- A number of smaller Noise Impact Assessments, Noise Monitoring Projects, Scoping Reports as well as Screening Investigations.

The author is an independent consultant to the project, the developer as well as Aurecon South Africa (Pty) Ltd. He,

- does not and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations
- have and will not have no vested interest in the proposed activity proceeding
- have no and will not engage in conflicting interests in the undertaking of the activity
- undertake to disclose all material information collected, calculated and/or findings, whether favourable to the developer or not
- will ensure that all information containing all relevant facts be included in this report.
In this report reference was made to the following documentation:

1. Acoustics, 2008: A review of the use of different noise prediction models for wind farms and the effects of meteorology
5. BWEA, 2005: Low Frequency Noise and Wind Turbines – Technical Annex
7. DEFRA, 2003: A Review of Published Research on Low Frequency Noise and its Effects, Report for Defra by Dr Geoff Leventhall Assisted by Dr Peter Pelmear and Dr Stephen Benton
9. DELTA, 2008: EFP-06 project: Low Frequency Noise from Large Wind Turbines, a procedure for evaluation of the audibility for low frequency sound and a literature study, Danish Energy Authority
11. Enertrag, 2008: Noise and Vibration, Hempnall Wind Farm
13. HGC Engineering, 2006: Wind Turbines and Infrasound, report to the Canadian Wind Energy Association
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17. Kamperman, GW. and James, RR, 2008: The “How to” guide to siting wind turbines to prevent health risks from sound

21. Noise-con, 2008: *Simple guidelines for siting wind turbines to prevent health risks*


28. SANS 10103:2008. *'The measurement and rating of environmental noise with respect to annoyance and to speech communication’.*

29. SANS 10210:2004. *'Calculating and predicting road traffic noise’.*

30. SANS 10328:2008. *'Methods for environmental noise impact assessments’.*

31. SANS 10357:2004 The calculation of sound propagation by the Concave method’.

32. USEPA, 1971: *Effects of Noise on Wildlife and other animals*


34. Van den Berg, G.P., 2004. *'Do wind turbines produce significant low frequency sound levels’?*. 11th International Meeting on Low Frequency Noise and Vibration and its Control

35. Windtest, Kaiser-Wilhelm-Koog GmbH, 2005: *'Report of acoustic emission of a wind turbine generator system of the Type V90-3MW, Mode 0 near Böckingharde (Germany), Report WT 4224/05’*


37. World Health Organization, 2009: *Night Noise Guidelines for Europe*

38. World Health Organization, 1999: *Protection of the Human Environment; Guidelines for Community Noise*
APPENDIX A

TYPICAL SOUND POWER LEVELS, VARIOUS TYPES OF EQUIPMENT
## Appendix A: Typical Sound Power Levels, various types of equipment

<table>
<thead>
<tr>
<th>Frequency</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-Weight Factor</td>
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End of report.
## DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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## PROJECT TITLE

**Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape**

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<tr>
<td>Cell: 021-526-9400</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>
4.2 The specialist appointed in terms of the Regulations

I, Morné de Jager, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

__________________________
Signature of the specialist:

Name of company (if applicable):

M2 Environmental Connections cc

Date: 05 September 2012
Annexure K1
Hi Cornelia,

Noise generation from Solar Facilities are generally limited. Photo-voltaic facilities generate no noise during the operational phase, and the noise from the construction activities generally would be acceptable if it takes place further than 400 meters from potential noise-sensitive developments.

The main noise source associated with Concentrated Solar Facilities is associated with the cooling fans from the Powerblock. Unless the facility have thermal storage capacity, it only operates during daylight hours and even if the facility have thermal storage capacity it is unlikely to operate after 22:00 at night when a quieter environment is more desirable. The noise generated from such a facility will be of low significance if they are further than 1,000 meters from any potential noise-sensitive development.

I have looked at the proposed locations of the Solar Facilities and can confirm that there are NO potential noise-sensitive development within 2,000 meters from this proposed facility. The probability of a noise impact occurring is very low and of least concern.

As always, please do not hesitate to contact me if you have any comments or questions.

Regards

Morné de Jager

for MENC0

*******************************************************************************

Morné de Jager

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Tel: 012 - 993 2165
Fax: 086 - 621 0292
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Annexure L
Socio-Economic Impact Assessment of the Kangnas Wind & Solar Energy Facilities

Draft Report 2012

Prepared by: Urban-Econ Development Economists
Tel: 044 873 4514
Fax: 086 693 8160
Email: george@urban-econ.com
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<th>Description</th>
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<tbody>
<tr>
<td>PV</td>
<td>Photovoltaic</td>
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<tr>
<td>CPV</td>
<td>Concentrated Photovoltaic</td>
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<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>LM</td>
<td>Local Municipality</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<td>DMA</td>
<td>District Municipal Area</td>
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<td>DM</td>
<td>District Municipality</td>
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<td>EAP</td>
<td>Economically Active Population</td>
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<td>LPR</td>
<td>Labour Participation Rate</td>
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<td>LED</td>
<td>Local Economic Development</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GVA</td>
<td>Gross Value Added</td>
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<td>CDM</td>
<td>Clean Development Mechanism</td>
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<td>IRP</td>
<td>Integrated Resource Plan</td>
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<td>IPAP</td>
<td>Industrial Policy Action Plan</td>
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<td>ISRDS</td>
<td>Integrated Sustainable Rural Development Strategy</td>
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<td>NCPGDS</td>
<td>Northern Cape Provincial Growth and Development Strategy</td>
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<td>NC LED</td>
<td>Northern Cape Local Economic Development</td>
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<td>IDP</td>
<td>Integrated Development Plan</td>
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<td>SMME</td>
<td>Small, Micro and Medium Enterprises</td>
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<td>Statistics South Africa</td>
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<td>Capital Expenditure</td>
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**Socio-Economic Impact Assessment**

**Kangnas Wind & Solar Energy Facilities**

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**DETAILS OF SPECIALIST AND DECLARATION OF INTEREST**

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**PROJECT TITLE**

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

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</tbody>
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---
4.2 The specialist appointed in terms of the Regulations

I, Craig van Niekerk declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
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- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Craig van Niekerk

Signature of the specialist:

Name of company (if applicable):

Urban-Econ Western Cape Pty Ltd

Date: 31st August 2012
**Section 1: Introduction**

1.1 **Background**

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) intends to develop a 750 MW wind energy facility and a 250 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility on farms near Springbok in the Northern Cape. Aurecon South Africa (Pty) Ltd was appointed to undertake an Environmental Impact Assessment for the proposed projects and in turn appointed Urban-Econ to undertake a socio-economic impact assessment of the proposed projects. The proposed wind and solar energy facilities are located approximately 48 km east of Springbok in the Northern Cape and can be accessed via the N14.

1.2 **Study Purpose & Approach**

The *purpose of this study* is to undertake the necessary research to provide socio-economic specialist inputs into the Kangnas development’s potential benefits or dis-benefits in the study area as well as to provide the quantification of socio-economic impacts during the construction and operational phase of the project.

This implies that Urban-Econ will be required to undertake the following as per the Terms of Reference (ToR) as proposed by Aurecon:

- Provide a baseline socio-economic analysis to provide an understanding of the current socio-economic environment;
- Undertake an in-depth analysis of proposed positive and negative socio-economic impacts resulting from the proposed projects;
- Describe potential impacts on socio-economic aspects. The following impacts should be focussed on:
  - Contribution to economic growth in the region (direct and indirect) – Gross domestic product per region (GDPR)
  - Impact on regional development (business and other)
  - Impact on productivity and production (sales, etc.) of existing firms in the region
  - Impact on infrastructure and resources in the region
  - Impact on employment and income
  - Impact on social lives of local communities
  - Improved competitiveness of the region
  - Change in the size of the local economy
  - Implications to local agriculture
- Economic impacts of the proposed project should be considered by applying one or a combination of the following procedures, depending on the availability and applicability of economic and econometric models:
  - Utilise existing national Social Accounting Matrix (SAM) tables to undertake the indirect impacts
  - Derive multipliers to apply to direct impacts
  - Apply industry standard production parameters related to the relevant sectors; and
  - Recommend mitigation measures to improve positive and decrease negative impacts as a result of the proposed projects.
The study approach involves the utilisation of an input/output model. The impact-modelling framework will be used to quantify the direct and indirect impacts of the proposed development on the economy, and the socio-economic benefits for the local communities. Inputs derived for the model were based on previous studies conducted as well as from the regional economic profile for the study area.

The tools most commonly utilised to estimate and forecast the employment; income and occupational impacts of development investments are Input/Output (I/O) Models. These models contain information on inter-industry relations, including tables that describe, for each industry included in the model, the amount of input the industry requires from other industries to produce one unit of output. Using such purchase and sales data, multipliers are calculated to forecast impacts, such as how the Rand spent on a development investment ripples through the economy. Measures of input include industrial output, employment and earnings by industry.

1.3 Study Area

Map 1.1 indicates the study area located within the Namakwa District boundaries.

Map 1.1 indicates that the Nama Khoi Local Municipality (LM) is the central LM within the Namakwa District Municipality. The main town in this LM is Springbok.
1.4 Report Outline

The report will contain the following sub-sections:

**Section 2: Economic Profile:** This section presents the baseline context on the study area against which potential impacts will be assessed.

**Section 3: Policy Overview:** The policy review will provide a concise summary of all the relevant policies and strategies and will also indicate whether the proposed Kangnas wind farm and PV plant supports or opposes the legislative framework.

**Section 4: Development Concept:** This section presents the alternative layout and land uses for the development and the infrastructural requirements.

**Section 5: Socio-Economic Impacts:** This section presents the economic impact analysis model, which determines the direct and indirect impact of capital investment in the proposed Kangnas wind farm and PV plant development on the local and regional economy, as well as the associated socio-economic impacts that may arise.

**Section 6: Impact Tables:** In this section the impact of the development across various evaluation criteria will be presented to assess whether the development will have a positive or negative impact.

**Section 7: Economic Development Scorecard:** This section concludes the report with the Economic Development Scorecard as provided by the DOE. The proposed Kangnas wind farm and PV plant impacts are measured against the minimum thresholds and targets set by the Economic Development Scorecard.
Section 2: Socio-Economic Profile

2.1 Introduction

The purpose of this section is to provide an overview of the current socio-economic situation within the Nama Khoi LM. This is done mainly to provide an indication of the overall performance of the local economic and demographic characteristics.

TAKE NOTE: For communities within the Nama Khoi LM, only Census 2001 data is available at present. Where possible, more recent (2007 – 2010) data (on Local Municipal level) has been incorporated and assumptions have been made to present a more recent profile. For reference, the 2001 data is also indicated where the 2009 data was incorporated.

In 2011 the demarcation of municipal boundaries in South Africa were changed so that DMA’s (District Municipal Areas) could be incorporated into local municipal boundaries.

TAKE NOTE: The statistics below are based on the old municipal boundary. In order to include the new municipal boundary Census 2011 data will need to be used (which will only become available in late 2012/2013).

2.2 Socio-Economic Profile

<table>
<thead>
<tr>
<th>SOCIO-ECONOMIC CRITERION</th>
<th>IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population &amp; Household Size (2010)</td>
<td></td>
</tr>
<tr>
<td>The Nama Khoi LM covers a geographical area of 14,921 km² which is approximately 12% of Namakwa’s total. The Municipality has a population density of 3.9 people per km² and a household density of 1.1 households per km². The most significant portion of Namakwa’s population (43%) resides in this Municipality.</td>
<td></td>
</tr>
<tr>
<td>This indicates that the communities within the Nama Khoi LM and Namakwa DM are dispersed. The town of Springbok has the largest population. Towns such as Buffelsrivier, Bulletrap, Carolusberg, and Vioolsdrif are very small and contain small populations. Development potential in very small towns will be very low.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1: Population & Household Totals

<table>
<thead>
<tr>
<th></th>
<th>Population total</th>
<th>Households total</th>
<th>Area (km²)</th>
<th>Population Density</th>
<th>Household Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>1,103,918</td>
<td>277,551</td>
<td>373,186</td>
<td>3.0</td>
<td>0.7</td>
</tr>
<tr>
<td>NDM</td>
<td>135,415</td>
<td>39,272</td>
<td>126,880</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>NKLM</td>
<td>57,791</td>
<td>17,069</td>
<td>14,921 (New demarcation: 17,989)</td>
<td>3.9</td>
<td>1.1</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2012)

The average population growth rates between 1996 and 2010 were: 0.6% for the Northern Cape Province, 0.4% for the Namakwa DM, and 0.8% for the Nama Khoi LM. Table 2.2 indicates the population distribution of the main-places in Nama Khoi LM.
The age distribution of a population is important because the largest population age group inevitably dictates its own demands on the market. Table 2.3 indicates the age profile of citizens living in the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**TABLE 2.3: AGE DISTRIBUTION**

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>27.4%</td>
<td>22.7%</td>
<td>20.5%</td>
</tr>
<tr>
<td>15-24</td>
<td>19.8%</td>
<td>17.4%</td>
<td>18.6%</td>
</tr>
<tr>
<td>25-64</td>
<td>46.8%</td>
<td>52.5%</td>
<td>54.3%</td>
</tr>
<tr>
<td>65+</td>
<td>6.0%</td>
<td>7.4%</td>
<td>6.6%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2010)

The dependency ratio indicates the amount of individuals that are below the age of 15 and over the age of 64, that are dependent on the Economically Active Population (EAP) (individuals that are aged 15 – 64 that are either working or able to work). As can be seen from the figure above:

- 27.1% of the Nama Khoi LM population are dependent on the EAP (72.9%)
- 30.1% of the Namakwa DM population are dependent on the EAP (69.9%)
- 33.4% of the Northern Cape population are dependent on the EAP (66.6%)

These dependency ratios could be higher as not every individual in the EAP is employed (i.e. some could be studying full-time into their 20’s; some could of been retrenched, some may be housewives, etc.).

The Nama Khoi gender distribution is 48.8% males and 51.2% females. The gender ratio can consequently be expressed as 95.1 males per 100 females.

The high proportion of potentially economically active persons implies that there is a larger human resource base for development projects to involve the local population and potentially a lower dependency rate due to the lower numbers of youth and old aged persons. However, the youth still represent a large proportion of the population, which means that even though the percentage of youth is less than that of the District, focus still needs to be placed on youth development.
### Health (2010)

Table 2.4 indicates the HIV/AIDS prevalence (percentage of the population infected with HIV/AIDS) for the Northern Cape Province, Namakwa DM and the Nama Khoi LM.

#### TABLE 2.4: HIV/AIDS PREVALENCE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>7.6%</td>
<td>46.2%</td>
</tr>
<tr>
<td>NDM</td>
<td>5.9%</td>
<td>60.8%</td>
</tr>
<tr>
<td>NKLM</td>
<td>6.1%</td>
<td>62.8%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2010)

Approximately 6% of the Nama Khoi population was infected with HIV/AIDS in 2010, which is higher than that of the District (5.9%). The portion of the Nama Khoi population infected with HIV/AIDS has more than doubled since 2001, with an increase of 62.8% from 2001 to 2010. It is important to note that this number might be much higher since there is a stigma associated with the virus and therefore few people get tested or even go to clinics to receive the necessary treatment. It is also important to note that the growth rate may also be increased due to more people having the courage to go to clinics rather than a growth in actual infections.

### Grants (2007)

Table 2.5 indicates the types of grants that are used/accessed in the Northern Cape Province, the Namakwa DM and the Nama Khoi LM.

#### TABLE 2.5: GRANTS

<table>
<thead>
<tr>
<th>2007</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old age pension</td>
<td>22.8%</td>
<td>30.6%</td>
<td>32.4%</td>
</tr>
<tr>
<td>Disability grant</td>
<td>16.6%</td>
<td>16.1%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Child support grant (linked to child)</td>
<td>56.2%</td>
<td>50.5%</td>
<td>48.6%</td>
</tr>
<tr>
<td>Care dependency grant</td>
<td>2.1%</td>
<td>1.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Foster care grant</td>
<td>0.3%</td>
<td>0.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Grant in aid</td>
<td>0.9%</td>
<td>0.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Social relief</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Multiple social grants</td>
<td>0.6%</td>
<td>0.7%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2007)

The grant that is accessed the most in the Nama Khoi LM is the Child Support Grant (48.6%), followed by the Old Age Pension (32.4%).

### Accessibility

The N7 connects Springbok to the south with Cape Town (Western Cape) and with Vioosodrift in the north. The N14 connects Springbok and Upington via Keimoes, Kakamas and Pofadder. The R382 is also a tarred road that connects Steinkopf with Port Nolloth. All the other roads in the Municipality are dirt.

The lack of good roads and far distances between markets puts a huge constraint on development.
Mode of Transport (2001)

The modes of transport in use are a consideration in local economic development. Table 2.6 indicates the mode of transport used by individuals in the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

<table>
<thead>
<tr>
<th>2001</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>On foot</td>
<td>66.8%</td>
<td>66.7%</td>
<td>62.4%</td>
</tr>
<tr>
<td>By bicycle</td>
<td>1.7%</td>
<td>1.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>By motorcycle</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>By car as a driver</td>
<td>9.2%</td>
<td>10.2%</td>
<td>10.5%</td>
</tr>
<tr>
<td>By car as a passenger</td>
<td>8.8%</td>
<td>8.1%</td>
<td>7.9%</td>
</tr>
<tr>
<td>By minibus/taxi</td>
<td>6.9%</td>
<td>2.8%</td>
<td>4.3%</td>
</tr>
<tr>
<td>By bus</td>
<td>6.2%</td>
<td>10.5%</td>
<td>13.9%</td>
</tr>
<tr>
<td>By train</td>
<td>0.2%</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2001)

The majority of the Nama Khoi LM’s population (62.4%) travel to school or to work by foot. Around 26.2% of the Nama Khoi population make use of public transport (i.e. the bus, train, taxi, or lifts with other people); while 0.8% make use of bicycles and 10.6% use their own private transport. Donkeys and horses as well as donkey/horse carts are also widely used in the area.

Dwelling Type (2010)

Table 2.7 and 2.8 indicates the types of dwellings households reside in the Northern Cape Province, the Namakwa DM, and in the Nama Khoi LM.

<table>
<thead>
<tr>
<th>2010</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>House or brick structure on a separate stand or yard</td>
<td>77.4%</td>
<td>81.4%</td>
<td>80.2%</td>
</tr>
<tr>
<td>Traditional dwelling/hut/structure made of traditional materials</td>
<td>5.2%</td>
<td>4.0%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Flat in a block of flats</td>
<td>1.7%</td>
<td>2.8%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Town/cluster/semi-detached house (simplex, duplex or triplex)</td>
<td>2.2%</td>
<td>3.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>House/flat/room, in backyard</td>
<td>1.5%</td>
<td>1.7%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Informal dwelling/shack, in backyard</td>
<td>1.9%</td>
<td>2.9%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Informal dwelling/shack, NOT in backyard, e.g. in an informal/squatter settlement</td>
<td>9.0%</td>
<td>2.0%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Room/flatlet not in backyard but on a shared property</td>
<td>1.0%</td>
<td>1.6%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2010)

The majority of households in the Nama Khoi LM are housed in a permanent house or brick structure. This is a positive indicator in terms of the development levels and quality of life in the area. Only 10.8% of the Nama Khoi population live in informal dwellings.
TABLE 2.8: DWELLING TYPE (COMMUNITIES)

<table>
<thead>
<tr>
<th></th>
<th>Buffelsriver</th>
<th>Bullertrap</th>
<th>Carolusberg</th>
<th>Concordia</th>
<th>Kleinzee</th>
<th>Komaggas</th>
<th>Nababeep</th>
<th>Okiep</th>
<th>Springbok</th>
<th>Steinkopf</th>
<th>Vioolsdrif</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House or brick structure on a separate stand or yard</td>
<td>89%</td>
<td>87%</td>
<td>67%</td>
<td>96%</td>
<td>36%</td>
<td>91%</td>
<td>86%</td>
<td>89%</td>
<td>74%</td>
<td>77%</td>
<td>8%</td>
</tr>
<tr>
<td>Informal dwelling/shack</td>
<td>4%</td>
<td>6%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>3%</td>
<td>8%</td>
<td>4%</td>
<td>7%</td>
<td>3%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2001)

Household Size (2010)

Table 2.9 indicates the average household size of households within the Northern Cape, Namakwa DM, and Nama Khoi LM from 1995 till 2010.

TABLE 2.9: HOUSEHOLD SIZE (AVERAGE OVER YEARS)

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>4.5</td>
<td>4.1</td>
<td>4.5</td>
</tr>
<tr>
<td>1996</td>
<td>4.4</td>
<td>4.1</td>
<td>4.3</td>
</tr>
<tr>
<td>1997</td>
<td>4.3</td>
<td>4.0</td>
<td>4.2</td>
</tr>
<tr>
<td>1998</td>
<td>4.2</td>
<td>3.9</td>
<td>4.1</td>
</tr>
<tr>
<td>1999</td>
<td>4.1</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td>2000</td>
<td>4.0</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>2001</td>
<td>4.0</td>
<td>3.7</td>
<td>3.8</td>
</tr>
<tr>
<td>2002</td>
<td>3.9</td>
<td>3.6</td>
<td>3.8</td>
</tr>
<tr>
<td>2003</td>
<td>3.9</td>
<td>3.6</td>
<td>3.7</td>
</tr>
<tr>
<td>2004</td>
<td>3.9</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>2005</td>
<td>3.9</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>2006</td>
<td>3.9</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2007</td>
<td>3.9</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2008</td>
<td>3.9</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2009</td>
<td>4.0</td>
<td>3.5</td>
<td>3.4</td>
</tr>
<tr>
<td>2010</td>
<td>4.0</td>
<td>3.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2010)

Table 2.10 indicates the household size in terms of number of household members for the Northern Cape, Namakwa DM and Nama Khoi LM. Only 2007 data was available and therefore no growth trend could be established.
Access to Services (2010)

Access to services includes:

- Access to water – water is important in every household for its varied uses such as for cooking, cleaning, gardening as well as for drinking. Drinking water needs to be clean to avoid water-borne diseases.
- Access to electricity – this includes what types of electricity households make use of for lighting their homes.
- Access to sanitation – sanitation is important to consider when local economic development projects are put forward. This is because the municipal water and sewerage works capacity constraints should be evaluated and adjusted according to the level of economic growth anticipated in the area, noting that with economic growth comes an increase in the number of households and businesses which need access to sanitation.
- Access to refuse removal services – there is a need for systematic refuse removal to ensure good health and hygienic conditions for the people who live within the boundaries of any municipality. The site where refuse is dumped has to be chosen strategically so as to avoid having residential or commercial sites nearby. Dumpsites subtract aesthetic value and contribute to air pollution.

Table 2.11 and 2.12 indicates the levels of access to services found in the Northern Cape Province, the Namakwa DM, and in the Nama Khoi LM.

TABLE 2.10: HOUSEHOLD SIZE (NUMBER OF MEMBERS)

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Member</td>
<td>4.4%</td>
<td>6.3%</td>
<td>6.3%</td>
</tr>
<tr>
<td>2 Members</td>
<td>5.8%</td>
<td>6.8%</td>
<td>6.1%</td>
</tr>
<tr>
<td>3 Members</td>
<td>36.6%</td>
<td>39.5%</td>
<td>37.6%</td>
</tr>
<tr>
<td>4 Members</td>
<td>1.6%</td>
<td>1.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>5 Members</td>
<td>1.4%</td>
<td>1.8%</td>
<td>1.9%</td>
</tr>
<tr>
<td>6 Members</td>
<td>6.4%</td>
<td>4.4%</td>
<td>5.5%</td>
</tr>
<tr>
<td>7 Members</td>
<td>1.4%</td>
<td>1.3%</td>
<td>1.2%</td>
</tr>
<tr>
<td>8 Members</td>
<td>0.8%</td>
<td>0.6%</td>
<td>0.7%</td>
</tr>
<tr>
<td>9 Members</td>
<td>39.1%</td>
<td>35.3%</td>
<td>37.9%</td>
</tr>
<tr>
<td>10 Members</td>
<td>0.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11 Members</td>
<td>0.0%</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>12 Members</td>
<td>0.0%</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>13 Members</td>
<td>1.7%</td>
<td>1.0%</td>
<td>0.8%</td>
</tr>
<tr>
<td>14 Members</td>
<td>0.6%</td>
<td>1.3%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

(Source: Quantec 2007)

The majority of households within the Nama Khoi LM have access to services (i.e. water, electricity, sanitation, and refuse removal). Even though this is a good indication of the service delivery in the area it does not mean that these services are provided constantly. Some of the problems include:

- There are severe water problems in the Nama Khoi LM (as in the entire Northern Cape) and the boreholes are very unreliable.
### SOCI-ECONOMIC CRITERION

<table>
<thead>
<tr>
<th>Other forms of electricity for lighting (i.e. solar, gas, paraffin, candles, etc)</th>
<th>14.2%</th>
<th>11.0%</th>
<th>5.7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flush or chemical toilet</td>
<td>67.8%</td>
<td>74.7%</td>
<td>79.8%</td>
</tr>
<tr>
<td>Other sanitation facilities (i.e. pit latrine, bucket latrine, etc)</td>
<td>32.2%</td>
<td>25.6%</td>
<td>20.2%</td>
</tr>
<tr>
<td>Refuse removed by local authority (at least once a week or less often)</td>
<td>72.0%</td>
<td>87.1%</td>
<td>93.7%</td>
</tr>
<tr>
<td>Refuse removed by other means (i.e. communal refuse dump, own refuse dump, or no rubbish disposal)</td>
<td>28.0%</td>
<td>12.9%</td>
<td>6.3%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data 2010)

**TABLE 2.12: ACCESS TO SERVICES (COMMUNITIES)**

<table>
<thead>
<tr>
<th>2001</th>
<th>Buffelsrivier</th>
<th>Bulletrap</th>
<th>Carolusberg</th>
<th>Concordia</th>
<th>Kleinze</th>
<th>Komaggas</th>
<th>Nababeep</th>
<th>Okiep</th>
<th>Springbok</th>
<th>Steinkopf</th>
<th>Vioolsdrif</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped Water (Less than 200m from dwelling)</td>
<td>96%</td>
<td>96%</td>
<td>100%</td>
<td>98%</td>
<td>100%</td>
<td>97%</td>
<td>95%</td>
<td>97%</td>
<td>96%</td>
<td>98%</td>
<td>51%</td>
</tr>
<tr>
<td>Electricity for lighting</td>
<td>84%</td>
<td>96%</td>
<td>99%</td>
<td>94%</td>
<td>100%</td>
<td>95%</td>
<td>76%</td>
<td>81%</td>
<td>94%</td>
<td>98%</td>
<td>28%</td>
</tr>
<tr>
<td>Flush or a Chemical Toilet</td>
<td>9%</td>
<td>46%</td>
<td>86%</td>
<td>50%</td>
<td>99%</td>
<td>22%</td>
<td>69%</td>
<td>67%</td>
<td>93%</td>
<td>84%</td>
<td>29%</td>
</tr>
<tr>
<td>Removed by local authority</td>
<td>46%</td>
<td>100%</td>
<td>99%</td>
<td>99%</td>
<td>100%</td>
<td>89%</td>
<td>98%</td>
<td>91%</td>
<td>99%</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2001)

- Around 70% of the Nama Khoi LM’s households have piped water inside their dwelling, which is higher than the overall total of the Northern Cape Province (43.9%) and the Namakwa DM (60.8%). Vioolsdrif has the lowest levels in terms of access to water.
- Around 94% of the Nama Khoi LM’s households use electricity to light their dwellings, which is higher than the overall total of the Northern Cape Province (85.8%) and the Namakwa District (89%). The majority of the communities within Nama Khoi LM have access to electricity but Vioolsdrif remains the worst off in terms of service.
- The majority of the Nama Khoi LM’s households (79.8%) have a flush or chemical toilet in their homes, which is higher than the overall of the Namakwa District Municipality (74.7%) and the Northern Cape Province (67.8%). The majority households in Carlusberg, Kleinze, Nababeep, Okiep, Springbok and Steinkopf have a flush or chemical toilet. Many households in Buffelsrivier, Bulletrap, Komaggas and Vioolsdrif do not have access to a flush or chemical toilet.
- The majority of the Nama Khoi LM’s households (93.7%) have their refuse removed by the local authority at least once a week or less often. Less than half of Buffelsrivier’s population gets their refuse removed by the local authority and residents in Vioolsdrif do not have their refuse removed by the local authority.

- More needs to be done to secure and save the water sources and increase their capacity so that water is available every day.
- When the wind blows then there are often blackouts, due to faltering or out-dated infrastructure. There is also a big problem with power surges that damage household appliances.
- Some community members indicated that they would prefer a flush or chemical toilet because their waterless toilets make them sick. The water sources in the area will need to be upgraded if everyone in the area was to have a flush or chemical toilet.
- Vioolsdrif has none of their refuse removed by the local authority. If there is a problem collecting their refuse then other options...
Education Levels (2007)

Education levels in any given market area will influence economic and human development. It is clear that low education levels lead to a low skills base in an area while high education levels have the opposite effect, producing a skilled or highly skilled population. There is also no doubt that household and personal income levels are either positively or adversely affected by education levels. Also, a population that is skilled does not necessarily aspire to employment but to entrepreneurship, which will add businesses to the area, increase economic activity and consequently increase the number of jobs available. Table 2.13 indicates the adult education levels (individuals aged 20 years and older) of citizens residing in the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

<table>
<thead>
<tr>
<th>教育水平（2007）</th>
</tr>
</thead>
<tbody>
<tr>
<td>教育水平在任何给定的市场区域将影响经济和人类发展。低教育水平导致一个区域的低技能基础，而高教育水平具有相反的效果，产生一个有技能或高技能的人口。同样不容忽视的是，家庭和个人收入水平要么正向要么负向地受教育水平影响。同样，一个有技能的人口不一定是就业的，而是创业的，这将为该地区增加企业，增加经济活动，从而增加就业岗位。表2.13表明，北开普省、南马夸省和南马科伊LM的成年公民（20岁及以上）的教育水平。</td>
</tr>
</tbody>
</table>

### TABLE 2.13: EDUCATION LEVELS (DM & LM)

<table>
<thead>
<tr>
<th>年份</th>
<th>北开普省</th>
<th>南马夸省</th>
<th>南马科伊LM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>NC</td>
<td>NDM</td>
<td>NKLM</td>
</tr>
<tr>
<td>没有上学</td>
<td>12.2%</td>
<td>5.8%</td>
<td>1.7%</td>
</tr>
<tr>
<td>一些初等教育</td>
<td>20.4%</td>
<td>19.4%</td>
<td>17.4%</td>
</tr>
<tr>
<td>完成初等教育（7年级）</td>
<td>7.4%</td>
<td>10.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>一些中等教育</td>
<td>33.8%</td>
<td>41.4%</td>
<td>42.7%</td>
</tr>
<tr>
<td>完成中等教育（12年级）</td>
<td>16.7%</td>
<td>15.3%</td>
<td>17.5%</td>
</tr>
<tr>
<td>一些中等教育与证书/文凭</td>
<td>3.2%</td>
<td>2.1%</td>
<td>2.5%</td>
</tr>
<tr>
<td>完成中等教育与证书/文凭</td>
<td>3.6%</td>
<td>3.6%</td>
<td>4.9%</td>
</tr>
<tr>
<td>高等教育</td>
<td>2.7%</td>
<td>2.4%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

（来源：Quantec Data, 2007）

大约2%的南马科伊LM的成年人口没有上学，这低于南马夸省5.8%的整体水平。只有9.6%的南马科伊的成年人口有证书/文凭或高等教育。成年教育水平对于南马科伊LM内的主要地方是表2.14所显示的。

### TABLE 2.14: EDUCATION LEVELS (COMMUNITY)

<table>
<thead>
<tr>
<th>年份</th>
<th>北开普省</th>
<th>南马夸省</th>
<th>南马科伊LM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>No schooling</td>
<td>Some primary</td>
<td>Complete primary</td>
</tr>
<tr>
<td>Buffelsrivier</td>
<td>5%</td>
<td>22%</td>
<td>26%</td>
</tr>
<tr>
<td>Bulletrap</td>
<td>6%</td>
<td>35%</td>
<td>21%</td>
</tr>
<tr>
<td>Carolusberg</td>
<td>1%</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Concordia</td>
<td>3%</td>
<td>22%</td>
<td>13%</td>
</tr>
<tr>
<td>Kleinzee</td>
<td>2%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Komaggas</td>
<td>3%</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Nababeep</td>
<td>4%</td>
<td>17%</td>
<td>12%</td>
</tr>
<tr>
<td>Okiep</td>
<td>3%</td>
<td>20%</td>
<td>14%</td>
</tr>
<tr>
<td>Springbok</td>
<td>6%</td>
<td>14%</td>
<td>9%</td>
</tr>
<tr>
<td>Steinkopf</td>
<td>7%</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>Vioolsdrif</td>
<td>2%</td>
<td>43%</td>
<td>12%</td>
</tr>
</tbody>
</table>

The majority of the adult population in Nama Khoi have some education but have not obtained their Grade 12. This means that the majority of the adult population have a low skill level and would either need job employment in low-skill sectors, or better education opportunities in order to improve the skills level of the area, and therefore their income levels.
The highest portion of adults with no form of schooling resides in Steinkopf, Bulte, Springbok, Buffelsrivier, and Nababeep. The majority of residents with an education level higher than Grade 12 (i.e. tertiary level) reside in Kleinzee.

**Skills Level (2009)**

Skills levels of the labour force has an impact on the level of income earned (i.e. the higher the skills levels the higher the annual income that could be earned). Table 2.15 illustrates the skills levels of the formally employed population within the Northern Cape Province, Namakwa DM and Nama Khoi LM.

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly skilled</td>
<td>11.7%</td>
<td>10.9%</td>
<td>11.7%</td>
</tr>
<tr>
<td>Skilled</td>
<td>39.7%</td>
<td>36.3%</td>
<td>38.5%</td>
</tr>
<tr>
<td>Semi- and unskilled</td>
<td>48.6%</td>
<td>52.8%</td>
<td>49.8%</td>
</tr>
</tbody>
</table>

Almost half (49.8%) of Nama Khoi LM’s population is semi- and unskilled. This is lower than the Namakwa DM but higher than the Northern Cape Province.

**Employment Status (2009)**

The employment profile of the study area is an important indicator of human development, but also of the level of disposable income and subsequently the expenditure capacity of the residing population. The employment rate refers to those economically active people who are unemployed and looking for work as well as persons who are unemployed and not looking for work but would accept work if it was offered to them. This category also includes the not economically active population, which are people who are not working, but are housewives, scholars/full-time students, pensioners, disabled people and people not wishing to work. Table 2.16 indicates the employment status of the individuals within the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>38.6%</td>
<td>45.8%</td>
<td>47.0%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>14.7%</td>
<td>10.9%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Not economically active</td>
<td>46.7%</td>
<td>43.2%</td>
<td>43.7%</td>
</tr>
</tbody>
</table>

The Nama Khoi LM’s employment status consists of:

- 47% employed – which is higher than the District and the Province
- 43.7% not economically active – which is higher than the District but lower than the Province
- 9.3% unemployed – which is lower than the District and the Province

The unemployment rate has decreased from 2001 to 2009 with labour...
economically active population.

- Labour participation rate (LPR) – which indicates the labour force (economically active population) as a percentage of the population in the age cohort of 15 to 64 years.
- The number of persons each economically active person has to support is measured by the labour dependency ratio.

Table 2.17 and 2.18 indicates the employment indicators for the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**TABLE 2.17: EMPLOYMENT INDICATORS (DM & LM)**

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate</td>
<td>27.6%</td>
<td>19.3%</td>
<td>16.5%</td>
</tr>
<tr>
<td>Labour Participation Rate</td>
<td>53.3%</td>
<td>56.8%</td>
<td>56.3%</td>
</tr>
<tr>
<td>Labour Dependency Ratio</td>
<td>2.9</td>
<td>2.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2009)

**TABLE 2.18: EMPLOYMENT INDICATORS (COMMUNITY)**

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate 2001</td>
<td>53%</td>
<td>40%</td>
<td>27%</td>
<td>44%</td>
<td>5%</td>
<td>41%</td>
<td>41%</td>
<td>39%</td>
</tr>
<tr>
<td>LPR 2001</td>
<td>54%</td>
<td>41%</td>
<td>64%</td>
<td>50%</td>
<td>89%</td>
<td>68%</td>
<td>56%</td>
<td>56%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2001)

The Nama Khoi LM’s:

- Unemployment rate (16.5%) is lower than that of the Namakwa DM (19.3%)
- Labour participation rate (56.3%) is lower than that of the Namakwa DM (56.8%)
- Has a labour dependency ratio of 2.5 which is lower than the Namakwa DM (2.6)

**Employment per Industry (2009)**

Table 2.19 and 2.20 indicates the sectors in which residents are employed within the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**TABLE 2.19: EMPLOYMENT PER INDUSTRY (DM & LM)**

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry &amp; fishing</td>
<td>16.6%</td>
<td>12.6%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>8.2%</td>
<td>16.3%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>3.8%</td>
<td>2.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Electricity, gas &amp; water</td>
<td>0.6%</td>
<td>0.4%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Construction</td>
<td>4.6%</td>
<td>5.7%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Wholesale &amp; retail trade, catering &amp; accommodation</td>
<td>16.1%</td>
<td>14.6%</td>
<td>17.3%</td>
</tr>
<tr>
<td>Transport, storage &amp; communication</td>
<td>3.2%</td>
<td>3.3%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Finance, insurance, real estate &amp; business services</td>
<td>9.2%</td>
<td>8.1%</td>
<td>8.1%</td>
</tr>
</tbody>
</table>
The majority of the Nama Khoi LM’s population is employed in the following sectors:
- General government (21.7%)
- Community, social and personal services (17.3%)
- Wholesale & retail trade, catering and accommodation (17.3%)
- Mining (16%)

The majority of the population in Vioolsdrif are employed in agriculture. In the other settlements the majority of people are employed in mining and government services.

### TABLE 2.20: EMPLOYMENT PER INDUSTRY (COMMUNITIES)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Buffelsrivier</th>
<th>Bulletrap</th>
<th>Carolusberg</th>
<th>Concordia</th>
<th>Kleinsee</th>
<th>Komaggas</th>
<th>Nababeep</th>
<th>Okiep</th>
<th>Springbok</th>
<th>Steinkopf</th>
<th>Vioolsdrif</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry &amp; fishing</td>
<td>7%</td>
<td>0%</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>30%</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>55%</td>
<td>12%</td>
<td>44%</td>
<td>12%</td>
<td>89%</td>
<td>64%</td>
<td>44%</td>
<td>18%</td>
<td>3%</td>
<td>9%</td>
<td>17%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>8%</td>
<td>0%</td>
<td>12%</td>
<td>7%</td>
<td>1%</td>
<td>0%</td>
<td>4%</td>
<td>7%</td>
<td>7%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Electricity, gas &amp; water</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Construction</td>
<td>2%</td>
<td>40%</td>
<td>5%</td>
<td>6%</td>
<td>2%</td>
<td>4%</td>
<td>4%</td>
<td>7%</td>
<td>8%</td>
<td>8%</td>
<td>0%</td>
</tr>
<tr>
<td>Wholesale &amp; retail trade, catering &amp; accommodation</td>
<td>6%</td>
<td>6%</td>
<td>9%</td>
<td>32%</td>
<td>2%</td>
<td>12%</td>
<td>14%</td>
<td>34%</td>
<td>27%</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>Transport, storage &amp; communication</td>
<td>0%</td>
<td>0%</td>
<td>3%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
<td>3%</td>
<td>3%</td>
<td>7%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Finance, insurance, real estate &amp; business services</td>
<td>0%</td>
<td>6%</td>
<td>8%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>6%</td>
<td>5%</td>
<td>10%</td>
<td>9%</td>
<td>0%</td>
</tr>
<tr>
<td>Community, social &amp; personal services, &amp; general government</td>
<td>22%</td>
<td>36%</td>
<td>17%</td>
<td>34%</td>
<td>2%</td>
<td>17%</td>
<td>21%</td>
<td>24%</td>
<td>37%</td>
<td>47%</td>
<td>42%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2001)

### Occupation Profile (2007)

The occupation profile is a strong indicator of the level of income generated by the local population. The occupation profile indicates whether the population has a skilled or unskilled labour force and in which professions people are absorbed into. **Table 2.21** indicates the different occupations that people are employed in, in the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

### TABLE 2.21: OCCUPATION PROFILE

<table>
<thead>
<tr>
<th>Occupation</th>
<th>2007</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislators; senior officials &amp; managers</td>
<td>8.1%</td>
<td>8.2%</td>
<td>9.7%</td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>8.6%</td>
<td>8.8%</td>
<td>9.5%</td>
<td></td>
</tr>
<tr>
<td>Technicians &amp; associate professionals</td>
<td>4.0%</td>
<td>3.7%</td>
<td>5.1%</td>
<td></td>
</tr>
<tr>
<td>Clerks</td>
<td>8.0%</td>
<td>7.8%</td>
<td>8.8%</td>
<td></td>
</tr>
<tr>
<td>Service workers; shop &amp; market sales workers</td>
<td>8.3%</td>
<td>8.5%</td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>Skilled agricultural &amp; fishery workers</td>
<td>6.9%</td>
<td>5.6%</td>
<td>4.3%</td>
<td></td>
</tr>
<tr>
<td>Craft &amp; related trades workers</td>
<td>10.6%</td>
<td>12.1%</td>
<td>11.9%</td>
<td></td>
</tr>
</tbody>
</table>
SOCIO-ECONOMIC CRITERION | IMPLICATIONS
--- | ---
Plant & machine operators & assemblers | 6.1% 6.9% 6.1%
Elementary occupations | 18.1% 19.0% 21.4%
Occupations unspecified & not elsewhere classified | 14.3% 12.7% 6.6%
Institution | 6.9% 6.7% 5.1%

(Source: Quantec Data, 2007)

The majority of the Nama Khoi LM’s population is employed in the following occupations:
- Elementary occupations (21.4%)
- Craft and related trades workers (11.9%)
- Service workers, shop and market sales workers (11.4%)

This indicates that there are limited professional skills in the area.

### Income Levels (2007)

In order to determine the people’s living standards as well as their ability to pay for basic services such as water and sanitation, the income levels of the employed population are analysed. Generally household income levels are one basis for determining poverty levels in a community. Additionally, the income levels of a particular area provide some insight into the economic behaviour of a particular community, i.e. the purchasing power of that community, the potential poverty levels that a community might be experiencing and vulnerability to changes in the economy.

Households that have either no income or a low-income fall within the poverty level (R0 – R38, 400 per annum); indicating that they experience difficulty in meeting their basic needs. A high poverty level results in a social dependency on the government and could lead to great strain on the government budget. A middle-income is classified as earning R38,401 – R307,200 per annum whereas a high-income is classified as earning R307,201 or more per annum. **Table 2.22** indicates the household income levels of the residents in the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**TABLE 2.22: INCOME LEVELS**

<table>
<thead>
<tr>
<th>Classification</th>
<th>2007</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No income</td>
<td>7.8%</td>
<td>6.3%</td>
<td>6.3%</td>
<td></td>
</tr>
<tr>
<td>R1 - R4,800</td>
<td>4.1%</td>
<td>3.2%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>R4,801 - R9,600</td>
<td>9.0%</td>
<td>6.6%</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>R9,601 - R19,200</td>
<td>23.1%</td>
<td>19.5%</td>
<td>17.9%</td>
<td></td>
</tr>
<tr>
<td>R19,201 - R38,400</td>
<td>22.6%</td>
<td>23.1%</td>
<td>24.2%</td>
<td></td>
</tr>
<tr>
<td>R38,401 - R76,800</td>
<td>15.1%</td>
<td>18.9%</td>
<td>19.1%</td>
<td></td>
</tr>
<tr>
<td>R76,801 - R153,600</td>
<td>9.2%</td>
<td>13.9%</td>
<td>14.3%</td>
<td></td>
</tr>
<tr>
<td>R153,601 R307,200</td>
<td>5.4%</td>
<td>5.3%</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>R307,201 - R614,400</td>
<td>2.6%</td>
<td>2.4%</td>
<td>2.9%</td>
<td></td>
</tr>
<tr>
<td>R614,401 R1,228,800</td>
<td>0.7%</td>
<td>0.5%</td>
<td>0.4%</td>
<td></td>
</tr>
<tr>
<td>R1,228,801 - R2,457,600</td>
<td>0.3%</td>
<td>0.2%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>R2,457,601 or more</td>
<td>0.3%</td>
<td>0.1%</td>
<td>0.0%</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2007)

This means that a focus of the LED strategy should be less on the quantity of job creation, but more on the quality of jobs created. The level of employment and the type of occupations taken up by the population of the Municipality directly affects the income levels of its people. The high poverty level has social consequences, for example, not being able to pay school fees, not having enough food in the house, not affording proper medical care, etc. Income categories will not improve unless their skills improve through better education attainment.
Within the Nama Khoi LM:

- 57.7% of households fall within the poverty level which is lower than the Namakwa DM and the Northern Cape Province.
- 39.1% of households earn a middle-income salary which is higher than the Namakwa DM and the Northern Cape Province.
- 3.2% of households earn a high-income salary which is higher than the Namakwa DM but lower than the Northern Cape Province.

**GDP (2009)**

Gross Domestic Product (GDP) comprises the value of all final goods and services, produced during a year, within the boundaries of a specific region and is commonly used to measure the level of economic activity in a specific area. For analytical purposes, GDP is utilised as an important indicator of economic activity. Generally, if the economy as a whole is performing well, demand for residential and commercial property can be expected to increase, and vice versa.

GVA (Gross Value Added) is linked as a measurement to GDP. The relationship is defined as: \( \text{GDP} = \text{GVA} + \text{Taxes} – \text{Subsidies} \). As the total aggregates of taxes on products and subsidies on products are only available at whole economy level, GVA is used for measuring Gross Regional Domestic Product and other measures of the output of entities smaller than a whole economy. GVA (Gross Value Added) is the difference between output and intermediate consumption for any given sector/industry. That is the difference between the value of goods and services produced and the cost of raw materials and other inputs which are used up in production.

TAKE NOTE: This data is based on “place of residence” and NOT “place of work”.

**Figure 2.1** indicates the GDP growth rates of the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**FIGURE 2.1: GDP GROWTH**

![GDP Growth Chart](Source: Quante Data 2009)

The Northern Cape Province had an average GDP growth rate of 2.2% during 1996 and 2009, while
the Namakwa DM had an average GDP growth rate of 1.3% and the Nama Khoi LM had an average GDP growth rate of 1% in the same period.

| GDP Sectoral Contribution (2009) |

Table 2.23 indicates the GDP contribution of each economic sector to the economies of the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

**TABLE 2.23: GDP SECTORAL CONTRIBUTION**

<table>
<thead>
<tr>
<th>2009</th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry &amp; fishing</td>
<td>6.2%</td>
<td>4.5%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>23.4%</td>
<td>34.9%</td>
<td>35.2%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>3.6%</td>
<td>2.2%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Electricity, gas &amp; water</td>
<td>2.1%</td>
<td>1.1%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Construction</td>
<td>1.7%</td>
<td>2.4%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Wholesale &amp; retail trade, catering &amp; accommodation</td>
<td>11.7%</td>
<td>9.5%</td>
<td>11.7%</td>
</tr>
<tr>
<td>Transport, storage &amp; communication</td>
<td>10.2%</td>
<td>10.7%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Finance, insurance, real estate &amp; business services</td>
<td>15.3%</td>
<td>11.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Community, social &amp; personal services</td>
<td>10.7%</td>
<td>11.9%</td>
<td>12.0%</td>
</tr>
<tr>
<td>General government</td>
<td>15.1%</td>
<td>11.8%</td>
<td>13.1%</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2009)

The sectors that contributed the most to the Nama Khoi LM’s GDP in 2009 were:
1. Mining and quarrying (35.2%)
2. General government (13.1%)
3. Community, social and personal services (12%)
4. Wholesale and retail trade, catering and accommodation (11.7%)
5. Transport, storage and communication (10.5%)
6. Finance, insurance, real estate and business services (10%)

Comparative advantage (2009)

A comparative advantage indicates a relatively more competitive production function for a product or service in a specific economy (regional or sub-regional) than in the aggregate economy (provincial or national). It therefore measures whether a specific economy produces a product or renders a service more efficiently than another.

One way to measure the comparative advantage of a specific economy is by way of the location quotient. A location quotient as a tool, however, does not take into account external factors such as government policies, investment incentives, and proximity to market, etc. which can influence the comparative advantage of an area. The Locational Quotient is used to calculate the comparative advantage of the relevant study areas. The location quotient is calculated ratios between two economies; in this case the metropolitan and local economies. This ratio is calculated for all industries to determine whether or not the district or local economy has a greater share or advantage of that industry. If an economy has a location quotient greater than 1, it means that economy enjoys a
comparative advantage. The interpretation of the locational quotient is illustrated in Table 2.24.

### TABLE 2.24: LOCATIONAL QUOTIENT INTERPRETATION

<table>
<thead>
<tr>
<th>Locational Quotient</th>
<th>Classification</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.75</td>
<td>Low</td>
<td>Regional needs are probably not being met by the sector resulting in an import of goods and services in this sector</td>
</tr>
<tr>
<td>0.75 to 1.24</td>
<td>Medium</td>
<td>Most local needs are being met by the sector. The region will probably be both importing and exporting goods and services in this sector</td>
</tr>
<tr>
<td>1.25 to 4.99</td>
<td>High</td>
<td>The sector is serving needs beyond the border, exporting goods and services in this sector to other regions or provinces</td>
</tr>
<tr>
<td>More than 5.00</td>
<td>Very High</td>
<td>This is indicative of a very high level of local dependence on the sector, typically in a “single-industry” community</td>
</tr>
</tbody>
</table>

(Source: Urban-Econ, 2011)

Table 2.25 indicates the sectors where the Nama Khoi LM has a comparative advantage in the Namakwa DM in terms of GDP and employment.

### TABLE 2.25: COMPARATIVE ADVANTAGE

<table>
<thead>
<tr>
<th>2009</th>
<th>In terms of GDP</th>
<th>In terms of Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>0.54</td>
<td>0.59</td>
</tr>
<tr>
<td>Mining</td>
<td>1.01</td>
<td>0.98</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.80</td>
<td>0.77</td>
</tr>
<tr>
<td>Electricity, gas and water</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>Construction</td>
<td>1.01</td>
<td>1.09</td>
</tr>
<tr>
<td>Wholesale and retail trade, catering and accommodation</td>
<td>1.23</td>
<td>1.19</td>
</tr>
<tr>
<td>Transport, storage and communication</td>
<td>0.98</td>
<td>1.01</td>
</tr>
<tr>
<td>Finance, insurance, real estate and business services</td>
<td>0.90</td>
<td>1.00</td>
</tr>
<tr>
<td>Community, social and personal services</td>
<td>1.01</td>
<td>0.98</td>
</tr>
<tr>
<td>General government</td>
<td>1.11</td>
<td>1.17</td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2009)

In terms of GDP the Nama Khoi LM has a comparative advantage within the Namakwa DM in the following sectors:

1. Wholesale and retail trade, catering and accommodation
2. General government
3. Mining
4. Community, social and personal services
5. Construction
6. Transport, storage and communication

And in terms of employment the Nama Khoi LM has a comparative advantage within the Namakwa DM in the following sectors:

1. Wholesale and retail trade, catering and accommodation
2. General government
3. Construction

order for development to occur basic services need to be in place, especially water, land and an enabling environment.
Labour Productivity (2009)

Labour productivity is the output of goods and services per labour unit. Labour productivity can be measured by dividing the economic production within a geographic area by the number of employed within that area, thereby indicating the value of output produced per worker. Table 2.26 indicates the labour productivity for the Northern Cape Province, the Namakwa DM, and the Nama Khoi LM.

