PROJECT DETAILS

REFERENCE NO.S	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 (WEF SUBSTATION & GRID CONNECTION) NEAS REF. NO. DEA/EIA/0001344/2012 DEA REF. NO. 14/12/16/3/3/2/447 (PV SUBSTATION & GRID CONNECTION) NEAS REF. NO. DEA/EIA/0001597/2012
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
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Authors:

.....	.....
CORNELIA STEYN	**SIMON CLARK**
Practitioner: Environment & Advisory Services	Practitioner: Environment & Advisory Services
Reviewed by:	**Approved by:**
.....	.....
LOUISE CORBETT *(Pr. Sci. Nat.)*	**ANDRIES VAN DER MERWE** *(Pr.Eng.)*
Associate: Environment & Advisory Services	Technical Director: Environment & Advisory Services

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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_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

EAP	Environmental Assessment Practitioner
EAPSA	Environmental Assessment Practitioner of South Africa
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Assessment Report
EMP	Environmental Management Programme
EMF	Environmental Management Framework
ERA	Electricity Regulation Act
FSR	Final Scoping Report
GHG	Greenhouse Gas emissions
GN	Government Notice
GWh	Gigawatt hours
ha	Hectares
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IEA	International Energy Agency
IEC	International Electro-technical Commission
IEIM	Integrated Environmental Information Management
IEP	Integrated Energy Plan
IPP	Independent Power Producer
IRP	Integrated Resource Plan
kV	Kilovolt
LOWMA	Lower Orange Water Management Area
LM	Local Municipality
MW	Megawatts
NEMA	National Environmental Management Act (No. 107 of 1998) (as amended)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (No. 25 of 1999)
NRTA	National Road Traffic Act
NWA	National Water Act
REFIT	Renewable Energy Feed-In Tariffs
RFP	Request for Qualification and Proposals
SABAP	Southern African Bird Atlas Project
SAHRA	South African Heritage Resources Agency
SACNSP	South African Council for Natural Scientific Professions
SACNSP	South African Council for Natural Scientific Professions
SAWS	South African Weather Service Station
SDF	Spatial Development Framework
SKA	Square Kilometre Array
ToR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
VIA	Visual Impact Assessment
WEF	Wind Energy Facility
WMA	Water Management Area
WULA	Water Use Licence Application

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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 140MW 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.