<table>
<thead>
<tr>
<th>SOcio-EconomiC Criterion</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Transport, storage and communication</td>
<td></td>
</tr>
<tr>
<td>5. Finance, insurance, real estate and business services</td>
<td></td>
</tr>
<tr>
<td>6. Mining</td>
<td></td>
</tr>
<tr>
<td>7. Community, social and personal services</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 2.26: LABOUR PRODUCTIVITY (GDP AT CURRENT PRICES), 2009**

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>NDM</th>
<th>NKLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry &amp; fishing</td>
<td>R 80 017</td>
<td>R 80 876</td>
<td>R 70 275</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>R 712 379</td>
<td>R 557 850</td>
<td>R 561 214</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>R 153 378</td>
<td>R 135 209</td>
<td>R 127 468</td>
</tr>
<tr>
<td>Electricity, gas &amp; water</td>
<td>R 612 740</td>
<td>R 561 622</td>
<td>R 554 532</td>
</tr>
<tr>
<td>Construction</td>
<td>R 67 695</td>
<td>R 79 570</td>
<td>R 72 281</td>
</tr>
<tr>
<td>Wholesale &amp; retail trade, catering &amp; accommodation</td>
<td>R 122 159</td>
<td>R 116 105</td>
<td>R 118 305</td>
</tr>
<tr>
<td>Transport, storage &amp; communication</td>
<td>R 515 109</td>
<td>R 489 828</td>
<td>R 515 118</td>
</tr>
<tr>
<td>Finance, insurance, real estate &amp; business services</td>
<td>R 257 394</td>
<td>R 227 233</td>
<td>R 200 932</td>
</tr>
<tr>
<td>Community, social &amp; personal services</td>
<td>R 104 650</td>
<td>R 106 774</td>
<td>R 109 554</td>
</tr>
<tr>
<td>General government</td>
<td>R 116 342</td>
<td>R 114 202</td>
<td>R 106 872</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>R 186 278</strong></td>
<td><strong>R 203 085</strong></td>
<td><strong>R 200 178</strong></td>
</tr>
</tbody>
</table>

(Source: Quantec Data, 2009)

The most productive sectors in terms of GDP output per employee in the Nama Khoi LM are:

1. Mining and quarrying
2. Electricity, gas and water
3. Transport, storage and communication

2.2 Conclusion

Many rural areas still lack basic infrastructure such as roads, water and electricity supply. This lack of infrastructure entrenches the problems of chronic poverty and limits the potential of communities to sustain economic growth, rural livelihoods and social development. It can be concluded that Nama Khoi LM still contains a high poverty level:

- 57.7% fall within poverty level (lower than the Namakwa DM and Northern Cape)
- 1.7% of adults have no education (better than the Namakwa DM and Northern Cape)
- 29.6% no water inside dwelling (better than the Namakwa DM and Northern Cape)
- 5.7% no electricity (better than the Namakwa DM and Northern Cape)
- 20.2% no sanitation (better than the Namakwa DM and Northern Cape)
- 10.8% resided in informal dwellings (higher than the Namakwa DM but lower than the Northern
16.5% unemployment rate (better than the Namakwa DM and Northern Cape)
49.8% semi- & unskilled (higher than the Namakwa DM but lower than the Northern Cape)
Main occupations in 2007: elementary occupations, craft & related trades workers, service workers, managers & officials, & professionals
Main contributors to GDP: Mining (35.2%), Government (25.1%), Wholesale (11.7%), Transport (10.5%), & Finance (10%).
-0.5% economic growth rate for 2000 – 2009 (lower than the Namakwa DM and Northern Cape)

It is evident that the leading sectors in the Nama Khoi LM are:
- Mining and quarrying
- Wholesale and retail trade, catering and accommodation
- Government and community services
- Finance, insurance, real estate and business services
- Transport, storage and communication
- Tourism (which is not classified as a SIC sector but which overlaps many sectors)

As mentioned earlier the mining sector is currently leaving the area which will have an impact on both GDP and employment. From the stakeholder interviews and current market trends it is clear that the following two economic sectors could have a future comparative advantage in the area:
- Agriculture, forestry and fishing
- Electricity, gas and water
Section 3: Policy Overview

3.1 Background

This policy overview reviews national, provincial and local policies and strategies relevant to economic development. The purpose of this sub-section is to understand the environment in which economic development is currently taking place within the Nama Khoi LM, as well as to determine whether the proposed wind farm and PV plant development near Springbok supports or opposes the relevant legislative framework.

### TABLE 3.1: POLICY REVIEW

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
<th>Economic Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>International</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kyoto Protocol</td>
<td>South Africa is a signatory to the Kyoto Protocol, although due to the fact that it is not a developed country, no emission reduction targets have been imposed on it. Nevertheless, the South African government is committed to reducing carbon emissions in both production and consumption streams. In 2009, during the Copenhagen climate negotiations the country announced that it would volunteer to reduce domestic GHG emissions by 34% by 2020 and by 42% by 2025 below the “business as usual” baseline, subject to the availability of adequate financial, technological and other support.</td>
<td>The proposed project could form part of the Kyoto Protocol and could apply for registration under the CDM (Clean Development Mechanism).</td>
</tr>
<tr>
<td><strong>South Africa</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Paper on Renewable Energy Policy (2003)</td>
<td>In this policy, government’s goal is to achieve a target of 10,000GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. However, the policy is being reviewed to assess progress after the first 5 years of policy implementation and also to propose medium to long-term renewable energy (RE) targets.</td>
<td>The proposed project forms part of the White Paper on Renewable Policy.</td>
</tr>
<tr>
<td>Integrated Resource Plan (IRP) for Electricity 2010 – 2030</td>
<td>The Integrated Resource Plan 2010-2030 (promulgated on 6 May 2011) projected that an additional capacity of 56 539 MW will be required to support the country’s economic development and ensure adequate reserves over the next twenty years. The required expansion is more than two times the size of the existing capacity of the system. A significant component of the IRP is the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity. Overall, the proposed plan implies the</td>
<td>The proposed project forms part of the IRP.</td>
</tr>
<tr>
<td>Policy</td>
<td>Description</td>
<td>Economic Development</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>New Growth Path Plan (2010)</strong></td>
<td>The New Growth Path Plan is the government’s programme of action that focuses on the creation of decent employment opportunities through the support of labour-intensive sectors and on ensuring long-term growth through the support of more advanced industries. As a starting point, employment creation is planned to be stimulated in a few sectors including the green economy sector. Government plans to create 300 000 employment opportunities in the green economy by 2020, more than two-thirds of which is intended to be created in construction, operation and maintenance of new environmentally friendly infrastructure.</td>
<td>The proposed project forms part of the New Growth Path Plan.</td>
</tr>
<tr>
<td><strong>Integrated Sustainable Rural Development Strategy (ISRDS 2000)</strong></td>
<td>The Integrated Sustainable Rural Development Strategy (ISRDS: 2000) aims to transform rural South Africa into an economically viable sector, which can make a significant contribution to the GDP of South Africa. The ISRDS is designed to realize a vision that will “attain socially cohesive</td>
<td>The proposed project forms part of the ISRDS through their various local development projects (Refer to Box 2 below).</td>
</tr>
</tbody>
</table>
A successful strategy to achieve integrated sustainable rural development will reflect each of its three key elements:

1. **Rural Development**
2. **Sustainability**
3. **Integration**

### Northern Cape Province

**Northern Cape Provincial Growth and Development Strategy (NCPGDS 2005)**

The core purpose of the NCPGDS is to enable stakeholders from public, private and parastatal sectors together with labour and civil society to determine a plan for sustainable growth and development of the Northern Cape. The NCPGDS sets the tone for development planning and outlines the strategic planning direction in the Province. The main objectives set by the NCPGDS for development planning in the Province are:

- Promoting the growth, diversification and transformation of the provincial economy
- Poverty reduction through social development
- Developing requisite levels of human and social capital
- Improving the efficiency and effectiveness of governance and other development institutions
- Enhancing infrastructure for economic growth and social development

The NCPGDS has identified the following interventions as the key to promoting economic growth in the Province:

1. Agriculture and agro-processing
2. Mining and mineral processing
3. Manufacturing
4. Fishing and mariculture
5. Tourism

Besides focusing on these sectors, the Local Municipality needs to meet basic needs, target vulnerable groups, focus on urban and rural development, and crime prevention.

### Northern Cape Local Economic Development Strategy (NC LED 2009)

The NC LED is intended to build a shared understanding of LED in the Province and put into context the role of local economies in the provincial economy. It seeks to mobilise local people and local resources in an effort to fight poverty. The NC LED Strategy investigated the options and opportunities available to broaden the local economic base of the Province in order to promote the creation of employment opportunities and the resultant spin-off effects throughout the local economy. Areas of opportunity include:

- Livestock products

The NDM LED provides the Local Municipality’s with leadership and direction in policy making, in order to administer policy, programmes and projects, and to be the main initiator of economic development programmes through public spending, regulatory powers and their promotion of industrial, small business development, social enterprises and cooperatives. The Local municipality’s need to create an enabling environment.
<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
<th>Economic Development</th>
</tr>
</thead>
</table>
|        | • Game farming  
|        | • Horticulture  
|        | • Mariculture  
|        | • Ago-related industries  
|        | • Tourism  
|        | • Manganese and iron Ore  
|        | • Beneficiation of minerals  
|        | • Renewable energy | for their communities. |

**The Northern Cape Municipal LED Framework (2010)**

The LED experience in the Northern Cape (and elsewhere) has indicated that local economies do not change when they need to. The broad aim of the Framework is to provide a common understanding of LED in the Province, a shared format for LED Strategies and structured support mechanisms. LED encompasses a range of disciplines including physical planning, economics and marketing. It also incorporates many local government and private sector functions including environmental planning, business development, infrastructure provision, real estate development and finance. The following LED Strategy Framework for municipalities in the Northern Cape:

- Phase 1: LED Visioning
- Phase 2: Situational Analysis
- Phase 3: LED Strategy Formulation
- Phase 4: Implementation Plan
- Phase 5: Monitoring and Review

The purpose of LED is to build up the economic capacity of a local area to improve its economic future and the quality of life for all. It is a process by which public, business and nongovernmental sector partners work collectively to create better conditions for economic growth and employment generation. At the end of each year every NC LED manager should ask her/himself two questions:

1. How many new jobs have I facilitated this year?
2. How much new investment have I facilitated this year?

**Namakwa District**

The 2006-2001 IDP as well as the first revision, 2008-2009, contains certain strategic and long term information (strategies, goals, targets, etc.) and are therefore an integral part of the development process of the District. During the past year several development activities were initiated through analysis reports, economic potential identification and an improved Sector Department involvement in the District. These initiatives are presently in progress, although in different stages. Identified projects were divided into 5 KPA’S namely:

- Municipal Transformation and Organisational Development
- Basic Service Delivery and Infrastructure
- Local Economic Development
- Municipal Financial Viability and Management
- Good Governance and Public Participation

The Namakwa District Municipality must promote local economic growth and social development in order to provide a better life for their communities. A stable and safe environment is essential for prosperous growth and development, thus creating an enabling environment for communities.
<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
<th>Economic Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality Local Economic Development</td>
<td>Understanding of LED in the District and put into context the role of local economies in the provincial economy. It seeks to mobilise local people and local resources in an effort to fight poverty. Various opportunities (projects and programmes) are identified in this strategy, namely:</td>
<td>Nama Khoi Local Municipality with leadership and direction in policy making, in order to administer policy, programmes and projects, and to be the main initiator of economic development programmes through public spending, regulatory powers and their promotion of industrial, small business development, social enterprises and cooperatives. The Nama Khoi Local municipality needs to create an enabling environment for its communities.</td>
</tr>
<tr>
<td>Strategy (LED 2009)</td>
<td>- Institutional Development for Investor Readiness (this is essentially a human capital development and municipal service delivery improvement strategy).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- SMME Development (cutting across sectors, this is reflected in specific SMME opportunities identified, as well as, for example, the One-Stop Mining Centre).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Agricultural Sector Development (including the Hoodia and Mariculture projects, the enabling public sector interventions and the implementation of new technologies as they become viable (such as new biotechnologies, irrigation techniques and so on).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Mining Sector Development (including the beneficiation projects, One-Stop Mining Centre and the implementation of new technologies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Industrial Development (programmes relating to the manufacturing projects identified and general improvement in living conditions, infrastructure (particularly transport) and overall economic growth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Renewable Energy Development (including wind, wave, solar, and biogas energy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Space Research and Development Spin-offs (prioritising the identification of spin-offs and enabling local entrepreneurs to exploit these opportunities).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Tourism Development (including the specific projects/SMME business opportunities and the enabling public sector interventions).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Quality of Life Improvement (this is seen as an all-encompassing thrust with specific programmes in the Expanded Public Works Programme aimed at improved infrastructure, overcoming backlogs in service delivery, providing education, health and safety services and so on. It should deal with the attractiveness of the area to investors in terms of quality of life and quality of labour and resources on the one hand, and the ability of locals to take advantage of economic opportunities on the</td>
<td></td>
</tr>
</tbody>
</table>
### Namakwa District Biodiversity Sector Plan (2008)

This Strategy serves to help guide land-use planning, environmental assessments and authorisations; and, natural resource management in order to promote development which occurs in a sustainable manner. It has been developed to further the awareness of the unique biodiversity in the area, the value this biodiversity represents to people as well as the management mechanisms that can ensure its protection and sustainable utilization.

The Nama Khoi Local Municipality can use this strategy to make sure local economic development does not infringe on biodiversity and critical biodiversity areas. The strategy also includes projections for sustainable development that can be included in development plans and future planning reports.

### NAMA KOHI LOCAL MUNICIPALITY

The vision of the Nama Khoi LM is: “To establish the most successful and responsible Municipality through outstanding consumer service delivery in benefit of the broader community.” The Nama Khoi LM strives for optimum, effective and responsible usage of limited available resources in order to deliver outstanding services to the community; and stimulate economic development, focusing on previously disadvantaged areas. Key performance areas within the Municipality include:

- Local economic development
- Institutional and government
- Health
- Land and housing
- Infrastructure and basic services
- Environment
- Social development
- Financial management
- Development goals

The Nama Khoi LM must promote local economic growth and social development in order to provide a better live for their communities. The focus is on basic services as well as the following sectors: electricity and water, agriculture, tourism, mining, and infrastructure development.

### Nama Khoi Local Municipality Local Economic Development Strategy (LED)

The LED vision of the Nama Khoi LM is: “The optimum beneficiation of limited resources; effective service delivery and support of economic development focusing on the upliftment of the previously disadvantaged.” Aims of the Municipality include:

- Spatial and land reform
- Social economic development
- Infrastructure development
- Economic development in the following sectors
  - Agriculture
  - Mining
  - Tourism and business
- Institutional capacity building

The Nama Khoi LED provides the direction in order to administer policy, programmes and projects, and to be the main initiator of economic development programmes through public spending, and regulatory powers. The Local municipality needs to create an enabling environment for its communities in order to foster this local economic development.
Nama Khoi Biodiversity Sector Plan (2008)

Namaqualand comprises of approximately one third of the Succulent Karoo biome, and lies within four of the six Local Municipalities within the NDM namely, the Richtersveld, Nama Khoi, Khai Ma and Kamiesberg local municipalities. The Nama Khoi LM is particularly a unique and diverse environment – owing in large part to the presence of four distinct bio-geographical regions within its boundaries. Climate change is going to have a big impact on the area. It is projected that a 2°C increase in temperature in the area will lead to a 10% reduction in rainfall. This decrease in rainfall is projected to result in a 35% decrease in livestock carrying capacity over the coming 200 years. It is hoped that the tourism industry will expand, and diversification of cropping – such as the sustainable harvesting of plants rich in essential oils – could prove a viable land use in the area. Specific guidelines are outlined for:
- Cultivation
- Road crossings
- Roads
- Grazing and trampling
- Fire
- Abstraction
- Dam
- Settlements and towns

Conservation of aquatic (river, wetland and estuary) resources can help ensure that the region can sustainably manage their water resources for the benefit of the human population, is able to withstand climate change, and conserve the municipality’s unique biodiversity. Development of roads, dams, and so forth also need to adhere to specific guidelines in order to ensure the conservation of aquatic resources.

The proposed Kangnas wind farm and PV plant developments have the potential to address a number of key policies and strategies on a national, provincial and local level. The development will address economic development issues such as infrastructure investment, increase in GGP, job creation and investment in renewable energy. The socio-economic development of the local communities will also be addressed through the various initiatives to be implemented alongside the proposed Kangnas wind farm and PV plant developments.
Section 4: Development Concept

4.1 Preamble

This section of the report presents and describes the alternative land uses which have been proposed for the development site. The concept behind the section is to orientate the reader with regards what has been proposed for development. In addition to this is will also highlight what infrastructural facilities are already available on site and what the development will still require in order to function effectively.

4.2 Background to Wind Farming

For human development to continue, industry will ultimately need to find sources of renewable or virtually inexhaustible energy. Even the most apparently "inexhaustible" sources like fusion involve the generation of large amounts of waste heat enough to place damaging stress on even a robust ecosystem like Earth's, at least for the organisms that depend upon stability of the system to survive.

There is a lot of underlying popular support for wind energy and the other renewables in the United States and Europe. But there is also much indifference as well.

Wind energy conversion is a fascinating field to study, if only because its past has been so checkered and its exact future is so uncertain. Unlike the aerospace industry, the computer industry, and almost any other successful industry you can name, wind energy is the leading mechanically-based renewable energy for much of man’s history and has never made anyone rich for long. But unlike many of these other industries, it has been around for thousands of years. It’s a technology that has been reinvented numerous times. We are left with the promise and the drive to succeed despite daunting (and sometimes puzzling) obstacles.

In the 1990s, the California wind farm market began to be affected by the expiration or forced re-negotiation of attractive power purchase contracts with the major California utilities: Southern California Edison and Pacific Gas and Electric. And much of the existing inventory of 1980’s wind turbines were really an albatross around the wind industry’s neck.

Renewal was needed, and was buoyed by "green power" initiatives in Colorado, Texas and elsewhere -- U.S. wind energy development resumed in 1999, with a much broader geographical base.

A variety of new wind projects were installed in the U.S. in the late ’90s, including a cluster of Zond Z-40 turbines (at left) operated for a utility in southwest Texas, a wind plant of 46 Vestas machines planned for Big Spring, Texas, a 10-megawatt wind plant in Northern Colorado, a number of plants in the upper midwest, and the “re-powering” of some projects in California. Some of these involve foreign machines manufactured in the U.S. There’s a sense that the industry is finally on the move again, with over 2000 megawatts of new capacity planned for 2001 in the U.S. alone. Existing and planned U.S. projects can be explored using the Wind Project Map maintained by the American Wind Energy Association.
The cost of energy from larger electrical output wind turbines used in utility-interconnected or wind farm applications has dropped from more than $1.00 per kilowatt-hour (kWh) in 1978 to under $0.05 per kWh in 1998, and is projected to plummet to $0.025 per kWh when new large wind plants come online in 2001 and 2002. The hardware costs of these wind turbines have dropped below $800 per installed kilowatt in the past five years, under-pricing the capital costs of almost every other type of power plant.

It's difficult to accurately compare the costs of wind plants and fossil fuel plants because the cost drivers are so different. Low installed-cost-per-kilowatt figures for wind turbines are somewhat misleading because of the low capacity factor of wind turbines relative to coal and other fossil-fuelled power plants. (*Note:* "capacity factor" is simply the ratio of actual energy produced by a power plant to the energy that would be produced if it operated at rated capacity for an entire year.) Capacity factors of successful wind farm operations range from 0.20 to 0.35 (0.3 to 0.4 in current South African conditions). These can be compared with factors of more than 0.50 for fossil-fuel power plants and over 0.60 for some of the new gas turbines.

However, the use of "capacity factor" is also misleading because wind has a "rubber" capacity factor that varies with the density of the wind resource. But that wind resource is constant for the life of the machine and is not subject to manipulation or cost increases. One reason why fossil fuels are so popular with investors is that many of the risks are passed on to consumers. Fossil fuel shortages result in an increase in revenues for investors, who are actually rewarded for: 1) speeding the depletion of a non-renewable resource or 2) not investing enough of their profits in support infrastructure, which (as we have seen in 2000-2001) drives up prices. If a big oil coal or gas company could start charging for the wind, they would make sure that wind power development happened.

Worldwide, there are 10 to 12 manufacturers of large, utility-scale systems, marketing 200kW to 3.0 MW systems of various configurations, including three-bladed machines with full-span pitch control and two-bladed, stall control machines with teetering hubs. News on these developments is available from the major industry magazine, The Windpower Monthly.

In the near future, wind energy will be the most cost effective source of electrical power. In fact, a good case can be made for saying that it already has achieved this status. The actual life cycle cost of fossil fuels (from mining and extraction to transport to use technology to environmental impact to political costs and impacts, etc.) is not really known, but it is certainly far more than the current wholesale rates. The eventual depletion of these energy sources will entail rapid escalations in price which -- averaged over the brief period of their use will result in postponed actual costs that would be unacceptable by present standards. And this doesn't even consider the environmental and political costs of fossil fuels use that are silently and not-so-silently mounting every day.

The major technology developments enabling wind power commercialization have already been made. There will be infinite refinements and improvements, of course. One can guess (based on experience with other technologies) that the eventual push to full commercialization and deployment of the technology will happen in a manner that no one can imagine today. There will be a "weather change" in the marketplace, or a "killer application" somewhere that will put several key companies or financial organizations in a position to profit. They will take advantage of public interest, the political and economic climate, and emotional or marketing
factors to position wind energy technology (developed in a long lineage from the Chinese and the Persians to the present wind energy researchers and developers) for its next round of development.

4.3 Background to Photovoltaic Plant

Photovoltaic is a marriage of two words: ‘photo’, from Greek roots, meaning light and ‘voltaic’ from ‘volt’ which is the unit used to measure electric potential at a given point. Photovoltaic systems use cells to convert solar radiation into electricity. The cell consists of one or two layers of a semi-conducting material. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity is. The most common semi-conductor material used in photovoltaic cells is silicon, an element most commonly found in sand. There is no limitation to its availability as a raw material; silicon is the second most abundant material in the earth's mass. Moreover a photovoltaic system does not need bright sunlight in order to operate. It can also generate electricity on cloudy days.

Solar photovoltaic (PV) cells convert sunlight, the world’s most abundant and widespread renewable energy source, directly into electricity. The first major use of solar cells occurred in the American space programme and satellites in orbit around the earth are still powered by solar electricity. Solar cells are used to generate electricity for:

- Water pumping
- Vaccine refrigeration
- Security lighting
- Electric fencing
- Household power
- Meteorological monitoring
- Radio repeaters
- Railway line switches
- Street lighting
- Highway telephones
- Calculators; and
- Watches

Photovoltaic cells (also called solar cells) are made from semiconductor material, usually silicon. The silicon is chemically treated so that the upper and lower layers are oppositely charged. Solar cells operate according to what is called the photovoltaic effect. In the photovoltaic effect, sunlight or photons, strike the surface of semi-conductor material such as silicon; energy penetrates the cell and dislodges electrons from the materials atoms. Certain chemicals added to the material's composition help establish a path for the freed electrons. This creates an electrical current. Metallic contacts placed in a grid on the top and bottom of the cell enables the current to flow through an external circuit. Most commonly the cells are electrically connected and mounted on a flat surface to make a flat plate PV module or panel.
Concentrating modules use lenses for example Fresnel lenses that concentrate the sunlight onto the solar cells. Because light is concentrated onto the cells, it is necessary to track the sun to keep sunlight focused on the cells. Flat plate panels are commercially available and more commonly used that concentrating modules.

The performance of a solar cell is measured in terms of its efficiency at turning sunlight into electricity. A typical commercial solar cell has an efficiency of 15%; about one-sixth of the sunlight striking the cell generates electricity. Improving solar cell efficiencies while holding down the cost per cell is an important goal of the PV industry.

The advantages of a PV plant are as follows:

- Electricity produced by solar cells is clean and silent
- Photovoltaic systems are quiet and visually unobtrusive, resulting in no noise or pollution
- Small-scale solar plants can take advantage of unused space on rooftops of existing buildings
- PV cells were originally developed for use in space, where repair is extremely expensive, if not impossible. PV still powers nearly every satellite circling the earth because it operates reliably for long periods of times with virtually no maintenance
- Solar energy is a locally available renewable resource. It does not need to be imported from other regions of the country or across the world. This reduces environmental impacts associated with transportation and also reduced our dependence on imported oil; and unlike fuels that are mined and harvested, when we use solar energy to produce electricity we do not deplete or alter the resource
- A PV system can be constructed to any size based on energy requirements. Furthermore, the owner of a PV system can enlarge or move it if his or her energy needs change
- No moving parts are required
- Well suited for distribution generation and the technology exists today and is rapidly improving
- Little of no transmission required
- Matches up well with air conditioning needs
- Requires minimal maintenance and the excess heat can be used for co-generation
- Grants and incentives are available and offered by respective governments to achieve their green energy needs and obligations

The disadvantages of a PV plant are as follows:

- Some toxic chemicals, like cadmium and arsenic, are used in the PV production process. These environmental impacts are minor and can be easily controlled through recycling and proper disposal
- Solar energy is somewhat more expensive to produce than conventional sources of energy due in part to the cost of manufacturing PV devices and in part to the conversion efficiencies of the equipment. As the conversion efficiencies continue to increase and the manufacturing costs continue to come down, PV will become increasingly cost competitive with conventional fuels
• Solar power is a variable energy source, with energy production dependent on the sun. Solar facilities may produce no power at all some of the time, which could lead to an energy shortage if too much of a region’s power comes from solar power.
• Requires inverter to produce AC current
• Requires storage or grid connection for continuous round-the-clock use
• Less available for heating demand (time of day and season)
• Exotic materials required in many thin-film systems
• Requires relatively large amounts of open space
• Relatively low efficiency (around 17-40%)
• Relatively low energy intensity
• Fragile materials
• Possible aesthetic issues
• Technology risk

The most important feature of solar PV systems is that there are no emissions of carbon dioxide during their operation. Although indirect emissions of carbon dioxide occur at other stages of the lifecycle, these are significantly lower than the avoided emissions. PV does not involve any other polluting emissions or the type of environmental safety concerns associated with conventional generation technologies. There is no pollution in the form of exhaust fumes or noise.

By 2030, according to the EPIA-Greenpeace Solar Generation Advanced Scenario, solar PV would have reduced annual global CO2 emissions by just over 1.6 billion tonnes. This reduction is equivalent to the output from 450 coal-fired power plants (average size 750 MW). Cumulative CO2 savings from solar electricity generation between 2005 and 2030 will have reached a level of 9 billion tonnes.

4.4 Development Activities

The proposed Kangnas wind farm and PV plant development will consist of two alternatives namely alternative 1 which is the preferred alternative and the no-go alternative which will occur if no development activities takes place on the farms.

An investment of about R 16 Billion (R11 Billion for the wind plant and R5 billion for the photovoltaic plant) with the site being an area of approximately 46 535 hectares (ha) in extent which is being considered for the construction of the proposed wind energy facility and the PV energy facility, and would include:

**Wind Energy Facility:**

- **Turbines**: The proposed wind energy facility would consist out of approximately 185 – 500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW (Size of machines will be negotiated at bidding time and will depend on resource, technology available and pricing package offered by turbine suppliers.)
- **Rotor and blades** which would be approximately 40 – 60 m long (80 – 120m rotor m diameter).
- **Nacelle** which also contains the generator, control equipment, gearbox and wind speed measure (anemometer) in order to monitor the wind speed and direction
- **Generator**
- **Towers** which would be between 60 or 120 m tall depending on the selected turbine.
- **Foundation** which would be approximately 20 m x 20 m and an average of 3 m deep.
- **Gravel surface access roads** of approximately 6-10 m wide would also be required between each turbine.
Cables connecting each turbine would interconnect and ultimately become a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible. The electricity distribution infrastructure would comprise of one transmission line (132, 220 or 400 kV). The proposed project could connect to the grid via up to four satellite substations that would link sectors of the facilities to a main substation which would connect to an overhead line. The proposed grid connection to the substation would be between approximately 0.5 and 20 km long, depending on the final location of the main wind and solar energy facilities. At the substation (200 m x 100 m) the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site.

Photovoltaic Energy Facility:
- 250 MW of PV and/or CPV
- The arrays and racks are founded into the ground through either concrete, screw or pile foundations.
- Gravel surface access road of approximately 6-10 m wide.
- Cables connecting the arrays would interconnect with overhead transmission lines that will follow the route of the access roads.
- Inverters located at nodes of PV strings will convert the Direct Current to an Alternating Current.
- The electricity distribution infrastructure would comprise of one transmission line (220 kV) traversing the site.
- The proposed project would connect to the grid via an onsite substation.

Mainstream will still need to apply for a connection, pay a connection charge and sign a connection and use-of-system agreement after a Record of Decision has been received from Department of Environmental Affairs. All IPPs will be provided non-discriminatory access to Eskom’s network, subject to the IPP’s obtaining its required approvals such as EIA’s and a generating and trading licence from NERSA.

4.5 Site for Development

The proposed Kangnas wind farm and PV energy facilities development will be located on farms near Springbok in the Northern Cape. The proposed wind and solar energy facilities are located approximately 48 km east of Springbok in the Northern Cape and can be accessed via the N14. The proposed site is situated in the Nama Khoi LM in the Northern Cape approximately 48 km east of Springbok. The site is accessed via the N14 (see Map 4.1). The site is approximately 46 535 ha in extent and consists of five portions of four farms. The landowners of the farms comprising the sites have entered into a long term agreement with Mainstream for the proposed projects. The farms are zoned Agriculture and are currently used for grazing sheep, and cattle.

The farms comprising the sites are tabulated below:

<table>
<thead>
<tr>
<th>FARM</th>
<th>LANDOWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77)</td>
<td>Mr Weich van Niekerk</td>
</tr>
<tr>
<td>Farm Koeris (Portion 1 of Farm No. 78)</td>
<td>Mr Weich van Niekerk</td>
</tr>
<tr>
<td>Farm Areb (remaining portion of Farm No. 75)</td>
<td>Mr Frank John Agenbag</td>
</tr>
<tr>
<td>Farm Smorgenschaduwé (Portion 0 of Farm No. 127)</td>
<td>Mr J Kennedy</td>
</tr>
</tbody>
</table>
Map 4.1 below indicates the location of the different farms which will the location of the wind farm and the PV plant facilities.

MAP 4.1: LOCATION OF THE PROPOSED WIND AND SOLAR ENERGY FACILITIES ON FIVE FARM PORTIONS NEAR SPRINGBOK IN THE NORTHERN CAPE

The proposed layout for the wind farm will be located on Kangnas Trust (Portion 3 and Remaining portion of Farm No. 77), Farm Koeris (Portion 1 of Farm No. 78), Farm Smorgenschaduwe (Portion 0 of Farm No. 127) and Farm Areb (remaining portion of Farm No. 75).

Figure 4.1 below indicates the layout of the wind farm activities.
The following images depict the sense of place of the Kangnas farms:

- Entrance to Kangnas Farm
- Entrance to Kangnas Farm
- Turn-off from N14 Highway
- Main Transport Route passing site (N14)
Section 5: Economic Impact

5.1 Introduction

The purpose of this section is to develop a better understanding of the potential socio-economic impacts of the proposed wind farm and PV plant developments near Springbok.

Economic impact refers to the effect on the level of economic activity in a given area as a result of some form of external intervention in the economy. For the purposes of this study, the local impacts refer to the proposed wind farm development’s impacts on the Namakwa District Municipality and specifically the study area which includes the Nama Khoi Local Municipality. These impacts are measured as a result of a capital investment by both the developer and the capital investment by the private sector (private sector leverage).

The analysis focuses on the expected changes that could be expected in the Nama Khoi Local Municipal economy and community and can best be estimated by using a technique called the I-O modelling. The I-O model translates the anticipated structural change in the economy as a consequence of the proposed development into direct and multiplicative (i.e. indirect and induced effects) in the economy. This technique is a generally accepted approach in an attempt to understand and quantify the potential effects of an exogenous change in the economy.

There are various measures, which can determine the impact of such actions on the local residents, and these include the following:

- **Impact on employment numbers**, i.e. the number of additional jobs created or jobs lost as a result of the change in the economic growth of the local economy. This is the most popular measure of economic impact because it is easier to comprehend than large, abstract Rand figures.
- **Value Added** (which is normally equivalent to Gross Geographical Product) is a broader impact of the full income effect. This measure essentially reflects the sum of wage income and corporate profit generated in the region.
- **Impact on household incomes** in the Nama Khoi LM increases as pay levels rise or additional workers are hired.
- **The impact on Business Output** (also referred to as revenue or sales volume) is the broadest measure of economic activity, as it generates the largest numbers. It includes the gross level of business revenue, which pays for cost of materials and cost of labour, as well as generating net business income profits.
- **Impacts** on the number of persons residing in the Nama Khoi LM, who are living in poverty.

The net economic impact is usually viewed as the expansion or contraction of an area’s economy, resulting from changes in (i.e., opening, closing, expansion or contraction of) a facility, project or programme. In the case of this study the possible impact of introducing a new economic activity into the Nama Khoi LM economy, namely a residential development.

The following impacts can usually be quantified:

- **Direct impact**: The direct impact is calculated from macro-economic aggregates occurring as a direct result of the project. The initial impact on GDP for example is taken from the financial information and equals the value added generated by a specific scenario.
- **The multiplicative effects** can be grouped into two distinct effects: indirect and induced.
Indirect impact: Indirect impacts are calculated from the activities of suppliers through application of the model. For purposes of this study, indirect suppliers include those industries who deliver goods and services to the activity under discussion (first round suppliers) including suppliers who on their part deliver goods and services to the first mentioned indirect suppliers.

Induced impacts: The impacts are the impacts on goods and services demanded due to the project. Examples include the income of employees and shareholders of the project as well as the income arising through the backward linkages of this spending in the economy. The impact is sometimes confused with the forward linkages of a project.

In order to simplify the impact assessment, households have been incorporated in the input/output model as a productive sector because they provide inputs in the form of labour and their reward (i.e. income) is spent in the economy. Thus, by closing the input/output model with respect to households, the direct and indirect multipliers are higher in order to accommodate the induced effects of household expenditure in the economy.

5.2 Understanding the Input Output Model

While there are many methods of regional economic impact analysis, the I-O modelling approach has proven to be a particularly effective method for evaluating the implications of introducing an exogenous change to the economy.

The Input-Output Table forms the nucleus of the I/O model. Essentially the Input-Output Table is nothing more than an extension of the National Accounts of a country, i.e. desegregating it into the various sectors of the economy. Therefore, the Input-Output Table is a quantified and summarised version of all transactions that took place between the main economic stakeholders in a particular year. For this reason, Input-Output Tables are compiled and published by Statistics South Africa (SSA), using primarily South African Reserve Bank Accounts data. These sectoral figures are therefore strictly compatible with the macro national accounting data published by the South African Reserve Bank and STATS SA on a regular basis.

The Input-Output modelling approach is recognised and accepted both nationally and internationally. The model utilised as part of this report was based on the national model and it has been adapted to reflect local economic dynamics and local forward and backward linkages.

The Input-Output Table makes provision for two kinds of transactions at a sectoral level, namely the purchase of intermediate and primary inputs on the one side, and the supply of intermediate and final outputs on the other side. In order to arrive at proper multipliers for the different sectors, household income expenditure has been included in the inter-industry section of the Input-Output Table. This implies that household income is treated as being spent within the economic system and is generating further economic activity.

1 Backward Linkages: This type of economic interaction refers to the raw material or intermediate products required as inputs into the delivering of the end product or service. In many cases the inputs required in the local economy cannot be delivered by the same economy and need to be inputted from other economies. In other cases the inputs are available but it is cheaper to obtain the same inputs from other outside economies.

2 Forward linkages: Forward linkages refer to the supplying of intermediate products as inputs into the production process, and/or delivering an end product or service at the end of the production process.
It is also important to note that the main economic decision-makers who are responsible for the transaction activities contained in the Input-Output Table are entrepreneurs, workers, households and government (all three levels).

Importantly, it is the matrices that can be derived from the I/O model that are used as instruments for economic analysis. This is done by means of the so-called technical input coefficient matrix and the Leontief Inverse matrix. The fundamental assumptions with regard to the I/O model, as well as the use of this model for analytical purposes, are:

1. Production activities in the economy are grouped in homogeneous sectors.
2. The mutual interdependence of sectors is expressed in meaningful input functions.
3. Each sector’s inputs are only a function of the specific sector’s production.
4. The production by different sectors is equal to the sum of the separate sectors’ of production.
5. The technical coefficients remain constant for the period over which forecast the projections is made.
6. There will be no major change in technology.

It should also be noted that:
1. All the Rand values in this report represent mid-2009 current prices.
2. The different measures of economic impact (jobs, GGP and new business sales) cannot be added together and should be interpreted as separate economic impacts.
3. The model quantifies direct and indirect economic impacts for a specific amount of time (e.g. 5 years). Therefore, the estimates that are derived do not refer to gradual impacts over time.

5.3 Capital Expenditure (CAPEX)
The following section describes the direct, indirect, induced and total impact of the construction of the proposed Kangnas Wind and Solar energy developments on the local, regional and national economies. The following should be noted when interpreting the tables presented below.

Tables 5.2 to 5.4 refer to the direct, indirect, induced and total impacts of the construction of the proposed development (i.e. excluding the operation impacts). During the construction phase the direct and indirect impacts are regarded as once off impacts that will occur for the duration of the construction phase of the development. The economic impacts will be assessed with regards to the impact on 3 main components of the economy. These components are:

- New Business Sales generated;
- Increase in GGP (production); and
- Impact on employment;

The cost implications for the CAPEX (capital expenditure) phase of the Kangnas Wind and Solar development are listed in table 5.1 below. As the investment for this particular project will come from local, district and national fronts the cost implications below also show the split of the cost between these three sources of investment.

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3 The baseline data is calculated as 2010 figures. This implies that the multipliers used are the latest 2010 figures – if the project is implemented after 2010, the model multipliers do not take into consideration any structural economic changes that might have occurred since 2010.
It must be noted that these figures are estimates and the actual figures may be slightly more or slightly less depending on the particular cost variable. Through these capital injections and the construction of the proposed facilities; new business sales will be generated within the local and regional economies in order to provide the materials and supplies needed during this phase. This will in turn stimulate local and regional production and employment opportunities within businesses that will be directly and indirectly involved during the construction phase, be it for the supply of building materials, specialist services or the actual construction of the facilities. The estimated cost implications during the CAPEX phase for the proposed Wind Farm and Photovoltaic plant are as follows;

**TABLE 5.1: COST AND INVESTMENT SPLITS FOR PROPOSED WIND FARM AND PHOTOVOLTAIC PLANT**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Entire Project</th>
<th>Each Phase of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wind Farm</td>
<td>Each Phase of Project</td>
</tr>
<tr>
<td><strong>Project Size</strong></td>
<td>750 MW</td>
<td>140 MW</td>
</tr>
<tr>
<td><strong>Project Cost (R’s millions) in 2012</strong></td>
<td>R11, 131, 000, 000</td>
<td>R2, 078, 000, 000</td>
</tr>
<tr>
<td><strong>Local Expenditure</strong></td>
<td>R4, 783, 000, 000</td>
<td>R893, 000, 000</td>
</tr>
<tr>
<td><strong>District Expenditure</strong></td>
<td>R901, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Rest of Country Expenditure</strong></td>
<td>R3, 881, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>% of local expenditure in Total Project costs</strong></td>
<td>43%</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Average Duration</strong></td>
<td>8 years</td>
<td>1.5 years</td>
</tr>
<tr>
<td><strong>Photovoltaic Plant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project Size</strong></td>
<td>250 MW</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Project Turnover</strong></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Project operating expenditure</strong></td>
<td>R4, 700, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Local Expenditure</strong></td>
<td>R2, 115, 000, 000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>% of local expenditure in total project costs</strong></td>
<td>45%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The cost implications were used in the formulation and calculation of the impact tables below. The impacts of the construction of the development on new business sales, production and employment stimulation are presented and discussed below.

**Additional New Business Sales:**
The establishment of the Kangnas Wind and Solar facilities will involve the establishment and construction of the various infrastructure and machinery needed for the operation of such facilities (such as the turbines, solar panels etc.). The businesses and firms that manufacture and supply the pertinent infrastructure and machinery will experience new business sales from the construction of the development.

It is recommended that the building material, supplies and labour that will be used during the construction phase be sourced locally within the country or district where possible, in order to maximise the positive impacts that the development will have within the local, district and national. Demand for products and services used during the construction phase will create and stimulate new business sales within the region, which will in turn stimulate production and increase the number of indirect and induced employment opportunities in the local economies.

**Table 5.2** below shows the direct, indirect, induced and total impact of the proposed Kangnas development on new business sales across the country. The figures below are in R’s millions.
Table 5.2 above shows that the Wind Farm will have a total impact (direct, indirect and induced impact) on new business sales in the local, regional and national economies to the amount of R13, 355, 000, 000 during the construction phase of the development. The Photovoltaic activities will have a total impact on new
business sales to the amount of R7, 911, 090, 000. It must be noted that these impacts will be distributed across the local, regional and national economies and are for the entire duration of the construction phase.

The total direct impact that the Wind Farm, during the construction phase of the development, will have on new business sales is R4, 256, 000, 000 while the Photovoltaic activities will have a total direct impact to the amount of R2, 115, 000, 000. This impact will accrue to businesses, suppliers and service providers that will be directly involved in the construction of the development, which will include logistics, manufacturing of the component parts of the wind and solar machinery, as well as the laying of external infrastructure (electricity lines, sewage pipes, water pipes etc.). This direct impact relates to the new sales stimulated as a result of the construction activities, goods and services required on site. As the component parts, equipment and infrastructure required for such a development are relatively unique and these manufacturing activities are scarce in South Africa, these benefits will most likely accrue to national and potentially international companies and manufacturers.

The most significant impact on new business sales as a result of the construction of the development will be the indirect impact, which will amount to R5, 663, 000, 000 for the development of the Wind Farm and will total R3, 505, 920, 000 for the Photovoltaic activities during the construction phase. The direct impact (highlighted above) traditionally filters down through the economy (trickle-down effect) in the form of expenditure through incomes generated through direct new business sales. The indirect impacts thus accrue to businesses which are not directly involved in the construction phase, but rather to businesses that provide goods, supplies, materials and services to those businesses that will be directly involved in the construction phase.

The total induced impact on new business sales during the construction phase will amount to R3, 436, 000, 000 for the Wind Farm development and will total R2, 290, 170, 000 during the construction of the Photovoltaic activities. The induced impact relates to benefits that accrue through increased sales and thus incomes of businesses directly and indirectly involved in the construction phase of the development. Through increased employment and thus income, businesses and employees are likely to increase expenditure within their local economy and includes all forms of expenditure such as general household expenditure (groceries, retail expenditure etc.); as well as business expenditure. The indirect and induced impacts are expected to be national, due to unique nature of the proposed development and the unique equipment it requires.

The No-Go alternative will result in the Kangnas Wind and Solar development not being constructed and thus the capital injection that would occur as a result of construction will no longer take place. Thus the No-Go alternative will not have an impact on new business sales during the construction phase, as no construction materials or labour will be required. This represents the opportunity cost, with regards to additional sales, that will be foregone through not constructing the facility.

**Additional GDP:**

Along with the increase in New Business Sales, the GDP locally, regionally and nationally will grow. Gross Domestic production (GDP) is defined as the total value of goods and services that are produced in a certain geographic area within a designated period of time (usually per annum), and is stimulated by capital investments such as that being made through the proposed development.

**Table 5.3** below shows the direct, indirect, induced and total impacts of the proposed Kangnas Wind and Solar development on additional production locally, regionally and nationally. The figures below are in R’s millions.

**TABLE 5.3: ADDITIONAL GDP (CONSTRUCTION PHASE)**
<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R 0</td>
<td>R 16,000,000</td>
<td>R 59,000,000</td>
<td>R 75,000,000</td>
</tr>
<tr>
<td>Mining</td>
<td>R 0</td>
<td>R 149,000,000</td>
<td>R 28,000,000</td>
<td>R 176,000,000</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>R 0</td>
<td>R 684,000,000</td>
<td>R 259,000,000</td>
<td>R 943,000,000</td>
</tr>
<tr>
<td>Utilities</td>
<td>R 0</td>
<td>R 34,000,000</td>
<td>R 56,000,000</td>
<td>R 90,000,000</td>
</tr>
<tr>
<td>Construction</td>
<td>R 519,000,000</td>
<td>R 113,000,000</td>
<td>R 17,000,000</td>
<td>R 649,000,000</td>
</tr>
<tr>
<td>Trade and accommodation</td>
<td>R 0</td>
<td>R 342,000,000</td>
<td>R 226,000,000</td>
<td>R 568,000,000</td>
</tr>
<tr>
<td>Transport</td>
<td>R 0</td>
<td>R 184,000,000</td>
<td>R 225,000,000</td>
<td>R 409,000,000</td>
</tr>
<tr>
<td>Financing</td>
<td>R 0</td>
<td>R 248,000,000</td>
<td>R 292,000,000</td>
<td>R 539,000,000</td>
</tr>
<tr>
<td>Business services</td>
<td>R 0</td>
<td>R 284,000,000</td>
<td>R 177,000,000</td>
<td>R 461,000,000</td>
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<tr>
<td>Services</td>
<td>R 0</td>
<td>R 108,000,000</td>
<td>R 179,000,000</td>
<td>R 288,000,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>R 519,000,000</strong></td>
<td><strong>R 2,161,000,000</strong></td>
<td><strong>R 1,518,000,000</strong></td>
<td><strong>R 4,199,000,000</strong></td>
</tr>
</tbody>
</table>

**Photovoltaic Plant**

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R 0</td>
<td>R15,680,000</td>
<td>R38,680,000</td>
<td>R54,350,000</td>
</tr>
<tr>
<td>Mining</td>
<td>R 0</td>
<td>R78,750,000</td>
<td>R18,780,000</td>
<td>R97,530,000</td>
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<tr>
<td>Manufacturing</td>
<td>R 0</td>
<td>R272,190,000</td>
<td>R177,440,000</td>
<td>R449,630,000</td>
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<tr>
<td>Utilities</td>
<td>R 0</td>
<td>R29,420,000</td>
<td>R38,050,000</td>
<td>R67,470,000</td>
</tr>
<tr>
<td>Construction</td>
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<td>R280,170,000</td>
<td>R11,510,000</td>
<td>R420,980,000</td>
</tr>
<tr>
<td>Trade and accommodation</td>
<td>R 0</td>
<td>R324,940,000</td>
<td>R150,630,000</td>
<td>R475,570,000</td>
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<tr>
<td>Transport</td>
<td>R 0</td>
<td>R70,030,000</td>
<td>R153,740,000</td>
<td>R223,770,000</td>
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<tr>
<td>Financing</td>
<td>R 0</td>
<td>R101,060,000</td>
<td>R189,330,000</td>
<td>R290,390,000</td>
</tr>
<tr>
<td>Business services</td>
<td>R 0</td>
<td>R131,330,000</td>
<td>R121,270,000</td>
<td>R252,590,000</td>
</tr>
<tr>
<td>Services</td>
<td>R 0</td>
<td>R45,430,000</td>
<td>R112,790,000</td>
<td>R158,220,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>R129,300,000</strong></td>
<td><strong>R1,348,990,000</strong></td>
<td><strong>R1,012,210,000</strong></td>
<td><strong>R2,490,500,000</strong></td>
</tr>
</tbody>
</table>

**No-Go Alternative**

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Mining</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Utilities</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Construction</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Trade and accommodation</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Transport</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Financing</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Business services</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td>Services</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
<td>R 0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>R 0</strong></td>
<td><strong>R 0</strong></td>
<td><strong>R 0</strong></td>
<td><strong>R 0</strong></td>
</tr>
</tbody>
</table>

(Source: Urban-Econ Input/Output Model, 2012)

**Table 5.3** above shows that the total value of R4,199,000,000 will be generated in the form of new production activities or GDP (gross domestic production) during the development of the Wind Farm; and will total R2,490,500,000 for the development of the Photovoltaic activities. The increase in new business sales (discussed in the section above) is the catalyst for the stimulation of additional GDP or production as an increase in sales has to be accompanied by an increase in production to satisfy the increase in demand generated by increased new business sales.
The direct impact that the Kangnas Wind Farm development will have on additional production is R519,000,000 and will total R129,300,000 for the development of the Photovoltaic activities. These benefits (for both the wind farm and photovoltaic activities) will all accrue to businesses and services in the construction sector. This new production involves the businesses and companies that will benefit directly from new business sales (discussed in section above).

The total indirect impact that the construction phase of the development will have on production for the development of the Wind Farm is R2,161,000,000 and for the development of the photovoltaic farm these indirect benefits will total R1,348,990,000 for the entire construction period. The benefits of the increased value of production will accrue to businesses that benefitted indirectly from new business sales. The total induced impact that will be generated in the form of additional production for the Wind Farm is R1,518,000,000 and the total induced impact that the Photovoltaic activities will have amounts to R1,012,210,000.

The No-Go alternative will result in the Kangnas Wind and Solar development not being constructed and thus the capital injection that would occur as a result of construction, will no longer take place. Thus the No-Go alternative will not have an impact on additional GDP during the construction phase, as no construction materials or labour will be required in this alternative. It thus represents the opportunity cost, with regards to additional GDP, that will be foregone through not constructing the facility.

**Employment Stimulation:**

**Table 5.4** below presents information and figures on the new employment opportunities that are expected to be generated during the construction of the proposed Kangnas Wind and Solar developments. It must be emphasised that employment opportunities that will be created during the construction phase are transitory in nature and will only last as long as construction on the site is being undertaken. However if the wind and solar energy industry begins to develop and grow in the country, these skills may become very unique resulting in the permanent employment of individuals in factories which manufacture such equipment (wind turbines and solar).

It must be noted that for the construction phase, limited information was provided by the developers regarding the cost implications pertaining to employment. Urban-Econ was only provided with direct costing which was provided on a person per month basis and was converted by Urban-Econ into persons per year. There are however, significant amounts in backward linkages which have not been made available. As such the employment impacts for the Photovoltaic activities are calculated based on assumptions in order to compensate for the lack of information which was provided.

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>328</td>
<td>1,179</td>
<td>1,507</td>
</tr>
<tr>
<td>Mining</td>
<td>0</td>
<td>672</td>
<td>152</td>
<td>824</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0</td>
<td>4,428</td>
<td>1,402</td>
<td>5,830</td>
</tr>
<tr>
<td>Utilities</td>
<td>0</td>
<td>78</td>
<td>140</td>
<td>218</td>
</tr>
<tr>
<td>Construction</td>
<td>1,086</td>
<td>1,867</td>
<td>300</td>
<td>3,253</td>
</tr>
<tr>
<td>Trade and accommodation</td>
<td>0</td>
<td>1,851</td>
<td>1,270</td>
<td>3,121</td>
</tr>
<tr>
<td>Transport</td>
<td>0</td>
<td>537</td>
<td>540</td>
<td>1,077</td>
</tr>
<tr>
<td>Financing</td>
<td>0</td>
<td>664</td>
<td>788</td>
<td>1,452</td>
</tr>
<tr>
<td>Business services</td>
<td>0</td>
<td>922</td>
<td>561</td>
<td>1,483</td>
</tr>
</tbody>
</table>
Table 5.4 above shows that during the construction phase of the development a total of 20,065 new employment opportunities should be created. In turn, the total number of new employment opportunities that will be created as a result of construction on the Photovoltaic facilities amounts to 14,688 which will distributed nationally. Majority if not all employment opportunities created during this construction phase are transitory in nature and will only last as long as construction on the development occurs. Once construction has been completed, the majority of these jobs will no longer be necessary since the phase is only temporary. Indirect and induced employment opportunities however, may be longer and more permanent in nature due to the filtering down of the impacts of increased sales and production, which may create more sustainable jobs, but direct employment will cease upon completion of construction.

The total direct impact that the wind farm development will have is the creation of 1,086 new opportunities for employment during the construction phase; while the development of the Photovoltaic activities will generate only 285 direct new employment opportunities. These will be created through the increased sales and production of those businesses directly involved in construction of the development in order to meet the increased demand for their materials, goods and services.

The total indirect impact of the proposed Wind Farm development on the creation of new employment is 11,812 during the construction phase; while the indirect impact of the construction of the Photovoltaic activities will generate 9,652. The increased business sales and production experienced by direct businesses will filter down into the rest of the local, regional and national economies through demand for materials, goods and services.
services. As this filtration process occurs, a greater number of businesses are impacted as it moves from direct to indirect and as such the total indirect impact is larger than the total direct impact.

The total induced impact of the development of the Wind Farm is the creation of 7,167 new employment opportunities in the local, regional and national economies; while the development of the Photovoltaic activities will have a total induced impact of 4,752 new employment opportunities during the construction phase.

As with production and new business sales, the No-Go alternative will have no impact on employment generation as this construction will not take place in this alternative, no labour will be needed and thus will not generate any new employment opportunities. The No-Go however does represent and display the opportunity cost with regards to employment, if the facility is not constructed.

5.3.1 Socio Economic Impact of the Construction phase

From the analysis above it can be seen that the wind farm will have the most significant economic (new business sales and GGP) and social (employment) impact. The associated economic impacts that may result from the construction of both the wind farm and the photovoltaic activities are listed below.

- The important stimulation of New Business Sales and GGP across all the economic sectors (manufacturing, finance, trade and accommodation etc.) with the local, regional and national economies, thus contributing positively to holistic development and increased performance of the regional and local economies.

- Significant indirect and induced impacts on New Business Sales in the manufacturing sector. The manufacturing sector (and more importantly the improvement of the manufacturing sector) is one of the most important sectors to improve the GGP of local economies and the GDP of the national economy. The manufacturing sector has seen a decline in its growth rate as far as contribution to the national economy is concerned since the early 1990’s. The manufacturing sector in the economy is largely dependent on the following industries:
  - Agri-processing
  - Automotive industry
  - Chemicals
  - ICT and electronics
  - Metals; and
  - Textiles, clothing and footwear.

The sector is generally labour intensive and has the added benefit of being able to absorb low skilled labour. With green energy production and manufacturing starting to become increasingly important around the world, the development of the wind farm and photovoltaic activities could help to initiate the establishment of a new manufacturing industry in the country, as well as benefit other green energy manufacturing activities located around the country.

- Increased capital investment in the area, through the initial capital contributions made during the construction phase. Any economy requires money in the form of investment or capital contributions in order to grow; as in order to make money, an economy needs individuals to spend money (investors and consumers).
Potential for the local SMME sector to benefit from the increased new business sales and are forecast to accrue within the local, regional and national economies. As has been mentioned afore there is significant potential that exists in the green energy industry, and as the SMME sector is one of the major launching pads for economic development (especially within lower income rural areas which have limited access to major markets). The construction and operation of the plant in the local and regional municipalities, is essentially bringing the market to these areas, presenting SMME’s with opportunities to capitalise either during the construction phase (in the form of supplies and services) or the operational phase (for example transportation of materials and labour to the site).