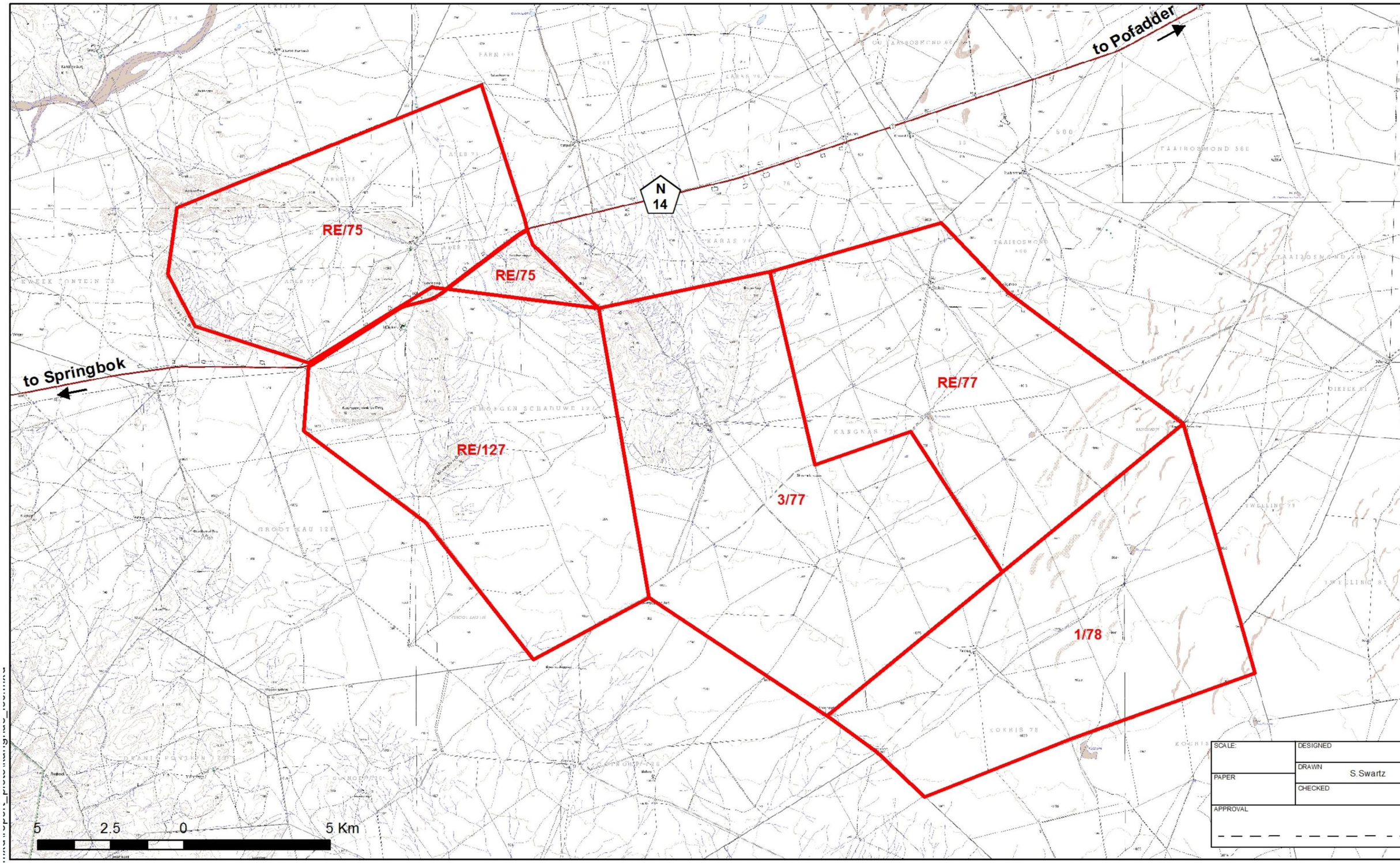

Figure 1.1: Location of the proposed wind and solar energy facilities and associated substation on five farm portions near Springbok in the Northern Cape

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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 2010[2].

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.

[2] GN No. R 543, 544, 545, 546 and 547 in Government Gazette No. 33306 of 18 June 2010.

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.

NO.	LISTED ACTIVITY	WIND RELEVANCY:	SOLAR RELEVANCY:	WIND AND SOLAR SUBSTATION & GRID CONNECTION RELEVANCY:
GN No. R544, 18 June 2010				
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
GN No. R545, 18 June 2010				
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 facilitiy would 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. R546, 18 June 2010				

NO.	LISTED ACTIVITY	WIND RELEVANCY:	SOLAR RELEVANCY:	WIND AND SOLAR SUBSTATION & GRID CONNECTION RELEVANCY:
12	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation	An area of approximately 346.8 ha of indigenous vegetation would be cleared for the wind facility.	An area of approximately 793 ha of indigenous vegetation would be cleared for the solar facility.	An area of approximately 4 ha of indigenous vegetation would be cleared for each of the two proposed substations.
14	The clearance of an area of 5 hectares or more of vegetation where 75 % or more of the vegetation cover constitutes indigenous vegetation (a) in the Northern Cape (i) All areas outside urban areas.	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.	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.	N/A

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.

[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 Aggeneys 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 pits[4]) 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 Resouces (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 Guidelines[5] 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).
- DEAT. 2002. IEIM, Information Series 3: Stakeholder Engagement (DEAT, 2002)
- IEIM, Information Series 4: Specialist Studies (DEAT, 2002).
- IEIM, Information Series 11: Criteria for determining Alternatives in EIA (DEAT, 2004)
- IEIM, Information Series 12: Environmental Management Plans (DEAT, 2004).

[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.

- Integrated Environmental Management Guideline Series, Guideline 4: Public Participation, in support of the EIA Regulations. Unpublished (DEAT, 2005).
- Integrated Environmental Management Guideline Series, Guideline 7: Detailed Guide to Implementation of the Environmental Impact Assessment Regulations. Unpublished (DEAT, 2007).

The following guidelines from the Department of Environmental Affairs and Development Planning (Western Cape) (DEA&DP) were also taken into consideration:

- Brownlie. 2005. Guideline for involving biodiversity specialists in EIA process (June 2005).
- Winter & Baumann. 2005. Guideline for involving heritage specialists in the EIR process (June 2005).
- Oberholzer. 2005. Guideline for involving visual and aesthetic specialists in the EIR process (June 2005).
- 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).
- DEA&DP.2011. Guideline on Alternatives, EIA Guideline and Information Document Series. (DEA&DP, October 2011).
- DEA&DP.2011. Guideline on Need and Desirability, EIA Guideline and Information Document Series. (DEA&DP, October 2011).
- DEA&DP.2011. Guideline on Public Participation, EIA Guideline and Information Document Series. (DEA&DP, October 2011).

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.