The additional social impacts⁴ that may result from the construction of the wind farm and photovoltaic facilities are listed below:

• The most valuable and important social contribution that the construction of the development will have (especially in the local economy) is the creation of employment. Although employment created during the construction phase is only transitory, it will provide valuable income for low income households in the local and regional economies. The social benefit of this impact is the preconceived notion that household income is often used synonymously and attached the concept of living standards.

• The additional social benefit that the development will have through the stimulation of employment and income is the creation of new demand within the local and regional economies. With increased income comes additional income for expenditure on goods and services supplied.

5.4 Operating Expenditure (OPEX)

The following section describes the economic impacts that would be observed during the operational phase of the both the Wind Farm and Photovoltaic development activities. Unlike capital expenditure impacts which are short term (between the beginning and conclusion of construction), operational impacts are assumed to be sustainable and long-term provided the development is fully functional. The figures therefore reflect the annual impacts that will be experienced during each year of the operation of the development.

As with the construction phase analysis the direct, indirect, induced and total impacts will be analysed with regards to the impact on:

• New Business Sales
• Additional GDP; and
• Employment creation

As with the construction phase of the development, the cost implications proposed for the operational phase of the development are presented in table 5.5 below.

### TABLE 5.5: COST AND INVESTMENT SPLITS DURING OPERATIONAL PHASE

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Entire Project</th>
<th>Each Phase of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Farm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

⁴ The significance of the potential socio economic impacts identified in the Final Scoping Report are discussed in more depth in section 6 of the report.
The cost implications were used in the formulation and calculation of the impact tables below. The impacts of the operations of the development on new business sales, production and employment stimulation are presented and discussed below.

Additional New Business Sales:

The cost implications for the annual operations are less than that of the construction phase and as a result the impacts on new business sales will be less than the impacts analysed in the construction phase. However as the impacts from the construction phase are a once off, and the impacts to be presented during the operational phase will accrue each year that the development is in operation; the total impacts from the operational phase will in time surpass those of the construction phase, provided the development operates for a number of years.

Table 5.6 below presents the direct, indirect, induced and total impacts on the year-on-year operations of the Kangnas development during the operational phase of the development. The figures below are in R’s millions.

### TABLE 5.6: NEW BUSINESS SALES (OPERATIONAL PHASE)

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R0</td>
<td>R460,000</td>
<td>R930,000</td>
<td>R1,390,000</td>
</tr>
<tr>
<td>Mining</td>
<td>R0</td>
<td>R2,630,000</td>
<td>R120,000</td>
<td>R2,740,000</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>R0</td>
<td>R2,270,000</td>
<td>R2,210,000</td>
<td>R4,480,000</td>
</tr>
<tr>
<td>Utilities</td>
<td>R124,920,000</td>
<td>R1,360,000</td>
<td>R420,000</td>
<td>R126,710,000</td>
</tr>
<tr>
<td>Construction</td>
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<td>R5,570,000</td>
<td>R50,000</td>
<td>R5,620,000</td>
</tr>
<tr>
<td>Trade and accommodation</td>
<td>R0</td>
<td>R10,340,000</td>
<td>R2,550,000</td>
<td>R12,890,000</td>
</tr>
<tr>
<td>Transport</td>
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<td>R4,950,000</td>
<td>R3,900,000</td>
<td>R8,860,000</td>
</tr>
<tr>
<td>Financing</td>
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<td>R11,530,000</td>
</tr>
<tr>
<td>Business services</td>
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<td>R3,720,000</td>
<td>R330,000</td>
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<td>Services</td>
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<td>R5,200,000</td>
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<tr>
<td>Total</td>
<td>R124,920,000</td>
<td>R41,010,000</td>
<td>R19,860,000</td>
<td>R185,800,000</td>
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</table>

Photovoltaic Plant

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R0</td>
<td>R140,000</td>
<td>R1,080,000</td>
<td>R1,210,000</td>
</tr>
<tr>
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<td>R100,000</td>
<td>R130,000</td>
<td>R230,000</td>
</tr>
<tr>
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<td>R1,090,000</td>
<td>R2,610,000</td>
<td>R3,690,000</td>
</tr>
<tr>
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<td>R480,000</td>
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</tr>
<tr>
<td>Construction</td>
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<td>R120,000</td>
<td>R60,000</td>
<td>R180,000</td>
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</tbody>
</table>
Table 5.6 above shows that the total impact that the wind farm should have on new business sales during the operational phase is R185,500,000 (summation of direct, indirect and induced impacts). These new business sales should accrue to businesses that are directly involved in the maintenance, security and other operational activities required for the proposed facilities. The total impact for the Photovoltaic activities during the operational phase is R158,260,000. These figures are significantly less than those of the construction phase, however as these benefits for new business sales will accrue on an annual basis, the longer the proposed activities are in operation, the added benefits will eventually eclipse those of the construction phase.

It should be encouraged that majority of the businesses and service providers involved in this stage of operations be sourced regionally and locally where possible, in order to maximise the benefits of both the direct, indirect and induced impacts in these economies.

The No-Go alternative will have any impact on new business sales during the operational phase of the Kangnas wind and solar development, as the No-Go implies that the site will not be developed and thus operational expenditure at the site will not occur and no positive or negative impacts will be generated within the local economies. It should be noted however that the No-Go alternative will present an opportunity cost for the region, as the total impacts of the preferred alternative will be lost and the sales that are likely to be generated and the additional stimulation of the economy via production and employment as a result of sales will not take place.

Additional GDP:

Table 5.7 below shows the direct, indirect, induced and total impacts of the proposed Kangnas wind and solar projects during the operational phase of the development. The figures below are in R’s millions.

<table>
<thead>
<tr>
<th>Sector Impacted</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>R0</td>
<td>R210,000</td>
<td>R430,000</td>
<td>R640,000</td>
</tr>
</tbody>
</table>
Table 5.7 above shows that the total impact that the wind farm will have on additional GDP during the operational phase is R39, 730, 000, while the total impacts of the Photovoltaic activities should amount to R45, 470, 000 during the operations of the proposed development. Once again it should be iterated that as the operational impacts accrue on an annual basis, the accumulated impacts during the operations of the plant will exceed those of the construction phase, provided the facilities operate for a number of years.

The direct stimulation for the increase in production is the increase in new business sales. Thus these two economic indicators are mutually related. As such there should be a link between the businesses that will benefit from the increase in new business sales and those that will benefit from an increase in production. Due
to sizable difference in the investment amounts between construction and operation the impacts displayed in table 5.7 are significantly lower than those of the construction phase.

The No-Go alternative will not have any impacts on additional production during the operational phase of the Kangnas Wind and solar development, as the No-Go implies that the development will not be developed and thus operational expenditure at the facility will not occur and no positive or negative impacts will be generated within the local and regional economies.

Employment Stimulations:

Table 5.8 below shows the direct, indirect, induced and total economic impacts of the development on labour and employment opportunities. With the sustainable nature of operational activities, the employment opportunities which are to be generated during this phase of the development, are purported to be full time or long term employment opportunities and if they are occupied by local residents and provided by local ventures, the development will benefit the local economies and ease unemployment and income hindrances, which in turn will stimulate further expenditure and sales within the economies.

<table>
<thead>
<tr>
<th>TABLE 5.8: EMPLOYMENT (OPERATIONAL PHASE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector Impacted</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Mining</td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Utilities</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Trade and accommodation</td>
</tr>
<tr>
<td>Transport</td>
</tr>
<tr>
<td>Financing</td>
</tr>
<tr>
<td>Business services</td>
</tr>
<tr>
<td>Services</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Photovoltaic Plant

| Sector Impacted | Direct Impact | Indirect Impact | Induced Impact | Total Impact |
| Agriculture | 0 | 1 | 8 | 9 |
| Mining | 0 | 0 | 0 | 0 |
| Manufacturing | 0 | 2 | 5 | 8 |
| Utilities | 130 | 0 | 0 | 130 |
| Construction | 0 | 0 | 0 | 1 |
| Trade and accommodation | 0 | 91 | 12 | 103 |
| Transport | 0 | 5 | 3 | 9 |
| Financing | 0 | 14 | 3 | 16 |
| Business services | 0 | 2 | 1 | 4 |
| Services | 0 | 9 | 20 | 29 |
| Total | 130 | 126 | 53 | 309 |

No-Go Alternative

| Sector Impacted | Direct Impact | Indirect Impact | Induced Impact | Total Impact |
| Agriculture | 0 | 0 | 0 | 0 |
| Mining | 0 | 0 | 0 | 0 |
| Manufacturing | 0 | 0 | 0 | 0 |
Table 5.8 above shows that the total impact the operational phase of the Kangnas wind and solar activities should have on employment is 226 new permanent employment opportunities during the operations of the wind farm, and 309 new permanent employment opportunities during the operations of the photovoltaic facility.

It should be encouraged that the majority of the labour be sourced from within the local and regional municipal labour pools, and if the relevant skills are not available then these should be sought out on a national basis. This will accentuate the positive benefits and impacts of the development on the regional economies. As the employment opportunities generated during the operational phase are more permanent and sustainable in the long run, as opposed to those generated during the construction phase (which are only transitory) sourcing of local labour during this phase will have a long term beneficial impact.

The No-Go alternative will not have any impacts on additional production during the operational phase of the Kangnas wind and solar development, as the No-Go implies that the development will not be developed and thus operational expenditure at the facility will not occur and no positive or negative impacts will be generated within the local and regional economies.

5.4.1 Socio Economic Impact of the Operational Phase

The associated social impacts that may result from the operation of the wind farm and photovoltaic facilities are listed below;

- With the operations of the wind farm and photovoltaic facilities, a need should arise for the upgrade of various infrastructures (roads, electricity etc.) in order to facilitate these operations and to promote economic and business development in the area.

- The tourism industry within the local economy will acquire an additional draw-card to strengthen and expand the industry in the local context.

- Additional investment through the continued operations of the plant is a viable assumption. With the operations of the wind and photovoltaic facilities in the local municipal area, it may serve as a catalyst for additional investment resulting from and relating to the generation and manufacture of green energy.

The additional social impacts\(^5\) that may result from the construction of the wind farm and photovoltaic facilities are listed below;

\(^5\) It must be noted that the significance of the socio economic impacts identified in the Final Scoping Report are discussed in greater detail in section 6 of the report.
The potential for infrastructure upgrades (mentioned above) will not only benefit the local economy, but will also benefit the local communities. Currently the area is in need of various infrastructure upgrades, especially with regards to electricity infrastructure.

One of the most important social benefits of the operations of the development is skills development. With the some 500+ individuals that are forecast to be generated by the development, a number of these have been designated for FET (further education training). This will enable local individuals to stimulate their own local economies, if the skills and training obtained is effectively re-integrated into the local and regional economies.

5.5 Synthesis

Table 5.9 and 5.10 below indicate the summary of the direct, indirect, induced and total impacts of the Kangnas wind and solar development on business sales, GDP and employment during the CAPEX and the OPEX phases of the development.

**TABLE 5.9: TOTAL IMPACT DURING THE CONSTRUCTION PHASE**

<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Layout 1: Wind Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Sales</td>
<td>R4, 255, 800, 000</td>
<td>R5, 662, 900, 000</td>
<td>R3, 436, 200, 000</td>
<td>R13, 354, 900, 000</td>
</tr>
<tr>
<td>Additional GGP</td>
<td>R519, 400, 000</td>
<td>R2, 161, 100, 000</td>
<td>R1, 518, 400, 000</td>
<td>R4, 198, 900, 000</td>
</tr>
<tr>
<td>Employment</td>
<td>1, 086</td>
<td>11, 812</td>
<td>7, 167</td>
<td>20, 065</td>
</tr>
</tbody>
</table>

| Alternative 1: Photovoltaic Farm |                  |                  |                |              |
| Business Sales   | R2, 115, 000, 000 | R3, 505, 900, 000 | R2, 290, 200, 000 | R7, 911, 100, 000 |
| Additional GGP   | R129, 300, 000   | R1, 349, 000, 000 | R1, 012, 200, 000 | R2, 490, 500, 000 |
| Employment       | 285             | 9, 652           | 4, 752         | 14, 688      |

| No-Go Alternative: |                  |                  |                |              |
| Business Sales   | R0               | R0               | R0             | R0           |
| Additional GGP   | R0               | R0               | R0             | R0           |
| Employment       | 0                | 0                | 0              | 0            |

(Source: Urban-Econ Input/Output Model, 2012)

Table 5.10 shows the total impact of the development during the operational phase.

**TABLE 5.10: TOTAL IMPACT OF DEVELOPMENT DURING THE OPERATIONAL PHASE**

<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Layout 1: Wind Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Sales</td>
<td>R124, 900, 000</td>
<td>R41, 000, 000</td>
<td>R19, 900, 000</td>
<td>R185, 800, 000</td>
</tr>
<tr>
<td>Additional GGP</td>
<td>R13, 500, 000</td>
<td>R17, 500, 000</td>
<td>R8, 700, 000</td>
<td>R39, 700, 000</td>
</tr>
<tr>
<td>Employment</td>
<td>69</td>
<td>107</td>
<td>46</td>
<td>222</td>
</tr>
</tbody>
</table>

| Alternative 1: Photovoltaic Farm |                  |                  |                |              |
| Business Sales   | R86, 000, 000   | R49, 700, 000    | R22, 600, 000  | R158, 300, 000 |
| Additional GGP   | R12, 000, 000   | R23, 600, 000    | R9, 900, 000   | R45, 500, 000 |
| Employment       | 130             | 126             | 53             | 309          |

| No-Go Alternative: |                  |                  |                |              |
| Business Sales   | R0               | R0               | R0             | R0           |
| Additional GGP   | R0               | R0               | R0             | R0           |
| Employment       | 0                | 0                | 0              | 0            |

(Source: Urban-Econ Input/Output Model, 2012)
Table 5.9 above shows that the positive impacts of the construction of alternative 1 (which will result in the development of the project) will have significant impacts on new business sales, additional production and employment. Thus from an economic analysis perspective, significant benefits can be derived from the construction of the facility, which will benefit economic activities and livelihoods in the regional and national economies; not to mention the significant investment that will be injected into the area as a result of the proposed project.

Table 5.10 shows that in addition to the economic benefits and positive impacts of the construction phase, the impacts of alternative 1 during the operational phase should have similar (yet not as excessive) positive impacts on new business sales, additional GDP and employment. This can be attributed to the smaller capital investment that needs to be made for each phase; however as the positive impacts of alternative 1 during the operational phase is cumulative on an annual basis, the project will continue to contribute positively to the local and regional economies for as long as the facility is in operation.

The No-Go alternative will have no economic impact on the indicators and thus will not have direct negative impact in the regional economies; however it will have no positive impacts, thus resulting in a neutral total impact. From an economic analysis basis the construction of the project as part of alternative 1 should yield greater positive impacts than the No-Go alternative.
Section 6: Impact Analysis

6.1 Introduction

The following section of the report will rate the impacts that the proposed alternatives (1 and No-Go) will have based on the evaluation criteria which is explained in more detail below. Through this rating the nature of the impacts can be identified (positive or negative) within the local and regional economies in order to provide a better understanding of how the development will impact various aspects of the economy and society.

To begin this section, the approach and explanation of the rating system will be provided to gain a better understanding regarding the process used to attain the ratings. This will be followed by the impact ratings of the development on new business sales, additional GDP, employment creation and loss, investment expenditure, electricity resources and tourism.

6.2 Approach

The proposed impact tables will rate the development in terms of quantified ratings which have been given to each criterion. This rating system is discussed more fully in the following sub-section. The objective of the impact table is to recommend an optimal alternative location for the development of the proposed Kangnas Wind Farm and PV plant developments according to various economic principles.

6.3 Method of assessing the significance of potential socio economic impacts

Each impact will be rated using the criteria specified in the Final Scoping report prepared by Aurecon for the EIA. The rating given will be according to the potential impact of each of the identified criteria on the two alternatives for the Kangnas Wind Farm and PV plant development. The criteria ratings will be described in the following sub-section. The proposed alternatives for the development will be rated according to the impacts listed below;

1. Impact on Regional Development
2. Impact on Size (GDP) of the Local Economy
3. Impact on Employment and Income
4. Impact on Investment Expenditure
5. Impact on Electricity Resources
6. Impact on Tourism
7. Impact on Agricultural Land
8. Impact on Infrastructure and Resources
9. Impact on Social Lives of local communities
10. Improved Competitiveness

For each impact, the extent (spatial scale), magnitude and duration (time scale) would be described. These criteria would be used to ascertain the significance of the impact, firstly in the case of no mitigation and then with the most effective mitigation measures in place. The significance of an impact is derived by taking into account the temporal and spatial scales and magnitude.

Once the significance of an impact has been determined, probability of this impact occurring as well as the confidence in the assessment of the impact would be determined using the rating systems outlined below. Finally the reversibility of the impact is estimated.
**Extent or Spatial Influence of Impact:**
- **Regional:** Beyond a 10 km radius of the candidate site.
- **Local:** Within a 10 km radius of the candidate site.
- **Site Specific:** On site or within 100 m of the candidate site.

**Magnitude of Impact (at the indicated spatial scale):**
- **High:** Natural and/or social functions and/or processes are severely altered
- **Medium:** Natural and/or social functions and/or processes are notably altered
- **Low:** Natural and/or social functions and/or processes are slightly altered
- **Very Low:** Natural and/or social functions and/or processes are negligibly altered
- **Zero:** Natural and/or social functions and/or processes remain unaltered

**Duration of Impact:**
- **Construction Period:** Up to 3 years
- **Short Term:** Up to 5 years after construction
- **Medium Term:** 5-15 years after construction
- **Long Term:** More than 15 years after construction

**Significance of Impact:**
- **High:** High magnitude with a regional extent and long term duration.
  High magnitude with either a regional extent and medium term duration or a local extent and long term duration.
  Medium magnitude with a regional extent and long term duration
- **Medium:** High magnitude with a local extent and medium term duration.
  High magnitude with a regional extent and construction period or a site specific and long term duration.
  High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration.
  Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term.
  Low magnitude with a regional extent and long term duration.
- **Low:** High magnitude with a site specific extent and construction period duration.
  Medium magnitude with a site specific extent and construction period duration.
  Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term.
  Very low magnitude with a regional extent and long term duration.
- **Very Low:** Low magnitude with a site specific extent and construction period duration.
  Very low magnitude with any combination of extent and duration except regional and long term.
- **Neutral:** Zero magnitude with any combination of extent and duration.

**Probability:**
- **Definite:** Estimated greater than 95 % chance of the impact occurring.
- **Probable:** Estimated 5 to 95 % chance of the impact occurring.
- **Unlikely:** Estimated less than 5 % chance of the impact occurring.
Confidence:

- **Certain**: Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
- **Sure**: Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
- **Unsure**: Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Reversibility:

- **Irreversible**: The activity will lead to an impact that is in all practical terms permanent.
- **Reversible**: The impact is reversible within 2 years after the cause or stress is removed.

The significance of the impact post mitigation is also indicated with regards the above impact criterion.

6.4 Impact of Development

The following section will display the extent of impacts that the proposed Kangnas Wind Farm and PV plant development will have in the local Nama Khoi municipality and the Namakwa District municipality as a whole. The impact of the electricity produced during the operational period will have an impact on the energy resources of the country; therefore National impacts will also result based on expenditure during the construction phase and electricity generated during the operational phase. It will provide quantitative analysis of these impacts based on the criterion mentioned in Section 6.3 above.

6.4.1 Impact on Regional Development

Table 6.1 illustrates the impact which the proposed Kangnas Wind Farm and PV plant development will have on the regional development in the local, regional and national context during the construction phase, as a result of new business sales.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

**Photovoltaic Activities**

| Spatial Extent        | Regional      | Regional          |
| Magnitude             | Medium        | Zero              |
| Duration              | Construction Period | Construction Period |
| Significance          | Medium        | Neutral           |
| Probability           | Probable      | Probable          |
Table 6.2 below shows the impact the Kangnas Wind Farm and PV plant developments will have on regional development, as a result of new business sales during the operational phase.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Short Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
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<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Short Term</td>
</tr>
<tr>
<td>Significance</td>
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</tr>
<tr>
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<td>Probable</td>
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<tr>
<td>Confidence</td>
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<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.1 shows that the significance of the impact of the development (wind farm and the photovoltaic activities) will be medium during the construction phase, in the event that alternative 1 (which will result in the construction and operations of the development) is the preferred alternative; and in the event that the No-Go alternative is preferred the development will have a neutral significance of an impact on new business sales on a regional spatial extent. The significance of the developments impact on new business sales during the operational phase will be low, if alternative 1 is preferred and will have a neutral significance of an impact on new business sales if the No-Go alternative is preferred.

Through making an attempt to source supplies and materials locally within South Africa, and only making use of international suppliers when absolutely necessary, during the construction period, the positive impacts of the development on new business sales nationally will be accentuated. As the supplies that will be required for the development of the wind farm and the photovoltaic facilities are relatively unique (as the renewable energy sector is not developed in the country) it is assumed that these supplies will have to be sourced from various regions of the country where such materials are available, making the impact national. The stimulation of new business sales as a result of the development will in turn stimulate additional production, employment and income within the regional (depending on where the supplies are sourced) and national economies.
The positive implications and dynamics of the operations of the Kangnas development will be similar to those of the construction phase; however the extent and significance of these positive impacts will be slightly tamer in comparison. This is due to the nature of the operations of such facilities, which after construction require only intermittent supplies and maintenance to ensure the facilities are running optimally. The operational implications however will accumulate from year-to-year and the construction impact is a once-off; thus with the continued operations of the development the positive impacts will be far greater for new business sales the longer the facility is operational.

6.4.2 Impact on Size (GDP) of the Local Economy

Table 6.3 illustrates the impact that the proposed Kangnas Wind Farm and PV plant development will have on additional production (GDP) within the economy of Nama Khoi and the South Africa as a whole.

### TABLE 6.3: IMPACT ON ADDITIONAL GDP DURING THE CONSTRUCTION PHASE

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Regional</td>
</tr>
<tr>
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<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
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<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

**Photovoltaic Activities:**

<table>
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<th>No-Go Alternative</th>
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</thead>
<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
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<td>Medium</td>
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</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.4 below shows the impact that the proposed development will have on additional production (GDP) during the operational phase.

### TABLE 6.4: IMPACT ON ADDITIONAL GDP DURING THE OPERATIONAL PHASE

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
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<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Short term</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
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<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
</tbody>
</table>
Table 6.3 shows that during the construction phase the significance of the impact on additional GGP resulting from the development activities will be medium if alternative one is preferred and will have a neutral impact if the No-Go alternative is preferred. The significance of the impacts on additional GGP mirrors those of the new business sales, as the two economic variables are linked and have a symbiotic relationship. As the No-Go represents the status quo it thus cannot have an impact as not a single brick would have been laid.

Table 6.4 above shows that during the operational phase of the development, the significance of the impact on additional GGP will be low if alternative 1 is preferred and will have a neutral significance impact if the No-Go alternative is preferred. This is also in correlation with the positive impact on new business sales during the operational phase, as increased new business sales leads to an increased demand for goods and services and thus production. The significance of the impact during the operational phase will be lower than that of the construction phase due to the cost implications required for the initial construction and the annual running of the development. However as the impacts of the operational phase are cumulative, these positive impacts will continue for as long as the development is in operation.

6.4.3 Impact on Employment and Income

Table 6.5 illustrates the impact that the proposed Kangnas Wind Farm and PV plant development will have on the creation and loss of employment within the local Nama Khoi municipality, as well as the Namakwa district and national job opportunities.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Confidence</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
</tbody>
</table>
Table 6.6 shows the impact the proposed development will have on employment creation and loss during the operational phase.

### TABLE 6.6: IMPACT ON EMPLOYMENT CREATION AND LOSS DURING THE OPERATIONAL PHASE

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Definite</td>
<td>Probable</td>
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<tr>
<td>Confidence</td>
<td>Certain</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Short Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>
Table 6.5 above shows that the significance impact that the entire Kangnas development will have on employment during the construction phase is medium, if alternative 1 is preferred; and the impact will be neutral if the No-Go alternative is preferred.

Table 6.6 forecasts that the significance of the impact during the operational phase of the entire development will be very low if alternative 1 is preferred, and will have a neutral significance impact on employment if the No-Go is preferred.

The medium impact of the construction phase forecasts the employment of some 31,500 employment opportunities to be created on a national scale; however the pitfall of the employment required during the construction phase is its temporary nature. The 31,500 employment opportunities created during this phase will only last for the 8 years required for the assembly and construction of the entire development (although the construction period forecast for the photovoltaic activities will be less than 8 years), and once the construction period ends these employment opportunities will cease. The most important factor required to maximise the benefits of the employment created through the construction phase is skills development and training within fields such of construction and logistics etc.

Employment generated during the operational phase is assumed to be more permanent in nature, as this employment created pertains to each year that the facility is in operation. Although the employment will be distributed locally, regionally and nationally (which waters down the positive impact of the development on employment locally and regionally) the creation of over 500 permanent employment opportunities by one developing sector is a significant positive for South Africa and the local and regional economies.

6.4.4 Investment Expenditure

Table 6.7 shows the impact that the Kangnas Wind Farm and PV plant development will have on the local, district and national economy of the study area in relation to its effect on investment expenditure during the construction phase.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Local</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
<td>High</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
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<td>Neutral</td>
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<tr>
<td>Probability</td>
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<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
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<td>Sure</td>
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<tr>
<td>Reversibility</td>
<td>Irreversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Local</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
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<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
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<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
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<tr>
<td>Probability</td>
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<td>Probable</td>
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<tr>
<td>Confidence</td>
<td>Certain</td>
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</tr>
</tbody>
</table>
Table 6.8 shows the impact that the proposed development will have on investment expenditure during the operational phase.

**TABLE 6.8: IMPACT ON INVESTMENT EXPENDITURE DURING THE OPERATIONAL PHASE**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
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<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
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</tr>
<tr>
<td>Spatial Extent</td>
<td>Site Specific</td>
<td>Site Specific</td>
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<td>Magnitude</td>
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<td>Zero</td>
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<tr>
<td>Duration</td>
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<td>Short Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
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<tr>
<td>Probability</td>
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<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
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<td>Sure</td>
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<tr>
<td>Reversibility</td>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
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<tr>
<td><strong>Photovoltaic Activities:</strong></td>
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<tr>
<td>Spatial Extent</td>
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<td>Site Specific</td>
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</tr>
<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.7 shows that the significance of the impact on investment as a result of the construction of the entire development will be medium, if alternative 1 is preferred and neutral if the No-Go is selected. Table 6.8 forecasts that the significance of the impact on investment as a result of the operations of the entire proposed development will be low, if alternative 1 is preferred and will have a neutral significance impact if the development does not go ahead.

The construction phase alone will result in significant capital investment, to the amount of R11 billion for the wind farm and over R5 billion for the photovoltaic activities. The product of this investment will not only be located within the region, but would arguably attract spin-off investments into the local economies.

The increased presence of the wind farm and photovoltaic facilities and activities could attract business enterprise investment, to the local economies, especially in the form of infrastructure upgrading and businesses and service providers that are required for these purposes. Potential perhaps exists for the development of the surrounding towns into green energy hubs.

### 6.4.5 Renewable Electricity Resources

Table 6.9 illustrates the impact that the proposed Kangnas Wind Farm and PV plant development will have on the supply of a renewable resource namely electricity i.e. energy.
### Table 6.9: Impact on Renewable Energy During the Construction Phase

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
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<tr>
<td>Spatial Extent</td>
<td>Site Specific</td>
<td>Site Specific</td>
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<td>Duration</td>
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<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
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<tr>
<td>Probability</td>
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<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
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<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
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<td></td>
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<td>Site Specific</td>
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<tr>
<td>Magnitude</td>
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<tr>
<td>Duration</td>
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<td>Construction Period</td>
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<td>Significance</td>
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<tr>
<td>Confidence</td>
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<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
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</tr>
</tbody>
</table>

Table 6.10 below shows the impacts the proposed development will have on the supply of electricity as a renewable resource during the operational phase.

### Table 6.10: Impact on Renewable Energy During the Operational Phase

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
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</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
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<td>Spatial Extent</td>
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<tr>
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<tr>
<td>Significance</td>
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<td>Confidence</td>
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<tr>
<td>Reversibility</td>
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<td>Reversible</td>
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<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
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<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
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<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
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<tr>
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<td>Short Term</td>
</tr>
<tr>
<td>Significance</td>
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<td>Neutral</td>
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<tr>
<td>Probability</td>
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<tr>
<td>Confidence</td>
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<td>Sure</td>
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<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>
Table 6.9 shows that the construction phase of the development will have a very low significance impact on renewable energy, if the alternative 1 is preferred and will have a neutral impact if the No-Go alternative is preferred. As the development will be constructed in phases (140MW each in terms of energy production capacity) the development will initially have very little impact on the energy supply as many of the turbines will not be operational (or even assembled) during this phase, meaning they cannot be generating any energy.

The operations (table 6.10) phase of the Kangnas development will have a medium significance impact on renewable energy if alternative 1 is preferred, as during the operational phase the renewable energy production stage of the development will commence, and electricity from the site will be added to the grid (the actual product of the wind farm and photovoltaic activities). Although the total energy production of the entire project is a 1,000MW, the renewable nature of the production method improves the significance of the impact, simple as a boost the green energy industry in the country. If the No-Go alternative is preferred, the Kangnas development will have a neutral impact on renewable energy, cause if the proposed activities do not exist, no energy can be produced.

6.4.6 Tourism and Tourism Industry

Table 6.11 illustrates the impact the proposed Kangnas Wind Farm and PV plant development will have on the local tourism economy of the study area in relation to facilitation of movement by tourists to the area during the construction phase.

**TABLE 6.11: IMPACT ON TOURISM DURING THE CONSTRUCTION PHASE**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
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<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
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<tr>
<td>Spatial Extent</td>
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<td>Site Specific</td>
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<td>Zero</td>
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<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
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<td>Neutral</td>
</tr>
<tr>
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<td>Probable</td>
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<tr>
<td>Confidence</td>
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<td>Sure</td>
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<td>Reversibility</td>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
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<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
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<tr>
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<tr>
<td>Duration</td>
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<td>Sure</td>
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<tr>
<td>Reversibility</td>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.12 below shows the impact that the proposed development will have on tourism and the tourism industry during the operational phase.
Table 6.12 shows that the construction of the Kangnas development will have a neutral significance impact on tourism and the local tourism industry, if alternative 1 is preferred. The motivation behind this is that the majority of the construction of the components of both the wind farm turbines and the solar panel technology used by the photovoltaic activities takes place off site and is then transported and assembled at the proposed site, resulting in virtually no environmental intrusion or waste production.

The significance of the impact, as a result of the operations of the Kangnas development is forecast to be low if alternative 1 is preferred. Although the operations and presence of a wind farm and photovoltaic activities could serve as tourist attraction and increase the diversity of tourism operations in the region (to include green tourism); it will not serve as a major drawcard for tourists, as such activities have little tourism value.

If the No-Go alternative is selected as the preferred alternative the Kangnas development will have a neutral significance impact on tourism. The reasoning for this is that if the Kangnas development does not go ahead it would not have taken or diminished the tourism value offered in the region and the already existing tourist draw cards will still be present in the area (meaning tourism will carry on as per usual).

### 6.4.7 Impact on Agricultural Land

Table 6.13 below highlights the impact that the proposed Kangnas Wind and Solar development will have on agricultural land on and around the proposed site of the development during the construction phase.

### TABLE 6.13: IMPACT ON AGRICULTURAL LAND DURING THE CONSTRUCTION PHASE

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
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<tr>
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<tr>
<td>Spatial Extent</td>
<td>Site Specific</td>
<td>Site Specific</td>
</tr>
</tbody>
</table>

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Table 6.14 below shows the impact that the proposed wind and solar development will have on agricultural land during the operational phase.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
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</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
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<td>Site Specific</td>
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<td>Zero</td>
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<td>Duration</td>
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<td>Short Term</td>
</tr>
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<tr>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
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<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
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<td>Site Specific</td>
</tr>
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<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
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<td>Neutral</td>
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</tbody>
</table>

Table 6.13 above forecasts that the Kangnas development will have a very low impact in agricultural land at the proposed site location, if alternative 1 is preferred. Currently the land at the proposed site is used for grazing, however with the construction and assembly of the turbines and solar panels, these grazing activities
(especially at the site) will be disturbed somewhat, due to the movement of materials and parts to and from the site.

Table 6.14 forecasts that the operations of the wind farm will have a neutral significance impact on agricultural land, if alternative 1 is preferred; and in turn the operations of the photovoltaic activities will have a very low impact on agricultural land if alternative 1 is preferred. The motivation behind this is that grazing activities can still take place around the turbines as they do not cause a spatial intrusion at their bases which may impede grazing; therefore having a neutral impact on the agricultural land. Photovoltaic activities however take up a bit more space and will thus decrease the grazing value of the erfs or land on which it will be located. The rent and rates which will be paid to the farmers who own the land on which the development will be located, should negate any of the negative impacts that the Kangnas development would have on agricultural land even though this impact is very low.

Both table 6.13 and table 6.14 show that the selection of the No-Go alternative will have a neutral significance impact on agricultural land as it represents the status quo, if the development where not to go ahead.

6.4.8 Impact on Infrastructure and Resources

Table 6.15 below shows the impact that the construction phase of the wind farm and photovoltaic activities will have on infrastructure development and resources in the local, regional and national economies.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Sure</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

| **Photovoltaic Activities:** | | |
| Spatial Extent              | Regional      | Regional          |
| Magnitude                   | Low           | Zero              |
| Duration                    | Construction Period | Construction Period |
| Significance                 | Low           | Neutral           |
| Probability                 | Probable      | Probable          |
| Confidence                  | Sure          | Sure              |
| Reversibility               | Irreversible  | Reversible        |
| Significance after mitigation| Low           | Neutral           |

Table 6.16 below shows the impacts that the proposed operations of the development will have on infrastructure and resources.
Table 6.16: Impact on Infrastructure and Resources During the Operation Phase

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Local</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Medium Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Definite</td>
<td>Definite</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Local</td>
<td>Local</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Medium Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.15 above forecasts that the significance of the impact on infrastructure and resources during the construction phase will be low, if alternative 1 is preferred; and it will have a neutral impact if the No-Go alternative is selected.

The operations of the Kangnas development will have a very low significance impact on infrastructure and resources if alternative 1 is selected; and will have a neutral impact if the No-Go alternative is preferred.

As the proposed site for the development is located outside the town of Springbok, it will not contribute significantly to improvement of the infrastructure of the town or other towns in the area. It will undoubtable have an impact on the electricity infrastructure in the region, mainly through the efficient and effective supply of electricity to local communities. The operations of the development may also result in the improvement of road and water infrastructure in the area, however as both technologies make use of very little water, these improvements are expected to be minimal.

6.4.9 Impact on Social Lives of Local Communities

Table 6.17 below shows the impact that the construction of the Kangnas development will have on the social lives of local communities.

Table 6.17: Impact on Social Lives During the Construction Phase

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Medium</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
</tbody>
</table>
Table 6.18 below shows the impact that the operational phase of the Kangnas development will have on the social lives of the local communities.

**TABLE 6.18: IMPACT ON SOCIAL LIVES DURING THE OPERATIONAL PHASE**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Medium Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Certain</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

**Photovoltaic Activities:**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Medium Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Certain</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.17 above shows that the construction phase of the Kangnas development will have a medium significance impact on social livelihoods in the local communities, if alternative 1 is selected; and will have a neutral impact if the No-Go alternative is preferred.

Table 6.18 forecasts that the operations of the Kangnas development will have a low significance impact on social livelihoods, if alternative 1 is preferred; and will have a neutral impact if the No-Go alternative is preferred.
The positive impacts that the development will have on new business sales and additional production in the local and regional economies, will contribute significantly to improved incomes and business development (standard and quality of living is often attached to household incomes). In addition, the employment that will provided and the recommended skills development that will result from the construction and operations will also improve the social dynamics of the local and regional area, by not only providing these households with a source of income, but also providing them with the means to generate their own income and create additional employment for local communities.

6.4.10 Impact on Competitiveness of the Region

Table 6.19 below shows the impact that the construction of the Kangnas development will have on the competitiveness of the region.

**TABLE 6.19: IMPACT ON COMPETITIVENESS DURING THE CONSTRUCTION PHASE**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Certain</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Photovoltaic Activities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction Period</td>
<td>Construction Period</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
<tr>
<td>Confidence</td>
<td>Sure</td>
<td>Certain</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Table 6.20 below shows the impact that the operations of the Kangnas development will have on the competitiveness of the region.

**TABLE 6.20: IMPACT ON COMPETITIVENESS DURING THE OPERATIONAL PHASE**

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Alternative 1</th>
<th>No-Go Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind Farm:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>Regional</td>
<td>Regional</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Very Low</td>
<td>Zero</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium Term</td>
<td>Medium Term</td>
</tr>
<tr>
<td>Significance</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable</td>
<td>Definite</td>
</tr>
</tbody>
</table>
Table 6.19 above forecasts that the significance of the entire developments impact on the competitiveness of the area will be very low during the construction phase, if alternative 1 is preferred; and it will have a neutral impact if the No-Go alternative is selected.

Table 6.20 above forecasts that the entire development will have a very low significance impact if alternative 1 is preferred will have a neutral impact if the No-Go alternative is preferred.

6.6 Cumulative Impacts

A number of other wind and solar energy developments are planned for the Northern Cape in addition to the Kangnas Wind and Solar project. A number of other wind and solar developments are to be located in the vicinity of the Kangnas development (Springbok wind energy facility, the Pofadder wind energy facility and the Kannikwavelakte wind energy facility). None of these developments have progressed past the EIA process. The cumulative impacts of the Kangnas wind and solar facility (independently and collectively with the other proposed developments) will be positive to both local and regional societies and economies. Cumulatively the impacts of the Kangnas development and the other proposed developments will be greatest on employment, and regional development in the form of new business sales and regional GGP (if mitigation measures and recommendations are implemented to stimulate manufacturing activities in the region to support the green industry, and spin off investments and activities).

Cumulative impacts from the site and other proposed developments will also have significant cumulative impacts on energy provision in the area. Although the energy generated from the sites will be sold to Eskom and feed into the main grid, the provision and upgrading of energy infrastructure in the immediate local municipalities will have positive cumulative impacts on energy provision which will also benefit local economies, which rely heavily on effective provision of electricity in order to function efficiently.

6.5 Synthesis

Table 6.21 below shows the individual impacts that the various alternatives will have on each of the criterion with regards to whether they will have a positive or negative impact and the overall impact of the alternative.
<table>
<thead>
<tr>
<th>Wind Farm:</th>
<th>Medium-Low</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Business Sales</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Additional GGP</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Employment Creation and Loss</td>
<td>Medium-very low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Investment Expenditure</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Electricity Resource</td>
<td>Very low-Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Tourism and Tourist Industry</td>
<td>Neutral-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Visual Impact</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>Very low-Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Noise</td>
<td>Low-Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Infrastructure and Resources</td>
<td>Low-very low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Social Livelihoods</td>
<td>Medium-low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>Very low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photovoltaic Activities:</th>
<th>Medium-Low</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Business Sales</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Additional GGP</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Employment Creation and Loss</td>
<td>Medium-very low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Investment Expenditure</td>
<td>Medium-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Electricity Resource</td>
<td>Very low-Medium</td>
<td>Neutral</td>
</tr>
<tr>
<td>Tourism and Tourist Industry</td>
<td>Neutral-Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Visual Impact</td>
<td>Very low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>Very Low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Noise</td>
<td>Low-Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Infrastructure and Resources</td>
<td>Low-very low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Social Livelihoods</td>
<td>Medium-low</td>
<td>Neutral</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>Very low</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

From an analysis of the impact tables in the section above and the summation in table 6.21; it is evident that the construction and operations of the Kangnas Wind and Solar plant will have a positive impact on the evaluation criteria although the magnitude of the impacts are not extravagant. The No-Go alternative, as presented in table 6.21, will have an overall neutral impact on the evaluation criteria within the local, regional and national economies.

This further compounds the results of the economic impact analysis (section 5) where the positive impacts of the Kangnas wind and solar facility would significantly benefit the local, regional and national economies, not to mention promote the Green Energy drive in the country; which will stand the country in good stead as traditionally sources of fuels (fossil fuels such as coal and oil) begin to reach the end of their natural supplies.
Section 7: Mitigation and Recommendations

7.1 Introduction
The following section of the report will list and provide a number of mitigation measures and recommendations pertaining to the development of the Kangnas Wind Farm and Photovoltaic facilities; including mitigation measures and recommendations pertaining to the socio-economic study, the impact analysis and the impact table sections of the report.

The purpose of these mitigation measures and recommendations is to maximise the positive impacts/benefits which the proposed development will have on the regional and national economies. In addition these measures will also be used to mitigate or reduce any negative impacts which the development may have, posing a stronger case for the Kangnas Wind Farm and Photovoltaic facilities.

7.2 Recommendations and Mitigation Measures
The following section of the report will provide recommendations and mitigation measures which have been identified throughout the process of the study. These recommendations and measures are listed below.

7.2.1 Socio-Economic Mitigation and Recommendation
The following mitigation measures and recommendations pertain to the implications identified in the Socio Economic profile section of the report;

- The Nama Khoi and Namakwa municipalities have a large labour force available (based on the economically active population) providing the area with a large human resource base for development projects in proposed in the area. Due to the small town nature of many settlements in the Nama Khoi and Namakwa municipalities and without any major economic activities in the area, the development potential of these towns is relatively small. The construction phase of the Kangnas development should provide in excess of 30,000 temporary employment opportunities, which will help bolster household incomes in the area and potentially provide these workers with some type of skills. It is thus essential that as part of the proposed development, basic construction skills programs
pertaining to the project are provided in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.

- The large percentage of the population which fall within the youth categories, also lends itself to youth development. Due to future importance of sectors such as renewable energy, the construction and operation of the Kangnas facility could provide an ideal practical learning environment for local and district schools. In addition, educational initiatives and programs could be implemented in local schools to promote the use of green energy and to educate the local youth on energy production and particularly on green energy production.

- Linking once again to the potential employment that will be generated by the construction and operation of the facility; approximately 3.1% of the local Nama Khoi local municipality population rely on government grants as their main source of income. Now although the employment created during the construction phase is only temporary, it will help bolster local household incomes, which will in turn help stimulate local expenditure, thus aiding the local economic environment (especially local businesses). The over 500 permanent employment opportunities will more than likely not be centralised to the local or district municipalities, however a certain percentage of this employment will be taken up by these labour markets.

- The area has a relatively low skills level with a large percentage of the population not having obtained a matric and with majority of the workforce being categorized as semi- and unskilled. In connection with the recommendations and mitigation above, active participation by the project in local schools and educational institutions, as well as adequate on-site training programs will bolster the positive impact that the development will have in the local economy, simply through raising the skills levels in the area and thus increasing the household income levels (higher earning employment is only possible with greater skills).

- Employment indicators show a labour force (economically active persons) where 53% of the population are unemployed or not economically active. This high percentage often indicates a local economy which is not able to generate enough employment to cater for the population increases. The investment and employment injection into the region as a result of the construction and operation of the facility, will go a long way to stimulating the local economy. This will enable the development to contribute positively to a local rural economy which is struggling to provide employment and thus the development itself can serve as a catalyst to help mitigate employment and more importantly, investment issues in the area.

- In the local economy General government is the largest provider of employment (21.7% of total employment), while wholesale, retail trade, catering and accommodation (17.3%) is the second largest provider of employment, with the mining sector represented the third most significant (16%). It has been noted in the primary research undertaken by Urban-Econ that the mining sector is looking to move out of the area, or at least decrease its investment in the area. With this sector providing such a large source of low skilled employment, it will have a significant negative impact in the area. Two sectors which have however been identified by stakeholders in the area which could enjoy a future comparative advantage in the area is the Agricultural sector and the electricity production sector, into which the proposed development will play a major role should it be constructed. It is thus recommended that the development be undertaken in order to capitalise on these trends and establish the region as one of the fore runners of green electricity production.
### 7.2.2 Economic Impact Analysis Mitigation and Recommendations

The following recommendations and mitigation measures pertain to the economic impact analysis that was presented in the report:

- In order to maximise the potential benefits of the construction phase of the development within the local and regional economies, it is recommended that local labour, resources and businesses be sourced during this stage. This will not only create new income in the local economies, but will also stimulate local business sales and production; which should continue to stimulate the local economies via the multiplier effect.

- It is also recommended (from the Economic Impact Analysis) that local labour, businesses and resources be sourced during the operational phase of the Wind Farm and Photovoltaic facilities, where possible. Due to the sustainable nature of operations; the employment, income and sales generated from these activities will aid the local economies in the long term, thus providing a more beneficial and lasting positive impact within the area.

- From the synthesis of the economic impact analysis, it is recommended that the construction and operations of the Wind Farm and the Photovoltaic activities be selected, as opposed to the No-Go. The main motivation behind this is the significant positive impacts that the operations and construction of the facility will have on business sales, additional GDP and employment. Thus the selection of the No-Go will simply represent the opportunity cost (economic impacts highlighted in section 5) in terms of economics of not going forward with the project.

- The opportunity to establish manufacturing activities in the local economies pertaining to the facilities on site also presents itself. This will however require further investigation and will also be dependent on whether the development goes ahead and whether the operations of the facility are feasible in the medium to short term. It is thus recommended that the local government and stakeholders undertake the necessary studies to ascertain as to whether establishing manufacturing activities in the area related to the proposed activities and the green energy industry is feasible. Manufacturing industries are known to absorb large amounts of relatively low-skilled labour, which will enable the development to further positively contribute to the unemployment in the area.

- Another recommendation related to the construction and operations of the facility is the putting in place of relevant and clearly defined procurement standards. Procurement policies are set in place by businesses to govern their choice of suppliers, products and the methods and procedures that are going to be used to communicate with their pertinent suppliers. These standards need to be carefully defined and analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers. The total investment into the construction and operations of the project are significant, thus the developers need to ensure that they are receiving the best quality from their suppliers, in order to ensure the success of the project.

It is thus recommended that the developers of the wind farm and photovoltaic activities establish procurement standards that are green friendly and standards of quality. Green procurement in this
regard would entail sourcing suppliers and products which are either green friendly and recyclable or use green energy manufacturing techniques to minimise carbon footprints. The sourcing of products and services which are not environmentally friendly in essence goes against the whole environmental premise behind green energy production.

7.3 Economic Requirements under the IPP Procurement Programme

The Northern Cape region of Southern Africa has been identified as producing levels of sunlight which is ideal for solar energy plants as well as sufficient wind for wind farms. In light of the current energy crisis and the pressure on the country to increase its share of renewable energy the opportunities for private renewable energy producers to supply Eskom power grid with energy is becoming more financially feasible.

On 16th March 2011, the South African Cabinet approved the IRP20, which is the government’s 20 year Sector Master Plan. It was envisioned that the REFIT process under the Department of Energy would be the planned renewable outlet to the market. This was replaced by the Independent Power Producers Procurement Programme (IPPPP), which was released on the 3rd August 2011 and which asks for 3,725 MW of power to be supplied by IPPs of which 91% relates to Wind and Solar. This programme relates to renewable energy IPPs and uses a revised tariff as a cap with competitive price bidding taking place up to the cap. Comments on the First BID submission Phase were completed on 31st August 2011 and First Bid Submissions were submitted on the 4th November 2011. Thereafter selection for preferred bidders took place on 25th November 2011. Phases 2 to 5 will follow accordingly.

As part of the IPPPP bidders will be evaluated in terms of economic development (30%) and price (70%). It is therefore imperative that the proposed project is able to illustrate how it will contribute towards economic and social development. And potential bidders who submit projects that fail to meet the economic development criteria identified below will not go through to the next round of bidding.

In terms of economic development, seven categories have been identified and these include the following:
1. Job creation (25% weighting)
2. Local Content (25% weighting)
3. Ownership (15% weighting)
4. Management Control (5% weighting)
5. Preferential Procurement (10% weighting)
6. Enterprise Development (5% weighting)
7. Socio-Economic Development (15% weighting)

For each of the above criteria (1 to 3 as well as 7), there is a minimum threshold that needs to be met. In terms of the other criteria (4 to 6), the Bidders are free to choose, which of these elements they want to pursue, if any. The economic development score card with the obligations of the Bidder together with the minimum thresholds (plus targets) are outlined below in Table 7.1.
Table 7.1: Economic Score Card for Photo Voltaic and Onshore Wind Farms

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Economic Development Obligations</th>
<th>Onshore Wind Farm</th>
<th>Photo Voltaic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Threshold</td>
<td>Target</td>
</tr>
<tr>
<td>Job Creation</td>
<td><strong>RSA Based Employees who are Citizens</strong></td>
<td>50%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td><strong>RSA Based Employees who are Black Citizens</strong></td>
<td>30%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td><strong>Skilled Employees who are Black citizens</strong></td>
<td>18%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td><strong>RSA based employees who are citizens from local communities</strong></td>
<td>12%</td>
<td>20%</td>
</tr>
<tr>
<td>Local Content</td>
<td><strong>Value of Local Content Spend</strong></td>
<td>15%</td>
<td>25%</td>
</tr>
<tr>
<td>Ownership</td>
<td><strong>Shareholding by Black People in the Project Company</strong></td>
<td>12%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td><strong>Shareholding by Black People in the Contractor responsible for construction</strong></td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td><strong>Shareholding by Black People in the Operations Contractor</strong></td>
<td>8%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td><strong>Shareholding by Local Communities in the Project Company</strong></td>
<td>2.5%</td>
<td>5%</td>
</tr>
<tr>
<td>Management Control</td>
<td><strong>Black top management</strong></td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Preferential Procurement</td>
<td><strong>BBBEE Procurement Spend</strong></td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td><strong>QSEs and EMEs Procurement</strong></td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td><strong>Women owned Vendors Procurement</strong></td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Enterprise Development</td>
<td><strong>Enterprise Development Contributions</strong></td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted Enterprise Development Contributions</strong></td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Socio-Economic Development</td>
<td><strong>Socio-economic development Contributions</strong></td>
<td>1%</td>
<td>1.5%</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted Socio-Economic Development Contributions</strong></td>
<td>1%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
If the developer wants to bid to become part of the IPP Procurement programme, they therefore need to populate the information into Table 7.1. This has not been undertaken as part of this study due to the fact that assumptions were made based on existing information where there was no information on the overseas trends with some adjustment to local labour costs and direct employment figures provided by the client. Furthermore, the costs of the PV system and the breakdown of expenditure would differ depending on the type of the PV technology they use and the tracking system they employ. At this stage it is unknown what technology will be utilised.
References


AURECON SOUTH AFRICA

Proposed Kangnas Wind and Solar Energy Facilities near Springbok

Final Soil and Agricultural Assessment Report

Issue Date: 16th August 2012
Revision No.: 1.1
Project No.: 11361
I, Kurt Barichievy, declare that I –

- act as an independent specialist consultant in the field of Soil Science and Agricultural Potential for the soil and agricultural assessment report for the proposed Kangnas Wind and Solar Energy Facilities near Springbok, Northern Cape Province;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

Mr. K. R. Barichievy Pr.Sci.Nat
Scientist
SiVEST Civil Engineering Division
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1 INTRODUCTION AND TERMS OF REFERENCE

Aurecon South Africa (Pty) Ltd (Aurecon) on behalf of Mainstream Renewable Power (Pty) Ltd (Mainstream) requested a baseline assessment of the soil, land use and agricultural characteristics for the area affected by the proposed Kangnas Wind and Solar Energy Facility, near Springbok in the Northern Cape Province of South Africa. The primary objective of this assessment is to provide specialist soil and agricultural input into the overarching EIA Report. In order to achieve this objective a study of the climate, soils, terrain, land capability, geology, current agricultural practices and agricultural potential was carried out. This report serves to summarise such a study, present the relevant results and mitigate the predicted impacts on local soil and agricultural resources.

During the preliminary phase of the environmental process a desktop agricultural study was undertaken, to flag any agriculturally related issues that may prevent the proposed development from going ahead. This EIA phase assessment and report intends to build on this previous study. The terms of reference, as provided by Aurecon, are to:

- Undertake a detailed soil assessment of the sites, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include:
  - Identification of the soil forms present on sites;
  - The size of the area where a particular soil form is found;
  - GPS readings of soil survey points;
  - The depth of the soil at each survey point;
  - Soil colour;
  - Limiting factors;
  - Clay content
  - Size of the site
  - Slope of the sites; and
  - A detailed map indicating the locality of the soil forms within the specified areas.
- Provide the exact locality of the site
- Describe current activities on the sites, developments and buildings;
- Describe surrounding developments/land uses and activities in a radius of 500 m of the sites, access routes and the condition thereof, the current status of the land (including erosion, vegetation and a degradation assessment) and possible land use options for the sites;
- Describe water availability, source and quality (if available);
- Detailed descriptions of why agriculture should or should not be the land use of choice;
- Undertake an assessment of the potential impacts on agriculture at the site in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the duration of the impact (construction, up to 10 years after construction, more than 10 years after construction). The assessment is to indicate the potential cumulative impacts;
- Describe potential mitigation measures to reduce or eliminate the potential agricultural impacts identified; and
- Provide a shape file containing the soil forms and relevant attribute data as depicted on the map.
- Provide an erosion management plan for monitoring and rehabilitating of erosion events associated with the facility.
Mainstream proposes to develop a 750 Megawatt (MW) wind energy facility, a 250 MW solar Photovoltaic (PV) and / or Concentrated Photovoltaic (CPV) energy facility and substation on a number of farm portions near the town Springbok in the Northern Cape. The proposed wind and solar energy facilities are located approximately 48 km east of Springbok and can be accessed via the N14 highway and connecting farm roads (Aurecon, 2012). The study area is approximately 46 543 hectares (ha) in extent and influences 5 farm portions of 4 farms (Figure 1).

In order to avoid duplication of information, the proposed wind and solar energy facilities and associated activities are assessed in a single Agricultural Assessment Report. It is hoped that this assessment, along with the other specialist studies, will indicate which areas to avoid due to high environmental sensitivity, and thus minimise the predicted impacts on the receiving environment.

1.1 Brief Description of the Project and Study Area

The purpose of this section is to provide basic site information for later reference. Please note that a more detailed description of the site’s characteristics are provided in Sections 4 through 7 of this report.

The Northern Cape Province is considered to be one of the most suitable regions for the establishment of wind farms and PV / CPV facilities due to the overriding climatic and environmental conditions. Accordingly, land portions located outside of Springbok have been identified as a potential site. As indicated, the overarching project contains a wind, solar and substation subproject, which will be constructed adjacent to each other. The wind energy facility could potentially consist of between 185 and 500 wind turbines, with maximum capacity of 750 MW. Once operational the solar subproject will have a capacity of 250 MW. Thus, the total capacity of the entire project will be 1000 MW. The power generated by the two proposed facilities would be transmitted to the national grid via transmission lines and nearby satellite substations (Aurecon, 2012).

The proposed development area is situated in the Namakwa District Municipality. The development influences a number of farm portions and the influenced landowners have entered into a long term agreement with Mainstream (Table 1).

Table 1: Farm and land owner details for the study area

<table>
<thead>
<tr>
<th>Farm</th>
<th>Land Owner</th>
<th>Farm Centroid</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kangnas (Farm No. 77 Portion 3)</td>
<td>Mr W van Niekerk</td>
<td>29° 35’ 39” S 18° 22’ 39” E</td>
<td>11 685</td>
</tr>
<tr>
<td>Kangnas (Farm No. 77 Portion Remainder)</td>
<td>Mr W van Niekerk</td>
<td>29° 33’ 24” S 18° 26’ 32” E</td>
<td>8 785</td>
</tr>
<tr>
<td>Koeris (Farm No. 78 Portion 1)</td>
<td>Mr W van Niekerk</td>
<td>29° 38’ 12” S 18° 28’ 46” E</td>
<td>8 868</td>
</tr>
<tr>
<td>Smorgen Schaduwe (Farm 127 Remainder)</td>
<td>Mr J Kennedy</td>
<td>29° 34’ 37” S 18° 16’ 44” E</td>
<td>9 558</td>
</tr>
<tr>
<td>Areb (Farm No. 75, Remainder)</td>
<td>Mr F Agenbag</td>
<td>29° 30’ 30” S 18° 13’ 54” E</td>
<td>7 647</td>
</tr>
</tbody>
</table>
Due to the sheer size of the project (totalling approximately 46 543 ha) a concise description of the general topography is difficult. However, the assessed area can be summarised as being dominated by vast plains with sporadic steep rocky outcrops and ridges. The farms are dominated by arid shrub vegetation and non-perennial streams. The study area is zoned as agricultural land, and is used as grazing land for sheep, cattle, goats and game. The veld is in average condition and there are some signs of overgrazing and erosion. The surrounding land is comparable to the study area and is dominated by agricultural grazing land. Other than scattered homesteads, storage sheds and kraals there is very little in terms of agricultural infrastructure.

Access to the sites is obtained via the N14 and inter-connecting farm roads. The internal roads are in a reasonable condition and most of the study area can be accessed via motor vehicle. Water is the major limiting factor to local agricultural enterprises and the assessed area contains no perennial rivers and nor does the project area border a perennial river.
Figure 1: Kangnas study area and influenced farm portions (Source: Aurecon, 2012)
2 DESCRIPTION OF PROPOSED ACTIVITIES AND TECHNICAL DETAILS

The technical details provided in this Section are primarily extracted from previous projects and the Final Scoping Report produced by Aurecon (2012). The proposed development includes the construction of both a wind and solar energy facility.

2.1 Wind Energy Facility

The proposed wind energy facility would consist out of approximately 185 - 500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW. A wind turbine is a rotary device that extracts energy from the wind. If the mechanical energy is used directly by machinery, such as for pumping water, cutting lumber or grinding stones, the machine is called a windmill. If the mechanical energy is instead converted to electricity, the machine is called a wind turbine. Figure 2 shows a wind energy facility in Texas, United States of America (Aurecon, 2012).

2.1.1 Components of a wind turbine

Wind turbines can rotate about either a horizontal or a vertical axis. Turbines used in wind farms for commercial production of electricity are usually horizontal axis, three-bladed and pointed into the wind by computer-controlled motors, as is proposed for this project. These have high tip speeds of over 320 km/hour, high efficiency, and low torque ripple, which contribute to good reliability (Aurecon, 2012).

The main components a wind turbine is made up are listed and described below:

- Rotor and blades;
- Nacelle;
- Generator;
- Tower; and
- Foundation.

![Figure 2: Brazos Wind Ranch located in Texas, USA (left) and Typical components of a horizontal axis wind turbine (right) (Source: Wikipedia, 2012a; cited in Aurecon, 2012).](image-url)
- **Rotor and blades**
The rotor has three blades that rotate at a constant speed, approximately 6-15 revolutions per minute (rpm) in the case of the turbines being considered at Kangnas. The blades are usually coloured light grey and, in the case of the proposed project, would be approximately 40 – 60 m long (80 – 120 m rotor diameter) (*Aurecon, 2012*).

- **Nacelle**
Larger wind turbines are typically actively controlled to face the wind direction measured by a wind vane situated on the back of the nacelle. By reducing the misalignment between wind and turbine pointing direction (yaw angle), the power output is maximised and non-symmetrical loads minimised. The nacelle can turn the blades to face into the wind (‘yaw control’). All turbines are equipped with protective features to avoid damage at high wind speeds. By turning the blades into the wind (‘furling’) the turbine ceases its rotation, accompanied by both electromagnetic and mechanical brakes. This would typically occur at very high wind speeds, typically over 72 km/h (20 m/s). The wind speed at which shut down occurs is called the cut-out speed. The cut-out speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level. The turbine controls the angle of the blades (‘pitch control’) to make optimal use of the available wind and avoid damage at high wind speeds. The nacelle also contains the generator, control equipment, gearbox and wind speed measure (anemometer) in order to monitor the wind speed and direction (*Aurecon, 2012*).

- **Generator**
The generator converts the turning motion of the blades into electricity. A gear box is commonly used for stepping up the speed of the generator. Inside the generator, wire coils rotate in a magnetic field to produce electricity. Each turbine has a transformer that steps up the voltage to match the transmission line frequency and voltage for electricity evacuation/distribution (*Aurecon, 2012*).

- **Tower**
The tower is constructed from tubular steel and supports the rotor and nacelle. For the proposed project the tower would be either 60 or 120 m tall, depending on the selected turbine. Wind has greater velocity at higher altitudes, therefore increasing the height of a turbine increases the expected wind speeds (*Aurecon, 2012*).

- **Foundation**
Foundations are designed to factor in both weight (vertical load) and lateral wind pressure (horizontal load). Considerable attention is given when designing the footings to ensure that the turbines are adequately grounded to operate safely and efficiently. The final foundation design of the proposed turbines is dependent on a geotechnical investigation; however it is likely that the proposed turbine foundations would be made of reinforced concrete. The foundations would be approximately 20 m x 20 m and an average of 3 m deep. The foundation would be cast *in situ* and could be covered with top soil to allow vegetation growth around the 6 m diameter steel tower (*Aurecon, 2012*).

### 2.1.2 Construction and operation of the proposed wind energy facility

The turbine tower comprises sections, the first is bolted to the concrete foundation and subsequent sections are lifted on site by a crane, manoeuvred into position and bolted together. A permanent hard
standing made of compacted gravel of approximately 20 m x 50 m would be constructed adjacent to each turbine location for the crane. The preliminary area within which turbines of the proposed wind energy facility would be located is indicated in Figure 3. Gravel surface access roads of approximately 6-10 m wide would also be required between each turbine. Cables connecting each turbine would interconnect and ultimately become a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible. Each turbine would have a transformer that steps up the voltage from 690 Volt to a medium voltage +/- 33 kilovolt (kV). This transformer is housed within each turbine tower or immediately outside the turbine.

The electricity distribution infrastructure would comprise of one transmission line (132 or 220 kV). The proposed project could connect to the grid via up to four satellite substations that would link sectors of the facilities to a main substation which would connect to an overhead line. The proposed route to the substation is approximately 20 km long. At the substation (100 m x 100 m) the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site.

A preliminary approximation of the water requirements for the construction phase of the proposed wind energy facility is 1500 cubic meters (m$^3$) of water per month. Mainstream has indicated that water could be sourced from underground sources (if available) depending on legal agreements and compensation with the landowners. Water might also have to be permitted by DWA. Both digger loaders and/or bulldozers would be required for land clearing and for the assembly of the facility.

Turbines are designed to operate continuously, unattended and with low maintenance for more than 20 years or greater than 120 000 hours of operation. Once operating, the proposed wind energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. There would be basic operation and maintenance including storage facilities on site.

A number of jobs during the construction phases and operational phases of the proposed wind facility would be created. The proposed project would make use of local labour as much as possible, and jobs would be preserved for local people as far as possible keeping in mind skills required of the jobs would be filled by people local to the community (Aurecon, 2012).

2.1.3 Decommissioning of the proposed wind energy facility

The proposed projects have a project lifespan of approximately 20 - 35 years, based on the mechanical characteristics of the turbines. However, as all the infrastructure, such as roads, transmission, substations and foundations would already be established, and the energy source (wind) is a renewable one the proposed projects would continue to be operated after 20 years. Turbines would be upgraded to make use of the latest technology available. All redundant equipment that was replaced would be removed from site and would be sold off or recycled (Aurecon, 2012).
Figure 3: Proposed Turbine Layout
2.2 Solar Energy Facility

A 250 MW solar energy facility with an approximate footprint of 1000 ha, is also proposed for the Kangnas study area. The proposed technology, to be used at the solar facility has not been finalised at this stage of the project. However, the facility will use Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) technology.

PV systems convert sunlight into energy. The smallest unit of a PV installation is a cell. The PV cells are made of silicone which acts as a semi-conductor. The cells absorb light energy which energizes the electrons to produce electricity. A number of solar cells electrically connected to each other and mounted in a support structure or frame, behind a glass sheet to protect the cells from the environment, is called a PV module. A number of cells form a module and a number of modules form an array (Figure 4). Modules are arranged in section sizes of approximately 40x5m called tables and are installed on racks which are made of aluminum or steel. Modules are designed to supply electricity at a certain voltage. The current produced is directly dependent on how much light strikes the module. The arrays are arranged into rows that form the solar field (Aurecon, 2012).

Figure 4: Components of PV technology: (i) Solar cell, (ii) module and (iii) array (Source: Nasa, 2002 cited in Aurecon, 2012).

Figure 5 below illustrates the components of the process of generating electricity from solar energy (sun) and fed into the grid. The fundamental difference between PV and CPV technology is that CPV uses optics such as lenses to concentrate a large amount of sunlight onto a small area of solar PV materials to generate electricity. The arrays and racks are founded into the ground through either concrete, screw or pile foundations (Figure 6). The arrays are wired to inverters that convert direct current (DC) into alternate current (AC) that can be fed into a national grid system (Aurecon, 2012).

It is argued that CPV technology can reduce overall cost by using more advanced technologies with higher efficiencies. Using CPV technology does require tracking systems to ensure the sunlight is
focused on the small cell. Tracking systems do increase the capital cost and maintenance cost of the project (Aurecon, 2012).

![Figure 5: Basic PV system layout (Source: Aurecon, 2012)](image)

PV Panels can also be mounted on tracking systems which follow the path of the sun to maximize the benefit of each ray of sunlight and allowing for the land underneath to be utilised as well (Figure 7). Shade crops can be cultivated under solar panels, increasing the diversity of crops that can be cultivated in sunny regions (Aurecon, 2012).

![Figure 6: Sheep grazing under a PV Ground Mounted system (Source: Wikipedia, 2012b; cited in Aurecon, 2012).](image)
2.2.1 Construction and operation of the proposed solar energy facility

The preliminary focus area of the proposed solar energy facility is illustrated in Figure 8 and has expected development footprint of approximately 1000 ha. Cables connecting the arrays would interconnect with overhead transmission lines that will follow the route of the access roads. The electricity distribution infrastructure would comprise of one transmission line (220 kV) traversing the site. The proposed project would connect to the grid via an onsite substation. The proposed route to the substation is approximately 1 km long. At the substation the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site (Aurecon, 2012).

Mainstream has indicated that water could be obtained from underground water sources depending on the legal agreements and compensation with the landowners. Water might also have to be extracted and permitted by DWA. The facility would be designed to operate continuously, unattended and with low maintenance for more than 20 years. Once operating, the proposed solar energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. The construction period is anticipated to last 24 months for the solar energy facility and 36 months for the wind energy facility months (Aurecon, 2012).

2.2.2 Decommissioning phase of the proposed solar energy facility

The PV site could be decommissioned at the end of the 20 year agreement, from the date of commissioning. The decommissioning is expected to take 6 months for the solar energy facility and 12 months for the wind energy facility. The module components would be removed and recycled as the silicon and aluminum can be re-used in the production of new modules (Aurecon, 2012).
Figure 8: Proposed location of the solar energy facility on Farm Areb (Source: Aurecon, 2012)
3. METHODOLOGY

The following methodology was followed in order to ascertain the status quo of soil and agricultural resources within the study area. Further, this study will outline the predicted impacts resulting from the proposed development and activities in the study area.

3.1 Desktop Study

A detailed desktop assessment was undertaken for the project area, this includes previously scoped and unscoped areas. The objective of this study is to broadly evaluate the soil and land use of the sites and receiving environment by interrogating relevant climate, topographic, land use and soil datasets. By utilising these data resources one is able to broadly assess the current soil, agricultural and land use characteristics and provide a basis for a more detailed and spatially relevant assessment.

3.2 Soil Survey

A detailed soil survey was conducted for the study area. At each sample point a hand auger was used to identify and describe the diagnostic horizons to form and family level according to "Soil Classification - A Taxonomic System for South Africa" as well as noting relevant soil characteristics such as depth, texture and limiting layers. At each auger point the relevant soil and land use data was recorded and the location of the auger point captured using a handheld GPS. This information was combined to produce detailed soil polygon maps.

3.4 Agricultural Potential Assessment

In terms of this study, agricultural potential is described as an area’s suitability and capacity to sustainably accommodate an agricultural land use. The soil information gained from the survey, along with the land use assessment is combined with climate, water resource, crop information and topographic data in order to provide a spatial classification of the land based on its agricultural potential. A study of local agricultural practices was also carried out.

3.5 Impact Assessment

The impact assessment utilises the findings of the soil survey and agricultural potential assessment in order to determine reference conditions of the soil and agricultural resources. Potential soil and agricultural impacts, as a result of the proposed activities, are described in this section and any major impacts/fatal flaws will be identified for consideration by the pertinent authorities.
4. DESKTOP AGRICULTURAL POTENTIAL ASSESSMENT

The objective of the desktop component of this assessment is to provide broad soil and agriculturally related characteristics of the project area. It should be clearly noted that, since the spatial information used to drive this portion of the assessment is of a reconnaissance nature, only large scale climate, land use and soil details are provided. More detailed and site specific information for the study area are provided in subsequent Sections of this report (Sections 5, 6 and 7).

Existing high level GIS data was sourced from National GIS Datasets as well as the Environmental Potential Atlas for South Africa (ENPAT) Database for the Northern Cape Province of South Africa, compiled by the Department of Environmental Affairs and Tourism (DEAT, 2001). The main purpose of ENPAT is to proactively indicate potential conflicts between development plans and critical, endangered or sensitive environments. More agriculturally relevant spatial information was obtained from the AGIS Database (http://www.agis.agric.za, accessed 18/03/2012).

4.1 Climate

The study area has an arid climate with a winter rainfall regime i.e. most of the rainfall is confined to winter and early autumn. The rainfall data for the study area was sourced from the Rainfall Atlas for South Africa (2006). According to this database the Mean Annual Precipitation (MAP) for the project area is approximately 195 mm per year with 68% of this falling between April and August (Figure 9). A MAP of 195 mm is deemed extremely low as 500 mm is considered the minimum amount of rain required for sustainable dry land farming (Smith, 2006). Thus, without some form of supplementary irrigation, natural rainfall for the study area is insufficient to produce sustainable harvests. The low rainfall and moisture availability is reflected in the lack of dry land crop production within the study area.

The region typically experiences hot days with an average mid-day temperature of 28°C in summer, with average night time temperatures dropping to around 4°C during winter (http://www.saexplorer.co.za). Evaporation for the region is estimated at between 2000 and 2200 mm per annum.

In summary the climate for the study area is highly restrictive to arable agriculture, which is primarily attributed to low, unpredictable and seasonal rainfall along with severe moisture availability restrictions.
Figure 9: Mean monthly rainfall graph for the Kangnas project area (Source: South African Rainfall Atlas)
4.2 Geology

The study area is underlain by a variety of geologic materials including, Sedimentary, Gneiss, Quartzite and Tillite (Figure 10). Non-descript sedimentary geologic materials dominate much of the Kangnas site, and this material is found on all 5 farm portions. Tillite, consisting of consolidated masses of unweathered blocks and unsorted glacial till, is found in non-contiguous zones throughout the study area and particularly on the remainder of Farm Kangnas (No.77)

Gneiss, a coarse grained metamorphic rock which is characterised by alternating light and dark bands, differing in mineral composition, is found along the western boundary of Farm Smorgen Schaduwe and Farm Areb. A ring of Quartzite, a medium grained metamorphic rock, underlies the north eastern portion of the study area and is formed from recrystallised sandstone with the fusion of sedimentary quartz grains.

Figure 10: Geological map
4.3 Terrain

Slope or terrain is used to describe the lie of the land. Terrain influences climate and soil characteristics and thus plays a dominant role in determining whether land is suitable for agriculture. In most cases sloping land is more difficult to cultivate and is usually less productive than flatland, and is subject to higher rates of water runoff and soil erosion (FAO, 2007).

The majority of the study area is characterised by flat plains and gently sloping topography with an average gradient of less than 5% (Figure 11). These plains are ideal areas for intensive agriculture, with a high potential for large scale mechanisation. From a developmental perspective, the flat topography will also allow for minimal earthworks and site preparation. The study area does, however, contain sporadic steep rocky outcroppings and ridges particularly on Farm Arab, Farm Smorgen Schaduwe and the northern areas of Portion 3 of the Farm Kangnas (No.77). These outcrops and ridges are limiting to arable agriculture and due to the extreme topography and associated engineering constraints these areas are excluded from the preliminary development layouts (Figures 3 and 8).

Figure 11: Digital Terrain Model and Slope Analysis of the study area
4.4 Land Cover / Use

According to Mucina and Rutherford (2006), the flat plains are classified as the Bushman Arid Grassland (Nama-karoo biome) vegetation type, while the ridges and high spots are classified as Bushman Inselberg Shrubland (Succulent-karoo biome). According to the ENPAT Database and 2010 land cover data the study area consists of a mix of natural veld and unimproved shrubland which is used as grazing land for sheep, goats and cattle (Figure 12). Vast grazing land is interspersed with non-perennial stream beds which flow intermittently and seasonal pans dot the landscape. According to the spatial databases there are no cultivated fields or irrigated lands which could be detrimentally impacted upon by the proposed development. The land uses surrounding the assessment area are virtually identical to the site itself and included grazing land for livestock and game.

Figure 12: Land Cover Map
4.5 Soil Characteristics

According to the ENPAT database the Kangnas site is dominated by red apedal soil types (Figure 13). A pedal soils lack well formed peds, other than porous micro-aggregates, and are weakly structured. As expected shallow, rocky soils correspond to the steeper slopes, ridges and high spots. These rocky areas are enveloped by shallow red apedal soils. Due to the overriding climatic conditions Calcium carbonate is expected to be present throughout the landscape. According to the AGIS database the soils on Kangnas Site are associated with a low water holding capacity and should drain freely. The southern and eastern portions of study area are classified as having an effective soil depth (depth to which roots can penetrate the soil) of less than 0.45 m deep, which is a limiting factor in terms of sustainable crop production (Figure 14). Marginally deeper soils are found on the northern portions of the site and particularly on Farm Areb.

Figure 13: Broad soil type map

There seems to be a contradiction between the soil description and soil depth information within the ENPAT data set for the red apedal soils in northern portions of the study area. The soil description suggest a soil profile of less than 0.3 m while the soil depth map gives a depth of between 0.45 – 0.75 m for the same area. A verified soil depth map is provided in Section 5.
Figure 14: Soil depth map
The ENPAT Database also provides an overview of the study area’s agricultural potential based on its soil characteristics, although it should be noted this spatial dataset does not take prevailing climate into account. According to the ENPAT agricultural dataset the south eastern portion of the study area is dominated by soils which have a poor suitability for arable agriculture but which can still be used as grazing land (Figure 15). This area includes Farm Koeris, the majority of the remainder of Farm Kangnas (No. 77) as well as the southern portions of Portion 3 of Farm Kangnas (No. 77) and Farm Smorgen Schaduwе (No.127).

Again the ridges and high spots are not suitable for agriculture, grazing or forestry due to rocky soils and rough topography. These areas are enveloped areas which are, not suitable for arable agriculture, but still remain suitable for grazing. Highly restrictive climate characteristics dramatically reduce the agricultural potential of the site.

Figure 15: Soil Potential Map

4.6 Desktop Agricultural Assessment: Results Summary

By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderately low for grazing. This poor agricultural potential rating is primarily due to highly restrictive climatic characteristics and soil related limitations. The site is not classified as high potential nor is it a unique dry land agricultural resource.
5. **SOIL SURVEY AND FIELD VERIFICATION**

A detailed soil survey was undertaken for the entire project area using a hand auger and GPS to record the location of each of the auger points. At each survey point the soil was described to form and family level according to "Soil Classification - A Taxonomic System for South Africa" (Soil Classification Working Group, 1991) and the following properties were noted:

- Estimation of ‘A’ horizon clay content,
- Permeability of upper B horizon,
- Effective rooting depth and pedological depth,
- Limiting layers,
- Soil Colour via the Munsell Soil Colour Charts,
- Signs of wetness,
- Surface rockiness,
- Surface crusting,
- Vegetation cover, and
- Detailed description of the particular area such as slope.

5.1 **Soil Descriptions**

This Section lists the major soil forms encountered during the soil survey along with a site-specific description of each soil form. Other soils encountered during the field verification, which were recorded sparsely across the site and therefore not fully described include:

- **Trawal** (Orthic A, Neocarbonate B, Dorbank)
- **Augrabies** (Orthic A, Neocarbonate B)

5.1.1 **Mispah Form**

**Soil Family:** Mostly 1100 (Non-bleached, non-calcareous), limited bleached and/or calcareous  
**Diagnostic Horizons and Materials:**  
A-Horizon: Orthic  
B-Horizon: Hard Rock  

**Site Specific Description:**  
The Mispah soil form falls within the lithic soil group. Lithic soils are associated with shallow soils where hard rock is found close to the soil surface. The Mispah soil form dominates the steeper slopes, outcrops and kopjes. The Orthic A was sandy and virtually structureless; an infield test indicated that the clay content of the A-horizon was less than 10%. The A-horizon varied from brown to ivory in colour and was generally 5 - 20 cm deep, directly overlying various hard rock materials. On the steeper slopes and crests, surface rocks are clearly visible (Figure 16).

**Land Use Capability:**  
This soil has an extremely low agricultural potential due to the distinct lack of rooting depth and water penetration. From a site specific perspective these soils are further compromised by severe slope limitations. Owing to these restrictions these soils are generally utilised for low potential grazing land
and conservation. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

![Image of shallow, rocky soils dominating the ridges and high spots](image)

**Figure 16**: Shallow, rocky soils dominate the ridges and high spots

### 5.1.2 Knersvlakte Form

**Soil Family**: Mostly 1100 (Non-Calcereous A), limited calcereous

**Diagnostic Horizons and Materials**:

- **A-Horizon**: Orthic
- **Sub-Horizon**: Dorbank

**Site Specific Description**:

The Knersvlakte soil form falls within the silicic soil group whose profiles are cemented by silica. The distribution of silicic soils is associated exclusively with arid landscapes (Fey, 2010). The Knersvlakte form is characterised by containing dorbank on the surface or directly below an Orthic A-horizon. Dorbank is a hard subsurface horizon cemented by silica which does not slake in either water or acid. During field verification it was noted that dorbank was often exposed at the surface and thus was classified as a truncated\(^2\) member of the Knersvlakte form (Figures 17 and 18). The dorbank horizon was generally brown, extremely hard and limiting to plant growth. Silic soils are more prominent in the north western portions of the study area. When not exposed at the surface, the Orthic A-horizon was pale brown in colour and lacked structure (<10% clay). A thin red Apedal A-horizon is not

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\(^2\) A truncated soil is a genetic soil that has lost part of its upper horizon(s) by erosion (adapted from the Soil Classification Working Group, 1991)
accommodated in the Knersvlakte form (See Garies Form, Section 5.1.3). However large portions of the project area contained non-contiguous areas of surface Dorbank and a thin red Apedal surface horizon which lead to these areas being classified as a Knersvlakte and Garies complex\(^5\).

**Agricultural Potential:**
The use of silicic soils in South Africa is limited due to the overriding climatic conditions in which these soils are found. The limitations of these soils include shallow depth, excessively high pH and low water holding capacity (Fey, 2010). When encountered on site this form generally had an effective depth of less than 0.2 m and thus is limiting to root growth. In order to be cultivated successfully the dorbank would need to be physically broken up, or perhaps even removed. In the context of this assessment this soil form has an extremely low agricultural potential but can be used for low intensity grazing land.

![Image of Dorbank](image_url)

**Figure 17:** An example of a shallow Knersvalkte form encountered on farm Areb

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\(^5\) A soil complex is a map unit used in soil surveys for two or more taxonomic unit which are so intimately mixed geography that is impractical to separate them (adapted from the Soil Classification Working Group, 1991)
5.1.3 Garies Form

Soil Family: 1000  
Diagnostic Horizons and Materials:  
A-Horizon: Orthic  
B-Horizon: Red Apedal B  
C-Horizon: Dorbank  

Site Specific Description:  
Like the Knersvlakte soil form, the Garies form falls within the silicic soil group. During field verification it was noted that the only difference between the Knersvlakte and the Garies forms is that the latter contained a red apedal surface horizon. The red apedal horizon was often found at the soil surface and contained a very low organic matter content directly overlying Dorbank. The red A-horizon was generally 10-15 cm deep and sandy. The underlying dorbank was generally brown, non-calcareous, extremely hard and limiting to plant growth (Figure 19). Large portions of the project area contained a mix of surface Dorbank and a shallow Red Apedal surface horizon overlying Dorbank, which lead to these areas being classified as a Knersvlakte and Garies complex.

Agricultural Potential:  
This form carries the same agricultural potential characteristics and recommendations as the Knersvlakte form. The limitations of these soils include shallow depth, excessively high pH and low water holding capacity (Fey, 2010). When encountered in the study this form generally had an effective depth of less than 0.3 m and thus is limiting to root growth. In order to be cultivated successfully the dorbank would need to be physically broken up, and perhaps even removed. In the
context of this assessment this soil form has a low agricultural potential but can be utilised as low intensity grazing land.

Figure 19: An example of typical Garies form, the underlying Dorbank (not shown) is impenetrable with a standard bucket auger

Figure 20: An example of a Garies and Knersvalkte complex
5.1.4 Coega Form

**Family:** 1000 / 2000 (Non-Calcareous and Calcareous A Horizon)

**Diagnostic Horizons and Materials:**
- **A-Horizon:** Orthic
- **B-Horizon:** Hardpan Carbonate

**Site Specific Description:**
The Coega soil form is an example of a calcic soil, whose profile contains at least one carbonate-rich horizon. Carbonate retention in the soil profile is a result of an arid climate where evaporation far exceeds rainfall. When encountered during the soil survey the A-horizon of this soil form was brown, thin and weakly structured (less than 10% clay). This Orthic A-horizon overlies a hard pan carbonate which was limiting to plant growth. The effective soil depth was generally less than 0.2 m (Figure 21). A soil complex of the Coega and Plooysburg forms was often noted during the soil survey and was mapped as such.

**Agricultural Potential:**
Calcic soils are associated with arid regions and thus the agricultural use of these carbonate rich soils in South Africa is limited. Limitations in terms of sustainable agricultural use include shallow rooting depth, high pH, high salinity and low plant Phosphorus availability (Fey, 2010). Such limitations restrict calcic soils to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

![Figure 21: Shallow and surface hardpan carbonate is common in the south eastern areas](image-url)
5.1.5 Plooysburg

**Family:** 1000 (Non Luvic B1)

**Diagnostic Horizons and Materials:**
- **A-Horizon:** Orthic
- **B-Horizon:** Red Apedal
- **C-Horizon:** Hard Pan Carbonate

**Site Specific Description:**
The Plooysburg form is another example of a calcic soil whose profile contains at least one carbonate-rich horizon. When encountered on the PDA the A-horizon of this soil form was red in colour and sandy. This Orthic A-horizon merges directly into a Red Apedal B-horizon which lacked structure other than the porous micro-aggregates and had a uniform red colour (Figure 22). The soil form was non-luvic and was generally in the south eastern portions of the study area. The entire profile did not test positive to the presence of carbonates when treated with cold 10% hydrochloric acid. A soil complex of the Coega and Plooysburg forms was often noted during the soil survey and was mapped as such. Shallow Hard Pan Carbonate was generally encountered within 0.3m of the soil surface and was limiting to plant roots.

**Agricultural Potential:**
This form carries the same agricultural potential characteristics and recommendations as the Coega form. When encountered in the study area this form generally had an effective depth of less than 0.3m and thus is limiting to root growth. The limitations in terms of sustainable agricultural use also include high pH and high salinity (Fey, 2010). Such limitations restrict this form to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

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4 Clay content did not increase with soil depth.
5 Soil profiles which contain carbonates effervesce visibly when treated with cold 10% hydrochloric acid.
5.2 Soil Summary

The soils identified on eastern half of the study area (Farm Koeris and south eastern portions of the Farm Kangnas) are predominantly calcic with a low agricultural potential (Figure 23 and 24). These soils are generally shallow with Hard Pan Carbonate being encountered within 0.3m of the soil surface. Calcic soils cover approximately 54% of the study area with Coega and Plooyburg soils being the dominant forms encountered.

Silic soils cover approximately 30% of the surveyed area and are more prominent in the northern and western parts of the study area (Farm Areb and Farm Smorgen Schaduwe). The dominant soil forms encountered were the Garies and Knersvlakte forms.

Rocky soils (Mispah) cover 16% of the surveyed area and dominate the rocky ridges, kopjes and high spots. Virtually all the soil encountered in the study area contained a layer that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. The soils showed limited signs of anthropogenic degradation. However, the steeper slopes and ridges are susceptible to soil erosion and signs of erosion were noted during the field visit.

The location and description of the sample points are provided in Appendix A: Soil Properties. This information was used to create a verified soil map showing homogeneous soil bodies for the study area (Figure 23). Combining the effective depth information (i.e. depth to root limiting layer) and Inverse Distance Weighting one is able to obtain a generalised soil depth (Figure 25). Soils with an effective depth of greater than 20 cm were rarely observed during the soil survey.
Figure 23: Verified Soil Map for the Kangnas Site

Figure 24: Graph showing the percentage area per soil form for the Kangnas Site
Figure 25: Verified Soil Depth Map
6. AGRICULTURAL POTENTIAL ASSESSMENT

In terms of this study, agricultural potential is described as an area’s suitability and capacity to sustainably accommodate an agricultural land use, with this potential usually being benchmarked against crop production.

6.1 Current Situation

The farms which constitute the Kangnas Project Area are predominately used as extensive grazing land for free range sheep production (Figure 26). After discussions with the various land owners the stocking rates are estimated at around 1 SSM (small stock unit) per 10 hectares (low density). There is a single, small herd of cattle on Farm Koeris, as well as small numbers of goat, usually around the homesteads (Figure 27). Water is the major limiting factor to local agricultural enterprises and the farms do not contain, nor do they border, a perennial river / freshwater impoundment which could be used as a source of irrigation water. The areas impacted by the current development layout do not currently accommodate any centre pivots, irrigation schemes or active agricultural fields. Seasonal pans tend to have the highest grazing potential due to the increased plant available water. Drinking water for the animals is sourced from the groundwater resources.

In terms of buildings there are scattered homesteads and sheds throughout the study area and these will be precluded from the development layout. The larger homesteads tend to be located near a reliable borehole.

Figure 26: A flock of sheep grazing on the Kangnas Site
5.2 Verified Agricultural Potential

Overall agricultural potential of the site is based on assessing a number of inter-related factors including climate, topography, soil type, soil limitations and current land use. Climate is the overriding and major limiting factor for agricultural potential at both sites. The combination of low, unpredictable rainfall and a severe moisture deficit means that sustainable arable agriculture cannot take place without some form of irrigation. The sites do not contain, nor are they bounded by a reliable surface water irrigation resource, and the use of borehole water for this purpose does not seem agriculturally and economically feasible. This is due to the high cost of borehole installation, the sheer volume of water required for irrigation purposes and the brackish nature of the local groundwater.

Sporadic steep, rocky outcroppings and ridges further reduce the agricultural potential of the study area (Figure 28). Away from these rocky areas the land is generally flat with an average gradient of less than 5%, these flatter areas are associated with a higher potential for grazing. Shallow calcic, sillic and lithic soils dominate the surveyed area. Virtually all the soil encountered in the study area contained a layer, close to the soil surface, that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. Effective soil depth rarely exceeded 30 cm. The physical and chemical limitations associated with the dominant forms restrict these soils to extensive and low density grazing land. A map indicating the agricultural potential for the Kangnas Site is provided in Figure 29. Overall the site has been classified as having a very low potential for crop production, due to an arid climate and highly restrictive soil characteristics. All the farm portions assessed are not classified as having high agricultural potential and are also not unique dry land agricultural resources. The Kangnas study area is considered to have a moderately low value when utilised as grazing land, its current use.

Figure 27: A small herd of cattle on Farm Koeris (these were the only cattle encountered during field verification)
Figure 28: An example of a rocky ridge encountered during the soil survey

Figure 29: Agricultural Potential Map for the Kangnas Site
7. AGRICULTURAL IMPACT ASSESSMENT

From an agricultural perspective the loss of high value farm land and/or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production (Smith, 2006). Consequently areas which can sustainably accommodate dry land production need to be protected from non-agricultural land uses. The desktop assessment, field verification and agricultural potential assessment (Sections 3, 4 and 5) has already shown that the study area is unsuitable for sustainable, dry land crop production and is dominated by unimproved grazing land.

The proposed development’s primary impact on agricultural activities will involve the construction of a wind energy facility, a solar energy facility, a main substation and associated infrastructure. The construction of these facilities will only influence a portion of the assessed area. An agricultural impact assessment was performed for both the wind and solar energy facilities and associated infrastructure. The methodology and results of this assessment are provided below.

7.1 Wind Energy Facility: Predicted Impacts on Agriculture

The proposed wind energy facility would consist out of approximately 185-500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW.

The construction entails the clearing of vegetation around the footprint of the turbine and the crane hardstand, as well as creating service roads (Section 1.2). Normal grazing (the primary agricultural activity) will be permitted around the turbines. The entire study area is dominated by grazing land and this activity is considered non-sensitive when assessed within the context of the proposed development. Consequently, the impact of the proposed development on the study area’s agricultural potential will be extremely low. The hardstand, turbine and associated infrastructure such as roads and substations footprint of typical wind energy facility generally covers approximately 1% of the impacted area. Again, this loss is considered inconsequential within the context of this assessment. The remaining land will continue to function as they did prior to the development.

There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the current wind turbine layout. Therefore, from an agricultural perspective, there are no fatal flaw areas for the wind energy facility. It is assumed and recommended that a non-developmental buffer will be placed around occupied homesteads. The land influenced by the proposed linking power lines, is dominated by unimproved grazing land. Owing to this the proposed power lines will have a very limited impact on agricultural production, as grazing can still take place under the power lines. The only loss of agricultural land will be directly below the tower’s footprint, which is insignificant.
7.2 Solar Energy Facility: Predicted Impacts on Agriculture

The proposed construction of a PV/CPV solar energy facility is planned for the north eastern portion of the Farm Areb. The proposed development’s primary impact on agricultural activities will involve the construction of the solar fields and associated infrastructure. This will entail the initial clearing of vegetation and levelling of the site. Unless grazing is permitted within the PV/CPV site, the proposed solar development will effectively eliminate the lands agricultural potential, for as long as the development persists (worst case scenario). However, the construction of the 250 MW solar field and associated infrastructure will only influence a small portion of the total farm area (approximately 1000 ha). The remaining land will continue to function as it did prior to the development (approximately 7 647 ha or 87%). In order to further mitigate the potential impact it is highly recommended that periodic grazing of sheep within the PV fields is allowed. This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.

The results of this assessment indicate that the Areb Farm has low agricultural value and is replaceable when assessed within the context of the proposed development. Consequently, the overall impact of the Solar Energy Facility on the study area’s agricultural potential and production will be low, due to the site’s low inherent agricultural potential and value. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development, and as such there are no problematic or fatal flaw areas for the proposed solar energy facility.

The proposed linking power lines, from the PV field to the substation, are dominated by unimproved grazing land. Owing to this the proposed power lines will have a very limited impact on agricultural production, as grazing can still take place under the power lines. The only loss of agricultural land will be directly below the tower’s footprint, which is insignificant.

7.3 Cumulative Impacts

The proposed developments are not expected to have any cumulative impact due to minor loss of agricultural land.

7.4 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include the context and the intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas Intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background or baseline conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in Section 7.5.1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.
7.5 Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental).

7.5.1 Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

<table>
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<tr>
<th>NATURE</th>
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<tr>
<td>Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.</td>
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<th>GEOGRAPHICAL EXTENT</th>
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<td>This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.</td>
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<th>PROBABILITY</th>
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<td>1</td>
<td>Unlikely</td>
<td>The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).</td>
</tr>
<tr>
<td>2</td>
<td>Possible</td>
<td>The impact may occur (Between a 25% to 50% chance of occurrence).</td>
</tr>
<tr>
<td>3</td>
<td>Probable</td>
<td>The impact will likely occur (Between a 50% to 75% chance of occurrence).</td>
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<tr>
<td>4</td>
<td>Definite</td>
<td>Impact will certainly occur (Greater than a 75% chance of occurrence).</td>
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### REVERSIBILITY

This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.

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<th>Completely reversible</th>
<th>The impact is reversible with implementation of minor mitigation measures</th>
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<tr>
<td>1</td>
<td>Partly reversible</td>
<td>The impact is partly reversible but more intense mitigation measures are required.</td>
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<tr>
<td>2</td>
<td>Barely reversible</td>
<td>The impact is unlikely to be reversed even with intense mitigation measures.</td>
</tr>
<tr>
<td>3</td>
<td>Irreversible</td>
<td>The impact is irreversible and no mitigation measures exist.</td>
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### IRREPLACEABLE LOSS OF RESOURCES

This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.

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<th>No loss of resource.</th>
<th>The impact will not result in the loss of any resources.</th>
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<td>2</td>
<td>Marginal loss of resource</td>
<td>The impact will result in marginal loss of resources.</td>
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<td>3</td>
<td>Significant loss of resources</td>
<td>The impact will result in significant loss of resources.</td>
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<tr>
<td>4</td>
<td>Complete loss of resources</td>
<td>The impact is result in a complete loss of all resources.</td>
</tr>
</tbody>
</table>

### DURATION

This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.

<table>
<thead>
<tr>
<th></th>
<th>Short term</th>
<th>The impact and its effects will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Medium term</td>
<td>The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>Long term</td>
<td>The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).</td>
</tr>
<tr>
<td>4</td>
<td>Permanent</td>
<td>The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).</td>
</tr>
</tbody>
</table>

**CUMULATIVE EFFECT**

This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negligible Cumulative Impact</td>
<td>The impact would result in negligible to no cumulative effects</td>
</tr>
<tr>
<td>2</td>
<td>Low Cumulative Impact</td>
<td>The impact would result in insignificant cumulative effects</td>
</tr>
<tr>
<td>3</td>
<td>Medium Cumulative impact</td>
<td>The impact would result in minor cumulative effects</td>
</tr>
<tr>
<td>4</td>
<td>High Cumulative Impact</td>
<td>The impact would result in significant cumulative effects</td>
</tr>
</tbody>
</table>

**INTENSITY / MAGNITUDE**

Describes the severity of an impact

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
<td>Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.</td>
</tr>
<tr>
<td>Points</td>
<td>Impact Significance Rating</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>6 to 28</td>
<td>Negative Low impact</td>
<td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td>
</tr>
<tr>
<td>6 to 28</td>
<td>Positive Low impact</td>
<td>The anticipated impact will have minor positive effects.</td>
</tr>
<tr>
<td>29 to 50</td>
<td>Negative Medium impact</td>
<td>The anticipated impact will have moderate negative effects and will require moderate mitigation measures.</td>
</tr>
<tr>
<td>29 to 50</td>
<td>Positive Medium impact</td>
<td>The anticipated impact will have moderate positive effects.</td>
</tr>
<tr>
<td>51 to 73</td>
<td>Negative High impact</td>
<td>The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.</td>
</tr>
<tr>
<td>51 to 73</td>
<td>Positive High impact</td>
<td>The anticipated impact will have significant positive effects.</td>
</tr>
<tr>
<td>74 to 96</td>
<td>Negative Very high impact</td>
<td>The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered “fatal flaws”.</td>
</tr>
<tr>
<td>74 to 96</td>
<td>Positive Very high impact</td>
<td>The anticipated impact will have highly significant positive effects.</td>
</tr>
</tbody>
</table>

**SIGNIFICANCE**

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

\[
\text{Significance} = (\text{Extent} + \text{Probability} + \text{Reversibility} + \text{Irreplaceability} + \text{Duration} + \text{Cumulative Effect}) \times \text{Magnitude/Intensity}.
\]

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.
7.5.2 Impact Summaries

Once rated, the impacts are summarised and a comparison made between pre- and post-mitigation phases. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison is then made to determine the effectiveness of the proposed mitigation measures and identify critical issues related to the environmental parameters. No significant impacts have been envisioned for the planning and decommission, while the construction and operation phases have been lumped into a single impact summary table for each of the proposed renewable energy facilities.

Impact Summary Wind Energy Facility

Table 2: Overarching impact rating table for the loss of agricultural land and degradation of soil resources (Wind Energy Facility)

<table>
<thead>
<tr>
<th>IMPACT TABLE (WIND ENERGY FACILITY)</th>
<th>Soil and Land Use Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Parameter</td>
<td>Loss of agricultural land and / or production as a result of the proposed activities</td>
</tr>
<tr>
<td>Issue/Impact/Environmental Effect/Nature</td>
<td>Site: Impacts will be restricted to the site.</td>
</tr>
<tr>
<td>Extent</td>
<td>Probability: Definite: A small loss of grazing land will definitely occur.</td>
</tr>
<tr>
<td>Probability</td>
<td>Reversibility: Completely Reversible: The land can be returned to grazing after the project has been decommissioned.</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Irreplaceable loss of resources: No Loss: If the homesteads are avoided, then the construction of the turbines and associated infrastructure, will not result in any irreplaceable agricultural resources being lost.</td>
</tr>
<tr>
<td>Duration</td>
<td>Cumulative effect: Long Term: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.</td>
</tr>
<tr>
<td>Intensity/magnitude</td>
<td>Significance Rating: Negligible Cumulative Impact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pre-mitigation impact rating</th>
<th>Post mitigation impact rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Probability</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Reversibility</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Irreplaceable loss</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Duration</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cumulative effect</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Intensity/magnitude</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Significance rating</td>
<td>-11 (low negative)</td>
<td>-11 (low negative)</td>
</tr>
</tbody>
</table>
Mitigation measures

- Due to the overarching site characteristics and the nature of the proposed development viable mitigation measures are limited and will most likely revolve around erosion control:
  - Clearing activities should be kept to a minimum (turbine and road footprint).
  - In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion.
  - If additional earthworks are required, any steep or large embankments that are expected to be exposed during the ‘rainy’ months should either be armoured with fascine like structures. A fascine structure usually consists of a natural wood material and used for the strengthening an earthen structures or embankments.
- Avoid homesteads and interact with land owners with regards to the final turbine positioning.
- If earth works are required then storm water control and wind screening should be undertaken to prevent soil loss from the site. See Erosion Management Plan for more details (Section 8).

Impact Summary Solar Energy Facility

Table 3: Pre-mitigation impact rating table for the loss of agricultural land and degradation of soil resources (Solar Energy Facility)

<table>
<thead>
<tr>
<th>Environmental Parameter</th>
<th>Soil and Land Use Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue/Impact/Environmental Effect/Nature</td>
<td>Loss of agricultural land and / or production as a result of the proposed activities</td>
</tr>
<tr>
<td>Extent</td>
<td>Site: Impacts will be restricted to the site.</td>
</tr>
<tr>
<td>Probability</td>
<td>Definite: Loss of grazing land will definitely occur.</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Completely Reversible: The land can be returned to grazing after the project has been decommissioned.</td>
</tr>
<tr>
<td>Irreplaceable loss of resources</td>
<td>Marginal Loss: The construction of the solar PV field and associated infrastructure will result in a very marginal loss of agricultural land, production and viability.</td>
</tr>
<tr>
<td>Duration</td>
<td>Long Term: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.</td>
</tr>
<tr>
<td>Cumulative effect</td>
<td>Negligible Cumulative Impact</td>
</tr>
<tr>
<td>Intensity/magnitude</td>
<td>Low: Impact affects the quality, use and integrity of the agricultural value / production in a way that is barely perceptible.</td>
</tr>
<tr>
<td>Significance Rating</td>
<td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td>
</tr>
</tbody>
</table>
### Table 4: Post-mitigation impact rating table for the loss of agricultural land and degradation of soil resources (Solar Energy Facility)

<table>
<thead>
<tr>
<th>Environmental Parameter</th>
<th>Soil and Land Use Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue/Impact/Environmental Effect/Nature</td>
<td>Loss of agricultural land and / or production as a result of the proposed activities</td>
</tr>
<tr>
<td>Extent</td>
<td>Site: Impacts will be restricted to the site.</td>
</tr>
<tr>
<td>Probability</td>
<td>Unlikely: If season grazing is accepted as a mitigation measure then the chance of losing significant agricultural resources is low.</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Completely Reversible: The land can be returned to grazing after the project has been decommissioned.</td>
</tr>
<tr>
<td>Irreplaceable loss of resources</td>
<td>No Loss: If periodic grazing is approved, as a viable mitigation measure, no irreplaceable agricultural resources will be lost.</td>
</tr>
<tr>
<td>Duration</td>
<td>Long Term: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.</td>
</tr>
<tr>
<td>Cumulative effect</td>
<td>Negligible Cumulative Impact</td>
</tr>
<tr>
<td>Intensity/magnitude</td>
<td>Low: Impact affects the quality, use and integrity of the agricultural value / production in a way that is barely perceptible.</td>
</tr>
<tr>
<td>Significance Rating</td>
<td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td>
</tr>
</tbody>
</table>

### Table 5: Pre- and Post-Mitigation impact ratings and proposed mitigation measures (Solar Energy Facility)

<table>
<thead>
<tr>
<th>Extent</th>
<th>Pre-mitigation impact rating</th>
<th>Post mitigation impact rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Reversibility</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Irreplaceable loss</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Duration</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cumulative effect</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Intensity/magnitude</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Significance rating</td>
<td>-12 (low negative)</td>
<td>-8 (low negative)</td>
</tr>
</tbody>
</table>

**Mitigation measures**
- Allow periodic grazing within the PV fields (sheep and wildlife). This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.
- Due to the overarching site characteristics and the nature of the proposed development viable mitigation measures are limited and will most likely revolve around erosion control:
  - Clearing activities should be kept to a minimum (panel and road footprint).
  - In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion.
  - If additional earthworks are required, any steep or large embankments that are expected to be exposed during the ‘rainy’ months should either be armoured with fascine like structures (unlikely scenario).
- If earth works are required then storm water control and wind
screening should be undertaken to prevent soil loss from the site (Section 8).

It is clear that even without mitigation measures the proposed activities will have a very low impact on current agricultural production, soil resources, agricultural potential and overall farm viability. From an agricultural perspective the vast majority of the entire site is suitable for the proposed development. Small areas surrounding existing homesteads have been declared No Go Zones from an Agricultural Perspective (Figure 30). These areas are currently precluded in the latest development layout.
Figure 30: No Go Map from an agricultural perspective and current development layout.
8. EROSION MANAGEMENT PLAN

Soil is a natural resource, is non-renewable in the short term and is expensive either to reclaim or improve following degradation (van Lynden & Oldeman, 1997).

Even though the areas directly affected by the proposed developments have low agricultural value and capability, the activities still have the potential to have negative implications on the immediate and surrounding soil and land resources. The International Soil Reference and Information Centre (ISRIC), the producers of the World Map of Human-Induced Soil Degradation, recognises two categories of human-induced soil degradation processes.

The **first category** deals with soil degradation by displacement of soil material mainly through water and wind erosion. Soil erosion causes land degradation through a reduction in agricultural potential in many parts of South Africa. The major issues surrounding soil erosion are the loss of the top soil layer required for plant growth, reduction of soil nutrients, siltation of aquatic systems as well as the general land and ecosystem degradation.

The **second category** of soil degradation deals with in-situ soil physical and chemical and biological deterioration. In-situ soil degradation due to anthropogenic activities can be divided into various classes and subclasses:

- **Physical Degradation** (waterlogging, compaction, crusting, pore modification, etc.)
- **Chemical Degradation** (eutrophication, acidification, salinisation, heavy metal pollution, etc.)
- **Biological Degradation** (pathogen introduction, modification of microbial activity etc.)

A single or combination of the aforementioned degradations leads to a decrease in soil quality/health which in turn influences land capability ratings (ISRIC, 1990). Due to the proposed activities this management plan focuses primarily on soil erosion however generic soil contamination mitigations are provided in Section 8.3.

### 8.1 Soil Erosion Monitoring

Due to the size of the site and without rigorous scientific methods and equipment, soil erosion will need to be monitored visually by the appointed Environmental Control Officer (ECO)⁶. Soil erosion is a natural process, whose rate and intensity can anthropogenically increased. Excessive erosion can lead to land degradation and in the reduction of the area’s carrying capacity. It is recommended that areas around the turbine footprint, crane hardstand and PV/CPV panels are visually monitored during audits. A photographic record of the on-site conditions will also aid in the identification of erosion problems. Signs of rill and gully erosion should be remediated as soon as possible. Typical remediation techniques are provided in Section 8.2, below.

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⁶ The person appointed will provide direction to the Contractor concerning the activities within the Construction Zone, and who will be responsible for conducting the Environmental Audit of the project during the construction and operational phases of the project.
8.2 Proposed Soil Erosion Mitigatory Measures

Clearing activities should be kept to a minimum and must only be undertaken during agreed working times as well as permitted weather conditions. If heavy rains are expected clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts. The further unnecessary removal of groundcover vegetation from slopes must be prevented, especially on steep slopes.

Following the clearing of an area, the surfaces of all exposed slopes must be roughened to retain water and increase infiltration (especially important during the wet season). Any steep or large embankments that are expected to be exposed during the ‘rainy’ months should either be armoured with fascine like structures or vegetated. A fascine structure usually consists of a natural wood material and used for the strengthening an earthen structures or embankments. If a cleared area is not going to be built on immediately, the top layer (nominally 150 mm) of soil should be removed and stockpiled in a designated area approved by the ECO. Vegetation shall be stripped in a sequential manner as the work proceeds so as to reduce the time that stripped areas are exposed to the elements. Top-soiling and re-vegetation shall start immediately after the completion of an activity and at an agreed distance behind any particular work front. It is highly recommended that existing farm roads are used as much as possible, while the additional creation of access roads should be kept to a minimum. Where roads need to be created, a dual tyre track road should be used rather than clearing an entire road width, this is particularly important for the larger construction vehicles (Figure 31).

![Figure 31: An example of a dual tyre track](image)
Storm water control and wind screening should be undertaken to prevent soil loss from the site. All embankments shall be protected by a cut off drain to prevent water from running down the face of the embankment and resulting in erosion. Typical erosion control measures such as the installation of silt fences, hay bales, EcoLogs™ and Bio Jute™ are recommended if erosion problems are noted during construction and operation phases (Figure 32).

Figure 32: Typical soil erosion mitigatory measure: BioJute Installation (top left); a silt fence protecting a stockpile (top right) and pegged hay bale wall used to reduce runoff velocities (bottom)

8.3 Proposed Groundwater and Soil Contamination Mitigatory Measures

Every precaution must be taken to ensure that any chemicals or hazardous substances do not contaminate the soil or groundwater on site.