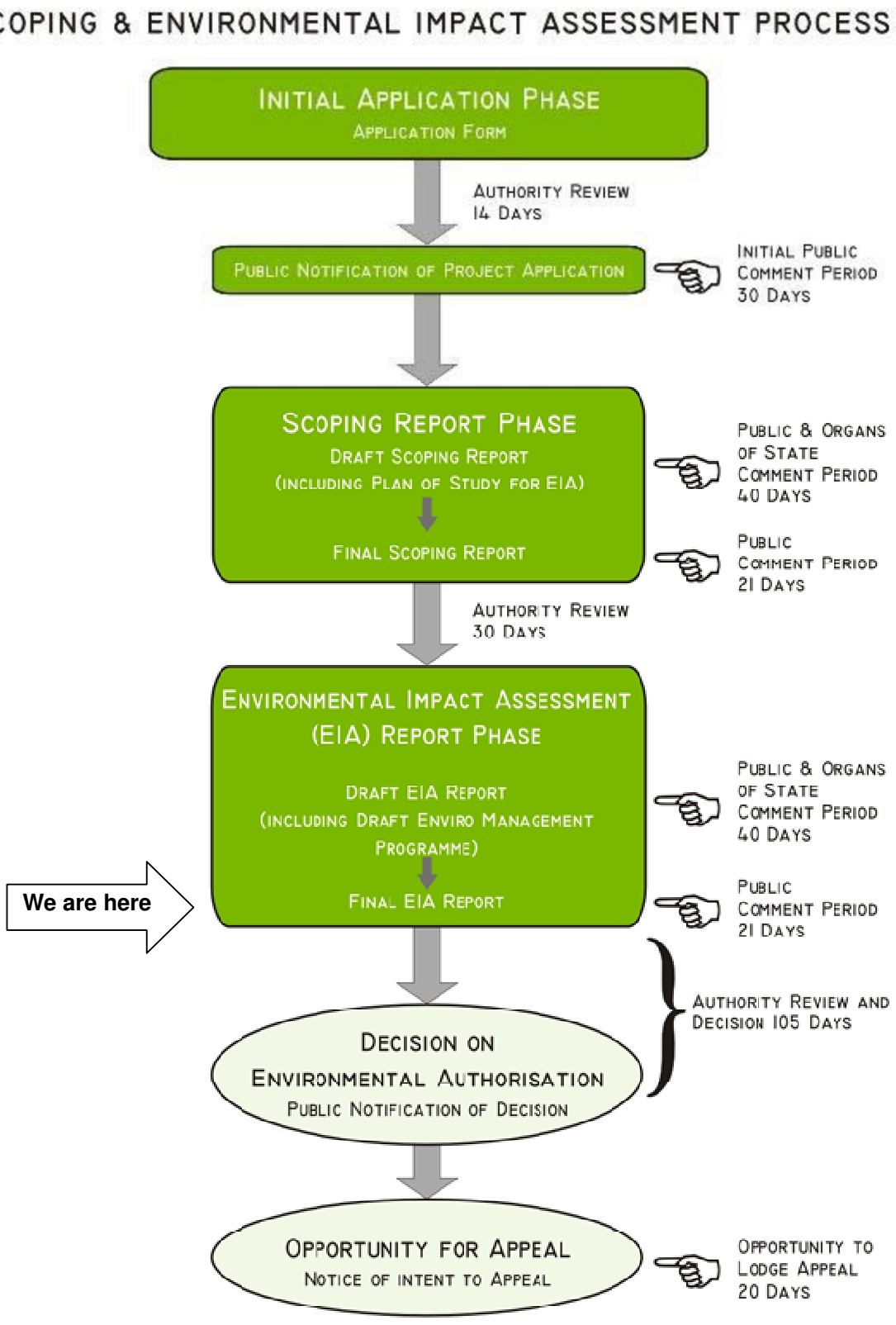

Figure 1.2: The EIA process in terms of NEMA

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, environmental groups, 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 ten ~~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 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.

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

	SECTION 31 OF REGULATION 543	CHAPTER OR SECTION
	Section 31(2) of Regulation 543	
(a)	Details of: (i) the EAP who prepared the report; and (ii) the expertise of the EAP to carry out an EIA;	1.6, page 74 (summaries of EAP CVs provided in Chapter 6 of FSR)
(b)	a detailed description of the proposed activity;	Chapter 3
(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: (i) a linear activity, a description of the route of the activity; or (ii) an ocean-based activity, the coordinates where the activity is to be	Chapter 4