For this purpose the Contractor must:

- Ensure that the mixing /decanting of all chemicals and hazardous materials should take place on a tray or impermeable surface.
- Waste generated from these should then be disposed of at a registered landfill site.
- Ensure all storage tanks are designed and managed in order to prevent pollution of drains, groundwater and soils.
- Construct separate storm water collection areas and interceptors at storage tanks, and other associated potential pollution activities.
- Ensure that use and storage of fuels and chemicals that could potentially leach into the ground be controlled. Adequate spillage containment measures shall be implemented, such as cut off drains, etc. Fuel and chemical storage containers shall be set on a concrete plinth. The containment capacity shall be equal to the full amount of material stored, plus 10%.
- Appoint appropriate contractors to remove any residue from spillages from site. Handling, storage and disposal of excess or containers of potentially hazardous materials shall be in accordance with the requirements of the above-mentioned Regulations and Acts.
- Ensure that used oils/lubricants are not disposed of on/near the site, and that contractors purchasing these materials understand the liability under which they must operate. The ECO will be responsible for reporting the storage/use of any other potentially harmful materials to the relevant authority.
- Ensure that potentially harmful materials are properly stored in a dry, secure environment, with concrete or sealed flooring. The ECO will ensure that materials storage facilities are cleaned/maintained on a regular basis, and that leaking containers are disposed of in a manner that allows no spillage onto the bare soil or surface water. The management of such storage facilities and means of securing them shall be agreed.
- Site staff shall not be permitted to use any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any other construction or related activities. Municipal water or another source approved by the ECO should rather be used for all activities such as washing of equipment, dust suppression, concrete mixing and compacting.

### 8.4 Stockpile Management

General requirements for stockpiles are that they should be situated in an area that should not obstruct the natural water pathways on site. Topsoil stockpiles will be kept separate from other stockpiles, shall not be compacted, and shall not exceed 2m in height. If they are exposed to windy conditions or heavy rain, they could either be protected by re-vegetation using an indigenous grass seed mix or cloth, depending on the duration of the project. The construction of a berm consisting of sand bags or a low brick wall can be placed around the base of the stockpile for retention purposes. They should be maintained free of alien vegetation and weeds by regular weeding. Stockpiles shall be kept free of any contaminants whatsoever, including paints, building rubble, cement, chemicals, oil, etc.

Subsoil and topsoil stockpiles will be moved to areas of final utilisation as soon as possible to avoid unnecessary erosion. Stockpiles not utilized within three months of the initial stripping process (or prior to the onset of seasonal rains) will be seeded with appropriate grass seed mixes, including indigenous grasses normally found in coastal grasslands or brush-packed to further avoid possible erosion.

### 8.5 Land Rehabilitation

All rubble is to be removed from the site to an approved landfill site as per construction phase requirements. No remaining rubble is to be buried on site. The site is to be free of litter and surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared.
9. SUMMARY AND RECOMMENDATIONS

Aurecon on behalf of Mainstream Renewable Power requested a baseline assessment of the soil, land use and agricultural characteristics for the area affected by the proposed Kangnas Wind and Solar Energy Facilities, near Springbok in the Northern Cape Province of South Africa. The primary objective of this assessment is to provide specialist soil and agricultural input into the overarching EIA Report. The study area is zoned as agricultural land and is primarily used as grazing land for sheep. Water is the major limiting factor to local agricultural enterprises and the assessed area contains no perennial rivers and nor does the project area border a perennial river.

The study area has an arid climate with a winter rainfall regime i.e. most of the rainfall is confined to winter and early autumn. MAP is approximately 195 mm per year. The low rainfall and moisture availability is reflected in the lack of dry land crop production within the study area. The climate for the study area is highly restrictive to arable agriculture, which is primarily attributed to low, unpredictable and seasonal rainfall along with severe moisture availability restrictions. The majority of the study area is characterised by flat plains and gently sloping topography with an average gradient of less than 5%. These plains are ideal areas for intensive agriculture, with a high potential for large scale mechanisation. From a developmental perspective, the flat topography will also allow for minimal earthworks and site preparation. The study area does, however, contain sporadic steep rocky outcroppings and ridges particularly on Farm Areb (No.75), Farm Smorgen Schaduwe (No.127) and the northern areas of Portion 3 of the Farm Kangnas (No.77). These outcrops and ridges are limiting to arable agriculture and due to the extreme topography and engineering constraints are excluded from the preliminary development layouts.

The soils identified on eastern half of the study area (Farm Koeris and south eastern portions of the Farm Kangnas) are predominantly calcic with a low agricultural potential. These soils are generally shallow with Hard Pan Carbonate being encountered within 30cm of the soil surface. Calcic soils cover approximately 54% of the study area with Coega and Ploosburg soils being the dominant forms encountered. Silic soils cover approximately 30% of the surveyed area and are more prominent in the northern and western parts of the study area (Farm Areb and Farm Smorgen Schaduwe). The dominant soil forms encountered were the Garies and Knersvlakte forms. Rocky soils (Mispah) cover 16% of the surveyed area and dominate the rocky ridges, kopjes and high spots. Virtually all the soil encountered in the study area contained a layer, close to the soil surface, that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. Effective soil depth rarely exceeded 30 cm. The physical and chemical limitations associated with the dominate forms restrict these soils to extensive grazing.

Overall the site has been classified as having a very low potential for crop production, due to an arid climate and highly restrictive soil characteristics. While, it is considered to have a moderately low value when utilised as grazing land, its current use.

The proposed wind energy facility would consist out of approximately 185 - 500 turbines with a maximum total installed capacity of 750 MW. Normal grazing (the primary agricultural activity) will be permitted around the turbines. The hardstand and turbine footprint of typical wind energy facility generally covers approximately 1% of the impacted area. This loss is considered inconsequential within the context of this assessment. The remaining land will continue to function as they did prior to
the development. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the current wind turbine layout. Therefore, from an agricultural perspective, if there are no fatal flaw areas for wind energy facility. It is assumed and recommended that a non-developmental buffer will be placed around occupied homesteads. A 300 m buffer should be sufficient but this distance should be finalised in consultation with the current land owners.

The proposed construction of a PV/CPV solar energy facility is planned for the north eastern portion of the Farm Areb. The proposed development’s primary impact on agricultural activities will involve the construction of the solar fields and associated infrastructure. The construction of the 250 MW solar field and associated infrastructure will only influence a small portion of the total farm area (approximately 1000 ha). The remaining land will continue to function as it did prior to the development (approximately 7 647 ha or 87%). In order to further mitigate the potential impact it is highly recommended that periodic grazing of sheep within the PV fields is allowed. This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.

The proposed developments are not expected to have any cumulative impact due to minor loss of low value agricultural land. The post mitigation impact scores for both developments are classified as low negative. From an agricultural perspective the vast majority of the site is suitable for the proposed development. Small areas surrounding existing homesteads have been declared No Go Zones from an Agricultural Perspective. These areas are currently precluded in the latest development layout. If the suggested mitigation measures and erosion management plan are correctly implemented there is no reason why the proposed wind and solar energy facilities cannot be accommodated on the Kangnas Project Site.
10. REFERENCES


World map of the status of human-induced soil degradation: an explanatory note. (1990)
### 11. APPENDIX A: SOIL PROPERTIES

<table>
<thead>
<tr>
<th>Auger Number</th>
<th>Soil Form</th>
<th>Soils Family</th>
<th>Effective Depth (m)</th>
<th>Limiting Layer</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Py</td>
<td>1000</td>
<td>0.2</td>
<td>HPC</td>
<td>18.4952</td>
<td>-29.5543</td>
</tr>
<tr>
<td>2</td>
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11. APPENDIX A: SPECIALIST DECLARATION

![Specialist Declaration](image)

Details of Specialist and Declaration of Interest

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**PROJECT TITLE**

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

Specialist:

Soil and Agricultural Potential

Kurt Barchewy

P.O. Box Maundzi

3201

Cell: 034 554 5442

Telephone: 033 347 1600

Fax: 033 347 5762

Professional affiliation(s) (if any)

Registered as a Professional Natural Scientist (P. Nat. Sc.) with the South African Council for Natural Scientific Professions - Earth Science (Registration No. 400128/11)

Project Consultant:

Aurecon South Africa (Pty) Ltd

Louise Corbett, Cornelia Steyn

P.O. Box 484, Cape Town

3201

Cell: +27 86 857 3332

Telephone: 021 526 6227

Fax: 021 526 6227

E-mail:

Louise.corbett@auenongroup.com / cornelia.steyn@auenongroup.com
4.2 The specialist appointed in terms of the Regulations,

Kurt Barkhuysen, declare that:

General declaration:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority, and that the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SIVEST SA (Pty) Ltd

Name of company (if applicable):

15 August 2012

Date:
Annexure M2
Hi Corlie,

Thanks for the update.

The new solar layout does not influence the recommendations of my report nor does it change the significance of the potential impacts on agricultural resources.

The areas directly affected by the revised solar layout are still characterised by soils with a low / very low potential for arable agriculture. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the revised solar layout. As such, from an agricultural perspective, if the suggested mitigation measures and erosion management plan are correctly implemented there is still no significant reason why the proposed solar energy facilities cannot be accommodated on the Kangnas Project Site.

I hope this response will suffice.

Kind regards

KURT BARICHIEVY
Pr.Sci.Nat
Scientist
SiVEST Civil Engineering Division
tel +27 33 347 1600  fax +27 33 347 5762  cell +27 84 554 9442
e-mail KurtB@sivest.co.za  website www.sivest.co.za

Consulting Engineers • Project Managers • Environmental Consultants • Town and Regional Planners
Durban • Johannesburg • Pietermaritzburg • Richards Bay • Ladysmith • Cape Town • Harare (Zimbabwe)

---

Hi Everyone

Based on the outcome of your studies, the applicant have revised the layout / location for the solar facility. We realise that you are working under a lot of pressure with many other consultants.

So to make things easier, we would appreciate if you could please respond in email (PLEASE DON'T UPDATE YOUR REPORTS!) on how your assessments (especially significance) are impacted by the new layout.

These emails will be included in the EIR as an annexure. If possible, please send your email by tomorrow.

Kind Regards

Corlie Steyn  | Environmental Management
Environmental Practitioner | Aurecon
T +27 44 805 5421  | M +27 82 575 7415
Disclaimer

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Annexure N1
PROPOSED WIND AND SOLAR (PHOTOVOLTAIC) ENERGY FACILITIES ON KANGNAS FARM NEAR SPRINGBOK IN THE NORTHERN CAPE
LIFE-CYCLE ENVIRONMENTAL MANAGEMENT PROGRAMME

FEBRUARY 2013

FINAL

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Cape Town
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Fax: (021) 527 9500
Email: louise.corbett@aurecongroup.com

PROPOSENENT
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Claremont, Cape Town
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Tel: (021) 657 4050
Fax: (021) 671 5665
E-mail: Hendrik.reyneke@mainstream.com
PROJECT DETAILS

REFERENCE NO.
DEA REF. NO. 14/12/16/3/3/2/346 (WIND)
NEAS REF. NO. DEA/EIA/0001222/2012
DEA REF. NO. 14/12/16/3/3/2/342 (PV)
NEAS REF. NO. DEAT/EIA/0001217/2012
DEA REF. NO. 14/12/16/3/3/2/386 (SUBSTATION & GRIDLINE)
NEAS REF. NO. DEA/EIA/0001344/2012
DEA REF. NO. TBC (PV SUBSTATION & GRID CONNECTION)
NEAS REF. NO. TBC

TITLE
Draft Final Life-Cycle Environmental Management Programme

AUTHORS & PREPARED BY
Corlie Steyn, Simon Clark and Louise Corbett of Aurecon South Africa (Pty) Ltd

CLIENT
Mainstream Renewable Power South Africa (Pty) Ltd

CLIENT REPRESENTATIVE
Hendrik Reyneke

REPORT STATUS
Draft Final

REPORT NUMBER
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REPORT DATE
November 2012-February 2013

Authors:

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Practitioner: Environment & Advisory Services Practitioner: Environment & Advisory Services

Approved by:

.................................................. ..................................................
LOUISE CORBETT (Pr. Sci. Nat.) ANDRIES VAN DER MERWE (Pr.Eng.)
Associate: Environment & Advisory Services Technical Director: Environment & Advisory Services

This report is to be referred to in bibliographies as: AURECON. 2013. Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape: Final Life-Cycle Environmental Management Programme. Report No. 6428a
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Appendix B: Construction EMP General Specifications (Comprehensive)
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<td>CEMP</td>
<td>Construction Phase Environmental Management Programme</td>
</tr>
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<td>Department of Environmental Affairs</td>
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<td>DEA&amp;DP</td>
<td>Department of Environmental Affairs and Development Planning</td>
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<td>DWA</td>
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<td>EA</td>
<td>Environmental Authorisation</td>
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<td>LEMP</td>
<td>Life-Cycle Environmental Management Programme</td>
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<td>NEMA</td>
<td>National Environmental Management Act (No. 107 of 1998)</td>
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<td>OHS</td>
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<td>SDEMA</td>
<td>Specification Data Environmental Management</td>
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1 OVERVIEW

This document represents the Life-Cycle Environmental Management Programme (LEMP) for the proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape.

1.1 Purpose of the LEMP

The LEMP has been included in the Environmental Impact Assessment Report (EIR) in order to provide a link between the impacts identified in the EIA Process and the actual environmental management on the ground during project implementation and operation. The purpose of this document is to provide for environmental management throughout the various life-cycle stages of the proposed development. The following stages are included:

- Planning and design,
- Pre-construction and construction,
- Operation, and
- Decommissioning.

Furthermore, this LEMP aims for alignment and optimisation of environmental management processes with conditions of authorisation that may arise, thereby ensuring that identified environmental considerations are efficiently and adequately taken into account during all stages of development.

1.2 Legal requirements of Environmental Management Programmes

In terms of the EIA Regulations (Regulation 543 of 18 June 2010) enacted in terms of the National Environmental Management Act (no. 107 of 1998) (NEMA), the proposed project triggers Activity 10, 11 and 18 of Regulation R544 (18 June 2010), Activity 1 and 7 of Regulation R545 (18 June 2010) as well as Activity 14 of Regulation R546 (18 June 2010). As the proposed project triggers listed activities in terms of Regulation R544, R545 and R546 it is necessary to submit an Environmental Impact Assessment Report (EIR) for Environmental Authorisation (EA) to the Department of Environmental Affairs (DEA). Section 22 (l) of the EIA Regulations require that a draft EMP is submitted as part of the EIR.

The contents of the EMP must meet the requirements outlined in Section 24N (2) and (3) of NEMA (as amended) and Section 33 of the EIA Regulations. The EMP must address the potential environmental impacts of the proposed activity on the environment throughout the project life-cycle including an assessment of the effectiveness of monitoring and management arrangements after implementation. The Department requires that the EMP be submitted together with the EIR so that it can be considered simultaneously. Table 1 lists the requirements of an EMP as stipulated by Section 33 of the EIA Regulations R543. Table 2 lists the requirements of an EMP as stipulated by Section 24N (2) and (3) of the NEMA (as amended).
Table 1: Section 33 of EIA Regulation R543 listing the requirements of an EMP

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<td>(i) the person who prepared the environmental management programme; and</td>
</tr>
<tr>
<td>(ii) the expertise of that person to prepare an environmental management programme;</td>
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<td>(b) information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by these Regulations, including environmental impacts or objectives in respect of—</td>
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<tr>
<td>(i) planning and design;</td>
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<td>(ii) pre-construction and construction activities;</td>
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<tr>
<td>(iii) operation or undertaking of the activity;</td>
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<tr>
<td>(iv) rehabilitation of the environment; and</td>
</tr>
<tr>
<td>(v) closure, where relevant.</td>
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<tr>
<td>(c) a detailed description of the aspects of the activity that are covered by the draft environmental management programme;</td>
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<tr>
<td>(d) an identification of the persons who will be responsible for the implementation of the measures contemplated in paragraph (b);</td>
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<td>(e) proposed mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon;</td>
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<tr>
<td>(f) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including, where appropriate, concurrent or progressive rehabilitation measures;</td>
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<td>(g) a description of the manner in which it intends to—</td>
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<tr>
<td>(i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;</td>
</tr>
<tr>
<td>(ii) remedy the cause of pollution or degradation and migration of pollutants;</td>
</tr>
<tr>
<td>(iii) comply with any prescribed environmental management standards or practices;</td>
</tr>
<tr>
<td>(iv) comply with any applicable provisions of the Act regarding closure, where applicable;</td>
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<tr>
<td>(v) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;</td>
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<td>(h) time periods within which the measures contemplated in the environmental management programme must be implemented;</td>
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<td>(i) the process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity;</td>
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<td>(j) an environmental awareness plan describing the manner in which—</td>
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<tr>
<td>(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and</td>
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<tr>
<td>(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment;</td>
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<td>(k) where appropriate, closure plans, including closure objectives.</td>
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The legislation hereby aims to ensure that effective environmental management is implemented throughout the life cycle of the project via the translation of EIA management actions into the LEMP.

The Department of Environmental Affairs & Development Planning (DEA&DP)’s Guideline for Environmental Management Plans (2005) aims to inform and guide the preparation and implementation of EMPs. The guideline defines EMPs as:

“an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning
of a project are prevented; and that the positive benefits of the project are enhanced”.

The guideline further provides “situations [that] could trigger the need for an EMP requiring authority approval”. One such trigger is:

“EMPs covering specific activities assessed through an over-arching EIA and incorporated into a Strategic Environmental Management Plan. A tiered system of EIA leading to a [Strategic EMP] and multiple EMPs may apply to large-scale complex developments with several sub-projects. In this case, an over-arching EIA may serve as the basis for environmental approval for the overall development. This may be supported by a [Strategic EMP] that is approved by the authorities. However, one or more EMPs may be required for the specific activities that form part of the larger development”.

Table 2: Section 24N (2) and (3) of the NEMA (as amended) listing the requirements of an EMP

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<td>(iii) the operation or undertaking of the activity in question;</td>
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<td>(vi) the rehabilitation of the environment; and</td>
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<td>(vii) closure, where relevant.</td>
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<tr>
<td>(b)</td>
<td>details of –</td>
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<tr>
<td>(c)</td>
<td>a detailed description of the aspects of the activity that are covered by the draft environmental management plan;</td>
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<tr>
<td>(d)</td>
<td>information identifying the persons who will be responsible for the implementation of the measures contemplated in paragraph (a);</td>
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<tr>
<td>(e)</td>
<td>information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance.</td>
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<tr>
<td>(f)</td>
<td>as far as is reasonable practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and</td>
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<tr>
<td>(g)</td>
<td>a description of the manner in which it intends to-</td>
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<tr>
<td></td>
<td>(i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;</td>
</tr>
<tr>
<td></td>
<td>(ii) remedy the cause of pollution or degradation and mitigation of pollutants; and</td>
</tr>
<tr>
<td></td>
<td>(iii) comply with any prescribed environmental management standards or practices.</td>
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<tr>
<td>24N.(3)</td>
<td>the environmental management programme must, where appropriate-</td>
</tr>
<tr>
<td>(a)</td>
<td>set out time periods within which the measures contemplated in the environmental management programme must be implemented;</td>
</tr>
<tr>
<td>(b)</td>
<td>contain measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of prospecting or mining operations or related mining activities which may occur inside and outside the boundaries of the prospecting area or mining area in question; and</td>
</tr>
<tr>
<td>(c)</td>
<td>develop an environmental awareness plan describing the manner in which-</td>
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<tr>
<td></td>
<td>(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and</td>
</tr>
</tbody>
</table>
(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment.

The LEMP aims to meet the EMP requirements as legislated by the NEMA Regulations (as amended) as well as falling in line with the DEA&DP guideline document for an Environmental Management Plan\(^1\). It should however be noted that no guideline or guidance exists in terms of best practice approach to LEMPs. This document should thus be seen in an iterative context allowing for amendments throughout the life-cycle of the project, allowing for adjustments as new information is made available.

1.3 Structure of the LEMP

As discussed above, the LEMP aims to address environmental management throughout the project life-cycle, from planning and design, through construction, to operation and potential decommissioning. The LEMP has been structured to include the following sections:

1. Discussion summarising environmental management influencing the planning and design of the proposed project (Chapter 2);
2. Construction EMP based on identified impacts and mitigation measures from the EIR (Chapter 3);
3. Operational Framework based on identified impacts and mitigation measures from the EIR (Chapter 4); and
4. Decommissioning Framework providing guidance on key considerations to be considered during decommissioning/closure (Chapter 5).

1.4 Expertise of Environmental Assessment Practitioners

Section 33 of EIA Regulations and Section 24N (2) and (3) of NEMA (as amended) requires that an EMP must include the details of the person(s) who prepared the EMP, and the expertise of that person to prepare an EMP. In this regard, the Curriculum Vitae of the Environmental Assessment Practitioners who compiled the LEMP are included in Appendix A.

2 PLANNING AND DESIGN

This section has been divided into subsections which outline how environmental considerations have informed and been incorporated into the planning and design phases of the proposed wind energy facility. Detailed design is usually undertaken as part of the pre-construction phase as it is a costly undertaking which is generally only costed for once all required authorisations have been obtained. Thus, the planning and design phases discussed are limited to those associated with the pre-authorisation phases. Mitigation measures have been recommended for the detailed design phase.

2.1 Project Description

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) intends to develop a 560 MW wind energy facility and a 225 MW solar Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) energy facility on the farms near Springbok in the Northern Cape. Associated with the proposed wind energy facility would be a substation, and the same for the proposed solar energy facility. Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the requisite environmental process as required in terms of the National Environmental Management Act (No. 107 of 1998), as amended, on behalf of Mainstream.

The proposed projects entail the generation of electricity from wind and solar resources. The construction period will entail approximately 12 - 18 months for the proposed wind energy facility and 24 - 18 months for the proposed solar photovoltaic energy facility. 180 wind turbines are proposed of 1.5 - 4 MW capacity. The proposed wind energy facility would consist of four phases of 140 MW each, the turbine sizes would range between 1.5 – 4 MW which means each 140 MW phase may consist of between 94 (using 1.5 MW machines) to 35 turbines using 4 MW machines. The combined four phases would have a maximum total installed capacity of 560 MW. The proposed solar energy facility (225 MW of photovoltaic (PV) and/or Concentrated PV (CPV)) may include tracking systems and would have an approximate footprint of 793 800 hectares (ha). An onsite connection is proposed via an existing 220 kilovolt Eskom line. It is proposed to construct one main substation linking each of the proposed energy facilities and the Eskom line and two satellite substations in the proposed wind energy facility that would link sectors of the facility to the main substation with overhead lines.

The proposed project would take place on the farms Kangnas (Farm No. 77 Portion 3 and the Remainder), Koeris (Farm No. 78 Portion 1), Areb (Farm No. 75 Portion 0) and Smorgenshaduwe (Farm No. 127 Portion 0) in the Northern Cape (see
2.2 Summary of Alternatives

To summarise, the feasible alternatives assessed in the EIR include the following:

 Proposed wind energy facility:
- Construction of four phases of 140 MW capacity with wind turbines ranging in size from 1.5-4 MW capacity;
- Associated infrastructure including:
  - Hard standings of 20-40 m x 40 m alongside turbines;
  - Access roads of 4 – 10 m wide between turbines;
  - Overhead or underground transmission lines connecting turbines;
  - One main substation connecting the proposed energy facilities to the Eskom line; and
  - Two satellite substations that would link sectors of the facility to a main substation with overhead lines.

 Proposed solar energy facility:
- Construction of 225 MW (three phases of 75 MW) of PV (tracking or fixed) and/or CPV (tracking);
- Associated infrastructure including:
  - Access roads of 4 – 10 m wide to the PV plant; and
  - One main substation with overhead lines.

The following feasible alternatives were considered in the EIR:

Proposed wind energy facility:
- Location alternatives:
Proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape: LEMP

2.3 Design of the project

The design for the proposed development should respond to the identified environmental constraints and opportunities. The following mitigation measures related to the design for the proposed developments have been recommended to reduce the environmental impacts.

**Proposed wind energy facility**

- No structures to be occupied or frequented by people shall be built within delineated servitude areas.
- Avoid Platbakkies Succulent Shrubland gravel patches.
- Restrict the construction footprint to a bare minimum.
- Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.
- Carefully monitor the local avifauna pre- and post-construction for a one year (12 month) period with monitoring scheduled in each of the four seasons as per as per Birdlife SA/Birds and Wind Energy Specialist Group requirements. Implement appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of the priority species listed in the Avifaunal Impact Assessment, or when collision or electrocution mortalities are recorded.
- Do not place turbines in the area indicated as having a High Bat Sensitivity (Figure 4.8). Give special attention to areas of Moderate Bat Sensitivity and prioritise these in post construction monitoring and implementation of mitigation measures;
- Consider implementing an ultrasonic deterrent device to repel bats from wind turbines should any turbines be placed in moderate sensitivity areas. If this measure proves
effective it may be implemented in place of curtailment upon agreement with a bat specialist, based on long term monitoring.

- Avoid homesteads and interact with land owners with regards to the final turbine positioning.
- Use LED lighting, where lighting is required.
- Keep lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3 of the Visual Impact Assessment).
- No branding on the turbines.
- No lights on the blade tips (within safety limits).
- Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.
- Compile a storm water management plan and maintain storm water run-off infrastructure on site.
- Direct the storm water management plan to addressing runoff discharge into watercourses flowing across the site.
- Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
- Minimise the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulted and bird friendly when configured.
- Bury transmission lines connecting each turbine to the installation to avoid avian collision with overhead lines.
- Adopt an exclusion zone of at least 1 km from any identified Verreaux’s eagle nests.
- Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact.
- Place wind turbines away from identified drainage channels.
- Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
- Maintain stream flow at all crossings over drainage channels or stream beds.
- Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
- Maintain a buffer of at least 30 m (measured from top of bank) adjacent to the identified ephemeral streams and at least 500 m from the springs.
- Consider ‘Orange Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.32. The buffer is approximately 700 m diameter.
- Consider ‘SMS Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.33. The buffer is approximately east/west and 1.9 km north/south (approximately 450 m from all recorded heritage sources).
- Consider ‘Gobees se Pan’ with its immediate surroundings a no-go area and a buffer as shown in (Figure 4.34). The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage sources).
• Consider ‘Springbokvlei’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.35. The buffer is approximately 900 m east/west and 1 000 m north/south (approximately 200 m from all recorded heritage sources).

• The potential graves and grave ARB2012/007 should be protected and conserved. SAHRA recommends that during the construction phase a temporary fence be built around them. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.

• Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context, where fencing is required.

• Maintain good sightlines on road junctions;

• Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

• Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200 m away from any house.

**Proposed solar energy facility**

• No structures to be occupied or frequented by people shall be built within delineated servitude areas.

• Avoid drainage lines and maintain a buffer of at least 30 m from drainage lines.

• Post-construction Monitoring of the local avifauna for a one year (12 month) period in accordance with Birdlife South Africa’s guidelines for solar energy facilities.

• Use LED lighting, where lighting is required.

• Keep lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3 of the Visual Impact Assessment).

• Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.

• Compile a storm water management plan and maintain storm water run-off infrastructure on site.

• Direct the storm water management plan to addressing runoff discharge into watercourses flowing across the site.

• Restrict the construction footprint to a bare minimum.

• Minimise the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulted and bird friendly when configured.

• Adopt an exclusion zone of at least 1 km from any identified Verreaux’s eagle nests.

• Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact.

• Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.

• Maintain stream flow at all crossings over drainage channels or stream beds.

• Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
• Maintain a buffer of at least 30 m (measured from top of bank) adjacent to the identified ephemeral streams and at least 500 m from the springs.
• Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context, where fencing is required.
• Maintain good sightlines on road junctions;
• Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

**Proposed wind energy facility substation and grid connection**

• No structures to be occupied or frequented by people shall be built within delineated servitude areas.
• Where possible, restrict construction activities to designated turbine sites and lay-down areas.
• Avoid Platbakkies Succulent Shrubland gravel patches.
• Restrict the construction footprint to a bare minimum.
• Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
• Minimise the length of all new power lines installed, ensure that all lines have flight diverters, are adequately consulted and bird friendly when configured.
• Bury transmission lines connecting each turbine to the installation to avoid avian collision posed by overhead lines.
• Adopt an exclusion zone of at least 1 km from any identified Verreaux’s eagle nests.
• Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact
• Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
• Maintain stream flow at all crossings over drainage channels or stream beds.
• Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
• Maintain a buffer of at least 30 m (measured from top of bank) adjacent to the identified ephemeral streams and at least 500m from the springs.
• Consider ‘Orange Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.32. The buffer is approximately 700 m diameter.
• Consider ‘SMS Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.33. The buffer is approximately east/west and 1.9 km north/south (approximately 450 m from all recorded heritage sources).
• Consider ‘Gobees se Pan’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.34. The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage sources).
Consider ‘Springbokvlei’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.35. The buffer is approximately 9 00 m east/west and 1 000 m north/south (approximately 200 m from all recorded heritage sources).

The potential graves and grave ARB2012/007 should be protected and conserved. SAHRA recommends that during the construction phase a temporary fence be built around them. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.

Minimise clearing activities (panel/turbine and road footprint).

Maintain good sightlines on road junctions;

Implement traffic control measures where necessary;

Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200 m away from any house

Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.

Carefully monitor the local avifauna pre- and post-construction for a one year (12 month) period with monitoring scheduled in each of the four seasons as per as per Birdlife SA/Birds and Wind Energy Specialist Group requirements. Implement appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of the priority species listed in the Avifaunal Impact Assessment, or when collision or electrocution mortalities are recorded.

Use LED lighting, where lighting is required.

Keep lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3 of the Visual Impact Assessment).

Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.

Proposed solar energy facility substation and grid connection

No structures to be occupied or frequented by people shall be built within delineated servitude areas.

Restrict the construction footprint to a bare minimum.

Minimise clearing activities (panel and road footprint).

Minimising the length of all new power lines installed, ensure that all lines have flight diverters, are adequately consulted and bird friendly when configured.

Adopt an exclusion zone of at least 1 km from any identified Verreaux’s eagle nests.

Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact

Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.

Maintain stream flow at all crossings over drainage channels or stream beds.
• Coincide/harmonise road infrastructure and power transmission lines to minimize the impact.
• Maintain a buffer of at least 30 m (measured from top of bank) adjacent to the identified ephemeral streams and at least 500 m from the springs.
• Maintain good sightlines on road junctions.
• Implement traffic control measures where necessary.
• Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.
• Post-construction Monitoring of the local avifauna for a one year (12 month) period in accordance with Birdlife South Africa’s guidelines for solar energy facilities.
• Use LED directional lighting without overhead lighting, where lighting is required.
• Maintain lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3 of the Visual Impact Assessment).
• Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.
Figure 2.1 Map indicating environmental sensitivity areas, buffers for the proposed site.
Figure 2.2 Map indicating environmental sensitivity areas, buffers and the proposed layout.
3 COMPLIANCE MONITORING

Prior to the commencement of construction and operation of the project a suitably qualified and experienced Environmental Control Officer (ECO) shall be appointed by the proponent to ensure that the mitigation rehabilitation measures and recommendations referred to in the EA are implemented and to ensure compliance with the provisions of the LEMP, thereby ensuring that identified environmental considerations are efficiently and adequately taken into account during all stages of development.

3.1 Roles and responsibilities

**Client**
Mainstream shall:
- Assume overall responsibility for the administration and implementation of the LEMP through an identified Project Manager or Engineer;
- Appoint or engage a suitably qualified Project Manager or Engineer; and
- Appoint or engage a suitably qualified independent ECO to monitor compliance with the LEMP and undertake monthly and close out audits of compliance with the requirements of the LEMP and provide a copy of the audit reports to DEA and the Contractor.

**Project Manager**
The Project Manager or Engineer shall:
- Have overall responsibility for the environment;
- Have the authority to stop works and issue fines, as necessary;
- Receive reports from the ECO and shall report to Mainstream; and
- Support the ECO in his/her roles and responsibilities.

**ECO**
The role of the ECO will be to oversee and monitor compliance with and implementation of the construction phase EMP and Operational Phase EMP, which includes compliance with the relevant conditions contained in the EA. This includes the following responsibilities:

i) Liaison with the Client, Project Manager or Engineer and DEA;

ii) Monitoring of all of the Contractor’s activities for compliance with the various environmental requirements contained in the construction Specification;

iii) Monitoring of compliance with the EA related to the construction phase as issued by DEA as well as other relevant environmental legislation;

iv) Reviewing of the Contractor’s environmental Method Statements;

v) Ensuring that the requisite remedial action is implemented in the event of non-compliance;

vi) Ensuring the proactive and effective implementation and management of environmental protection measures;

vii) Ensuring that a register of public complaints is maintained by the Contractor and that any and all public comments or issues are appropriately reported and addressed;

viii) Routine recording and reporting of environmental activities on a weekly and monthly basis;

ix) Recording and reporting of environmental incidents.
The duties of the ECO during operation phase will include:

i) Liaison with the Client and DEA;

ii) Monitoring of the operation of the project for compliance with the various environmental requirements contained in the Framework Operational EMP;

iii) Ensuring the proactive and effective implementation and management of environmental protection measures; and

iv) Monitoring of compliance with the EA related to the operational phase as issued by DEA as well as other relevant environmental legislation.
4 CONSTRUCTION PHASE EMP

The Construction EMP aims to address mitigation measures pertaining to the construction phase as identified during the course of the EIA. This section includes the General Specifications whilst the Project Specification Data, addressing general construction issues and issues that are not addressed by the General Specifications, respectively. It should be noted that the Draft Specification Data should be revised as required post authorisation to ensure that all relevant conditions of the EA have been addressed.

The complete General Specifications have been included in Appendix B and include the following sections:

- Scope
- Normative References
  - Supporting Specifications
- Definitions
- Requirements
  - Material
  - Material handling, use and storage
  - Hazardous substances
  - Shutter oil and curing compound
  - Bitumen
  - Plant
  - Ablution facilities
  - Solid waste management
  - Contaminated water
  - Site structures
  - Noise control
  - Lights
  - Fuel (petrol and diesel) and oil
  - Workshop, equipment maintenance and storage
  - Dust
  - Methods and procedures
  - Environmental awareness training
  - Construction personnel information posters
  - Site clearance
  - Site division
  - Site demarcation
  - “No go” areas
  - Protection of natural features
  - Protection of flora and fauna
  - Protection of archaeological and paleontological remains
  - Access routes/ haul roads
  - Cement and concrete batching
  - Earthworks
  - Pumping
  - Bitumen
  - Fire control
  - Emergency procedures
  - Community relations
  - Erosion and sedimentation control
  - Aesthetics
  - Recreation
  - Access to site
  - Crane operations
  - Trenching
  - Demolition
  - Drilling and jack hammering
  - Stockpiling
  - Site closure and rehabilitation
  - Temporary re-vegetation of the areas disturbed by construction
  - Temporary site closure
- Compliance with requirements and penalties
  - Compliance
  - Penalties
  - Removal from site and suspension of Works
- Measurement and Payment
  - Basic principles
    - General
    - All requirements of the environmental management specification
    - Work “required by the Specification Data”
  - Billed items
    - Method Statements: Additional work
    - All requirements of the environmental management specification

The following section provides the Draft Specification Data which, along with the General Specifications, will be included in all contract documentation associated with the proposed projects and will accordingly be binding on the Contractor.
4.1 Project Specifications

SDEMA ENVIRONMENTAL MANAGEMENT (SPEC EMA)

SCOPE: The general principles contained within this Specification Data: Environmental Management (SDEMA) shall apply to all construction related activities. All construction activities shall observe any relevant environmental legislation and in so doing shall be undertaken in such a manner as to minimise impacts on the natural and social environment.

SDEMA2 INTERPRETATIONS

SDEMA2.1 Application

This Specification contains clauses specifically applicable and related to the environmental requirements for the proposed Wind and Solar (Photovoltaic) Energy Facilities on Kangnas Farm near Springbok in the Northern Cape.

Where any discrepancy or difference occurs between this SDEMA and the Specification: Environmental Management (Comprehensive), the provision of this Specification shall prevail.

Definitions (Subclause 3)

For the purposes of this Specification the following definitions shall be added:

**Working area:** The land and any other place on, under, over, in or through which the Works are to be executed or carried out, and any other land or place made available by the Employer in connection with the Works. The Working Area shall include the site office, construction camp, stockpiles, batching areas, the construction area, all access routes and any additional areas to which the Engineer permits access. The construction footprint must be kept to a minimum.

SDEMA3 MATERIALS

SDEM3.1 Materials handling, use and storage (Subclause 4.1.1)

The Engineer shall be advised of the areas that the Contractor intends to use for the stockpiling of both natural and manufactured materials. No stockpiling shall occur outside of the working area (as designated by the engineer) and without the Engineer’s prior approval of the proposed stockpiling areas. Imported material shall be free of litter, contaminants or exotic plant seed. The Contractor shall ensure that material is not stockpiled along the border of any water body (permanent or seasonal).

Location and treatment of material stockpiles shall take consideration of prevailing wind directions and dwellings. Stockpiles shall be stored under cover so as to prevent erosion and run off during rainy periods. No rubble, earth or other material shall be dumped within the Eskom servitude restriction area.
Topsoil (100 -200 mm) from construction areas where vegetation clearing is required shall be removed and stockpiled for rehabilitation purposes. This shall be spread over the top of the turbine foundation after the turbine has been erected and any other disturbed areas which are to be rehabilitated and seeded with indigenous species. Ground shall be returned as far as possible to original levels/gradients and any excess material shall not be left in piles, but shall be removed off-site.

Dust suppression measures shall be used particularly during dry periods of weather during the summer months.

All materials on the construction sites should be properly stored and contained. Storage of materials and builders’ rubble shall be screened from public view.

Cut material shall be used, where possible in construction or on site (e.g. in grading gravel roads), or removed from site.

**SDEM3.2 Hazardous substances (Subclause 4.1.2)**

Procedures detailed in the Materials Safety Data Sheets (MSDS) shall be followed in the event of an emergency situation.

Potentially hazardous substances shall be stored, handled and disposed of as prescribed by the Engineer.

An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage shall be compiled and implemented. This shall include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.

**SDEM3.3 Shutter oil and curing compound (Subclause 4.1.2.1)**

Shutter oil and curing compound shall be stored and dispensed within a bunded area, and not located closer than 32 m from the top of the river banks/water courses/drainage lines.

**SDEMA4 REQUIREMENTS**

**SDEMA4.1 Ablution facilities (Subclause 4.2.1)**

A sufficient number of chemical toilets shall be provided by the Contractor in the construction camp area and at appropriate locations approved by the Engineer. Temporary/ portable toilets shall not be located within 100 m from the top of the river banks/water courses/drainage lines. Any septic tanks constructed for the project should be located at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/wellpoints. The ratio of ablution facilities for workers should not be less than that required by the Construction Regulations of 2003 of the Occupational Health and Safety Act. All
temporary portable toilets shall be secured to the ground to prevent them from toppling due to wind or any other cause.

**SDEMA4.2 Solid Waste Management (Subclause 4.2.2)**

Hazardous wastes (if any) shall only be sent to landfill sites registered for hazardous wastes. Burying or burning of solid waste shall be prohibited on site. A waste management system shall be established to ensure regular waste removal and disposal at a licensed landfill.

**SDEMA4.3 Contaminated Water (Subclause 4.2.3)**

The Contractor shall prevent the discharge of any pollutants, such as soaps, detergents, cements, concrete, lime, chemicals, hydrocarbons, glues, solvents, paints and wastewater into the surrounding terrestrial and aquatic environment. Should any discharge be necessary it will require the engineer’s approval prior to discharging any contaminated water into a lined sump, which will allow sediment particles to settle. Surface contaminants shall be separated by skimming off the surface. Dried particulates collected from the sump and skimmed pollutants such as oils and petrochemicals shall be collected and disposed of at a registered landfill site. The remaining water shall then be drained into an unlined drainage pond where the water can filter into the ground. The pond shall be located in an area approved by the ECO and Engineer. To excavate the pond the top 300 mm of soil shall be removed and stored separately. Once construction is complete the pond shall be backfilled and the top material replaced to cover the area for rehabilitation.

**SDEMA4.4 Site Structures (Subclause 4.2.4)**

No site structures shall be located within 32 m from the top of the river banks/water courses/drainage lines. Construction yards should be restricted in extent as far as possible and should be screened by visually impermeable material.

Ensure the camp is neat and tidy at all times. Site offices, if required, should be limited to single storey and should be sited carefully using temporary screen fencing to screen from the wider landscape.

Where site offices are required, these shall be limited to single storey and temporary screen fencing used to screen offices from the wider landscape.

**SDEMA4.5 Noise control (Subclause 4.2.5)**

Construction traffic shall be routed as far as practically possible from potentially sensitive receptors.

A good working relationship between the developer and all potentially sensitive receptors shall be ensured by establishing communication channels to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include:
Proposed working times;
how long the activity is anticipated to take place;
what is being done, or why the activity is taking place;
contact details of a responsible person where any complaints can be lodged should there be an issue of concern.

When working within 500 m of a potential sensitive receptor, the number of simultaneous activities (e.g. construction of access roads, trenches, etc) shall be limited to the minimum as far as possible. Furthermore, working time shall be co-ordinated with periods when the receptors are not at home, where possible. An example would be to work within the 08:00 to 14:00 time-slot to minimize the significance of the impact because potential receptors are most likely at school or at work, minimizing the probability of an impact happening.

Use of the smallest/quietest equipment for the particular purpose shall be considered.

Ensure that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
- Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors;
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
- Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200m away from any house;
- Ensure acceptable noise levels (SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
- Ensuring compliance with the Noise Control Regulations;
- Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them (within 500 m). Information that should be provided to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  - Proposed working times;
  - how long the activity is anticipated to take place;
  - what is being done, or why the activity is taking place;
  - contact details of a responsible person where any complaints can be lodged should there be an issue of concern.

- If any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured.
- The construction crew must abide by the local by-laws regarding noise; and
- Where possible construction work should be undertaken during normal working hours (06H00 – 22H00; adopted from SANS 10103:2008.), from Monday to Saturday; If agreements can be reached (in writing) with the all the surrounding (within a 1 km) potentially sensitive receptors, these working hours can be extended.

SDEMA4.6  Fuel (Petrol and Diesel) and oil (Subclause 4.2.7)
Fuels in the form of diesel and petrol shall not be stored within 32 m from the top of any river banks/water courses/drainage lines.

**SDEMA4.7 Equipment Maintenance and Storage (Subclause 4.2.8)**

Wastewater generated from construction or the washing of vehicles shall not be permitted to enter water courses, either directly or via a stormwater system.

**SDEMA4.8 Stormwater Erosion Control (Add Section 4.2.10)**

A stormwater management plan shall be compiled and implemented. The plan shall ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan shall include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures shall promote the dissipation of storm water run-off. Establish the stormwater system as a priority, so that all runoff is led to the designated drainage from the site.

The Contractor shall take reasonable measures to control the erosive effects of stormwater runoff. Any runnels or erosion channels developed during the construction period or during the maintenance period shall be backfilled and compacted to limit the impacts of sediment deposition into the surrounding aquatic environment.

Run-off over any exposed areas should be mitigated to reduce the rate and volume of run-off and prevent erosion occurring on the site and within the freshwater features and drainage lines. Contaminated runoff from the construction site(s) should be prevented from entering any rivers/streams.

**SDEMA4.9 Method Statements (Subclause 4.3.1)**

The following additional method statements shall be provided by the Contractor within 14 days of the receipt of the Letter of Acceptance and prior to the activity covered by the Method Statement being undertaken:

- Logistics for the environmental awareness course for all the Contractors employees.
- Emergency procedures for fire, accidental leaks and spillages of hazardous materials including:
  - who shall be notified in the event of an emergency, including contact numbers for the relevant local authority,
  - where and how any hazardous spills will be disposed of,
  - the size of spillage which the emergency procedures could contain,
  - location of all emergency equipment and an indication of how regularly the emergency equipment will be checked to ensure that it is working properly.
- Location and layout of the construction camp in the form of a plan showing offices, stores for fuels, hazardous substances, vehicle parking, access point, equipment cleaning areas and staff toilet placement.
• Location, layout and preparation of cement/concrete batching facilities including the methods employed for the mixing of concrete and the management of runoff water for such areas. An indication shall be given of how concrete spoil will be minimised and cleared.
• Method of undertaking earthworks, including spoil management, erosion, dust and noise controls.
• Method of undertaking blasting.
• Management measures to be undertaken in instances where traffic flows may be interrupted.
• Extent of areas to be cleared, the method of clearing and the preparation for this clearing so as to ensure minimisation of exposed areas.
• Measures to be put in place during temporary closure periods, e.g. December holidays.
• Measures to be put in place to limit sediment deposition into the surrounding terrestrial and aquatic environment.

SDEMA4.10 Site Clearance (Subclause 4.3.4)

The Contractor shall strip the top material and root material of cleared vegetation (top 100-200 mm layer), for subsequent use during rehabilitation and re-vegetation. Top material shall be stripped from all areas of the Working Area where topsoil will be impacted by construction activities, including areas for temporary facilities, as directed by the Engineer. The Contractor shall not make use of herbicides or other chemical methods to clear the proposed site especially near the identified water courses. In order to limit erosion the Contractor shall retain original groundcover, as far as practically possible, adjacent to the aquatic environment and to the trenching line.

SDEMA4.11 No go areas (Subclause 4.3.7)

All works to be undertaken shall be within the boundary of the site. A “no go” area shall extend on either side of the working area i.e. all areas outside of the defined working area and designated access roads. The working area shall be demarcated in an appropriate manner determined by the Engineer. The “no-go” area shall be demarcated by a semi-permanent fence to prevent workers from entering the undisturbed areas.

Based on the ecological importance, all construction activities shall remain outside of all aquatic environments, with special efforts implemented to maintain a 32 m buffer between construction related activities and any rivers/water courses/drainage lines. These no go areas shall stay in place until construction of the infrastructure within the buffer area must commence.

The recommended ecological sensitivity and buffer areas indicated in Figure 1.1 & 1.2 shall be demarcated as “no go” areas and construction activities shall remain outside these designated areas. These include the following no - go heritage areas: (i) “Orange Hill” with a buffer of 700 m,(ii) “SMS Hill” with approximately a 450 m buffer from all recorded heritage sources, (iii) “Gobeesvlei and its immediate surroundings with a buffer of 350 m and (iv) Springbokvlei with a buffer of 200 m. Old buildings shall be fenced off during construction to avoid vandalism of the
buildings, kraal complexes must be avoided and access roads re-routed to avoid damage to the buildings.

No mechanical equipment, including mechanical excavators or high lifting machinery, shall be used in the vicinity of Eskom’s apparatus and/or services, without prior written permission having been granted by Eskom. If such permission is granted the Contractor must give at least seven working days’ notice prior to the commencement of work. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued by the relevant Eskom Manager Note: Where and electrical outage is required, at least fourteen work days are required to arrange it.

No equipment associated with earthworks shall be allowed outside of the site and defined access routes, or within “no go” areas, unless expressly permitted by the Engineer.

**SDEMA4.12 Protection of flora and fauna (Subclause 4.3.9)**

No flora shall be removed or damaged, outside of the designated working area, without specialist botanical input. The collection of firewood by construction workers should be prohibited.

Any snakes found on site shall be removed from site and released into an area away from the site, without harm.

The contractor shall ensure that the time a trench is left exposed is kept to a minimum, and that open trenches are inspected on a daily basis for animals which may have fallen or become trapped. Any animals found trapped in any trenches shall be freed without harm.

A vegetation rehabilitation plan shall be compiled and implemented with the aid of a rehabilitation specialist. The specialist is to recommend species to be used in rehabilitation as well as any special measures for rehabilitation such as shade-netting and alien vegetation removal. Restoration shall be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats. Where indigenous vegetation will be affected, a plant rescue and protection plan shall be compiled and implemented which allows for the maximum transplant of conservation important species from areas to be transformed. This plan will be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase.

Any of the cleared areas onsite that are not hardened surfaces shall be rehabilitated after construction is completed by revegetating the areas disturbed by the construction activities with suitable indigenous plants. Any disturbed areas shall be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.

An alien invasive management plan shall be compiled and implemented. The plan shall include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.
An open space management plan shall be compiled and implemented.

Disturbance associated with the operation of the facility shall be minimised, by scheduling maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times—such areas will be identified during the pre-construction and operational monitoring. An avifauna and bat monitoring programme shall be compiled and implemented to document the effect of the construction period on avifauna and bats. This will be compiled by a qualified specialist.

SDEMA4.13 Protection of archaeological and palaeontological remains (Subclause 4.3.10)

The ECO shall be alert to the two known fossil sites within the site as well as possibility of fossil remains being found either on the surface or exposed by fresh excavations during construction. Should substantial fossil remains be exposed during construction, these should be safeguarded by the ECO, preferably in situ, and the South African Heritage Resources Association (SAHRA) should be notified by the ECO so that appropriate mitigation can be undertaken.

In the case of unexpected exposure of below-ground archaeological or fossil material during excavations, SAHRA must be consulted immediately to ensure timeous implementation of appropriate mitigation measures. In the event of accidental uncovering of graves, work must stop immediately and the SAHRA Burials Unit must be notified. An archaeologist or palaeontologist shall be involved to assist with the investigation and procedures to address the situation.

SDEMA4.14 Access routes/ haul roads (Subclause 4.3.11)

Access roads shall be kept tidy.

Eskom’s rights and services shall be acknowledged and respected at all times. Unobstructed access shall be granted to Eskom to access their servitudes.

The contractor shall ensure that all regulations relating to traffic management are observed and local traffic officials are informed of the proposed construction activities. As far as possible, attempts shall be made to ensure that high construction related road usage coincides with low traffic flow periods.

Turbine components shall be transported overnight as far as possible.

Signage and safety measures during the construction of the access roads shall comply with the guidelines as set out in the latest issue of the SADC Road Traffic Signs Manual. Standard “construction ahead” warning signs should be placed on all relevant roads in the area. Ensure access roads are kept clean and storage of materials is screened.
A traffic management plan for the site access roads shall be compiled and implemented to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan shall include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.

A transportation plan shall be compiled and implemented for the transport of turbine components, main assembly cranes and other large pieces of equipment.

**SDEMA4.15  Cement and concrete batching (Subclause 4.3.12)**

No cement and / or concrete batching shall occur within the “no-go” areas or within 32 m from the top of any river banks/water courses/drainage lines. Reasonable measures shall be implemented to limit contaminated surface run-off into the surrounding vegetation.

**SDEMA4.16  Earthworks (Subclause 4.3.13)**

Any blasting is to be executed by a suitably qualified person. Controlled blasting techniques shall be employed to minimise dust and fly rock during blasting.

Blasting should not take place during the breeding seasons (mostly spring) of the resident avifaunal community (as determined by avifaunal monitoring) and in particular for priority bird species.

The use of explosives of any type within 500 m of Eskom’s services shall only occur with Eskom’s previous written permission. If such permission is granted the Contractor must give at least fourteen working days prior notice of the commencement of blasting. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued in terms of the blasting process. It is advisable to make application separately in this regard.

Prior to blasting the Contractor shall notify the relevant occupants/ owners of surrounding land and address any concerns. Buildings within the potential damaging zone of the blast shall be surveyed preferably with the owner present, and any cracks or latent defects pointed out and recorded either using photographs or video. All Local Authority regulations are to be adhered to and all service infrastructures are to be located prior to commencement of blasting activities.

Blasting or drilling shall take place during normal working hours. The Contractor shall notify emergency services, in writing, a minimum of 24 hours prior to any blasting activities commencing on site. Adequate warning must be issued to all personnel on site prior to blasting activities taking place. All legally required signals are to be clearly indicated. The Engineer shall be issued daily updates of the days intended blasting activities.

The Contractor shall prevent damage to special features and the general environment, which includes the removal of flyrock. Damage caused by blasting / drilling shall be repaired to the satisfaction of the Engineer.
Minimise areas disturbed at any one time and protect exposed soil against wind erosion, e.g. by dampening with water or covering with hessian.

Changes in ground level may not infringe statutory ground to conductor clearances or statutory visibility clearances with respect to existing powerlines onsite. Clearances between Eskom’s live electrical equipment and the proposed construction work shall be observed as stipulated in terms of Regulation 15 of the Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) at all times.

SDEMA4.17 Community relations (Subclause 4.3.18)

Maintain a register that shall contain details of the measures taken to resolve complaints and the details of the communication of these measures to the person who raised the complaint.

SDEM4.18 Erosion and sedimentation control (Subclause 4.3.19)

Where necessary, sedimentation barriers shall be laid between the Work Area and the “no-go” areas to limit sediment deposition. The sedimentation barrier shall consist of a geotextile fabric stretched across and attached to supporting posts and stabilised with sandbags. The barrier shall be inspected daily and any damage shall be repaired immediately. Sediment deposits shall be removed once they reach half the height of the barrier.

An erosion management plan for monitoring and rehabilitating erosion events associated with the facility shall be compiled and implemented. Appropriate erosion mitigation shall form part of this plan to prevent and reduce the risk of any potential erosion. Construction activities should as far as possible be limited to the identified sites for the proposed wind and solar energy facilities and the identified access routes.

Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited.

Clearing of debris, sediment and hard rubble associated with the construction activities should be undertaken post construction to ensure that flow within the drainage channels are not impeded or diverted. Rehabilitate disturbed stream bed and banks and revegetation with suitable indigenous vegetation. A Stormwater Management Plan must be compiled to manage the run off from the solar energy facility. Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the energy facilities site. Should any erosion features develop, they should be stabilised as soon as possible.

SDEMA4.19 Site closure and rehabilitation (Subclause 4.3.28)

All construction debris found within the disturbed areas shall be removed and disposed of at a registered landfill site.
A vegetation rehabilitation plan shall be compiled with the aid of a rehabilitation specialist, for inclusion in the Construction EMP. The plan shall recommend species to be used in rehabilitation as well as any special measures for rehabilitation such as shade-netting and alien vegetation removal. The construction footprint associated with the activity shall be re-vegetated with indigenous vegetation, as directed by the rehabilitation plan. Disturbed areas shall be rehabilitated as soon as possible after construction.

Vegetated areas should preferably be watered if planted in the dry season to aid in establishment of plants; alternately rehabilitation should take place in the wet season; or as agreed with the rehabilitation specialist in the rehabilitation plan.

SDEMA4.20 Labour requirements (Add Subclause 4.3.32)

Recruitment shall be based on sound labour practices and with gender equality in mind. Obtain a list of locally available labour and skills. Preference shall be given to local communities.

Appropriate training shall be provided to enable individuals to apply their skills to other construction and development projects in the region once the construction phase is completed.

SDEMA5 COMPLIANCE WITH REQUIREMENTS AND PENALTIES

SDEMA5.1 Penalties (Subclause 5.2)

Stop order works will be issued for the transgressions listed below. Stop order works may be issued per incident at the discretion of the Engineer.

a) Any employees, vehicles, plant, or thing related to the Contractor’s operations operating within the designated boundaries of a “no-go” area.
b) Any vehicle driving in excess of designated speed limits.
c) Persistent and unrepaired oil leaks from machinery.
d) Persistent failure to monitor and empty drip trays timeously.
e) The use of inappropriate methods for refuelling.
f) Litter on site associated with construction activities.
g) Deliberate lighting of illegal fires on site.
h) Employees not making use of the site ablution facilities.
i) Failure to implement specified noise controls 
j) Failure to empty waste bins on a regular basis.
k) Inadequate dust control.
l) A spillage, pollution, fire or any damage to any watercourse/ wetland resulting from negligence on the part of the Contractor.
m) Any act, that in the reasonable opinion of the Engineer, constiutes a deliberate contravention of the requirements of these Specifications

The Engineer will determine what constitutes a transgression in terms of this clause, subject to the provisions of Clause 57(1) of the General Conditions of Contract. In the event that transgressions continue the Contractor’s attention is drawn to the provisions of Sub-clause
55(1) of the General Conditions of Contract 2004 under which the Engineer may cancel the Contract.

4.2 Project Specifications from EIA

The project specifications as have arisen from the EIA is presented here, per application. These would need to be incorporated into the specifications above on a project by project basis.

**Proposed wind energy facility**
- Wherever possible, restrict construction activities to designated turbine sites and lay-down areas.
- Micro-site turbines with the aid of a botanist, to avoid sensitive sites.
- Undertake affordable long term monitoring of bats and the potential impacts of turbines on them to effectively fine tune mitigation. Pre-construction monitoring is optional for this site.
- Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.
- Source supplies of services, labour and products from the local and regional economies, where possible.
- Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.
- Rehabilitate previously modified areas continually and avoid invasive alien plant growth.
- Stabilise any erosion areas effectively as they develop.
- Where possible, restrict construction activities to designated turbine sites and lay-down areas.
- Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
- Reduce and maintain minimum noise when blasting for wind turbines foundations. No blasting during breeding seasons (mostly spring: avifaunal monitoring programme to recommend) of resident avifaunal community and priority species. Synchronise with neighbouring blasts where possible.
- Re-schedule construction or maintenance activities for turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
- Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
- Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from
any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.

- Notify the responsible Environmental Control Officer “ECO” of the known fossil sites and discovery of fossil remains on site during construction.
- Safeguard (preferably in situ) all fossil remains (e.g. vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) discovered during construction, ECO to alert the South African Heritage Resource Agency (SAHRA) for further action by a permitted professional palaeontologist (e.g. recording, sampling or collection). Curate all fossil material in an approved repository (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards developed by SAHRA.
- A temporary fence to be built around potential graves and grave ARB2012/007. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.
- Implement dust control measures.
- Strictly control all litter.
- Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping/rehabilitation.
- Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
- Rehabilitate the foundation area upon completion of construction phase.
- Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour.
- Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner.
- Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
- Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.
- Minimise clearing activities (panel/turbine and road footprint).
- Withhold activities in the event of heavy rains to reduce the risk of erosion.
- Undertake storm water control and wind screening where earth works are required, prevent soil loss.
- Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.
- Implement traffic control measures where necessary.
- Transport components overnight as far as possible.
- Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see FEIR figure 4.21 for sensitive receptors);
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
• Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
• Ensuring compliance with the Noise Control Regulations;
• Ensure a good working relationship between the developer and all potentially sensitive receptors. Establish communication channels and notify the sensitive receptor if work is to take place close to them (within 500 m). Provide information to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  o Proposed working times;
  o Timespan that the activity is anticipated to last
  o The specific activity and the need there of;
  o Contact details for lodging complaints and other issues of concern
• Ensure that equipment is well-maintained and fitted with correct and appropriate noise abatement measures.
• Conduct noise monitoring for complaints received and provide feedback on measured levels.
• Ensure that the construction crew abides to the local by-laws regarding noise; and if possible undertake construction work during normal working hours (06h00 – 22h00; adopted from SANS 10103:2008), from Monday to Saturday; with extension upon agreement (in writing) with all surrounding (within a 1 km) potentially sensitive receptors.
• Comply with the various pieces of legislation controlling the use of hazardous substances at a construction site.

Proposed solar energy facility
• Where possible, collect seeds from Parkinsonia africana (wild green hair trees) to be cultivated offsite. The cultivated shrubs could be planted on the site and effectively used for visual screening of the PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.
• Source local labour, businesses and resources for supply, where possible.
• Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.
• Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.
• Stabilise any erosion areas effectively as they develop.
• Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
• Reduce and maintain minimum noise if blasting is required. No blasting during breeding seasons (mostly spring: avifaunal monitoring programme to recommend) of resident avifaunal community and priority species. Synchronise with neighbouring blasts where possible.
• Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Rehabilitate previously modified and disturbed areas to avoid erosion or invasive alien plant growth.
- Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
- Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
- Implement dust control measures.
- Strictly control all litter.
- Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
- Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
- Rehabilitate the foundation area upon completion of construction phase.
- Source supplies of services, labour and products from the local and regional economies during construction stage.
- Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour.
- Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner.
- Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
- Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.
- Minimise clearing activities (panel/turbine and road footprint).
- Withhold activities in the event of heavy rains to reduce the risk of erosion.
- Undertake storm water control and wind screening where earth works are required, prevent soil loss.
- Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.
- Transport components overnight as far as possible.
- Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see FEIR figure 4.21 for sensitive receptors).
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
- Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors.
- Ensuring compliance with the Noise Control Regulations.
Proposed wind energy facility substation and grid connection

- Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
- Confine construction activities to identified site and access routes.
- Continuously rehabilitate previously modified areas.
- Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.
- Source supplies of services, labour and products from the local and regional economies, where possible.
- Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Compile a storm water management plan and maintain storm water run-off infrastructure on site.
- Stabilise any erosion areas effectively as they develop.
- Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
- Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
- Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablation facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
- Construct any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well-points.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
- Notify the responsible Environmental Control Officer “ECO” of the known fossil sites and discovery of fossil remains on site during construction.
- Safeguard (preferably in situ) all fossil remains (e.g. vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) discovered during construction, ECO to alert the South African Heritage Resource Agency (SAHRA) for further action by a permitted professional palaeontologist (e.g. recording, sampling or collection). Curate all fossil material in an approved repository (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards developed by SAHRA.
- A temporary fence to be built around potential graves and grave ARB2012/007. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.
• Implement dust control measures.
• Strictly control all litter.
• Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
• Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
• Rehabilitate the foundation area upon completion of construction phase.
• Constrain all signage (if any).
• Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour.
• Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner.
• Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
• Withhold activities in the event of heavy rains to reduce the risk of erosion.
• Undertake storm water control and wind screening where earthworks are required, prevent soil loss.
• Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.
• Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see FEIR figure 4.21 for sensitive receptors);
• Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
• Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors.
• Ensuring compliance with the Noise Control Regulations.
• Ensure a good working relationship between the developer and all potentially sensitive receptors. Establish communication channels and notify the sensitive receptor if work is to take place close to them (within 500 m). provide information to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  o Proposed working times;
  o Timespan that the activity is anticipated to last
  o The specific activity and the need there of;
  o Contact details for lodging complains and other issues of concern
• Ensure that equipment is well-maintained and fitted with correct and appropriate noise abatement measures.
• Conduct noise monitoring for complains received and provide feedback on measured levels.
• Ensure that the construction crew abides to the local by-laws regarding noise; and if possible undertake construction work during normal working hours (06h00 – 22h00; adopted from SANS 10103:2008), from Monday to Saturday; with extension upon agreement (in writing) with all surrounding (within a 1 km) potentially sensitive receptors.
• Comply with the various pieces of legislation controlling the use of hazardous substances at a construction site.

Proposed solar energy facility substation and grid connection

• Wear possible, collect seeds from Parkinsonia africana (wild green hair trees) and cultivate off site. The cultivated shrubs could be planted on the site and effectively used for visual screening of the solar PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.
• Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
• Confine construction activities to identified sites and access routes.
• Rehabilitate previously modified areas continually.
• Continuously monitor invasive alien plant growth to promptly detect re-establishment.
• Compile a storm water management plan and maintain storm water run-off infrastructure on site.
• Stabilise any erosion areas effectively as they develop.
• Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
• Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
• Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
• Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
• Construct any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well-points.
• Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
• Implement dust control measures.
• Strictly control all litter.
• Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
• Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
• Constrain all signage (if any).
• Source supplies of services, labour and products from the local and regional economies, where possible.
• Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour.
• Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner.
• Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.
• Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.
• Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
• Withhold activities in the event of heavy rains to reduce the risk of erosion.
• Undertake storm water control and wind screening where earth works are required, prevent soil loss.
• Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.
• Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see FEIR figure 4.21 for sensitive receptors);
• Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
• Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors.
• Ensuring compliance with the Noise Control Regulations.
5 OPERATIONAL FRAMEWORK EMP

The information is summarised in tabular format illustrating the activity, aspect, impact, mitigation measure, performance indicators, resources, schedule and verification. These criteria are listed and explained below:

The following components are identified/described:

- **Activity**: component/activity of the project for which the impact has been identified;
- **Aspect**: the aspect of the above activity which will be impacted;
- **Impact**: the environmental impact identified and to be mitigated;
- **Mitigation measure**: measures identified for implementation in terms of environmental management to reduce, rectify or contain the identified environmental impact – mitigation is divided into the following:
  - **Objective**: desired outcome of mitigation measure,
  - **Mechanism**: method of achieving the objective;
- **Performance indicators**: outcomes that will indicate achievement of objective/s;
- **Responsibility**: party or parties identified for implementation of mitigation measure/s;
- **Resources**: available resources to aid implementation of mitigation;
- **Schedule**: timeframe in which identified impact and mitigation measure is anticipated to occur; and
- **Verification**: party or parties identified as responsible for review and assessment of final outcome.
This section contains the Operational Framework EMP table which constitutes the Operational Framework EMP. It is important to note that this Framework EMP has been compiled prior to authorisation of the proposed project and will be updated to include the conditions of the EA that will be issued by DEA as part of the EA.

### Operational Framework Environmental Management Programme Table

<table>
<thead>
<tr>
<th>NO.</th>
<th>ACTIVITY</th>
<th>ASPECT</th>
<th>IMPACT</th>
<th>MITIGATION MEASURE: (objective and mechanism)</th>
<th>PERFORMANCE INDICATOR</th>
<th>RESPONSIBILITY</th>
<th>RESOURCES</th>
<th>SCHEDULE</th>
<th>VERIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All Activities (wind energy facility)</td>
<td>Environmental management documentation and procedures</td>
<td>No framework within which to locate the management of the operational phase. No procedures against which to assess environmental performance during the operational phase and thus no measure of compliance.</td>
<td><strong>Objective:</strong> To ensure that the operation of the WEF does not result in avoidable impacts on the environment, and that any impacts that do occur are anticipated and managed. <strong>Mechanism:</strong> 1) Appoint a suitably qualified ECO to monitor compliance (either independent or in-house). 2) Audit the compliance with the requirements of the environmental specification contained within the OEMP.</td>
<td>Environmental impacts effectively monitored and managed during the operational phase. Comprehensive record of compliance and remedial actions available to Mainstream and the authorities.</td>
<td>ECO</td>
<td>OEMP</td>
<td>Twice in the 1st three years and then once every five years</td>
<td>Mainstream DEA</td>
</tr>
<tr>
<td>2.</td>
<td>All Activities Protection of the surrounding environment (aquatic and terrestrial)</td>
<td>Effects that the operation and maintenance of the energy facilities would have on the surrounding environment (including local flora, fauna, bats, avifauna and watercourses around the</td>
<td><strong>Objective:</strong> To ensure that impacts on the surrounding biophysical environment are minimised during the operational phase. <strong>Mechanism:</strong> 1) During maintenance activities limit movement to disturbed areas. 2) Limit operational activities as far as</td>
<td>The surrounding environment including aquatic and terrestrial ecology is not impacted on.</td>
<td>ECO</td>
<td>Environmental Management Procedures OEMP</td>
<td>As maintenance is required on site.</td>
<td>Mainstream DEA</td>
<td></td>
</tr>
<tr>
<td>NO.</td>
<td>ACTIVITY</td>
<td>ASPECT</td>
<td>IMPACT</td>
<td>MITIGATION MEASURE: (objective and mechanism)</td>
<td>PERFORMANCE INDICATOR</td>
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</tbody>
</table>
| 4.  | All Activities | Environmental management of the operational phase | Positive impacts on socio-economic environment during operation | **Objective:** To ensure that the operation of the energy facility maximises positive impacts on the socio-economic environment.  
**Mechanism:**  
1) Train local people for operation and maintenance of facility.  
2) Employ local labour for | Consult annual skills and training records, employment records and proof of staff residency in the area prior to employment | ECO Mainstream | Environmental Management Procedures OEMP | During Operational Phase (full lifetime) when the need arises to employ people. | Mainstream DEA |

3) Any areas disturbed during maintenance should be rehabilitated.  
4) Ensure ongoing implementation of the storm water management plan to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.  
5) Ensure ongoing implementation of the alien invasive and vegetation rehabilitation management plans.
### Operational Framework Environmental Management Programme Table

<table>
<thead>
<tr>
<th>NO.</th>
<th>ACTIVITY</th>
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<td></td>
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<td>the operational phase, where possible, and particularly for day to day operations and maintenance.</td>
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</tr>
</tbody>
</table>
5.1 Project Specifications from EIA

The project specifications as have arisen from the EIA is presented here, per application. These would need to be incorporated into the specifications above on a project by project basis.

**Proposed wind energy facility**

- Minimize the disturbance associated with the operation of the facilities, schedule maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times. Keep disturbance from maintenance activities at a minimum where specific turbines fall within sensitive areas.
- Carry out post-construction monitoring of possible bat fatalities at least four seasons at the proposed wind energy facility, focus on turbines in the Moderate bat sensitivity areas and at the two small caves on site. Pre-construction monitoring is optional for this site.
- Share research from long term monitoring with academic institutions to aid in research of the potential impacts of wind energy facilities on bats.
- Where recommended by long-term bat monitoring, curtail\(^2\) selected turbines to lessen bat mortalities. Curtailment should be informed by long term bat monitoring.
- Establish an educational notice board as an ideal practical learning environment for local and district schools.
- Educate surrounding receptors on the sound generated by the wind energy facility; maintain essential public relations and community involvement throughout the lifespan of the proposed facility.
- Provide a contact number of the developer in the case of sudden and sharp increases in sound levels resulting from mechanical malfunctions or perforations or slits in the blades.
- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Consider marking the turbine blades to reduce collisions, if recommended by the avifaunal study.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
- Constrain all signage (if any).
- Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see FEIR figure 4.21 for sensitive receptors);
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
- Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
- Ensuring compliance with the Noise Control Regulations;
- Source local labour, businesses and resources for supply, where possible.

\(^2\) Curtailment is where the turbine cut-in speed is raised to a higher wind speed based on the principle that bats will be less active in strong winds due to the fact that their insect food cannot fly in strong wind speeds, and the small insectivorous bat species need to use more energy to fly in strong winds.
Proposed solar energy facility

- Establish an educational notice board as an ideal practical learning environment for local and district schools.
- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
- Constrain all signage (if any).
- Source local labour, businesses and resources for supply, where possible.

Proposed wind energy facility substation and grid connection

- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
- Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors.
- Ensure compliance with the Noise Control Regulations.
- Minimize the disturbance associated with the operation of the facilities, schedule maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times.
- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
- Source local labour, businesses and resources for supply, where possible.

Proposed solar energy facility substation and grid connection

- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
- Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors.
- Ensure compliance with the Noise Control Regulations.
- Minimize the disturbance associated with the operation of the facilities, schedule maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times.
- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
- Source local labour, businesses and resources for supply, where possible.
6 DECOMMISSIONING

6.1 Decommissioning of the proposed wind energy facility

The turbine infrastructure which would be utilised for the proposed project is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Generally a power purchase agreement (PPA) of 20 years is signed with the energy buyer. After the PPA comes to an end the PPA may be renegotiated at terms that are financially viable at that point in time. The PPA may be based on a shorter term agreement using the existing turbines (if the existing turbines are still suitable) or a longer term PPA may be negotiated based on repowering (refurbishment) of the proposed wind energy facility. It is most likely that refurbishment of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time. New turbine technology may also reduce potential environmental impacts.

Where no new PPA can be negotiated it is likely that the wind farm would be decommissioned according to requirements in the EMP and as required by any other legislation/regulations at that time.

The following decommissioning and/or repowering activities have been considered to form part of the project scope of the proposed wind energy facility:

6.1.1 Site preparation

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

6.1.2 Disassemble and replace existing turbines

A large crane would be brought on site. It would be used to disassemble the turbine and tower sections. These components would be reused, recycled or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades. The land-use would revert back agriculture/ grazing.

6.2 Decommissioning phase of the proposed solar energy facility

The PV site has a project lifespan of approximately 20 years, based on the photo sensitivity life cycle of the panels. The loss in efficiency occurs due to various climatic conditions that contribute to their affectivity. However, as all the infrastructure, such as roads, transmission, substations and foundations would already be established, and the energy source (solar) is a renewable one the proposed project would continue to be operated after 20 years. The solar panels would be upgraded to make use of the latest technology available. All redundant
equipment that would need to be replaced would be removed from site and would be sold off or recycled.

6.3 Way Forward

If the facilities are decommissioned then the sites would be fully rehabilitated in accordance with requirements in terms of relevant legislation such as the National Environmental Management Act. All roads would be left on site, as it would assist the farmer in accessing his land, unless the farmer requires otherwise.
7 CONCLUSION

In conclusion it should be noted that the LEMP should be regarded as a living document and changes should be made to the LEMP as required by project evolution, while retaining the underlying principles and objectives on which the document is based.

The compilation of the LEMP has incorporated impacts and mitigation measures from the EIR as well as incorporating principles of best practice in terms of environmental management. By identifying the potential impacts, mitigation measures, performance indicators, responsibilities, available resources, potential schedule and verification responsibility, the LEMP has provided a platform on which both the construction phase and the operational phase EMPs can be founded. The LEMP has ensured that the individual EMPs will be able to incorporate mitigation measures based on the project in its entirety as opposed to phase-specific measures.
APPENDIX A
CURRICULUM VITAE OF ENVIRONMENTAL ASSESSMENT PRACTITIONERS
APPENDIX B
CONSTRUCTION EMP GENERAL SPECIFICATIONS
(COMPREHENSIVE)
Annexure N2
CURRICULUM VITAE

Name of Firm : Aurecon South Africa (Pty) Ltd
Profession : Environmental Practitioner
Years with Firm : 5
Name of Staff : Louise Corbett
Year of Birth : 1981
Nationality : South African

Membership in Professional Societies:
Member of the South African affiliate of the International Association for Impact Assessment, (IAIAsa)
Treasurer of IAIAsa (2009-2011)

Key Qualifications:
Miss Louise Corbett, an Environmental Practitioner in the Cape Town office has a Bachelors of Science (Hons) degree in Environmental and Geographical Science, specialising in Environmental Management, from the University of Cape Town. Louise has six years’ experience in the environmental field and has compiled and managed numerous environmental investigations including Environmental Impact Assessments, Environmental Management Plans and Environmental Management Programmes. Louise has undertaken work in a number of sectors, including industrial, wastewater, waste and housing but specialises in the energy, and particularly renewable energy, sector. Louise is a member of the South African affiliate of the International Association for Impact Assessment and is a registered Professional Natural Scientist with the South African Council for Natural Scientific Professions.

Experience Record:

1a) Regulatory Processes and Environmental Impact Assessment: Impact Assessment:

2011 - present
Project Manager
- Proposed Hydropower Station on Riemvasmaak Farm on the Orange River near Augrabies, Northern Cape
- Three Proposed Solar Energy Facilities near Copperton, Northern Cape
- Two Proposed Wind Energy Facilities on the Eastern Plateau near De Aar, Northern Cape
- Three Proposed Solar Energy Facilities near De Aar, Northern Cape
- Proposed Reverse Osmosis Plant at Hendrina Power Station, Mpumalanga
- Proposed Wind Energy Facility near Komsberg, Western Cape
- Proposed Wind Energy Facility near Copperton, Northern Cape
- Proposed Stormwater System Rehabilitation at Zevenwacht, Western Cape
- Proposed Hydropower Station on the Orange River near Kakamas, Northern Cape
- Proposed Brine and Groundwater Treatment Works at Tutuka Power Station, Mpumalanga
- Proposed Expansion of the Piketberg Wastewater Treatment Works, Piketberg, Western Cape
- Proposed coal mine expansion near Tete, Mozambique
- Proposed wind monitoring masts in Middelburg, Eastern Cape
- Proposed wind monitoring masts in De Aar, Northern Cape
- Proposed wind monitoring masts in Cookhouse, Eastern Cape Eastern
- Proposed Fisantekraal New Town Development
- Proposed Langelfontein Windfarm, West Coast
- Proposed Coal-Fired Power Station in the Waterberg, Limpopo
- Proposed Subdivision of Farm Palmiet River No. 319, Elgin
2008  Proposed Sedgefield Off-Channel Dam, Sedgefield  Project Staff
2007-  Proposed Plant Extraction Facility in the Paarl Industrial Area, Paarl  Project Staff
2008  Proposed upgrade of fuel pipelines at the Cape Town International Airport.  Project Manager
2006-  Proposed rezoning of public open space (portion of Erf 10565) in Boston.  Project Manager
2007  Proposed upgrade of N1 intersections near De Doorns.  Project Manager
2006-  Proposed development of the Ibhubesi Gas Field and associated infrastructure, West Coast, South Africa.  Project Staff
2007  Proposed new regional landfill to service the City of Cape Town.  Project Staff
2007  Proposed subdivision and rezoning of Erf 1366, Eerste River.  Project Manager
2007  Proposed subdivision and rezoning of Erf 23300, Maitland (Royal Maitland Phase 3).  Project Manager
2007  Proposed subdivision and rezoning of Erf 3410, Simon’s Town.  Project Manager
2007  Proposed subdivision and rezoning of Erf 1, Simon’s Town.  Project Manager
2007  Proposed Rocklands Eco Estate.  Project Manager
2007  Proposed upgrade of facilities at the River Club, Observatory.  Project Manager

1b) Regulatory Processes and Environmental Impact Assessment: Mining and Oil and Gas Prospecting Applications:

2007  Proposed deepwater geophysical survey of the South African Continental Margin.  Project Manager
2007  Proposed 2D seismic survey in the Northern Block, offshore Namibia.  Project Manager
2007  Proposed borrow pits for the upgrade of road sections in the Central Karoo District.  Project Manager
2006-  Proposed borrow pits for the upgrade of road sections in the Overberg District.  Project Staff
2007  Proposed geotechnical survey in the Southern and Northern Blocks offshore Namibia.  Project Manager
2006  Proposed reseal of Trunk road 44/1, Main roads 401, 404, 368 and the upgrade of Divisional road 1834 and the development of an associated borrow pit near Uniondale.  Project Manager

2) Environmental Management Plans:

2010  Construction Environmental Management Plan for Stellenbosch Dams Rehabilitation  Project Manager
2006  Construction Environmental Management Plan for Sitari Fields Golf Estate, Firgrove/ Macassar.  Project Staff

3) Institutional and Policy Development and Professional Review Services:

2007-  Department of Economic Affairs Environment and Tourism Decision-making Support.  Project Staff
2008  

4) Other:

2011  Environmental Input to a Potential Hydropower Station on the Orange River, Northern Cape  Project Manager
2008  Environmental Input to Sites for a Solar Cell Factory  Project Staff


Countries of Work Experience: South Africa, United Kingdom, Canada, Mozambique

Education:
- BSc (Hons) Environmental Management, University of Cape Town, 2004.
- BSc Environmental & Geographical Science, University of Cape Town, 2003.

Employment Record:
2009 - present  
Senior Environmental Practitioner, Aurecon (Pty) Ltd
2007- 2009  
Environmental Practitioner, Ninham Shand (Pty) Ltd
2006-2007  
Environmental Consultant, CCA Environmental (Pty) Ltd
2005- 2005  
Systems Administrator, Morrison’s Plc, London UK
2004- 2005  
Customer Services Advisor, Barclays Bank Plc, London UK
2003-2004  
Fairmont Gold Attendant, Fairmont Chateau Whistler, Whistler Canada
2003-2003  
Practical Demonstrator to undergraduate Environmental and Geographical Science students, University of Cape Town

Languages: 
English (first), Afrikaans

Annexure N3
Curriculum vitae: Mr A VAN DER MERWE

Name : VAN DER MERWE, ANDRIES  
Date of Birth : 23 September 1973  
Profession/Specialisation : Environmental Engineering and Environmental Auditing  
Years with Firm : 16  
Nationality : South African  
Years experience : 16

Key qualifications

Andries van der Merwe is an environmental engineer who has been involved in a wide spectrum of infrastructure development projects throughout Africa. He is a trained SABS/ISO 14001 environmental management systems (EMS) auditor and his specific expertise allows him to assume a leading role in the compilation of environmental management systems (EMSs) and environmental management plans (EMPs) for all life-cycle phases of typical infrastructure development projects as well as the monitoring and auditing of the implementation of EMSs and EMPs on site. Recent projects of this nature include the operational EMP for the Sunderland Ridge Wastewater Treatment Works, the design and construction EMP for the Gautrain project and the EMP implementation monitoring on the 60km Polokwane Effluent Transfer Project.

He regularly acts as project team leader and provides technical assistance and input with regard to environmental impact assessments (EIAs) and environmental management frameworks (EMFs). Recent projects include the EIA, visual assessment and public participation process for the proposed 132kV overhead powerlines from Ha Lejone to the Lihobong and Kao diamond mines in Lesotho and the EIA for the Mavoco Hazardous Waste Disposal Facility outside Maputo in Mozambique. EMFs were recently completed for Alexandra in Johannesburg as part of the Presidential Alexandra Renewal Project, for the Mussulo Peninsula outside Luanda in Angola, as part of the master plan for the development of the peninsula, as well as for the City of Windhoek in Namibia. He has completed a number of environmental risk assessments, a recent example being that completed for the operational activities of the Nelspruit Airport in Mpumalanga.

He has been involved in a number of training and capacity building projects in the field of environmental management. Recent examples include the second phase of the Integrated Industrial Pollution Prevention programme in Mozambique that focused on capacity building in the Environmental Ministry in Mozambique, with specific emphasis on hazardous waste, pollution control and related strategies as well as the environmental management module of the European Union funded infrastructure asset management training programme run by the National Department of Provincial and Local Government in South Africa for officials of various local and district authorities. He has drafted a Technical Information Document summarising the requirements for environmental impact assessments (EIAs) for engineering work in terms of the South African environmental legislation to assist engineers and developers in understanding these requirements and contributed to the training material on environmental management issues for a SAICE project management course.

Employment record

03/2009 - date Aurecon (previously Africon, Ninham Shand and Connell Wagner), Environmental Engineer and Auditor/Associate  
2004 - 02/2009 Ninham Shand, Associate  
08/1999 - 2004 Africon, Environmental Engineer and Auditor  
08/1998 - 07/1999 Africon, Resident Engineer  
01/1996 - 07/1998 Africon, Design Engineer

Experience record

Emergency Desalination Plant (Mossel Bay, South Africa) 05/2010 - Date. Project Leader. Compilation of a Section 24G application in terms of the National Environmental Management Act for an emergency 15ML/d seawater reverse osmosis plant as a result of more than 1:150 year drought situation in the Southern Cape, inclusive of a construction phase environmental Management Plan. (Mossel Bay Municipality).

Application of a Multi-criteria Decision Making Model to rank development sites within Etosha

Aurecon is a global group created by the coming together of three world-class companies, Africon, Connell Wagner and Ninham Shand in March 2009. References to the three heritage companies accurately reflects the applicable legal entities at the time of project execution, although it is now presented as the experience and expertise of Aurecon.
Environmental impact assessment for the Moatize Coal Mine expansion project (Tete, Mozambique) 03/2010 - 04/2011. Project Leader. The additional infrastructure required for the Moatize Coal Mine expansion included a second primary crusher and second coal processing plant, increased raw water supply and storage capacity, an upgraded water treatment plant and power substation, a new coal conveyor system, enlarged storage yard to accommodate two lines of coal, optimised materials handling between the existing operations and proposed expansion, upgraded leachate cut-off drains, upgraded tailings dam effluent filtration system, and solid waste landfill and hazardous waste disposal facilities. The environmental impact assessment coincided with a pre-feasibility study (FEL2 Level) undertaken to determine the infrastructure required to accommodate the expansion of the mine. The aim of the assessment was to seek a decision regarding the project acceptability from the Mozambican environmental authorities (MICOA) through an update of the assessment completed for the first Moatize Mine complex and to describe, include and assess the proposed additional infrastructure. Involved for 1.3 person-months. (Vale).

Environmental impact assessments for the Nacala Rail Corridor (Mozambique and Malawi) 03/2010 - Date. Project Leader. A series of four environmental impact assessment packages for the proposed 860km Nacala Rail Corridor for the export of coal from the Vale Moatize Mine involving the construction and rehabilitation of the railway line between the loading terminal at the mine and the offloading terminal at the proposed deep-water port at Nacala-a-Velha, passing through southern Malawi. The project assessed the following components: the expansion of the existing mine loading terminal to accommodate the additional train traffic, transport of coal in trains (each comprising 4 diesel electric locomotives and 115 wagons with a capacity of 60t), management of train movement in the yards with priority given to loaded trains, signalling and control of movement of trains along the route based on GPS technology to allow for monitoring the movement of each and depots along the route to allow for provision of supplies and exchange of teams. It also included the deep-water port at Nacala-a-Velha with new coal terminal off-loading facilities using rail car tippler dumpers, workshops to house rolling stock and to allow for maintenance of trains following discharge and infrastructure for fuel provision. Construction is proposed to start mid-2011, with export capacity ramping up to 26Mtpa in 2016. The focus of the assessments was to review the relevant scoping reports, EPDA reports and available baseline data and acquiring updated information where necessary to describe and assess the predicted social and environmental impacts of the proposed additional infrastructure. Each package included a common assessment of the strategic impacts related to the project as a whole within the region, to allow for an understanding of each component within the bigger picture. (Vale).

Social and environmental management plan for new sulphuric acid storage tank at the Rössing Uranium Mine (Arandis, Namibia) 02/2010 - 06/2010. Project Leader. Compilation of a social and environmental management plan for the proposed new 15Kt sulphuric acid storage tank located within the mine precinct adjacent to similar tanks to increase acid storage capacity. Involved for 0.1 person-months. (Rössing Uranium/Rio Tinto).

Garden route environmental management framework (South Africa) 06/2008 - 05/2009. Environmental Engineer. Supporting role contributing to the hydrology and infrastructure information layers and provision of local liaison support for the development of the Garden Route Environmental Management Framework, focusing on the Kaaimans River to Noetzie study area on the Garden Route in the Southern Cape. Involved for 0.2 person-months. (earthINC / Department of Environmental Affairs and Tourism).

Emergency Desalination Plant (Plettenberg Bay, South Africa) 12/2009 - Date. Project Leader. Compilation of a Section 24G application in terms of the National Environmental Management Act for an emergency 2Ml/d seawater reverse osmosis plant as a result of more than 1:150 year drought situation in the Southern Cape, inclusive of a construction phase Environmental Management Plan. (Bitou Municipality).

HSE Brochure for Rössing Uranium’s Expansion project (Arandis, Namibia) 09/2009 - Date. Project Leader. The project entailed the compilation of a succinct and easily accessible brochure describing Rössing Uranium’s Health, Safety and Environmental Management system components such as management policies, programs and procedures already in use at the mine for wider public understanding. (Rössing Uranium/Rio Tinto).

Decommissioning of the Sonae Novobord Fibreboard Factory (George, South Africa) 07/2009 - Date. Project Leader. The project consisted of an environmental management plan for the decommissioning of the Sonae Novobord factory in George Industria, with a focus on the recovery and handling of salvageable...
materials and the lawful recovery and safe disposal of hazardous wastes and contaminated soil. Later also appointed to act as the Environmental Control Officer during the decommissioning phase to oversee the implementation of the Environmental Management Plan. (Sonae Novobord).

**Emergency upgrading of Keurbooms rising main and pumps and later application for authorisation for a further length of rising main rehabilitation (Plettenberg Bay, South Africa) 06/2009 - Date. Project Leader.** Project consisted of the urgent environmental application for the upgrading of the Keurbooms pumpstation, abstraction works and an initial length of steel rising raw water main to allow for an increase in river abstraction and later the application for environmental management plan. Subsequently also appointed as the environmental control officer for the construction phases. (Bitou Municipality).

**Social and environmental screening of potential railway route alternatives (Southern Malawi) 05/2009 - 12/2009. Project Leader.** The project consisted of the screening of 4 potential railway alternatives through southern Malawi, as part of a wider study to determine the feasibility of establishing an export corridor from Tete in Mozambique, through Malawi, to the port of Nacala-a-Velha in Nampula. The environmental screening coincided with a FEL2 level engineering study evaluating the technical and financial feasibility of the routes. The environmental and social screening was done using a simplified Multi-criteria Decision Making Model and comprised a review of background information, authority liaison and meetings, compilation of a list of suitable social and environmental screening criteria and rating methodology for each specified criteria, a detailed legal framework review, fieldwork to confirm sensitivity of the receiving environment, a fatal flaw analysis, GIS mapping of findings, preparation of cost estimates of social and environmental mitigation measures including resettlement (split into capital and operational costs) and presentation of the findings and recommendations in a summary report. Involved for 0.8 person-months. (Vale).

**Social and environmental management plan for mineral exploration drilling (Arandis, Namibia) 01/2009 - 01/2011. Project Leader.** The project entailed the compilation of a social and environmental management plan for exploration drilling activities within the overlap of the sensitive Namib-Naukluft Park and Rössing Uranium mine license area. Later also appointed for a phase 2 exploration drilling social and environmental management plan to address more detailed infill drilling, inclusive of rehabilitation plans for drill sites and access routes. Involved for 0.5 person-months. (Rössing Uranium / Rio Tinto).

**Phase 2: Social and environmental impact assessment for Rössing Uranium's expansion project (Namibia) 08/2008 - Date. Project Leader.** Social and environmental impact assessment for the second phase of Rössing Uranium's expansion project including increased production in the current SJ open pit and the establishment of associated process facilities including additional crushers and ore stockpiles, the establishment of an acid heap leaching facility that would be a first in uranium processing, increased waste rock dump capacity and increased tailings capacity. Involved for 12.5 person-months. (Rössing Uranium / Rio Tinto).

**Environmental and socio-economic impact assessment for proposed NamPower coal-fired power station at Walvis Bay (Namibia) 05/2008 - 08/2009. Environmental Engineer.** Environmental and socio-economic impact assessment for proposed NamPower coal-fired power station at Walvis Bay that included a site screening and selection process through the application of a multiple criteria decision-making model, a scoping study and the development of an Environmental Management Plan (EMP). Involved for 2 person-months. (Namibian Power Corporation).

**Social and environmental management plan for Rössing Uranium Expansion SEIA Phase 1 (Namibia) 02/2008 - 08/2008. Environmental Engineer.** The social and environmental management plan for the first phase of Rössing Uranium's expansion project including an acid plant, ore sorter and SK4 pit. Involved for 1.5 person-months. (Rössing Uranium / Rio Tinto).

**Environmental impact assessment for the feasibility update and the development of studies to evaluate the transport of coal from Moatize to Nacala and its shipment (Mozambique) 11/2008 - 06/2009. Environmental Project Leader.** Updating the 2006 Bankable Feasibility Study (BFS) to 14Mt/tpa and to create a rail capacity simulation and trade-offs model for the ramp-up period. Alternative heavy haul routes had to be investigated on Sections 2 and 3 before it was assumed that the base case route was the best route for the new tonnages. Included in the study was a phased upgrade of railway line from 4-26Mt/tpa. Responsible for the high level environmental screening. Involved for 3 person-months. (Vale).

**Application of a multiple criteria decision-making model to optimise future land use planning at Rössing Uranium (Namibia) 04/2008 - 03/2009. Project Leader.** Development and application of a multiple criteria decision-making (MCDM) model to optimise future land use planning focusing on the new
waste dump areas, heap leach and ripios sites and mine tailings areas. Involved for 1 person-month. (Rössing Uranium / Rio Tinto).

**Social and environmental impact assessment for a bulk sulphur handling facility (Walvis Bay, Namibia) 07/2008 - 12/2009. Project Leader.** The project entailed the compilation of a social and environmental impact assessment, inclusive of a social and environmental management plan for the proposed bulk sulphur importation, stockpiling and handling facility in the Port of Walvis Bay. Involved for 0.5 person-months. (Rössing Uranium/Rio Tinto).

**Paratus emergency generation facility (Walvis Bay, Namibia) 05/2008 - 08/2008. Environmental Engineer.** The project entailed the environmental authorisation process in relation to a proposed 50MW heavy fuel oil emergency electricity generation facility located within Walvis Bay. Involved for 0.5 person-months. (Namibian Power Corporation).

**Environmental impact assessment for the upgrade to the Knysna wastewater treatment works (Knysna, South Africa) 10/2007 - 05/2008. Internal Reviewer.** Environmental Impact Assessment and Environmental Management Plan for the upgrade to the existing Knysna Wastewater Treatment Works in the sensitive Knysna Lakes area in the Southern Cape. Involved for 0.1 person-months. (Knysna Municipality).

**Environmental screening of infrastructure alternatives, Sishen Iron Ore, Sishen (South Africa) 09/2007 - 12/2007. Project Leader.** Environmental screening of proposed infrastructure route alternatives, as input into the design processes for the relocation of infrastructure required as part of the Sishen Expansion Project, to increase production at the Sishen opencast iron ore mine. Involved for 0.5 person-months. (Kumba Iron Ore).

**Automotive supplier park (Rosslyn, South Africa) 02/2007 - 12/2007. Project Manager and Environmental Control Officer.** Providing environmental management support to the Supplier Park Development Company in the second phase of the establishment of the Automotive Supplier Park in Rosslyn, north of Pretoria. Fulfilling the role of Environmental Control Officer during the construction phase of new projects within the park in this Gauteng Province Blue IQ initiative. Involved for 1.7 person-months. (Project Management Solutions Africa / Supplier Park Development Company).

**Upgrading of Khutala pumpstation (Kriel, South Africa) 03/2007 - 08/2007. Project Leader.** Basic Assessment for the construction of a bypass pipeline at the Khutala Pumpstation to ensure increased capacity and reduced operating cost of the facility. Involved for 0.45 person-months. (Department of Water Affairs and Forestry).

**Basic assessment for the VRESAP access road (Vaal Marina, South Africa) 05/2007 - 09/2007. Project Leader.** Basic Assessment for the 2.2km access road to the Boschkop pumpstation of the Vaal River Eastern Sub-system Augmentation Project (VRESAP) through the Vaal Marina and traversing Gauteng and Mpumalanga Provinces. Involved for 0.4 person-months. (Vaal Pipeline Consultants / Trans Caledon Tunnel Authority).

**Polokwane effluent transfer project (Polokwane, South Africa) 02/2007 - 12/2007. Environmental Control Officer.** Acting as the part-time Environmental Control Officer on this project to transfer treated sewage effluent from the Polokwane wastewater treatment works to the AngloPlatinum mine outside Mokopane, including two pumpstations, approximately 60km pipeline and several reservoirs along the alignment. Involved for 2 person-months. (AngloPlatinum).

**Upgrading of the Rietfontein nature reserve (Paulshof, South Africa) 06/2007 - 09/2007. Project Leader.** Acting as Environmental Control Officer on the construction phase of the upgrading of facilities within the Rietfontein Nature Reserve in Paulshof, northern Johannesburg. The first phase of upgrading focused on the establishment of and environmental educational centre within the reserve. Involved for 0.2 person-months. (Johannesburg City Parks).


**Rietfontein Weir dredging and landfilling (Trichardt, South Africa) 04/2006 - 12/2007. Project Leader.** The EIA for the dredging and landfilling of contaminated silt from the Rietfontein Weir in the Trichardtspruit
north of the SASOL Syferfontein Mine outside Trichardt, inclusive of the public participation process and permitting of the proposed hazardous waste landfill. Involved for 1.5 person-months. (Department of Water Affairs and Forestry).

**Lesotho highlands further phases studies (Lesotho) 04/2006 - 01/2007. Environmental Engineer.** Application of the Ideal Mode Analytical Hydrarchy Process Multiple Criteria Decision Making (MCDM) Model in the initial technical planning workshop to optimise potential further phases alternatives in the Lesotho Highlands Water Project, with specific focus on MCDM Model setup, configuration and application. Involved for 0.8 person-months. (Lesotho Highlands Water Commission).

**Joint Maputo river basin water resources study (Mozambique, Swaziland and South Africa) 09/2006 - 03/2007. Environmental Engineer.** Compilation of an Environmental Impact Assessment (EIA) Best Practice Guideline, based on a comparative review of EIA triggers and process requirements in the Tripartite Permanent Technical Committee member countries and international best practice, that contributed to an integrated comprehensive study of the water resources of the Maputo River Basin, covering Mozambique, Swaziland and South Africa. Involved for 1 person-month. (Tripartite Permanent Technical Committee / European Union).

**McHardy stream diversion basic assessment (Cullinan, South Africa) 07/2006 - 09/2007. Project Leader.** The Basic Assessment in terms of the National Environmental Management Act EIA Regulations for the diversion of the McHardy Stream through the Cullinan Diamond Mine grounds to establish separation of polluted runoff from mining activities and unpolluted natural stormwater flow. Involved for 0.63 person-months. (De Beers Group Cullinan Diamond Mine).

**Upgrading of the K46 bridge over the Jukskei River (Dainfern, South Africa) 08/2006 - 09/2007. Environmental Engineer.** An application for exemption from the requirements for environmental authorisation for the proposed upgrading of the K46 route over a total distance of 8km, inclusive of alignment improvements and the construction of new dual carriageway bridges to accommodate the 1:100 year flood where the alignment crosses the Jukskei River at Dainfern north of Johannesburg. Involved for 0.33 person-months. (Gautrans).

**Laudium bulk supply upgrade (Laudium, South Africa) 12/2006 - 12/2007. Project Leader.** Basic Assessment for the upgrading of an existing bulk supply line of 1.5km to an internal diameter of 700mm, linking a Rand Water Supply to the City of Tshwane reservoir in Laudium. Involved for 0.6 person-months. (City of Tshwane).

**Doornkraal reservoir (Polokwane, South Africa) 11/2006 - 12/2007. Environmental Control Officer.** Acting as part-time Environmental Control Officer on the 30MI Doorkraal Reservoir construction, west of Polokwane. Involved for 0.8 person-months. (AngloPlatinum).

**Sunderland ridge WW TW EMP implementation monitoring and operational EMP (Centurion, South Africa) 06/2006 - 12/2006. Environmental Engineer.** The monitoring of construction EMP implementation on site for the upgrading of the Sunderland Ridge Wastewater Treatment Works in Centurion to increase operational capacity with 20MI day and reporting on EMP implementation status, including preparation of monthly summary reports for submission to the provincial environmental authority. Completion of an Operational EMP for the upgraded facility. Involved for 0.81 person-months. (City of Tshwane Metropolitan Municipality).

**BKM Mine Infrastructure (South Africa) 02/2006 - 03/2006. Project Leader.** Environmental technical assistance to the engineering design team involved with the design of mine access and services infrastructure for the BKM iron ore mine. The assistance focused on the review of all available baseline information and mine environmental authorisation applications to establish a list of criteria that would ensure compliance to environmental best practice and authorisation permit conditions applicable to design of services infrastructure. The proposed mine will be an opencast mine with a washing, screening and beneficiation plant, ore stockpiles, crushing plant, conveyors and a rapid rail loading facility. Involved for 0.2 person-months. (BKM Iron Ore Mine).

**Technical and project management assistance to the Komati Basin Water Authority (Swaziland) 06/2006 - 08/2006. Environmental Engineer.** Environmental management assistance to the Komati Basin Water Authority (KOBWA), with a specific focus on compilation of a tender document used in a call for tenders for the second round of ecological and aquatic monitoring, tender evaluation and adjudication. Monitoring requirements based on the treaty between South Africa and Swaziland, as input into the study to determine the environmental water requirements. Involved for 0.25 person-months. (Komati Basin Water Authority).
Bizana solid waste disposal site (Bizana, South Africa) 10/2005 - 02/2006. Environmental Engineer. The development of proposals for the formalisation of the existing Bizana solid waste dump and the operational and decommissioning EMP to guide operations up to the final closure of the site. Involved for 0.3 person-months. (Mbizana Local Municipality).

Kokstad solid waste management section 78 assessment (Kokstad, South Africa) 05/2005 - 03/2006. Environmental Engineer. A Section 78 assessment in terms of the Municipal Systems Act to assess existing solid waste management processes in Kokstad and evaluate the merits of both internal and external service providers based on financial modelling of both scenarios. Provided technical solid waste management input to the assessment. Involved for 0.25 person-months. (PriceWaterHouseCoopers Inc / Greater Kokstad Municipality).

Braamhoek pumped storage access roads (South Africa) 08/2005 - 02/2006. Project Leader. An EIA for the access roads to the Braamhoek pumped storage scheme, spanning the KwaZulu-Natal and Free State border and includes both the upgrading of sections of existing roads and the construction of new sections of road in mountainous areas. Involved for 0.2 person-months. (ESKOM Generation Division).

Senqu and Senqunyane bridges (Lesotho) 06/2005 - 02/2006. Project Leader. An EIA for two bridges spanning the Senqu and Senqunyane Rivers in Lesotho, as part of the proposed Roma-Semongkong-Sekake Road that will reduce travel time to and from the south of Lesotho and increase accessibility to the remote villages to the north of the Senqu and Senqunyane Rivers. Involved for 0.5 person-months. (Lesotho Ministry of Public Works Roads Branch).

Mafikeng industrial development zone (Mafikeng, South Africa) 01/2005 - 01/2006. Project Leader. A due diligence assessment and EIA for the proposed Mafikeng Industrial Development Zone that is planned around the existing Mafikeng Airport. The development caters for export and high-tech industries and includes a variety of industrial and technology land uses. Initial development is focused on providing for minerals export, livestock export and quarantine facilities and a cluster of light industrial stands. Involved for 0.5 person-months. (Mafikeng Industrial Development Zone (Pty) Ltd).

KwaDukuza solid waste management section 78 assessment (KwaDukuza, South Africa) 07/2005 - 03/2006. Environmental Engineer. A Section 78 assessment in terms of the Municipal Systems Act to assess existing solid waste management processes in KwaDukuza and evaluate the merits of both internal and external service providers based on financial modelling of both scenarios. Provided technical solid waste management input to the assessment. Involved for 0.2 person-months. (PriceWaterHouseCoopers Inc / Greater KwaDukuza Municipality).

City of Tshwane city development strategy (Tshwane, South Africa) 07/2005 - 07/2005. Environmental Engineer. Technical and engineering input into the review and updating of the City of Tshwane City Development Strategy, with specific inputs provided focusing on general environmental management strategic issues and solid waste management opportunities and constraints. The strategy aims to unlock the potential of the north of Tshwane through providing suitable infrastructure to stimulate growth. Involved for 0.2 person-months. (City of Tshwane Metropolitan Municipality).

Groenpunt Prison wastewater treatment works (Sasolburg, South Africa) 08/2005 - 11/2005. Environmental Engineer and Project Leader. A scoping assessment and EMP for the upgrading of the wastewater treatment works at the Groenpunt Prison on the banks of the Vaal River at Sasolburg. The upgraded works will reduce the pollution risk that the existing system poses and will mainly treat effluent from the large piggery on site. Involved for 0.25 person-months. (Stewart Scott International / Department of Public Works).

Integrated industrial pollution prevention - Phase 2 national hazardous waste management strategy (Mozambique) 01/2004 - 03/2006. Environmental Engineer and Project Leader of Subconsultancy Team. Technical assistance to the Environmental Ministry of Mozambique, in association with Ramboll, as part of the Integrated Industrial Pollution Prevention Programme (Phase 2) funded by DANIDA. This programme is aimed at hazardous waste management in Mozambique and capacity building within the Ministry regarding issues relating to the identification, handling, disposing, monitoring and regulating of hazardous waste. It also involves monitoring operations at the newly established hazardous waste disposal facility at Mavoco, Beluluane. Involved for 2.5 person-months. (Ministerio para a Coordenacao a Accao Impacto Ambiental (Micoa) / DANIDA).
**Coega IDZ Zone 1 infrastructure** (Port Elizabeth, Eastern Cape, South Africa) 05/2004 - 03/2006. *Environmental Control Officer.* Environmental technical assistance to the project implementation team involved with the design and construction supervision of the infrastructure developed for Zone 1 of the Coega Industrial Development Zone outside Port Elizabeth in the Eastern Cape Province, and acting as the Environmental Control Officer on site for the duration of construction. Involved for 1.1 person-months. (Coega Development Corporation).


**North-West Agrivillage project (Mafikeng, South Africa)** 09/2004 - 01/2005. *Project Leader.* An EIA for a new rural agricultural project, inclusive of an access road, outside Mafikeng, as part of a poverty relief initiative under the Expanded Public Works Programme. Involved for 0.2 person-months. (North West Provincial Department of Public Works).

**Facim commercial development** (Mozambique) 10/2004 - 01/2005. *Project Leader.* Environmental opinion and detailed EMP for the Facim Commercial Development that includes an exhibition area, conference facilities, shopping centre and office space in downtown Maputo and potentially presents the single largest private real estate investment in Mozambique. Involved for 0.5 person-months. (HLM Financial Enterprises CC).

**Ekurhuleni Northern Region Environmental Management Framework (EMF)** (South Africa) 03/2004 - 01/2005. *Environmental Engineer.* Development of an integrated environmental management framework (EMF) to facilitate the current conflict between development, conservation and high potential agricultural land in Ekurhuleni. Involved for 0.8 person-months. (Ekurhuleni Metropolitan and Gauteng Department of Agriculture, Conservation and Environment (GDACE)).

**DPLG / EU capacity building phase 2** (South Africa) 07/2004 - 02/2005. *Environmental Training Facilitator.* Follow-up to the pilot project to establish environmental capacity on local and district authority level for the operation and maintenance of municipal infrastructure services - environmental management module presented to officials from various authorities in Mpumalanga and Limpopo Provinces. Involved for 1 person-month. (Department of Provincial and Local Government).


**Mehloding adventure trail access roads** (Eastern Cape, South Africa) 06/2004 - 12/2004. *Environmental Auditor.* Monitoring of the implementation of the construction EMP for the construction of vehicular access roads in mountainous terrain to the chalets of the Mehloding Adventure Trail near Maluti in the Eastern Cape Province. Involved for 1 person-month. (Alfred Nzo District Municipality).

**Gautrain Rapid Rail Link EMP** (South Africa) 03/2003 - 02/2007. *Environmental Engineer and Project Leader.* Review of the environmental Record of Decision for the project, drafting of a construction EMP framework for the client to use in their bid for the project and assistance with specialist environmental management aspects throughout the bidding process. Subsequent further EMP development and refinement following the announcement of Bombela Consortium as the preferred bidder, leading to development of both design criteria and a construction phase EMP for the project. Involved for 7.2 person-months. (Bombela Consortium).

Engineer. EIA for the first phase infrastructure development for the Limpopo National Park comprising a camp, workshop, administrative complex, staff housing, ranger posts and new entrance gate. Involved for 2 person-months. (Limpopo National Park / Peace Parks Foundation).


Windhoek Environmental Structure Plan (ESP) and policy (Windhoek, Namibia) 01/2003 - 05/2004. Environmental Engineer. The ESP is a GIS-based product that provides essential information for land use planning for development programmes and classify the area into environmental zones for various types of development and is supported by a database of physio-ecological information. The project also involved the drafting of an Environmental Policy for the city of Windhoek after completion of the ESP. Involved for 1.5 person-months. (City of Windhoek).


Rehabilitation EMP for road TR1/11 (Namibia) 11/2003 - 12/2003. Environmental Engineer and Project Leader. Drafting of an EMP for the construction and rehabilitation phases of Road TR1/11 from Ondangwa to Oshikango in Namibia. Involved for 0.5 person-months. (Roads Authority of Namibia).

Water services development plan (WSDP) for Tshwane (Gauteng, South Africa) 04/2003 - 12/2003. Environmental Engineer and Project Leader. Drafting of the environmental policy and strategic environmental management plan and for the City of Tshwane Division: Water and Sanitation, and completion of the environmental chapter for the WSDP. Involved for 2 person-months. (City of Tshwane Metropolitan Municipality).

New Lesotho parliament building and staff housing (Lesotho) 03/2003 - 10/2003. Project Leader. Environmental Impact Statement (EIS) for the proposed new Lesotho Parliament and staff housing complex in Maseru, inclusive of a social impact assessment and specialist vegetation study, as well as an EMP containing mitigatory measures for potential impacts. Involved for 0.5 person-months. (Ministry of Public Works: Building Design Services).

Environmental management system for Yum! Restaurants International (South Africa) 07/2003 - 10/2003. Environmental Auditor and Project Leader. First phase of Environmental Management System development for Yum! Restaurants International that represents KFC in South Africa, including a gap analysis, a legal review and review of existing operational policies and procedures with recommendations for further EMS development. Involved for 0.5 person-months. (Yum! Restaurants International).

Master plan for the development of Mussulo Peninsula (Luanda, Angola) 01/2002 - 12/2003. Environmental Engineer. The project entailed the development of a master plan for the development of the Mussulo Peninsula, incorporating an Environmental Management Framework (EMF) to focus development on the least sensitive areas, as well as proposals for applicable design standards and norms based on the carrying capacity of the Peninsula to ensure sustainable development. Involved for 3 person-months. (Ministério dos Transportes de Angola).
Spatial representation of industrial areas in Gauteng Province and recommendations on Buffer Zones Phase 2 (Gauteng, South Africa) 12/2002 - 02/2003. Environmental Engineer. Phase 2 of this project entailed the refining and spatial representation of different categories of industrial land use in Gauteng Province in a Geographic Information System (GIS) based decision support tool with recommendations on buffer zones for each. Involved for 1 person-month. (Gauteng Department of Agriculture, Conservation, Environment and Land Affairs).

Nestlé Isando EIA (South Africa) 11/2002 - 12/2003. Environmental Engineer and Project Leader. An EIA for the new dry pet food plant for Nestlé Purina Petcare in Isando including specialist air pollution dispersion modelling and noise assessment. The aim of the study was to establish status quo conditions on site prior to operation, predict impacts and propose suitable mitigation where applicable. Involved for 0.5 person-months. (Nestlé Purina Petcare - Friskies).


Environmental Impact Assessment (EIA) for the Telemetry masts for Kanyamazane Water Treatment Works (WTW) and reticulation system (Kanyamazane Mbombela, South Africa) 03/2002 - 08/2002. Environmental Engineer and Project Leader. Responsible for Environmental Impact Assessments (EIAs) for four telemetry masts of the treatment and reticulation system of the Southern Nsikazi Regional Water Scheme, also including construction Environmental Management Plans (EMPs). Involved for 1 person-month. (Mbombela Local Authority).


Instream Flow Requirements (IFR) for rivers in the King Sabata Dalindyebo study area (King Sabata, South Africa) 06/2002 - 07/2002. Environmental Engineer. The project included the ecological classification of rivers and estimates of Instream Flow Requirements (IFR) with recommendations on integrated environmental management procedures and ecological management categories for planning purposes. Involved for 1 person-month. (Department of Water Affairs and Forestry (DWAF)).


Spatial representation of industrial areas in Gauteng and recommendations on buffer zones (Gauteng, South Africa) 01/2002 - 03/2002. Environmental Engineer. The development of a Geographic Information System (GIS) based decision support tool to ensure that housing projects in Gauteng are not allowed in areas posing environmental and health risks, by mapping and classifying all industrial areas in the province and establishing worst and best case buffer zones based on legal requirements and expert consultation. Involved for 1 person-month. (Gauteng Department of Agriculture, Conservation, Environment and Land Affairs).


Survey of tourism potential and Socio-economic Impact Assessment (SIA) in four focus areas, namely: Madikwe, Barberton, Valley of the Olifants and Khayelitsha (South Africa) 01/2002 - 05/2002. Environmental Engineer. The project involved a tourism promotion and development potential survey and a Socio-economic Impact Assessment (SIA) to review socio-economic conditions, estimate tourism demands and determine socio-economic impacts of tourism development in each of the focus areas. Involved for 1 person-month. (Japanese International Cooperation Agency (JICA)).
Environmental Impact Assessment (EIA) and review of engineering design of the Mavoco hazardous waste disposal facility (Beluluane, Mozambique) 01/2002 - 02/2003. Environmental Engineer. Responsible for Environmental Impact Assessment (EIA), Social Impact Assessment, (SIA) and Environmental Management Plans (EMPs) for construction, operation and rehabilitation phases and review of engineering design of the Mavoco Hazardous Waste Landfill site and access road near Mozal. Involved for 2 person-months. (Ministério para a Coordenação da Acção Ambiental (Micoa)).

Environmental Management Plan (EMP) implementation monitoring on the Mohale feeder roads bridge sites (Mohale, Lesotho) 11/2001 - 02/2003. Environmental Auditor. Responsible for monitoring of the implementation of the construction Environmental Management Plan (EMP) and recommendations on mitigation on the three Mohale Feeder Roads bridge sites. Involved for 2 person-months. (Lesotho Highlands Development Authority (LHDA)).

Environmental Management Framework (EMF) for Alexandra Township (Alexandra, South Africa) 06/2001 - 10/2001. Environmental Engineer. The Alexandra Environmental Management Framework (EMF) was developed on a GIS platform integrating impact management policy with spatial environmental priorities to seek sustainable development as part of the Presidential Alexandra Renewal Project. The EMF was developed at a scale of 1:5000 to indicate the required level of detail to fast-track environmental approvals and permitting procedures in areas with low sensitivity and included a generic environmental management plan (EMP) for construction in these areas. Involved for 1 person-month. (Gauteng Department of Agriculture, Conservation, Environment and Land Affairs).

Kamiesberg Electrification Project Environmental Impact Assessment (EIA) (Northern Cape, South Africa) 01/2001 - 03/2001. Environmental Engineer and Project Leader. The project included an Environmental Impact Assessment (EIA) for the provision of 3 phase electricity to 8 rural settlements in the Kamiesberg District in Namaqualand, including the assessment of the alignment of approximately 160km of new overhead electricity supply lines. Involved for 1 person-month. (Kamiesberg Municipal Authority).

Bronberg Reservoir Environmental Management Plan (EMP) (Pretoria, South Africa) 04/2000 - 10/2005. Environmental Auditor. The project comprised an Environmental Management Plan (EMP) for the construction of the new 100Ml Bronberg Reservoir, also including site implementation monitoring and auditing. Involved for 1.5 person-months. (Greater Pretoria Metropolitan Council (GPMC)).


Mohale Dam feeder roads Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) (Mohale, Lesotho) 11/2000 - 08/2001. Environmental Engineer. The project included and Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), review of the route alignments and an Environmental Management Plan (EMP) for the construction phase of the feeder roads around the Mohale Dam, as part of Phase 1B of the Lesotho Highlands Water Transfer Scheme. Involved for 3 person-months. (Lesotho Highlands Development Authority (LHDA)).


Qumbo and Gqunu Bulk Water Supply Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) (Eastern Cape Province, South Africa) 02/2000 - 03/2000. Environmental Engineer. The project included an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) to mitigate negative impacts associated with the construction of infrastructure required to supply the villages of Qumbo and Gqunu with piped water. Involved for 1 person-month. (Eastern Cape
Tsomo Sewage Treatment Works (Eastern Cape, South Africa) 02/2000 - 03/2000. Environmental Engineer. Responsible for an Environmental Impact Assessment (EIA) and Management Plan (EMP) for sewage treatment works for Tsomo Village. Involved for 1 person-month. (Eastern Cape Department of Public Works).

North West Road upgrade Environmental Management Plan (EMP) (North West Province, South Africa) 10/2000 - 11/2000. Project Leader and Environmental Auditor. The project involved the establishment of a generic Environmental Management Plan (EMP) for an extensive road rehabilitation project including borrow pits for the upgrading of 42 roads in the North West Province. Involved for 0.5 person-months. (North West Provincial Department of Public Works).


Centurion major roads planning (Centurion, South Africa) 08/1999. Design Engineer and Project Leader. Responsible for network planning for Irene as part of the Centurion major roads planning. Involved for 1 person-month. (Centurion Town Council).

Centurion Environmental Management Framework (EMF) Phase1 (Centurion, South Africa) 08/1999 - 10/1999. Environmental Engineer. The project consisted of Phase 1 of the Centurion EMF covering the planning of one forum of Centurion at a scale of 1:15000 on a Geographical Information Systems (GIS) platform integrating an impact management policy with spatial environmental priorities to seek sustainable development within Centurion. Involved for 1 person-month. (Centurion Town Council).

Ethiopian roads Environmental Impact Assessment (EIA) review (Ethiopia) 09/1999 - 11/1999. Research Member of Environmental Impact Assessment Team. The project comprised and environmental and social impact assessment of the proposed construction and upgrading of 2 200km of major routes including a construction Environmental Management Plan (EMP) and detailed mitigation plans. Involved for 1 person-month. (Ethiopian Roads Authority).

Scoping report and Environmental Management Plan (EMP) for remedial work at Leopard Creek Golf Estate (Malelane, South Africa) 09/1999 - 11/1999. Environmental Engineer. The project involved an extended scoping study for the construction of a 140m gabion structure on the southern embankment of the Crocodile River in Mpumalanga. Involved for 1 person-month. (Leopard Creek Golf Estate).


Environmental Impact Assessment (EIA) and visual assessment for Siemens Cellular Telecommunications Masts (South Africa) 09/1999 - 06/2002. National Project Manager. The project involved an Environmental Impact Assessment (EIA) and visual assessments and public participation processes, for the construction of cellular telecommunication masts (and permitting) involving both exemption and scoping with mitigation measures for 1600 potential cellular masts for the 3rd cellular licence in South Africa in Cape Town, Pretoria, Johannesburg and Durban. Involved for 8 person-months. (Siemens Telecommunications).


Kumasi, Tamale and Secondi Landfill Sites (Kumasi, Tamale, and Secondi in Ghana) 06/1998 - 07/1998. Design Engineer and Project Leader. Responsible for the design, modelling and volume
calculations for Kumasi, Tamale and Secondi landfill sites. Involved for 1 person-month. (Ghana Department of Local Government).

**Upgrading of streets and stormwater in Mbabane (Mbabane, Swaziland) 02/1998 - 08/1998. Design Engineer and Project Leader.** Responsible for the design and documentation for the upgrading of streets and stormwater. Involved for 4 person-months. (Mbabane Local Authority).

**Roads and volume calculations for Mbabane Landfill Site (Mbabane, Swaziland) 12/1997 - 02/1998. Design Engineer.** Responsible for the design of roads and volume calculations for the Mbabane Landfill Site. Involved for 2 person-months. (Mbabane Local Authority).

**Stormwater drainage design for Taung Hospital (Taung, South Africa) 08/1997 - 03/1998. Design Engineer.** Responsible for the stormwater drainage design for the hospital grounds. Involved for 2 person-months. (Department of Public Works).

**Samrand Avenue (Centurion, South Africa) 10/1997 - 03/1998. Design Engineer.** Responsible for the design of Samrand Avenue West of P66-1 in Centurion. Involved for 3 person-months. (Centurion Town Council).

**Stormwater drainage and pavement design at the South African Bank Note Printers (Pretoria, South Africa) 02/1997 - 03/1997. Design Engineer.** Responsible for stormwater drainage and pavement design for the revised main entrance to the South African Bank Note Printers. Involved for 1 person-month. (SA Bank Note Printers).

**Sunnyside Campus of the University of South Africa (UNISA) (Pretoria, South Africa) 02/1997 - 05/1997. Design Engineer.** Responsible for the civil design of alterations to roads and parking areas for UNISA's Sunnyside Campus. Involved for 2 person-months. (UNISA).

**Design services for Gabonewe School (Gabonewe, South Africa) 06/1997 - 07/1997. Design Engineer and Project Leader.** Responsible for the design of access roads and parking areas for Gabonewe School. Involved for 1 person-month. (Department of Education).

**Design of New Park Shopping (Kimberley, South Africa) 02/1997 - 10/1997. Design Engineer and Project Leader.** Responsible for the design of civil works for New Park Shopping Centre including stormwater, access roads, intersections and parking areas. Involved for 3 person-months. (Moolman Brothers).

**Stormwater infrastructure design proposal (Johor Bahru, Malaysia) 05/1997 - 11/1997. Design Engineer.** Responsible for the design proposal for stormwater infrastructure for the Johor Bahru Development. Involved for 2 person-months. (Johor Bahru Development).

**Design of stormwater drainage at Technikon North West (Ga-Rankuwa, South Africa) 03/1997 - 05/1997. Design Engineer.** Responsible for the design of stormwater drainage at Technikon North West residences. Involved for 1 person-month. (Technikon North West).

**Design of new sports fields at Technikon North West (Ga-Rankuwa, South Africa) 01/1997 - 02/1997. Design Engineer and Project Leader.** Responsible for the design and documentation for new sports fields, including drainage culverts. Involved for 2 person-months. (Technikon North West).

**Civil design for Latter Day Saints' Meeting House (Atteridgeville, South Africa) 07/1997 - 10/1997. Design Engineer and Project Leader.** Responsible for the civil design for the LDS meeting house. Involved for 1 person-month. (Latter Days Saints' Church).

**Phatsima Township Phases 1 and 2 (Rustenburg, South Africa) 01/1996 - 04/1998. Design Engineer.** Responsible for the design of an access road to Phatsima Township Phases 1 and 2. Involved for 2 person-months. (Rustenburg Town Council).

**Tlhabane Township Phases 1 and 2 (Rustenburg, South Africa) 01/1996 - 04/1998. Design Engineer.** Responsible for the design of streets and stormwater in Tlhabane Township Phases 1 and 2. Involved for 2 person-months. (Rustenburg Town Council).

**Stormwater and pavement designs at Berea City Complex (Pretoria, South Africa) 01/1996 - 08/1997. Design Engineer.** Responsible for stormwater drainage and pavement designs at Berea City Complex.
Involved for 3 person-months. (EG Chapman Properties).

**Design of access road and parking areas at Technikon North West (Ga-Rankuwa, South Africa)** 02/1996 - 05/1997. *Design Engineer and Project Leader*. Responsible for the design of an access road and parking areas at Technikon North West. Involved for 3 person-months. (Technikon North West).

**Stormwater master plan for Tlhabane Township (Rustenburg, South Africa)** 07/1996 - 10/1996. *Design Engineer*. Responsible for a stormwater master plan for Tlhabane Township, including stormwater drainage development phasing with expenditure estimates for 5 years. Involved for 3 person-months. (Rustenburg Town Council).


**Stormwater master plan for Phatsima (Rustenburg, South Africa)** 07/1996 - 10/1996. *Design Engineer*. Responsible for a stormwater master plan for Phatsima Township, including stormwater drainage development phasing with expenditure estimates for 5 years. Involved for 3 person-months. (Rustenburg Town Council).

**Education**

1995 : BEng (Civil), University of Pretoria, South Africa

**Career enhancing courses**

2011 : Investment in African mining International Conference 2011 (Mining Indaba), Cape Town, International Investment Conferences
2010 : Basic MS Projects Course, Aurecon
2009 : BST Financial Management Course, Aurecon
2009 : Life-Long Learning Solutions CPD DVD Series 2009, South African Association of Consulting Engineers (SAACE)
2008 : Life-Long Learning Solutions CPD DVD Series 2008, South African Association of Consulting Engineers (SAACE)
2008 : ProMan Financial Management Course, Ninham Shand, Cape Town
2007 : Life-Long Learning CPD DVD Series 2007, South African Association of Consulting Engineers (SAACE)
2007 : Handling projects in a Consulting Engineer's Practice, South African Institution of Civil Engineering (SAICE)
2006 : Business Finances for Built-Environment Professionals, South African Institution of Civil Engineering (SAICE)
2006 : Life-Long Learning Solutions CPD DVD Series, South African Association of Consulting Engineers (SAACE)
2006 : Environmental Law Update, North-West University, South Africa
2005 : Environmental Law Update, North-West University, South Africa
2004 : Internal Assessor / Moderator Course, Africon, South Africa
2002 : Business Writing Skills, Pula Madibogo
2002 : Role of IT in Management of the RSA Environment, South African Institution of Civil Engineering (SAICE)
2000 : Environmental Auditing, University of Potchefstroom, South Africa
2000 : Environmental Law, University of Potchefstroom, South Africa
2000 : Environmental Management Systems (SABS/ISO 14001), University of Potchefstroom, South Africa
2000 : Introduction to Environmental Management, University of Potchefstroom, South Africa
2000 : Microsoft Access, Finlore Education
1999 : Environmental Governance, University of South Africa (UNISA)
1998 : Internet and Email, South African Institution of Civil Engineering (SAICE)
1997 : Basic Portuguese, Africon/University of South Africa
1997 : Microsoft Excel Advanced, Edu-Pro, South Africa
1997 : Microsoft Windows 95 Advanced, Edu-Pro, South Africa
1997 : Design of Streets and Stormwater, University of Pretoria, South Africa
1996 : Communication Skills 1, Africon, South Africa
1996 : Microsoft Windows 95, Edu-Pro, South Africa
1996 : Model Maker DTM, Model Maker Systems
1996 : Internal Project Management, Africon, South Africa
1996 : Communication Skills 2, Africon, South Africa

Professional affiliations

Registered Professional Engineer, Engineering Council of South Africa (ECSA)
Member, South African Institution of Civil Engineers
Member, Institute of Waste Management of South Africa (IWMSA)
Member, International Association of Impact Assessment (IAIA)

Languages

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Honours and awards

Merit award for excellence in Landscape Architecture in the category for ecological planning for the Centurion Environmental Management Framework (EMF) project completed in 2001 received from the Institute of Landscape Architects of South Africa (ILASA) in 2003.

Publications


Referees

<table>
<thead>
<tr>
<th>Company</th>
<th>Contact Person</th>
<th>Telephone nr.</th>
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<tbody>
<tr>
<td>ABB</td>
<td>Mr Walter Ringelmann</td>
<td>+27 11 236 7221</td>
</tr>
<tr>
<td>City of Tshwane Metro</td>
<td>Mr Hannes Scholtz</td>
<td>+27 12 308 8820</td>
</tr>
<tr>
<td>Lesotho Highlands Development</td>
<td>Mr Ikarabele Sello</td>
<td>+266 311 280/314 324</td>
</tr>
</tbody>
</table>

By my signature below I certify the correctness of the information above and my availability to undertake this assignment.
Annexure N4
CURRICULUM VITAE

Name of Firm : Aurecon (Pty) Ltd  
Name of Staff : Simon Clark  
Profession : Environmental Practitioner  
Year of Birth : 1978  
Years with Firm : Nationality : South African

Membership in Professional Societies:

Key Qualifications:

Mr Clark, an Environmental Practitioner in the Cape Town office has a Bachelors of Arts degree in Environment Management, from the University of South Africa. Simon has over 6 months experience in the environmental field and has assisted in compiling environmental investigations including Basic Assessments Environmental Scoping and Environmental Impact Assessments.

Experience Record:

1a) Regulatory Processes and Environmental Impact Assessment: Impact Assessment:

2011-present  Proposed Expansion of Sherwood Poultry Farm near Malmesbury, Western Cape. Project Staff
2011-present  Proposed Development of 15 Luxury Apartments on Lions Hill, Western Cape. Project Staff
2011-present  Working for Wetlands Rehabilitation Projects, Provincial. Project Staff
2011-present  Proposed construction of an anaerobic digester for the generation of electricity at Elgin Fruit Juices, Grabouw Project Staff
2011-present  Proposed Wind Energy Facility near Vredenburg, Western Cape. Project Staff
2011-present  Proposed Wind Energy Facility near Velddrif, Western Cape. Project Staff
2011-present  Proposed Wind Energy Facility near Saldanha, Western Cape. Project Staff

4) Other:

2011 Due Diligence for the proposed upgrade of Buffeljagt Divisional Road 1326, Buffeljagtstrivier area near Swellendam, Western Cape.

Countries of Work Experience:  South Africa, United Kingdom.

Education:  BA Environmental Management, University of South Africa 2010.

Employment Record:

- 2001- present  Environmental Practitioner, Aurecon (Pty) Ltd
- 2008- 2010  Manager Soundlab (Pty) Ltd
- 2006-2007  Key Account Manager META (Pty) Ltd
- 2004- 2006  General Manager Sound Around CC
- 2001- 2004  Sales Manager TPG CC

Languages:  English (first), Afrikaans
Annexure N5
CURRICULUM VITAE

Name of Firm: Aurecon South Africa (Pty) Ltd
Name of Staff: C J Steyn
Profession: Environmental Practitioner
Year of Birth: 1974
Years with Firm: <1
Nationality: South African

MEMBERSHIP IN PROFESSIONAL SOCIETIES:

- International Association for Impact Assessment – South African Affiliate (IAIAasa)

KEY QUALIFICATIONS:

Corlie holds a BA degree (1995), Higher Education Diploma (1996) and Honours degree in Geography (Cum Laude) (1997) from University of Pretoria. She has had extensive experience in environmental management, research projects, and lectures part-time at Nelson Mandela Metropolitan University for the Department Nature Conservation. She spent a number of years as an environmental officer with the Department of Environmental Affairs and Development Planning of the Western Cape provincial government where she was primarily responsible for the evaluation and review of Environmental Impact Assessments (EIAs), as well as advising on law enforcement and environmental matters. Furthermore, Corlie has gained substantive experience in managing public participation processes, including in-depth interviews with stakeholders, chairing workshops and presenting final reports to government departments and civil society stakeholders. Corlie is currently studying towards an MPhil in Environmental Management at the University of Stellenbosch, South Africa.

EDUCATION:

- BA degree, University of Pretoria, South Africa, 1995
- Higher Education Diploma, University of Pretoria, South Africa, 1996
- Honours: Geography, University of Pretoria, South Africa, 1997

EXPERIENCE RECORD:

Coastal and Marine Management at Nelson Mandela Metropolitan University (NMMU), Saasveld Campus, George, South Africa
Part-time Lecturer
Appointed to lecture fourth year students in Coastal Management including the legislative background, detailed case studies, and biophysical, social and economic factors related to coastal and marine management. (Nelson Mandela Metropolitan University).

January 2008 to December 2010  Scenario planning to assess the implications of climate change on land and water use within the agricultural sector of the Garden Route, Western Cape, South Africa  Project Leader

Appointed to compile a literature review of existing data relating to the implications of changes in temperature and rainfall patterns on agricultural practices, both nationally and internationally. The project included collation of climatic data for the Garden Route obtained from the CSIR, an assessment of current agricultural practices in the Garden Route and a study of farmers’ attitudes towards changing rainfall patterns and other climatic variables. The assessment involved meetings with representatives from the Department of Agriculture and other stakeholders. The results were incorporated into a scenario planning exercise to determine trends in the observed and projected climate for the project area. Final results were confirmed by a specialist review panel who suggested recommendations to the farmers, agricultural unions, relevant government departments and politicians based on the projected outcomes. Final reports were disseminated to government departments and civil society stakeholders to inform planning initiatives. (Eden District Municipality and Wildlife Society of South Africa).

May 2008 to April 2010  Review of impact assessments and appeals, George, South Africa  Principal Environmental Officer (Contract)

Review of impact assessments and appeals in terms of the Environment Conservation Act (ECA), inclusive of site visits and providing comment on land development processes. (Western Cape Department of Environmental Affairs and Development Planning).

January 2008 to April 2008  Review of the biodiversity components of municipal Spatial Development Frameworks in the Western Cape  Environmental Practitioner

Appointed to provide an overview of the requirement for biodiversity in spatial development frameworks (SDFs), and an assessment of the current status of biodiversity in these SDFs in the Western Cape as part of the UNDP and GEF funded Cape Action for People and the Environment initiative. (Ninham Shand for South African National Biodiversity Institute).

February 2007 to April 2008  Independent review of EIA applications  Specialist Independent Reviewer

Review of EIA applications to assist the Eastern Cape Province with the processing of the backlog of applications in terms of the Environment Conservation Act (ECA). (Eastern Cape Department of Economic Development, Environment and Tourism).

March 2003 to December 2006  Review of impact assessments and appeals, George, South Africa  Environmental Officer

Review of applications in terms of the National Environmental Management Act (NEMA), obtaining comment from relevant authorities with regard to applications, conducting site visits, providing
comment on land development processes, providing comment on environmental management program reports, liaison with stakeholders on the implementation of the relevant environmental legislation and checking legal non-compliance. The role also included liaison with municipalities and other stakeholders and mentoring junior environmental officers. (Western Cape Department of Environmental Affairs and Development Planning).

CAREER ENHANCING COURSES:

2006 : Sustainable Development Implementation Plan, Department of Environmental Affairs and Development Planning of the Western Cape
2005 : Environmental Law for Environmental Managers, North West University
2005 : Sustainable Livelihoods, IDL Group
2004 : Environmental Impact Assessment Process, Department of Environmental Affairs and Development Planning of the Western Cape

PAPERS AND PUBLICATIONS:


EMPLOYMENT RECORD:

2011 - date Joined Aurecon South Africa (Pty) Ltd as a Senior Environmental Practitioner
2007 - date Part-time lecturer in Coastal and Marine Management, Nelson Mandela Metropolitan University, George, South Africa
2008 - 2010 Environmental Practitioner (Contract), WESSA, George, South Africa
2008 - 2010 Principal Environmental Officer (Contract), Provincial Department of Environment Affairs and Development Planning, George, South Africa
2007 Environmental Practitioner (Contract), Ninham Shand
2003 - 2006 Environmental Officer, Provincial Department of Environment Affairs and Development Planning, George, South Africa
2000 - 2003 High School Teacher (Geography and French) Pro-Arte Alphen Park, Pretoria, South Africa
1999 High School Teacher (Geography and French) East Brook and Forest Gate, London, United Kingdom
1998 Assistant, Macaroon Civil Engineers, Pretoria, South Africa
LANGUAGES:

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<td>French</td>
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CERTIFICATION:

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe my qualifications, my experience, and me. I also certify that I have given permission for my CV to be included in the proposal.

__________________________ Date: ________________
(Signature of staff member and authorised representative of the firm) (Day / Month / Year)

Full name of staff member: CORNELIA JOHANNA STEYN

Full name of authorised representative: ______________________________________________
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SPECIFICATION EM : ENVIRONMENTAL MANAGEMENT (COMPREHENSIVE)

1. SCOPE

This Specification covers the requirements for controlling the impact of construction activities on the environment. It contains clauses that are generally applicable to the undertaking of civil engineering works in areas where it is necessary to impose pro-active controls on the extent to which the construction activities impact on the environment.

Interpretations and variations of this Specification are set out in the Specification Data.

2. NORMATIVE REFERENCES

2.1 Supporting specifications

Where this Specification is required for a project the following specifications shall, inter alia, form part of the Contract Document.

a) Specification Data;
b) SANS 1200 Series of Standardized Specifications;
   i) SANS 1200 A or SANS 1200 AA, as applicable;
c) Specification AO,
d) Construction Regulations, 2003, and
e) Standards listed in Appendix A. ¹

3. DEFINITIONS

For the purposes of this Specification the definitions and abbreviations given in the applicable specifications listed in 2.1 and the following definitions shall apply:

Environment : The surroundings within which humans exist and that are made up of:
   i) the land, water and atmosphere of the earth;
   ii) micro-organisms, plant and animal life;
   iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and
   iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Potentially hazardous Substance : A substance that, in the reasonable opinion of the Engineer, can have a deleterious effect on the environment.

Method Statement : A written submission by the Contractor to the Engineer in response to the Specification or a request by the Engineer, setting out the plant, materials, labour and method the Contractor proposes using to carry out an activity, identified by the relevant specification or the Engineer when requesting the Method Statement, in such detail that the Engineer is enabled to assess whether the Contractor’s proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications.

¹ See Appendix A
The Method Statement shall cover applicable details with regard to:
- construction procedures,
- materials and equipment to be used,
- transportation of equipment/materials to and from site,
- movement of equipment/material on site,
- storage of materials on site,
- containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur,
- timing and location of activities,
- areas of non-compliance with the Specifications, and
- any other information deemed necessary by the Engineer.

Reasonable: Unless the context indicates otherwise, reasonable in the opinion of the Engineer after he has consulted with a person, not an employee of the Employer, suitably experienced in "environmental implementation plans" and "environmental management plans" (both as defined in Act No 107,1998).

Solid waste: All solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Contaminated water: Water contaminated by the Contractor's activities, e.g. concrete water and runoff from plant/ personnel wash areas.

Topmaterial: The top 150 mm of soil (topsoil) and root material of cleared vegetation.

4. REQUIREMENTS

4.1 Materials

4.1.1 Materials handling, use and storage

The Contractor shall ensure that any delivery drivers are informed of all procedures and restrictions (including "no go" areas) required to comply with the Specifications. The Contractor shall ensure that these delivery drivers are supervised during off loading, by someone with an adequate understanding of the requirements of the Specifications.

Materials shall be appropriately secured to ensure safe passage between destinations. Loads including, but not limited to sand, stone chips, fine vegetation, refuse, paper and cement, shall have appropriate cover to prevent them spilling from the vehicle during transit. The Contractor shall be responsible for any clean-up resulting from the failure by his employees or suppliers to properly secure transported materials.
4.1.2 Hazardous substances

Procedures detailed in the Material Safety Data Sheets (MSDSs) shall be followed in the event of an emergency situation.

Petroleum, chemicals, harmful and hazardous waste shall be stored in an enclosed and bunded area. This area shall be subject to the approval of the Engineer. The waste shall be disposed of at a hazardous waste disposal site as approved by the Engineer.

4.1.2.1 Shutter oil and curing compound

Shutter oil and curing compound pose a risk of causing water and soil contamination and accordingly are regarded as potential hazardous substances. The Contractor shall ensure that shutter oil and curing compound containers in use are stored within the fuel bund. The remaining containers shall be inspected regularly to ensure that no leakage occurs. When shutter oil or curing compound is dispensed, the proper dispensing equipment shall be used, and the storage container shall not be tipped in order to dispense the oil/compound. The dispensing mechanism of the shutter oil/curing compound storage container shall be stored in a waterproof container when not in use.

Shutter oil and curing shall be used in moderation and shall be applied under controlled conditions using appropriate equipment. The Contractor shall take all reasonable precautions to prevent accidental and incidental spillage during the application of these compounds.

In the event of a shutter oil or curing compound spill, the source of the spillage shall be isolated, and the spillage contained. The Contractor shall clean up the spill, either by removing the contaminated soil or by the application of absorbent material in the event of a larger spill. Treatment and remediation of the spill area shall be undertaken to the reasonable satisfaction of the Engineer.

4.1.2.2 Bitumen

The Engineer shall be advised of the area that the Contractor intends using for the storage of bitumen drums/products. The storage area shall have a smooth impermeable (concrete or 250 µm plastic covered in sand) floor. The floor shall be bunded and sloped towards a sump to contain any spillages of substances. The bund shall be inspected and emptied daily, and serviced when necessary. The bund shall be closely monitored during rain events to ensure that it does not overflow.

4.2 Plant

4.2.1 Ablution facilities

The Contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are properly stored and removed from Site. Discharge of waste from toilets into the environment and burial of waste is strictly prohibited.

Washing, whether of the person or of personal effects and acts of excretion and urination are strictly prohibited other than at the facilities provided.
4.2.2 Solid waste management

The Contractor shall provide sufficient bins with lids on Site to store the solid waste produced on a daily basis. Solid, non-hazardous waste shall be disposed of in the bins provided and no on-site burying, dumping or burning of any waste materials, vegetation, litter or refuse shall occur. Bins shall not be allowed to become overfull and shall be emptied a minimum of once daily. The waste may be temporarily stored on Site in a central waste area that is weatherproof and scavenger-proof, and which the Engineer has approved.

All solid waste shall be disposed of off site at an approved landfill site. The Contractor shall supply the Engineer with a certificate of disposal.

4.2.3 Contaminated water

The Contractor shall set up a contaminated water management system, which shall include collection facilities to be used to prevent pollution, as well as suitable methods of disposal of contaminated water. The Contractor shall prevent the discharge of water contaminated with any pollutants, such as soaps, detergent, cements, concrete, lime, chemicals, glues, solvents, paints and fuels, into the environment.

The Contractor shall notify the Engineer immediately of any pollution incidents on Site. The Engineer’s approval is required prior to the discharge of contaminated water to the Municipal sewer system.

4.2.4 Site structures

All site establishment components (as well as equipment) shall be positioned to limit visual intrusion on neighbours and the size of area disturbed. The type and colour of roofing and cladding materials to the Contractor’s temporary structures shall be selected to reduce reflection.

4.2.5 Noise control

The applicable regulations framed under the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), and the provisions of SANS 1200 A Subclause 4.1 regarding “built-up areas” shall apply to all areas within audible distance of residents whether in urban, peri-urban or rural areas.

Appropriate directional and intensity settings are to be maintained on all hooters and sirens, and the Contractor shall provide and use suitable and effective silencing devices for pneumatic tools and other plant such that the noise level in inhabited areas and dwellings adjacent to the work areas will not increase by more than 7 dB(A)Leq 60 above residual background sound levels. Similarly in habituated areas adjacent to access roads maximum noise levels shall not exceed 60 dB(A)Leq 60 and maximum sound pressure level of 70 dB(A).

Where excess noise generation is unavoidable, the Contractor shall, by means of barriers, effectively isolate the source of any such noise in order to comply with the said regulations. The Contractor shall restrict any of his operations that may result in undue noise disturbance to those communities and dwellings abutting the Site to the hours of 08:00 to 17:00 on weekdays and Saturdays. No work will be permitted on Sundays unless otherwise agreed to with the Engineer.

No amplified music shall be allowed on Site. The use of radios, tape recorders, compact disc players, television sets etc shall not be permitted unless the volume is kept sufficiently low as to avoid any intrusion on members of the public within range. The Contractor shall not use sound amplification equipment on Site unless in emergency situations.
4.2.6 Lights

The Contractor shall ensure that any lighting installed on the site for his activities does not interfere with road traffic or cause a reasonably avoidable disturbance to the surrounding community or other users of the area.

4.2.7 Fuel (petrol and diesel) and oil

Unless otherwise specified in the Specification Data, fuel may be stored on site in an area approved by the Engineer. The Contractor shall ensure that all liquid fuels (petrol and diesel) are stored in tanks with lids, which are kept firmly shut or in bowsers. The tanks/bowsers shall be situated on a smooth impermeable surface (concrete or 250 µm plastic) with an earth bund (plastic must have a 5 cm layer of sand on top to prevent damage and perishing). The impermeable lining shall extend to the crest of the bund and the volume inside the bund shall be 130% of the total capacity of all the storage tanks/bowsers. The bunded area shall be covered to protect it from rain. Provision shall be made for refuelling at the fuel storage area, by protecting the soil with 250 µm plastic covered with a minimum of a 5 cm layer of sand.

If fuel is dispensed from 200 litre drums, only empty externally clean drums may be stored on the bare ground. All empty externally dirty drums shall be stored on an area where the ground has been protected. The proper dispensing equipment shall be used, and the drum shall not be tipped in order to dispense fuel. The dispensing mechanism of the fuel storage drum shall be stored in a waterproof container when not in use.

The Contractor shall prevent unauthorised access into the fuel storage area. No smoking shall be allowed within the vicinity of the fuel storage area. The Contractor shall ensure that there is adequate fire-fighting equipment at the fuel stores.

Where reasonably practical, plant shall be refuelled at the fuel storage area or at the workshop as applicable. If it is not reasonably practical then the surface under the refuelling area shall be protected against pollution to the reasonable satisfaction of the Engineer prior to any refuelling activities. The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown and where possible be designed to encapsulate minor hydrocarbon spillage. The quantity of such materials shall be able to handle a minimum of 200 l of hydrocarbon liquid spill. The Contractor shall obtain the Engineer's prior approval for any refuelling or maintenance activities.

4.2.8 Workshop, equipment maintenance and storage

Leaking equipment shall be repaired immediately or removed from the Site. Where practical, all maintenance of equipment and vehicles on Site shall be performed off Site or in the workshop. If it is necessary to do maintenance outside of the workshop area, the Contractor shall obtain the approval of the Engineer prior to commencing activities. The Contractor shall ensure that in his workshop and other plant maintenance facilities, including those areas where, after obtaining the Engineer's approval, the Contractor carries out emergency plant maintenance, there is no contamination of the soil or vegetation. The workshop shall have a smooth impermeable (concrete or 250 µm plastic covered with sand) floor. The floor shall be bunded and sloped towards an oil trap or sump to contain any spillages of substances (e.g. oil).

When servicing equipment on site, drip trays shall be used to collect the waste oil and other lubricants. Drip trays shall also be provided in construction areas for stationary plant (such as compressors) and for "parked" plant (such as scrapers, loaders, vehicles). Drip trays shall be inspected and emptied daily. Drip trays shall be closely monitored during rain events to ensure that they do not overflow. Where practical, the Contractor shall ensure that equipment is covered so that rainwater is excluded from the drip trays.
The washing of equipment shall be restricted to urgent or preventative maintenance requirements only. All washing shall be undertaken off Site or in the workshop. The use of detergents for washing shall be restricted to low phosphate and nitrate containing, low sudsing-type detergents.

4.2.9 Dust

The Contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the Engineer. The Contractor’s dust management planning shall, as a minimum, take cognisance of the following:

- Schedule of spraying water on unpaved roads paying due attention to control of runoff.
- Speed limits for vehicles on unpaved roads and minimisation of haul distances.
- Measures to ensure that material loads are properly covered during transportation.
- Schedule for wheel cleaning and measures to clean up public roads that may be soiled by construction vehicles.
- Minimisation of the areas disturbed at any one time and protection of exposed soil against wind erosion, e.g. by dampening with water or covering with straw.
- Location and treatment of material stockpiles taking into consideration prevailing wind directions and location of sensitive receptors.
- Controlled blasting techniques to minimise dust and fly rock during blasting.
- Adherence to the dust loads and protective gear stipulated in the Occupational Health and Safety Act.
- Reporting mechanism and action plan in case of excessive wind and dust conditions.

During summer, a water tanker shall be permanently available for the control of dust generation, and the Contractor shall ensure that the sprays do not generate excess run off. During winter, provision shall be made for a tanker, as required by the Engineer.

During high wind conditions, the Contractor shall comply with the Engineer’s instructions regarding dust-damping measures. The Engineer may request the temporary cessation of all construction activities where wind speeds are unacceptably high, and until such time as wind speeds return to acceptable levels.

As required by the Specification Data, the Contractors shall develop and implement a programme for the monitoring of dust fallout in areas where dust generation may be expected.

4.3 Methods and procedures

4.3.1 Method Statements

Any Method Statement required by this Specification, the Specification Data or the Engineer shall be produced within such reasonable time as is required by this Specification, the Specification Data or the Engineer. The Contractor shall not commence the activity until the Method Statement has been approved. Except in the case of emergency activities, the Contractor shall allow a period of two weeks for approval of the Method Statement by the Engineer. Such approval shall not unreasonably be withheld.

Method Statements in respect of environment management that shall be provided by the Contractor within 14 days of receipt of the letter of acceptance and prior to the activity covered by the Method Statement being undertaken, include:

1) Location and structure of the fuel storage site, including the type and volume of storage container and the design and capacity of the bund.
2) Solid waste (refuse) control and removal of waste from the Site, including the number, type and location of rubbish bins, the manner and frequency with which the waste will be removed from site and the disposal site.

3) Contaminated water management system, including an indication of the source and volume of contaminated water and how this would be disposed of.

4) Dust control, including methods to prevent dust generation and methods to reduce dust where its generation is unavoidable.

5) Location and layout of the construction camp in the form of a plan showing offices, stores for fuels and explosives, vehicle parking, access point, equipment cleaning areas and staff toilet placement.

6) Location of proposed site access routes and proposed traffic safety measures.

7) Emergency procedures for fire, and accidental leaks and spillages of hazardous materials.

8) Location, layout and preparation of cement/concrete batching facilities including the methods employed for the mixing of concrete and the management of runoff water from such areas. An indication shall be given of how concrete spoil will be minimised and cleared.

9) Method of undertaking earthworks, including spoil management, erosion, dust and noise controls.

10) Motivation and method for undertaking any construction related activities within a “no-go” area, including requisite emergency procedures. Unless need clearly motivated and proposed methodology exhibits clear focus on environmentally sensitive construction practice, no activity will be permitted within the defined “no-go” areas.

4.3.2 Environmental awareness training

Within seven days of the Commencement Date, the Contractor’s site staff including foremen and site management staff shall attend an environmental awareness training course, of approximately one-hour duration. The Contractor shall liaise with the Engineer prior to the Commencement Date to fix a date and venue for the course. The Contractor shall provide a suitable venue with facilities as required by the Specification Data, and ensure that the specified employees attend the course.

No more than 20 people shall attend each course and the Contractor shall allow for sufficient sessions to train all personnel. Subsequent sessions shall be run for any new personnel coming onto site.

The environmental awareness training course shall be held in the morning during normal working hours. Any new employees coming on to site after the initial training course and the Contractor’s suppliers and subcontractors shall also attend the course. Provision should also be made for quarterly refreshers courses to be undertaken during the course of the Contract. The Contractor shall ensure that all attendees sign an attendance register, and shall provide the Engineer with a copy of the attendance register the day after each course.
4.3.3 Construction personnel information posters

The Contractor shall erect and maintain information posters for the information of his employees depicting actions to be taken to ensure compliance with aspects of the Specifications. Such posters will be supplied by the Engineer and shall be erected at a location specified by the Engineer.

4.3.4 Site clearance

The Contractor shall ensure that the clearance of vegetation is restricted to that required to facilitate the execution of the Works. Site clearance shall occur in a planned manner, and cleared areas shall be stabilised as soon as possible. The detail of vegetation clearing shall be to the Engineer’s approval. All cleared vegetation shall either be mulched and mixed into the topsoil stockpiles or disposed of at an approved disposal site. The disposal of vegetation by burying or burning is prohibited without the requisite permit from the local authority.

The Contractor shall strip the Topmaterial within the working areas. The Topmaterial shall be stockpiled separately from subsoil and used for subsequent rehabilitation and revegetation. Topmaterial stockpiles shall not be compacted.

Should fauna be encountered during site clearance, earthworks shall cease until fauna have been safely relocated.

4.3.5 Site division

The Engineer shall be advised of the area that the Contractor intends using for his site establishment. The Contractor’s camp shall occupy as small an area as possible, and no site establishment shall be allowed within 50 m of any watercourse unless otherwise approved by the Engineer.

The Contractor shall inform the Engineer of the intended actions and programme for site establishment. The site layout shall be planned to facilitate ready access for deliveries, facilitate future works and to curtail any disturbance or security implications for neighbours.

4.3.6 Site demarcation

As required by the Specification Data, the Contractor shall erect and maintain permanent and/or temporary fences of the type and in the locations directed by the Engineer. Such fences shall, if so specified, be erected before undertaking designated activities.

4.3.7 "No go" areas

If so required by the Specification Data, certain areas shall be considered "no go" areas. The Contractor shall ensure that, insofar as he has the authority, no unauthorised entry, stockpiling, dumping or storage of equipment or materials shall be allowed within the demarcated “no go” areas.

“No go” areas shall be demarcated with fencing consisting of wooden or metal posts at 3 m centres with 1 plain wire strand tensioned horizontally at 900 mm from ground level. Commercially available danger tape shall be wrapped around the wire strand. The Contractor shall maintain the fence for the duration of construction and ensure that the danger tape does not become dislodged.
4.3.8 Protection of natural features

The Contractor shall not deface, paint, damage or mark any natural features (e.g. rock formations) situated in or around the Site for survey or other purposes unless agreed beforehand with the Engineer. Any features affected by the Contractor in contravention of this clause shall be restored/ rehabilitated to the satisfaction of the Engineer.

The Contractor shall not permit his employees to make use of any natural water sources (e.g. springs, streams, open water bodies) for the purposes of swimming, personal washing and the washing of machinery or clothes.

4.3.9 Protection of flora and fauna

Except to the extent necessary for the carrying out of the Works, flora shall not be removed, damaged or disturbed nor shall any vegetation be planted without authorisation.

Trapping, poisoning and/ or shooting of animals is strictly forbidden. No domestic pets or livestock are permitted on Site.

Where the use of herbicides, pesticides and other poisonous substances has been specified, they shall be stored, handled and applied with due regard to their potential harmful effects.

4.3.10 Protection of archaeological and palaeontological remains

The Contractor shall take reasonable precautions to prevent any person from removing or damaging any fossils, coins, articles of value or antiquity and structures and other remains of archaeological interest discovered on the Site, immediately upon discovery thereof and before removal. The Contractor shall inform the Engineer immediately of such a discovery and carry out the Engineers instructions for dealing therewith. All construction within the vicinity of the discovery shall cease immediately and the area shall be cordoned off until such time as the Engineer authorises resumption of construction in writing.

The Engineer will contact the relevant heritage authority.

4.3.11 Access routes / haul roads

Access to the Construction camp and working areas shall utilise existing roads or tracks. Entry/exit points onto public roads shall take cognisance of traffic safety. Traffic safety measures shall included appropriate signage and signalmen where relevant.

On the Site, and, if so required by the Specification Data, within such distance of the Site as may be stated, the Contractor shall control the movement of all vehicles and plant including that of his suppliers so that they remain on designated routes, are distributed so as not to cause an undue concentration of traffic and that all relevant laws are complied with. In addition such vehicles and plant shall be so routed and operated as to minimise disruption to regular users of the routes not on the Site. On gravel or earth roads on Site and within 500 m of the Site, the vehicles of the Contractor and his suppliers shall not exceed a speed of 20 km/h.

Mud and sand deposited onto public roads by construction activities shall be cleared on a daily basis.
4.3.12 Cement and concrete batching

Where applicable, the location of the batching plant (including the location of cement stores, sand and aggregate stockpiles) shall be as approved by the Engineer. The concrete/cement batching plant shall be kept neat and clean at all times.

No batching activities shall occur directly on unprotected ground. The batching plant shall be located on a smooth impermeable surface (concrete or 250 µm plastic covered with 5 cm of sand). The area shall be bunded and sloped towards a sump to contain spillages of substances. All wastewater resulting from batching of concrete shall be disposed of via the contaminated water management system and shall not be discharged into the environment. Contaminated water storage areas shall not be allowed to overflow and appropriate protection from rain and flooding shall be implemented.

Empty cement bags shall be stored in weatherproof containers to prevent wind blown cement dust and water contamination. Empty cement bags shall be disposed of on a regular basis via the solid waste management system, and shall not be used for any other purpose. Unused cement bags shall be stored so as not to be affected by rain or runoff events. In this regard, closed steel containers shall be used for the storage of cement powder and any additives. The Contractor shall ensure that sand, aggregate, cement or additives used during the mixing process are contained and covered to prevent contamination of the surrounding environment.

The Contractor shall take all reasonable measures to prevent the spillage of cement/concrete during batching and construction operations. During pouring, the soil surface shall be protected using plastic and all visible remains of concrete shall be physically removed on completion of the cement/concrete pour and appropriately disposed of. All spoiled and excess aggregate/cement/concrete shall be removed and disposed of via the solid waste management system.

Where “readymix” concrete is used, the Contractor shall ensure that the delivery vehicles do not wash their chutes directly onto the ground. Any spillage resulting from the “readymix” delivery shall be immediately cleared and disposed of via the solid waste management system.

4.3.13 Earthworks

All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities, particularly with regards to erosion and dust generation. No equipment associated with earthworks shall be allowed outside of the Site and defined access routes unless expressly permitted by the Engineer.

4.3.14 Pumping

Pumps shall be placed over a drip tray in order to contain fuel spills and leaks. The Contractor shall take all reasonable precautions to prevent spillage during the refuelling of these pumps.

The Contractor shall ensure that none of the water pumped during any dewatering activities, including well points, is released into the environment without the Engineer’s approval. The Engineer’s approval is required prior to the discharge of this water into the Municipal sewer system.
4.3.15 Bitumen

Over spray of bitumen products outside of the road surface and onto roadside vegetation or the surrounding environment shall be prevented using a method approved by the Engineer.

When heating bitumen products, the Contractor shall take cognisance of appropriate fire risk controls. Heating of bitumen products shall only be undertaken using LPG or similar zero emission fuels and appropriate fire fighting equipment shall be readily available.

Stone chip/gravel excess shall not be left on road / paved area verges. This shall be swept / raked into piles and removed to an area approved by the Engineer.

Water quality from runoff from new/ fresh bitumen surfaces will be monitored visually by the Engineer and remedial actions taken where necessary by the Contractor.

4.3.16 Fire control

No fires may be lit on site. Any fires that occur shall be reported to the Engineer immediately. Smoking shall not be permitted in those areas where it is a fire hazard. Such areas shall include the workshop and fuel storage areas and any areas where the vegetation or other material is such as to make liable the rapid spread of an initial flame. In terms of the Atmospheric Pollution Prevention Act (No. 45 of 1965), burning is not permitted as a disposal method.

The Contractor shall ensure that there is basic fire-fighting equipment available on Site at all times. This shall include at least rubber beaters when working in urban open spaces and fynbos areas, and at least one fire extinguisher of the appropriate type when welding or other “hot” activities are undertaken.

4.3.17 Emergency procedures

The Contractor’s procedures for the following emergencies shall include:

i) Fire

The Contractor shall advise the relevant authority of a fire as soon as one starts and shall not wait until he can no longer control it. The Contractor shall ensure that his employees are aware of the procedure to be followed in the event of a fire.

ii) Accidental leaks and spillages

The Contractor shall ensure that his employees are aware of the emergency procedure(s) to be followed for dealing with spills and leaks, which shall include notifying the Engineer and the relevant authorities. The Contractor shall ensure that the necessary materials and equipment for dealing with spills and leaks is available on Site at all times. Treatment and remediation of the spill areas shall be undertaken to the reasonable satisfaction of the Engineer.

In the event of a hydrocarbon spill, the source of the spillage shall be isolated, and the spillage contained. The area shall be cordoned off and secured. The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown and where possible be designed to encapsulate minor hydrocarbon spillage. The quantity of such materials shall be able to handle a minimum of 200 ℓ of hydrocarbon liquid spill.
4.3.18 Community relations

The Contractor shall erect and maintain information boards in the position, quantity, design and dimensions specified. Such boards shall include contact details for complaints by members of the public in accordance with details provided by the Engineer.

The Contractor shall keep a “Complaints Register” on Site. The Register shall contain all contact details of the person who made the complaint, and information regarding the complaint itself.

4.3.19 Erosion and sedimentation control

The Contractor shall take all reasonable measures to limit erosion and sedimentation due to the construction activities. Where erosion and/or sedimentation, whether on or off the Site, occurs despite the Contractor complying with the foregoing, rectification shall be carried out in accordance with details specified by the Engineer. Where erosion and/or sedimentation occur due to the fault of the Contractor, rectification shall be carried out to the reasonable requirements of the Engineer.

Any runnels or erosion channels developed during construction or during the defects liability period shall be backfilled and compacted. Stabilisation of cleared areas to prevent and control erosion shall be actively managed. Consideration and provision shall be made for various methods, namely, brushcut packing, mulch or chip cover, straw stabilising (at a rate of one bale/20 m² and rotovated into the top 100 mm of the completed earthworks), watering, soil binders and anti erosion compounds, mechanical cover or packing structures (e.g. Hessian cover).

Traffic and movement over stabilised areas shall be restricted and controlled, and damage to stabilised area shall be repaired and maintained to the satisfaction of the Engineer.

4.3.20 Aesthetics

The Contractor shall take reasonable measures to ensure that construction activities do not have an unreasonable impact on the aesthetics of the area.

4.3.21 Recreation

If so required by the Specification Data, the Contractor shall take measures to reduce disruption to recreational users of the area abutting the Site.

4.3.22 Access to site

The Contractor shall ensure that access to the Site and associated infrastructure and equipment is off-limits to the public at all times during construction. If so required, as directed by the Engineer, the Contractor shall fence the site to ensure effective control of access to the site. This fence shall be a diamond mesh fence or similar with a minimum height of 1.8 m, and it shall be erected around the site and shall be maintained for the duration of construction.

4.3.23 Crane operations

Drive plants shall be well maintained and drip trays shall be positioned at potential leak areas. Over-greasing of crane cables shall be avoided.

Movement and lifting of hazardous materials shall be undertaken such that they do not cause a pollution, spillage or safety risk (in particular were concrete buckets are in use).
4.3.24 Trenching

Trenching for services shall be undertaken in accordance with the engineering specifications with the following environmental amplifications, where applicable:

a) Soil shall be excavated and used for refilling trenches i.e. soil from the first trench shall be excavated and stockpiled, thereafter soil from the second excavated trench length shall be used to backfill the trench behind it once the services have been laid. The last trench shall be filled using the soil stockpiled from the first trench.

b) Trench lengths shall be kept as short as practicably possible before backfilling and compacting.

c) Trenches shall be re-filled to the same level as (or slightly higher to allow for settlement) the surrounding land surface to minimise erosion.

4.3.25 Demolition

Hazardous and non-hazardous materials shall be separated at site and disposed of in a manner approved by the Engineer.

All buildings older than 60 years require a permit from South African Heritage Resources Agency in terms of the National Heritage Resources Act (no. 25 of 1999). A demolition permit is also required from the local authority in terms of the National Building Regulations.

4.3.26 Drilling and jack hammering

The Contractor shall take all reasonable measures to limit dust generation and noise as a result of drilling operations. The Contractor shall ensure that no pollution results from drilling operations, either as a result of oil and fuel drips, or from drilling fluid.

Any areas or structures damaged by the drilling and associated activities shall be rehabilitated by the Contractor to the satisfaction of the Engineer.

4.3.27 Stockpiling

The Engineer will identify suitable sites for stockpiling. Stockpiles shall be convex in shape, shall be no higher than 2 m and shall be located so as to cause minimal disturbance. Stockpiles shall be so placed to occupy minimum width compatible with the natural angle of repose of material, and measures shall be taken to prevent the material from being spread over too wide a surface. Where required, appropriate precautions shall be taken to prevent the erosion and limit the compaction of the stockpiles. The Contractor shall ensure that all stockpiles do not cause the damming of water or run off, or is itself washed away.

Topmaterial stockpiles shall not be covered with any material (e.g. plastic) that may kill seeds or cause it to compost. If the stockpiles start to erode significantly or cause dust problems, they shall be covered with hessian. Where practical, Topmaterial shall not be left for longer than six to eight months before being used for rehabilitation. If stored for longer than six months, the Topmaterial shall be analysed and, if necessary, upgraded before placement.
4.3.28 Site closure and rehabilitation

Any areas that the Engineer believes may have been impacted upon or disturbed, shall be rehabilitated to the satisfaction of the Engineer, which includes all areas where Topmaterial has been stripped. Once construction is complete the Contractor shall clear everything from the Site not forming part of the Permanent Works. The area to be rehabilitated shall first be landscaped to match the topography of the surrounding area as it was prior to construction. The composition of vegetation to be used for any rehabilitation shall be as specified in the Specification Data.

The Contractor may not use herbicides, pesticides, fertilisers or other poisonous substances for the rehabilitation process unless otherwise agreed with the Engineer.

All rehabilitated areas shall be considered “no go” areas and the Contractor shall ensure that none of his staff or equipment enters these areas.

The Contractor shall undertake to remove all alien vegetation re-establishing on the area and shall implement the necessary temporary or permanent measures to combat soil erosion.

4.3.29 Temporary revegetation of the areas disturbed by construction.

Where there is likely to be a delay of greater than two weeks in the landscaping and revegetation of a disturbed area or where that site is likely to be the subject of further construction activities at a later stage, the Contractor shall ensure that the area is temporarily revegetated to combat dust generation and prevent erosion. This revegetation shall occur incrementally immediately upon completion of the construction activities at the subject location.

Prior to revegetation structures and material not forming part of the Permanent Works, including remnants of building materials, concrete foundations, timber and other foreign debris, shall be removed and disposed of via the solid waste management system. The area shall be revegetated as follows:

a) The surface shall be levelled by hand or machine as far as practically possible.

b) Alien vegetation shall be cleared by cutting the plants off at ground level, and painting the stump with 0.5% Garlon in diesel.

c) For areas with a slope of greater than 1:3, straw shall be utilised as a binding material to stabilise the soil during revegetation and rehabilitation of the site. Straw shall consist of natural, dried fibres of hay or chaff of various lengths between 50 mm and 400 mm, delivered to Site in bales and shall be applied evenly by hand or machine at a rate of 1 bale per 20 m² over the area to be revegetated. It shall then immediately be rotovated into the upper 100 mm layer of soil.

d) The prepared area shall be hydro- or hand-seeded at a rate of 40 kg/ha using Rye grass (Lolium multiflorum). In the event of hand-seeding, the seed mixture as specified shall be mixed with two parts per volume of clean dry plaster sand, then divided in half and applied evenly in two successive applications, one after the other, by means of an approved hand seeding machine (known colloquially as a “tefsaaier”). On completion of the seeding the surface shall be lightly raked to cover the seed with no more than 5 mm of soil.

e) Water used for the irrigation of vegetated areas shall be free of pollutants that will have a detrimental effect on the plants. The vegetated area shall only be watered once, immediately following seeding. Watering should be carried out from a tanker, using a fine nozzle spray to avoid erosion and disturbance of the vegetation. Water for irrigation purposes may not be drawn from any water body.
No construction equipment, vehicles or unauthorised personnel shall be allowed onto areas that have been vegetated. Only persons or equipment required for the preparation of areas, application of fertiliser and maintenance of revegetated area shall be allowed to operate on these areas.

4.3.30 Temporary site closure

If the site is closed for a period exceeding one week, the Contractor, in consultation with the Engineer shall carry out the following checklist procedure.

**Hazardous materials stores**
Outlet secure / locked  
Bund empty (where applicable)  
Fire extinguishers serviced and accessible  
Secure area from accidental damage e.g. vehicle collision  
Emergency and contact details displayed  
Adequate ventilation

**Safety**
All trenches and manholes secured  
Fencing and barriers in place as per the Occupational Health and Safety Act (No 85 of 1993)  
Emergency and management contact details displayed  
Pipe stockpile wedged/ secured

**Erosion**
Wind and dust mitigation in place  
Slopes and stockpiles at stable angle  
Revegetated areas watering schedules and supply secured

**Water contamination and pollution**
Cement and materials stores secured  
Toilets empty and secured  
Refuse bins empty and secured  
Drip trays empty and secure (where possible)  
Structures vulnerable to high winds secure

5. COMPLIANCE WITH REQUIREMENTS AND PENALTIES

5.1 Compliance

Environmental management is concerned not only with the final results of the Contractor's operations to carry out the Works but also with the control of how those operations are carried out. Tolerance with respect to environmental matters applies not only to the finished product but also to the standard of the day-to-day operations required to complete the Works.

It is thus required that the Contractor shall comply with the environmental requirements on an ongoing basis and any failure on his part to do so will entitle the Engineer to certify the imposition of a penalty as detailed below.
5.2 Penalties

Penalties will be issued for certain transgressions. Penalties may be issued per incident at the discretion of the Engineer. Such penalties will be issued in addition to any remedial costs incurred as a result of non-compliance with this Specification. The Engineer will inform the Contractor of the contravention and the amount of the penalty, and shall be entitled to deduct the amount from monies due under the Contract.

Penalties will be as set out in the Specification Data.

5.3 Removal from site and suspension of Works

The Engineer may instruct the Contractor to remove from Site any person(s) who in their opinion is guilty of misconduct, or is incompetent, negligent or constitutes an undesirable presence on Site. Subclause 4.1.9 of this Specification requires that all Plant be in good working order, and accordingly the Engineer may order that any Plant not complying with the Specifications be removed from Site. Where the Engineer deems the Contractor to be in breach of any of the requirements of this Specification, he may order the Contractor to suspend the progress of the Works or any part thereof.

6. Void

7. Void

8. MEASUREMENT AND PAYMENT

8.1 Basic principles

8.1.1 General

Except as specified below, or in the Specification Data or as billed, no separate measurement and payment will be made to cover the costs of complying with the provisions of this Specification and such costs shall be deemed to be covered by the rates tendered for the items in the Bill of Quantities completed by the Contractor when submitting his tender.

8.1.2 All requirements of the environmental management specification

All work not measured elsewhere, associated with complying with any requirement of this Environmental Management specification will be measured and paid as a sum.

The tendered sum shall cover the cost of with complying with the environmental management specification and shall include for all materials, labour and plant required to execute and complete the Works as specified, described in the Bill of Quantities or shown on the Drawing(s).

8.1.3 Work "required by the Specification Data"

Where a clause in this Specification includes a requirement as "required by the Specification Data", measurement and payment for compliance with that requirement shall be in accordance with the relevant measurement and payment clause of the Specification Data.
8.2 Billed items

8.2.1 Method Statements: Additional work

No separate measurement and payment will be made for the provision of Method Statements but, where the Engineer requires a change on the basis of his opinion that the proposal may result in, or carries a greater than warranted risk of damage to the environment in excess of that warranted by the Specifications, then any additional work required, provided it could not reasonably have been foreseen by an experienced contractor, shall be valued in accordance with the Clause in the General Conditions of Contract dealing with Provisional Sums.

A stated sum is provided in the Bill of Quantities to cover payment for such additional work.

8.2.2 All requirements of the environmental management specification

Unit: ....................................................................................................................... Sum

All other work not measured elsewhere, associated with complying with any requirement of the environmental management specification shall be measured as a sum.

The tendered rate shall cover any cost associated with complying with the environmental management specification and shall include for all materials, labour and plant required to execute and complete the work as specified, described in the Bill of Quantities or shown on the drawing(s).

---o0o---
APPENDIX A : APPLICABLE STANDARDS

Reference is made to the latest issues of the following standards:

SANS 1200 A       General
SANS 1200 AA      General (small works)

Specification AO   Occupational Health and Safety


---o0o---
**Department of Environmental Affairs Requirements**

The Department of Environmental Affairs (DEA) accepted the Final Scoping Report (FSR) on 8 October 2012 and requested that a list of information be provided with the Environmental Impact Assessment Report (EIAR). DEA also listed the same requirements in their acceptance of the application forms for the substation and grid connections associated with the wind and solar energy facilities on 24 July 2012 and 10 December 2012. These are listed below, together with the location of the relevant information.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Location in EIAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>• All applicable Departmental Guidelines must be considered throughout the application process.</td>
<td>Noted.</td>
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<tr>
<td>• Please be advised that in terms of the EIA Regulations and NEMA the investigation of alternatives is mandatory. Alternatives must therefore be identified, investigated to determine if they are feasible and reasonable. It is also mandatory to investigate and assess the option of not proceeding with the proposed activity (the &quot;no-go&quot; option).</td>
<td>Considerations in identification of preferred alternative – Section 3.4</td>
</tr>
<tr>
<td>• Should water, solid waste removal, effluent discharge, storm water management and electricity services be provided by the municipality, you are requested to provide this office with written proof that the municipality has sufficient capacity to provide the necessary services to the proposed development. Confirmation of the availability of services from the service providers must be provided together with the reports to be submitted.</td>
<td>No services would be provided by the municipality.</td>
</tr>
<tr>
<td>• In the reports to be submitted it must clearly be demonstrated in which way the proposed development will meet the requirements of sustainable development. You must also consider energy efficient technologies and water saving devices and technologies for the proposed development.</td>
<td>The layouts of the proposed projects were revised in order to avoid environmental sensitivities identified by the specialists (see Section 3.4.4). Furthermore recommendations from the specialists have been incorporated into the Draft Lifecycle Environmental Management Programme (see Annexure N). These measures demonstrate how the proposed projects meet the requirements of sustainable development.</td>
</tr>
<tr>
<td>• A detailed and complete EMPr must be submitted with the EIR. This EMPr must not provide recommendations but must indicate actual remediation activities which will be binding on the applicant. Without this EMPr the documents will be regarded as not meeting the requirements and will be returned to the applicant for correction.</td>
<td>Refer to the Draft Lifecycle Environmental Management Programme (LEMPr) – Annexure N.</td>
</tr>
<tr>
<td><strong>The applicant/EAP</strong> is required to inform this Department in writing upon submission of any draft report, of the contact details of the relevant State Departments (that administer laws relating to a matter affecting the environment) to whom copies of the draft report were submitted for comment. Upon receipt of this confirmation, this Department will in accordance with Section 240 (2) &amp; (3) of the National Environmental Management Act, 1999 (Act 107 of 1998) inform the relevant State Departments of the commencement date of the 40 day commenting period.</td>
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<td>This is noted.</td>
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</table>

| Should it be necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999), please submit the necessary application to SAHRA or the relevant provincial heritage agency and submit proof thereof with the Environmental Impact assessment Report. The relevant heritage agency should also be involved during the public participation process and have the opportunity to comment on all the reports to be submitted to this Department. |
| Both SAHRA and Northern Cape Heritage have been sent a copy of the Draft EIR to provide comment on the proposed projects. Copies of the signed delivery notes are included in this annexure. |

| A copy of the final site layout plan. EIR. All available biodiversity information must be used in the finalisation of the layout plan. Existing infrastructure must be used as far as possible e.g. roads. The layout plan must indicate the following: |
| Refer to the Figure 1.1 for the proposed turbine and PV panel layouts. Related infrastructure is included in the Final EIAR. Refer to Figure 2.1 and 2.2 of the Draft Lifecycle Environmental Management Programme (LEMPr) – Annexure N. |

- Turbine positions and its associated infrastructure;  
- Foundation footprint;  
- Permanent laydown area footprint;  
- Construction period laydown footprint;  
- Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible);  
- Wetlands, drainage lines, rivers, stream and water crossing of roads and cables indicating the type of bridging structures that will be used;  
- The location of heritage sites that will be affected by the facility and associated infrastructure;  
- Sub-station(s) and/or transformer(s) sites including their entire footprint;  
- Cable routes and trench dimensions (where they are not along internal roads);
• Connection routes (including pylon positions) to the distribution/transmission network;
• Cut and fill areas at panel sites, along roads and at sub-station/transformer sites indicating the ejected volume of each cut and fill;
• Borrow pits;
• Spoil heaps (temporary for topsoil and subsoil and permanently for excess material);
• All existing infrastructure on the site, especially roads;
• Environmental sensitive features and buffer areas.
• Buildings including accommodation; and
• All “no-go” areas.
• A map combining the final layout plan superimposed (overlain) on the environmental sensitivity map;

| An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process. | Refer to Figure 2.1 and 2.2 of the LEMPr – Annexure N. |
| A map combining the final layout plan superimposed (overlain) on the environmental sensitivity map. | Refer to Figure 2.1 and 2.2 of the LEMPr – Annexure N. |
| The Environmental Management Programme (EMPr) to be submitted as part of the EIR must include the following: | Refer to the LEMPr – Annexure N. These measures have been included in the LEMPr. |
| • All recommendations and mitigation measures recorded in the EIR; | |
| • An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien a species is undertaken; | |
| • A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase; | |
| • A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one |
time and to speed up the recovery to natural habitats;

- An open space management plan to be implemented during the construction and operation of the facility;
- A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations;
- A transportation plan for the transport of turbine components, main assembly cranes and other large pieces of equipment;
- A storm water management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water run-off;
- An erosion management plan for monitoring and rehabilitating erosion events associated with the facility; Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion;
- An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems;
- An avifauna and bat monitoring programme to document the effect of the operation of the energy facility on avifauna and bats. This must be compiled by a qualified specialist;
- An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process; and
- Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants.

You are requested to submit two (2) electronic copies (CD/DVD) and two (2) hard copies of the Draft and Final EIR to the Department as per regulation 34(1) (b) of the EIA.

Noted.

Please also find attached information that must be used in the preparation of the Environmental impact Report. This will enable the Department to speedily review the EIAR and make a decision on the application.

Noted.

You are hereby reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended that no activity may commence prior to an environmental authorisation being granted by the Department.

Noted.

A list of information required by DEA as part of the submission of the Final EIAR was also attached to DEA’s letter of approval of the FSR. This list included General Site Information, Site Maps and GIS Information and Regional Map and GIS Information. This information will be provided on a CD/DVD to DEA along with the Final EIAR.
SAHRA AND NORTHERN CAPE HERITAGE SIGNED
DELIVERY NOTES
**Account Number**: N 20106

**Sender's Name**: SIMON CLARK

**Company Name**: AURECON S.A(PJY)LTD

**Street Address**: 1 CENTURY CITY DRIVE, WATERFORD PRECINCT, CENTURY CITY, CAPE TOWN

**City/Town**: CENTURY CITY, CAPE TOWN

**Sender's Reference / Order No.**: 1228373/2021

**Consignee**: ANDREW TIMOTHY

**Company Name**: HERITAGE NORTHREN CAPE PROVINCIAL

**Street Address**: 1 ROSE STREET

**City/Town**: KIMBERLEY

**Dimensions (cm)**: L 40 x W 50 x H 1

**Weight**: 1 kg

**Service for Domestic Shipments**: SAME DAY EXPRESS

**Service for International Shipments**: EXPEDITED EXPRESS

**Declared Value for Customs**: $0

**Exporter's Code**: E0000000

**Description of Contents**: CLOTHES

**Date**: 28/11/2021

**Time**: 16:50

**Proof of Delivery**: 28/11/2021

**Received in Good Order and Condition**: 28/11/2021

**Signed**: ASNC

**BRK**
Annexure P
A brief assessment has been undertaken to determine the extent to which the proposed Kangnas Wind and Solar Energy Facilities comply with the current Equator Principles (EP). Also taken into consideration were the requirements noted in the draft EP III document published on 13 August 2012\(^1\). Based on our knowledge of the proposed facilities, the projects are most likely Category B projects according to the International Finance Corporation and appear to comply with the principles (although some aspects to be confirmed fall outside the scope of the EIA/EMP itself).

Table 1: Extent to which the proposed wind and solar energy facilities on Kangnas Farm near Springbok, Northern Cape complies with the Equator Principles

<table>
<thead>
<tr>
<th>Equator Principle</th>
<th>Description of Equator Principle</th>
<th>Compliance (Y/N)</th>
<th>Comment on extent of compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle 1:</td>
<td>Review and Categorisation</td>
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<td></td>
<td>The risk of the project is categorized in accordance with internal guidelines based upon the environmental and social screening criteria of the IFC. Projects are classified, relating to social or environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts).</td>
<td></td>
<td>The projects have not been officially categorised by the EP Financial Institutions (EPFIs). However, based on assessment of potential impacts of the projects in the Environmental Impact Assessment report, they are likely to be classified as Category B projects.</td>
</tr>
<tr>
<td>Principle 2:</td>
<td>Social and Environmental Assessment (Draft Principles: Environmental and Social Assessment)</td>
<td>Y</td>
<td>A full Environmental Impact Assessment (EIA) process was undertaken, consisting of Scoping and EIA phases. The EIA identifies potential environmental and social impacts and proposes mitigation and management measures via a number of specialist studies. Based on the outcome of these specialist studies, the site layout was revised to incorporate specialist findings and ensure that the proposed facility stays clear of environmentally and culturally sensitive areas. A Lifecycle Environmental Management Programme (EMP) is appended to the EIA report in accordance with the requirements set out in the</td>
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<td></td>
<td>For all medium or high risk projects (Category A and B projects), sponsors complete an Environmental Assessment (full-scale, limited/focused or application in terms of siting, pollution standards, design criteria or construction standards), the preparation of which must meet certain requirements and satisfactorily address key environmental and social issues. Specialised studies may also be required.</td>
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\(^1\) Official First Draft of EP III for Public Consultation, 13 August 2012
<table>
<thead>
<tr>
<th>Equator Principle</th>
<th>Description of Equator Principle</th>
<th>Compliance (Y/N)</th>
<th>Comment on extent of compliance</th>
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</thead>
</table>
| Principle 3:     | The Environmental Assessment report addresses:                                                 | Y                | The EIA report describes the baseline biophysical and socio-economic environments, identifies potential impacts (including cumulative impacts) on the environment and recommends mitigation measures to avoid or reduce negative impacts and improve or enhance positive impacts. Where necessary, specialist studies were undertaken to ensure sufficient information was available to assess potential impacts. The Lifecycle EMP provides for the implementation of mitigation and control measures during the lifecycle of the facility including waste management, fire prevention and dangerous substances. Public participation was also undertaken during the EIA process to ensure the comments and concerns of interested and affected parties were taken into consideration. The EIA complies with the relevant South African environmental legislation, namely NEMA. It should be noted that while some aspects of occupational health and safety have been addressed by the EIA and EMP, this will be dealt with on a more comprehensive level through compliance of the project with the Occupational Health and Safety Act (Act 85 of 1993).
|                  | • baseline environmental and social conditions;                                                 |                  | It should further be noted that the land on which the project is proposed to be implemented would be leased from the landowner.                                                                                                                                                                                                                                                                 |
|                  | • requirements under host country laws and regulations;                                        |                  | The IFC Performance Standards, Guidance Notes and Industry Specific Guidelines dated January 2012 acts as a guideline on how to identify, avoid, mitigate and manage risks and impacts in a sustainable way. These standards require that all environmental risks and impacts must be managed via an Environmental and Social Management Plan (ESMP) that is in line with the applicable laws and regulations. It should be noted that while some aspects of occupational health and safety have been addressed by the EIA and EMP, this will be dealt with on a more comprehensive level through compliance of the project with the Occupational Health and Safety Act (Act 85 of 1993). |
|                  | • applicable international treaties and agreements;                                              |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • sustainable development and use of renewable natural resources;                              |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • protection of human health, cultural properties, and biodiversity, including endangered species |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • sensitive ecosystems;                                                                        |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • use of dangerous substances;                                                                 |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • major hazards;                                                                               |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • occupational health and safety;                                                              |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • fire prevention and life safety;                                                             |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • socio-economic impacts;                                                                      |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • land acquisition and land use;                                                               |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • involuntary resettlement, impacts on indigenous peoples and communities;                     |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • cumulative impacts of existing projects, the proposed project, and anticipated future projects |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • participation of affected parties in the design, review and implementation of the project;    |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • consideration of feasible environmentally and socially preferable alternatives;              |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • efficient production, delivery and use of energy; and                                        |                  |                                                                                                                                                                                                                                                                                                                                 |
|                  | • pollution prevention and waste minimisation, pollution controls (liquid effluents and air emissions) and solid chemical waste management. |                  |                                                                                                                                                                                                                                                                                                                                 |
| Applicable Social and Environmental Standards (Draft Principles: Environmental and Social Standards) |                                                                 |                  |                                                                                                                                                                                                                                                                                                                                 |

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<th>Equator Principle</th>
<th>Description of Equator Principle</th>
<th>Compliance (Y/N)</th>
<th>Comment on extent of compliance</th>
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<tr>
<td>Principle 4:</td>
<td>Based on the findings and</td>
<td>Y</td>
<td>Social Management System (ESMS). However, some of these standards may not specifically be covered by the EIA report or Lifecycle EMP and will therefore have to be met through implementation.</td>
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<tr>
<td>Action Plan and</td>
<td>recommendations of the EIA, an</td>
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<td>Management System</td>
<td>environmental management plan</td>
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<td>(Draft Principles:</td>
<td>(EMP) is prepared detailing</td>
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<td>Environmental and</td>
<td>how to monitor, manage and</td>
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<td>Social Management</td>
<td>mitigate environmental and social</td>
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<td>System and Action</td>
<td>risks arising from the project.</td>
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<td>Plan)</td>
<td>Note: According to the new</td>
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<td>draft principles, and</td>
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<td>Environmental and Social</td>
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<td>Management Plan (ESMP) will</td>
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<td>be required.</td>
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<td>Principle 5:</td>
<td>Interested and affected parties</td>
<td>Y</td>
<td>As part of the EIA process, interested and affected parties (I&amp;APs) were required to register with the Aurecon Public Participation Office, in accordance with Regulation No. 543, Section 56 of the National Environmental Management Act (Act 107 of 1998). I&amp;APs were consulted throughout the EIA process and were provided with opportunities to review draft and final versions of the Scoping and EIA phase (includes the Lifecycle EMP) documents. Documentation in this regard is included in the EIA report.</td>
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<tr>
<td>Consultation and</td>
<td>(I&amp;APs) need to be consulted in</td>
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<td>Disclosure</td>
<td>a structured and culturally</td>
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<td>(Draft Principles:</td>
<td>appropriate manner throughout</td>
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<tr>
<td>Stakeholder</td>
<td>the project, and be informed of</td>
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<td>Engagement)</td>
<td>all risks, mitigation measures,</td>
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<td>and benefits of the proposed</td>
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<td>project. Note: The draft Equator</td>
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<td>Principles (EP) requires a</td>
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<td>process of Informed Consultation</td>
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<td>and Participation that</td>
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<td>complies with the application</td>
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<td>national laws. In addition, the</td>
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<td>Assessment documentation and</td>
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<td>ESMP must be made available to</td>
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<td>the public.</td>
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<td>Principle 6:</td>
<td>Grievance mechanisms need to be</td>
<td>Y</td>
<td>Procedures governing the submission and resolution of grievances are outlined in the EMP.</td>
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<td>Grievance Mechanism</td>
<td>established as part of the</td>
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<td>Management System</td>
<td>management system (i.e. the ESMP</td>
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<td>according to the draft EP).</td>
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<td>Principle 7:</td>
<td>For all Category A projects and,</td>
<td>Y</td>
<td>Independent environmental consultants undertook the EIA process. Based on the official classification of the project (Principle 1) it may be necessary for the developer to appoint an independent reviewer to review the EIA process. However, according to the draft EP requirements, the EPFI may determine whether an independent or an internal review is sufficient.</td>
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<td>Independent Review</td>
<td>as appropriate, for Category B</td>
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<td>projects, an independent social</td>
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<td>or environmental expert not</td>
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<td>directly associated with the</td>
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<td>borrower will review the</td>
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<td>Assessment, AP and consultation</td>
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<td>process documentation in order to</td>
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<td>assist EPFI's due diligence, and</td>
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<td>assess Equator Principles</td>
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<td>compliance. Note: The draft EP</td>
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<td>requires an Independent</td>
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<td>Environmental and Social</td>
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<td>Consultant to carry out an</td>
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<tr>
<td>Equator Principle</td>
<td>Description of Equator Principle</td>
<td>Compliance (Y/N)</td>
<td>Comment on extent of compliance</td>
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<tr>
<td>Principle 8:</td>
<td><strong>Covenants</strong></td>
<td>Y</td>
<td>Compliance with relevant laws, periodic reporting, and decommissioning are dealt with comprehensively in the EMP. The EMP will be updated annually throughout the life of the project.</td>
</tr>
<tr>
<td></td>
<td>Covenants need to be established to ensure compliance with environmental laws and AP, provide periodic reports as agreed with EPFIs, and to decommission the project in accordance with an agreed plan. Note: The draft EP includes ESMPs as well under Principle 8.</td>
<td></td>
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<tr>
<td>Principle 9:</td>
<td><strong>Independent Monitoring and Reporting</strong></td>
<td>Y</td>
<td>Independent monitoring and reporting are detailed in the EMP, and will either be conducted by an independent expert, or carried out in-house and signed-off by the relevant monitoring authority.</td>
</tr>
<tr>
<td></td>
<td>To ensure ongoing monitoring and reporting over the life of the loan, EPFIs will, for all Category A projects, and as appropriate, for Category B projects, require appointment of an independent environmental and/or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs. Note: The draft EP requires an independent environmental and social consultant or qualified and experienced external experts to verify its monitoring information which would be shared with the EPFIs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principle 10:</td>
<td><strong>EPFI Reporting</strong></td>
<td></td>
<td>Annual reports detailing the compliance or non-compliance of the project to the Equator Principles, as determined by the independent expert listed in Principle 9, will need to be made available to the public.</td>
</tr>
<tr>
<td></td>
<td><em>(Draft Principles: Reporting and Transparency)</em></td>
<td></td>
<td>With regards to the draft EP requirements, comments received during the EIA process have been captured and responded to in Comments and Response Reports included in the EIA documentation. Furthermore, the requirement to report on greenhouse gas emission levels during the operational phase should be easy to demonstrate compliance with.</td>
</tr>
<tr>
<td></td>
<td>Each EPFI adopting the Equator Principles commits to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations. Note: The draft EP requires the borrower to disclose the assessment document and ESMP online (only if the company have a website). The process and results of stakeholder consultation, actions agreed to, will be taken account taken of and documented. Furthermore, for all Category A projects, and as appropriate, for Category B projects, the borrower must publically report greenhouse gas emission levels during the operational phase emitted over 100 000 tonnes of the CO₂ equivalent annually.</td>
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</table>
Annexure Q
Wind facility operation phase impacts:

Botanical impacts
- Wherever possible, restrict construction activities to designated turbine sites and lay-down areas.
- Avoid Platbakkies Succulent Shrubland gravel patches.
- Micro-site turbines with the aid of a botanist, to avoid sensitive sites.
- Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.

Impacts on fauna
- No mitigation is recommended

Avifaunal (bird) impacts
- Carefully monitor the local avifauna pre- and post-construction for a one year (12 month) period with monitoring scheduled for 15-18 days in each of the four seasons. Implement appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of the priority species listed in the Avifaunal Impact Assessment, or when collision or electrocution mortalities are recorded.
- Minimize the disturbance associated with the operation of the facilities, schedule maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times. Keep disturbance from maintenance activities at a minimum where specific turbines fall within sensitive areas.

Bat impacts
- Do not place turbines in the area indicated as having a High Bat Sensitivity (Figure 4.9). Give special attention to areas of Moderate Bat Sensitivity and prioritise these in post-construction monitoring and implementation of mitigation measures;
- Undertake affordable long term monitoring of bats and the potential impacts of turbines on them to effectively fine tune mitigation.
- Carry out post-construction monitoring of possible bat fatalities at least four seasons at the proposed wind energy facility, focus on turbines in the Moderate bat sensitivity areas and at the two small caves on site. Pre-construction monitoring is optional for this site.
- Consider implementing an ultrasonic deterrent device to repel bats from wind turbines should any turbines be placed in moderate sensitivity areas. If this measure proves effective it may be implemented in place of curtailment upon agreement with a bat specialist, based on long term monitoring; and
- Share research from long term monitoring with academic institutions to aid in research of the potential impacts of wind energy facilities on bats.
- Where recommended by long-term bat monitoring, curtail selected turbines to lessen bat mortalities. Curtailment should be informed by long term bat monitoring.

1 Curtailment is where the turbine cut-in speed is raised to a higher wind speed based on the principle that bats will be less active in strong winds due to the fact that their insect food cannot fly in strong wind speeds, and the small insectivorous bat species need to use more energy to fly in strong winds.
**Heritage resources impacts (including palaeontology)**
- No mitigation is recommended

**Visual impacts**
- Use LED lighting.
- Keep lighting to an efficient minimum while still keeping within the safety norms. (see Annexure 3).
- Continuously rehabilitate previously modified areas.
- Ensure no branding on the turbines.
- No lights on the blade tips (within safety limits).

**Impacts on local and regional economy (employment)**
- Source local labour, businesses and resources for supply, where possible.
- Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.

**Impacts on social environment**
- Establish an educational notice board as an ideal practical learning environment for local and district schools.
- Source supplies from local labour, businesses and resources, where possible.
- Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.

**Impacts on agricultural land**
- Avoid homesteads and interact with land owners with regards to the final turbine positioning.

**Impacts on noise**
- Educate surrounding receptors on the sound generated by the wind energy facility; maintain essential public relations and community involvement throughout the lifespan of the proposed facility.
- Provide a contact number for the operator of the wind farm in the case of sudden and sharp increases in sound levels result from mechanical malfunctions or perforations or slits in the blades.

**Impacts on freshwater**
- Limit operational activities as far as possible to the delineated site and the identified access routes.
- Continuously monitor invasive alien plant growth to promptly detect re-establishment.
- Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.
Compile a storm water management plan and maintain storm water run-off infrastructure on site.

Stabilise any erosion areas effectively as they develop.

Wind facility construction phase impacts:

Botanical impacts
- Where possible, restrict construction activities to designated turbine sites and lay-down areas.
- Avoid Platbakkies Succulent Shrubland gravel patches.

Avifauna impacts
- Restrict the construction footprint to a bare minimum.
- Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
- Reduce and maintain minimum noise when blasting on the ridge-top for wind turbines foundations. No blasting during breeding seasons (mostly spring: avifaunal monitoring programme to recommend) of resident avifaunal community and priority species. Synchronise with neighbouring blasts where possible.
- Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
- Minimising the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulted and bird friendly when configured.
- Burry transmission lines connecting each turbine to the installation to avoid avian collision posed by overhead lines.
- Re-schedule construction or maintenance activities for turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
- Consider marking the turbine blades to reduce collisions.

Bats impacts
- Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact

Sedimentation and erosion impacts
- Place wind turbines away from identified drainage channels.
- Confine construction activities to identified wind energy facility site and access routes.
- Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
• Maintain stream flow at all crossings over drainage channels or stream beds.
• Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
• Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
• Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
• Maintain a buffer of 30 m (measured from top of bank) adjacent to the identified ephemeral streams and 500m from the springs.
• Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
• Construct all septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well-points.
• Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.

Heritage resources impacts
• Consider ‘Orange Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.32. The buffer is approximately 700 m diameter.
• Consider ‘SMS Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.33. The buffer is approximately east/west and 1.9 km north/south (approximately 450 m from all recorded heritage sources).
• Consider ‘Gobees se Pan’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.34. The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage sources).
• Consider ‘Springbokvlei’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.35. The buffer is approximately 9 00 m east/west and 1 000 m north/south (approximately 200 m from all recorded heritage sources).
• A temporary fence to be built around potential graves and grave ARB2012/007. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.

Impacts on Palaeontology
• Notify the responsible Environmental Control Officer “ECO” of the known fossil sites and discovery of fossil remains on site during construction.
• Safeguard (preferably in situ) all fossil remains (e.g. vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) discovered during construction, ECO to alert the South African Heritage Resource Agency (SAHRA) for further action by a permitted professional palaeontologist (e.g. recording, sampling or collection). Curate all fossil material in an approved repository.
(e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards developed by SAHRA.

Visual impacts
- Implement dust control measures.
- Strictly control all litter.
- Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
- Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
- Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context.
- Rehabilitate the foundation area upon completion of construction phase.
- Constrain all signage (if any).

Impacts on socio-economic environment
- Source supplies of services, labour and products from the local and regional economies during construction stage.
- Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour;
- Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner; and
- Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
- Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.

Impacts on Agriculture
- Minimise clearing activities (panel/turbine and road footprint).
- Withhold activities in the event of heavy rains to reduce the risk of erosion.
- Undertake storm water control and wind screening where earth works are required, prevent soil loss.
- Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.

Transportation impacts
- Maintain good sightlines on road junctions;
- Implement traffic control measures where necessary;
- Transport components overnight as far as possible; and
- Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

Noise impacts
• Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see Figure 4.21 for sensitive receptors);
• Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
• Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200 m away from any house;
• Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
• Ensuring compliance with the Noise Control Regulations;
• Ensure a good working relationship between the developer and all potentially sensitive receptors. Establish communication channels and notify the sensitive receptor if work is to take place close to them (within 500 m). provide information to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  o Proposed working times;
  o Timespan that the activity is anticipated to last
  o The specific activity and the need there of;
  o Contact details for lodging complains and other issues of concern;
• Ensure that equipment is well-maintained and fitted with correct and appropriate noise abatement measures.
• Conduct noise monitoring for complains received and provide feedback on measured levels.
• Ensure that the construction crew abides to the local by-laws regarding noise; and if possible undertake construction work during normal working hours (06h00 – 22h00; adopted from SANS 10103:2008), from Monday to Saturday; with extension upon agreement (in writing) with all surrounding (within a 1 km) potentially sensitive receptors.

Storage of hazardous substances on site
• Implement measures as provided in the EMP, which *inter alia* specify storage details of hazardous compounds and emergency procedures in the event of a spillage; and
• Comply with the various pieces of legislation controlling the use of hazardous substances at a construction site.

Dust impacts
• Implement measures as provided in the EMP, including procedures dealing with dust pollution events including watering of roads, etc.

Wind energy facility substation and grid connection construction phase impacts:

*Botanical impacts*
• Where possible, restrict construction activities to designated turbine sites and lay-down areas.
• Avoid Platbakkies Succulent Shrubland gravel patches.

*Avifauna impacts*
• Restrict the construction footprint to a bare minimum.
• Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
• Reduce and maintain minimum noise when blasting on the ridge-top for wind turbines foundations. No blasting during breeding seasons (mostly spring: avifaunal
monitoring programme to recommend) of resident avifaunal community and priority species. Synchronise with neighbouring blasts where possible.

- Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
- Minimising the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulted and bird friendly when configured.
- Burry transmission lines connecting each turbine to the installation to avoid avian collision posed by overhead lines.
- Re-schedule construction or maintenance activities for turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
- Consider marking the turbine blades to reduce collisions.

**Bats impacts**

- Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact.

**Sedimentation and erosion impacts**

- Place wind turbines away from identified drainage channels.
- Confine construction activities to identified wind energy facility site and access routes.
- Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
- Maintain stream flow at all crossings over drainage channels or stream beds.
- Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
- Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
- Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
- Maintain a buffer of 30 m (measured from top of bank) adjacent to the identified ephemeral streams and 500m from the springs.
- Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
- Construct all septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well-points.
- Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.
**Heritage resources impacts**

- Consider ‘Orange Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.32. The buffer is approximately 700 m diameter.
- Consider ‘SMS Hill’ with its surrounds a no-go area and a buffer as shown in Figure 4.33. The buffer is approximately east/west and 1.9 km north/south (approximately 450 m from all recorded heritage sources).
- Consider ‘Gobees se Pan’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.34. The buffer is approximately 1.2 km east/west and 1.3 km north/south (approximately 350 m from all recorded heritage sources).
- Consider ‘Springbokvlei’ with its immediate surroundings a no-go area and a buffer as shown in Figure 4.35. The buffer is approximately 900 m east/west and 1000 m north/south (approximately 200 m from all recorded heritage sources).
- A temporary fence to be built around potential graves and grave ARB2012/007. The fence must be placed 2 meters away from the perimeter of the graves. No development is allowed within 20 meters from the fence line surrounding the burials. These graves must be indicated on all construction maps to ensure their continued protection.

**Impacts on Palaentology**

- Notify the responsible Environmental Control Officer “ECO” of the known fossil sites and discovery of fossil remains on site during construction.
- Safeguard (preferably in situ) all fossil remains (e.g. vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons, buried laminated shales) discovered during construction, ECO to alert the South African Heritage Resource Agency (SAHRA) for further action by a permitted professional palaeontologist (e.g. recording, sampling or collection). Curate all fossil material in an approved repository (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards developed by SAHRA.

**Visual impacts**

- Implement dust control measures.
- Strictly control all litter.
- Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
- Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
- Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context.
- Rehabilitate the foundation area upon completion of construction phase.
- Constrain all signage (if any).

**Impacts on socio-economic environment**

- Source supplies of services, labour and products from the local and regional economies during construction stage.
• Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour;
• Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner; and
• Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
• Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.

Impacts on Agriculture
• Minimise clearing activities (panel/turbine and road footprint).
• Withold activities in the event of heavy rains to reduce the risk of erosion.
• Undertake storm water control and wind screening where earth works are required, prevent soil loss.
• Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.

Transportation impacts
• Maintain good sightlines on road junctions;
• Implement traffic control measures where necessary;
• Transport components overnight as far as possible; and
• Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

Noise impacts
• Ensure equivalent A-weighted daytime noise levels below 45 dBA at potentially sensitive receptors (see Figure 4.21 for sensitive receptors);
• Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA;
• Prevent the generation of disturbing or nuisance noises for example a transformer must be placed more than 200 m away from any house
• Ensure acceptable noise levels (within SANS guidelines) at surrounding stakeholders and potentially sensitive receptors;
• Ensuring compliance with the Noise Control Regulations;
• Ensure a good working relationship between the developer and all potentially sensitive receptors. Establish communication channels and notify the sensitive receptor if work is to take place close to them (within 500 m). provide information to the potential sensitive receptor(s), at least 2 days before the work takes place, include:
  o Proposed working times;
  o Timespan that the activity is anticipated to last
  o The specific activity and the need there of;
  o Contact details for lodging complains and other issues of concern
• Ensure that equipment is well-maintained and fitted with correct and appropriate noise abatement measures.
• Conduct noise monitoring for complaints received and provide feedback on measured levels.
• Ensure that the construction crew abides to the local by-laws regarding noise; and if possible undertake construction work during normal working hours (06h00 – 22h00; adopted from SANS 10103:2008), from Monday to Saturday; with extension upon agreement (in writing) with all surrounding (within a 1 km) potentially sensitive receptors.

Storage of hazardous substances on site
• Implement measures as provided in the EMP, which inter alia specify storage details of hazardous compounds and emergency procedures in the event of a spillage; and
• Comply with the various pieces of legislation controlling the use of hazardous substances at a construction site.

Dust impacts
• Implement measures as provided in the EMP, including procedures dealing with dust pollution events including watering of roads, etc.

Wind energy facility substation and grid connection operational phase impacts:
Botanical impacts
• Wherever possible, restrict construction activities to designated turbine sites and lay-down areas.
• Avoid Platbakkies Succulent Shrubland gravel patches.
• Micro-site turbines with the aid of a botanist, to avoid sensitive sites.
• Place underground cables in shallow trenches alongside the internal access roads to avoid additional impacts to those caused by roads.

Avifaunal (bird) impacts
• Carefully monitor the local avifauna pre- and post-construction for a one year (12 month) period with monitoring scheduled for 15-18 days in each of the four seasons. Implement appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of the priority species listed in the Avifaunal Impact Assessment, or when collision or electrocution mortalities are recorded.
• Minimize the disturbance associated with the operation of the facilities, schedule maintenance activities to avoid and/or reduce disturbance in sensitive areas at sensitive times. Keep disturbance from maintenance activities at a minimum where specific turbines fall within sensitive areas.

Bat impacts
• Do not place turbines in the area indicated as having a High Bat Sensitivity (Figure 4.9). Give special attention to areas of Moderate Bat Sensitivity and prioritise these in post construction monitoring and implementation of mitigation measures;
• Undertake affordable long term monitoring of bats and the potential impacts of turbines on them to effectively fine tune mitigation.
• Carry out post-construction monitoring of possible bat fatalities at least four seasons at the proposed wind energy facility, focus on turbines in the Moderate bat sensitivity
areas and at the two small caves on site. Pre-construction monitoring is optional for this site.

- Consider implementing an ultrasonic deterrent device to repel bats from wind turbines should any turbines be placed in moderate sensitivity areas. If this measure proves effective it may be implemented in place of curtailment upon agreement with a bat specialist, based on long term monitoring; and
- Share research from long term monitoring with academic institutions to aid in research of the potential impacts of wind energy facilities on bats.
- Where recommended by long-term bat monitoring, curtail selected turbines to lessen bat mortalities. Curtailment should be informed by long term bat monitoring.

*Heritage resources impacts (including palaeontology)*

- No mitigation is recommended

*Visual impacts*

- Use LED lighting.
- Keep lighting to an efficient minimum while still keeping within the safety norms. (see Annexure 3).
- Continuously rehabilitate previously modified areas.
- No branding on the turbines.
- No lights on the blade tips (within safety limits).

*Impacts on local and regional economy (employment)*

- Source local labour, businesses and resources for supply, where possible.
- Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.

*Impacts on social environment*

- Establish an educational notice board as an ideal practical learning environment for local and district schools.
- Source supplies from local labour, businesses and resources, where possible.
- Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.

*Impacts on agricultural land*

- Avoid homesteads and interact with land owners with regards to the final turbine positioning.

*Impacts on noise*

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2 Curtailment is where the turbine cut-in speed is raised to a higher wind speed based on the principle that bats will be less active in strong winds due to the fact that their insect food cannot fly in strong wind speeds, and the small insectivorous bat species need to use more energy to fly in strong winds.
• Educate surrounding receptors on the sound generated by the wind energy facility; maintain essential public relations and community involvement throughout the lifespan of the proposed facility.
• Provide a contact number of the developer in the case of sudden and sharp increases in sound levels result from mechanical malfunctions or perforations or slits in the blades.

**Impacts on freshwater**
• Limit operational activities as far as possible to the delineated site and the identified access routes.
• Continuously monitor invasive alien plant growth to promptly detect re-establishment.
• Locate any septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/well points.
• Compile a storm water management plan and maintain storm water run-off infrastructure on site.
• Stabilise any erosion areas effectively as they develop.

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**Solar facility operation phase impacts:**

**Botanical impacts**
• Avoid drainage lines and maintain a buffer of at least 30 m from drainage lines.
• Collect seeds from *Parkinsonia africana* (wild green hair trees) cultivated offsite. The cultivated shrubs could be planted on the site and effectively used for visual screening of the PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

**Impacts on fauna**
• *No mitigation is recommended*

**Avifaunal (bird) impacts**
• Post-construction Monitoring of the local avifauna for a one year (12 month) period in accordance with Birdlife South Africa's guidelines for solar energy facilities

**Bat impacts**
• *No mitigation is recommended.*

**Heritage resources impacts (including palaeontology)**
• *No mitigation is recommended*

**Visual impacts**
• Use LED directional lighting without overhead lighting.
• Maintain lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3).
• Rehabilitate previously modified areas continually.

**Impacts on local and regional economy (employment)**
• Source local labour, businesses and resources for supply, where possible.
• Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.

*Impacts on social environment*
• Establish an educational notice board as an ideal practical learning environment for local and district schools.
• Source supplies from local labour, businesses and resources, where possible.
• Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.

*Impacts on agricultural land*
• Allow periodic grazing of sheep within the PV site to minimise loss of grazing land.

*Impacts on noise*
• No mitigation is recommended

*Impacts on freshwater*
• Direct the storm water management plan to addressing runoff discharge into watercourses flowing across the site

*Solar facility construction phase impacts:*

*Botanical impacts*
• Where possible, collect seeds from *Parkinsonia africana* (wild green hair trees) and cultivate off site. The cultivated shrubs could be planted on the site and effectively used for visual screening of the solar PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

*Impacts on avifauna*
• Restrict the construction footprint to a bare minimum.
• Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
• Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
• Minimising the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulated and bird friendly when configured.
• Burry transmission lines connecting each turbine to the installation to avoid avian collision posed by overhead lines.
• Re-schedule construction or maintenance activities for turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
• Consider marking the turbine blades to reduce collisions
• Adopt an exclusion zone of at least 1 km for Verreaux’s eagle.

_Bats impacts_
• Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact.

_Sedimentation and erosion impacts_
• Place wind turbines away from identified drainage channels.
• Confine construction activities to identified wind energy facility site and access routes.
• Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
• Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
• Maintain stream flow at all crossings over drainage channels or stream beds.
• Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
• Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
• Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
• Maintain a buffer of 30 m (measured from top of bank) adjacent to the identified ephemeral streams and 500m from the springs.
• Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
• Construct all septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/wellpoints.
• Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.

_Heritage resources impacts (including Palaeontology)_
• _No mitigation is recommended_

_Visual impacts_
• Implement dust control measures.
• Strictly control all litter.
• Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
• Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
• Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context.
• Rehabilitate the foundation area upon completion of construction phase.
• Constrain all signage (if any).

**Impacts on socio-economic environment**
• Source supplies of services, labour and products from the local and regional economies during construction stage.
• Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour;
• Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner; and
• Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
• Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.

**Impacts on local economy (employment)**
• No mitigation is recommended.

**Impacts on social conditions**
• No mitigation is recommended.

**Impacts on Agriculture**
• Minimise clearing activities (panel/turbine and road footprint).
• Withhold activities in the event of heavy rains to reduce the risk of erosion.
• Undertake storm water control and wind screening where earth works are required, prevent soil loss.
• Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.

**Transportation impacts**
• Maintain good sightlines on road junctions;
• Implement traffic control measures where necessary;
• Transport components overnight as far as possible; and
• Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

**Noise impacts**
• No mitigation is recommended.

**Storage of hazardous substances on site**
• No mitigation is recommended

**Dust impacts**
• No mitigation is recommended
Solar energy facility substation and grid connection construction phase impacts:

*Botanical impacts*

- Collect seeds from *Parkinsonia africana* (wild green hair trees) and cultivate off site. The cultivated shrubs could be planted on the site and effectively used for visual screening of the solar PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

*Impacts on avifauna*

- Restrict the construction footprint to a bare minimum.
- Demarcate ‘No-go’ areas identified during pre-construction, to minimise disturbance associated with construction of the facility.
- Exclude development or disturbance from sensitive areas, including the Secretary bird nest site and the two wetland sites (the ‘Granite Pan’ and Steenbok Pan), currently outside or on the edge of the footprint area for the wind energy facility but will be impacted during the construction phase.
- Minimising the length of all new power lines installed, ensure that all lines have flight diverters, are adequately insulted and bird friendly when configured.
- Burry transmission lines connecting each turbine to the installation to avoid avian collision posed by overhead lines.
- Re-schedule construction or maintenance activities for turbines positioned in areas subsequently identified as particularly important for disturbance and/or displacement of sensitive, priority bird species.
- Consider marking the turbine blades to reduce collisions
- Adopt an exclusion zone of at least 1 km for Verreaux’s eagle.

*Bats impacts*

- Avoid placing associated infrastructure (substation, gridline, roads) in areas with a High Bat Sensitivity. No underground cabling should be laid in such areas, if so; carry out vegetation rehabilitation to rectify the impact.

*Sedimentation and erosion impacts*

- Place wind turbines away from identified drainage channels.
- Confine construction activities to identified wind energy facility site and access routes.
- Limit disturbance of drainage channels when constructing transmission lines and rehabilitate accordingly upon completion of construction.
- Utilise existing road infrastructure to minimize the overall disturbance and if access routes are to be constructed through ephemeral streams, maintain minimum disturbance.
- Maintain stream flow at all crossings over drainage channels or stream beds.
- Coincide/ harmonise road infrastructure and power transmission lines to minimize the impact.
- Rehabilitate disturbed areas to avoid erosion or invasive alien plant growth.
- Rehabilitate all crossings over drainage channels or stream beds after the construction phase to maintain flow.
- Maintain a buffer of 30 m (measured from top of bank) adjacent to the identified ephemeral streams and 500m from the springs.
• Properly store and contain all materials on the construction sites. Manage waste disposal properly. Provide regularly serviced ablution facilities at least 100 m away from any drainage areas/ephemeral streams and within terms of the EMP for the construction phase.
• Construct all septic tanks at least 100 m (measured from top of bank) from the ephemeral streams and at least 1 000 m away from the springs or any boreholes/wellpoints.
• Maintain storm water run-off infrastructure to mitigate water flow and quality impacts of storm water leaving the energy facilities site. Stabilise all erosion features effectively.

**Heritage resources impacts (including Palaeontology)**
- No mitigation is recommended

**Visual impacts**
- Implement dust control measures.
- Strictly control all litter.
- Stockpile all topsoil (if any) in a suitable location and re-utilise it for landscaping / rehabilitation.
- Dispose excess material from earthworks offsite or through natural landscaping of areas. No dumping or piling.
- Use grey chain link fence or similar (not exceeding N14) to blend with the agricultural landscape context.
- Rehabilitate the foundation area upon completion of construction phase.
- Constrain all signage (if any).

**Impacts on socio-economic environment**
- Source supplies of services, labour and products from the local and regional economies during construction stage.
- Implement labour contracts whereby Contractors are required to employ a certain percentage of local labour;
- Encourage the local authority to implement a services management plan to monitor demand on infrastructure services so that upgrades or new services can be installed in a timeous manner; and
- Provide basic construction skills programs pertaining to the projects in order to maximise the benefits of the project in the local municipality and to leave a lasting influence on the workforce.
- Implement an educational initiative during the construction phases to avail an ideal practical learning environment for local and district schools.

**Impacts on local economy (employment)**
- No mitigation is recommended.

**Impacts on social conditions**
- No mitigation is recommended.
Impacts on Agriculture
- Minimise clearing activities (panel/turbine and road footprint).
- Withhold activities in the event of heavy rains to reduce the risk of erosion.
- Undertake storm water control and wind screening where earth works are required, prevent soil loss.
- Armour any steep or large embankments that are expected to be exposed during the ‘rainy’ months. Use a fascine structure consisting of a natural wood material to strengthen earthen structures or embankments.

Transportation impacts
- Maintain good sightlines on road junctions;
- Implement traffic control measures where necessary;
- Transport components overnight as far as possible; and
- Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts etc are scheduled.

Noise impacts
- No mitigation is recommended.

Storage of hazardous substances on site
- No mitigation is recommended

Dust impacts
- No mitigation is recommended

Solar energy facility substation and grid connection operational phase impacts:
Botanical impacts
- Avoid drainage lines and maintain a buffer of at least 30 m from drainage lines.
- Collect seeds from Parkinsonia africana (wild green hair trees) cultivated offsite. The cultivated shrubs could be planted on the site and effectively used for visual screening of the PV infrastructure where required while simultaneously keeping them as part of the vegetation on the site.

Avifaunal (bird) impacts
- Post-construction Monitoring of the local avifauna for a one year (12 month) period in accordance with Birdlife South Africa’s guidelines for solar energy facilities.

Bat impacts
- No mitigation is recommended.

Heritage resources impacts (including palaeontology)
- No mitigation is recommended

Visual impacts
- Use LED directional lighting without overhead lighting.
• Maintain lighting to an efficient minimum while still keeping within the safety norms (see Annexure 3).
• Rehabilitate previously modified areas continually.

**Impacts on local and regional economy (employment)**
• Source local labour, businesses and resources for supply, where possible.
• Compile relevant and clearly defined procurement standards to govern choices of suppliers, products and procedures for communication with suppliers. Maintain well defined standards as analysed by the developer, for quality and sustainability purposes, as well as for monitoring and evaluation of the suppliers and service providers.

**Impacts on social environment**
• Establish an educational notice board as an ideal practical learning environment for local and district schools.
• Source supplies from local labour, businesses and resources, where possible.
• Encourage the local government and stakeholders to undertake studies to ascertain the feasibility of establishing manufacturing activities in the area related to the proposed activities and if green energy industry is feasible.

**Impacts on agricultural land**
• Allow periodic grazing of sheep within the PV site to minimise loss of grazing land.

**Impacts on noise**
• *No mitigation is recommended*

**Impacts on freshwater**
• Direct the storm water management plan to addressing runoff discharge into watercourses flowing across the site