	SECTION 31 OF REGULATION 543	CHAPTER OR SECTION
	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;	Chapter 4
(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;	Section 1.4.4 and **Annexure B**
(f)	a description of the need and desirability of the proposed activity;	Section 3.1
(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;	Section 3.4 and Chapter 4
(h)	an indication of the methodology used in determining the significance of potential environmental impacts;	**Annexure D**
(i)	a description and comparative assessment of all alternatives identified during the environmental impact assessment process;	Chapter 4
(j)	a summary of the findings and recommendations of any specialist report or report on a specialised process;	Chapter 4
(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;	Chapter 4
(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;	Chapter 4
(m)	a description of any assumptions, uncertainties and gaps in knowledge;	Section 1.5
(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;	Section 5.6.3
(o)	an environmental impact statement which contains-	Chapter 5

	SECTION 31 OF REGULATION 543	CHAPTER OR SECTION
	(i) a summary of the key findings of the environmental impact assessment; and (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;	
(p)	a draft environmental management programme containing the aspects contemplated in regulation 33;	**Annexure N**
(q)	copies of any specialist reports and reports on specialized processes complying with regulation 32;	**Annexures E-M**
(r)	any specific information that may be required by the competent authority; and	**Annexure O**
(s)	any other matters required in terms of sections 24(4)(a) and (b) of the Act.	
	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 the Energy Policy of the Republic of South Africa (1998);
-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 (CO_2), methane, water vapour, nitrous oxide, chlorofluorocarbons, halons and peroxyacylnitrate. 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 CO_2 emissions worldwide. In Africa, the CO_2 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 CO_2 emissions. The global per capita CO_2 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.

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

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.

2.1.3 White Paper on Renewable Energy (2003)

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[6].

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[7].

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)[8] 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

[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)
[8] http://www.ipp-renewables.co.za/wp-content/uploads/2011/08/Tender_Notice.png (accessed 30/10/11)

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[9].

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**[10]. 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[11].

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

Technology	MW	Price cap (per MWh)
Onshore wind	1 850	R 1 150
Concentrated solar thermal	200	R 2850
Solar photovoltaic	1 450	R 2850
Biomass solid	12.5	R 1070
Biogas	12.5	R 800
Landfill gas	25	R 600
Small hydro	75	R 1 030
Small projects[12]	100	As above
TOTAL	**3 725**	

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]

Submission no.	Submission date	Preferred bidder selection date	Signing of agreements date
First	4 November 2011	25 November 2011	9 July 2012 – 20 July 2012
Second	5 March 2012	21 May 2012	11 - 22 February 2013
Third	~~7 May 2013~~ 19 August 2013	Dates to be announced by DOE	Dates to be announced by DOE
Fourth	Dates to be announced by DOE	Dates to be announced by DOE	Dates to be announced by DOE
Fifth	Dates to be announced	Dates to be announced by	Dates to be announced

[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)
[11] http://www.ipp-renewables.co.za/wp-content/uploads/2011/08/Tender_Notice.png (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)

Submission no.	Submission date	Preferred bidder selection date	Signing of agreements date
	by DOE	DOE	by DOE

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[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*

[14] http://www.eskom.co.za/c/article/150/independent-power-prodicers-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

	Total generating capacity in 2030		Capacity added (including committed) from 2010-2030		New (uncommitted) capacity options from 2010-2030	
Technology	**MW**	**%**	**MW**	**%**	**MW**	**%**
Coal	41 074	45.9	16 383	29.0	6 250	14.7
OCGT	7 330	8.2	4 930	8.7	3 910	9.2
CCGT	2 370	2.6	2 370	4.2	2 370	5.6
Pumped Storage	2 912	3.3	1 332	2.4	0	0
Nuclear	11 400	12.7	9 600	17.0	9 600	22.6
Hydro	4 759	5.3	2 659	4.7	2 609	6.1
Wind	9 200	10.3	9 200	16.3	8 400	19.7
CSP	1 200	1.3	1 200	2.1	1 000	2.4
PV	8 400	9.4	8 400	14.9	8 400	19.7
Other	890	1.0	465	0.8	0	0
Total	**89 532**	**100**	**56 539**	**100**	**42 539**	**100**

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

QUESTION	RESPONSE
NEED (TIMING)	
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?	*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*

QUESTION	RESPONSE
	sell energy to the national grid.
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?	*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.*
3. Does the community/ area need the activity and the associated land use concerned (is it a societal priority)?	*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.*
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?	*The proposed project would feed into the national Eskom grid through an onsite connection, which forms part of the EIA process.*
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)?	*No. It should be noted that once the proposed projects are operational, there would be a very limited requirement for municipal services.*
6. Is this project part of a national programme to address an issue of national concern or importance?	*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).*
DESIRABILITY (PLACING)	
1. Is the development the best practicable environmental option (BPEO) for this land/ site?	*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.*
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*

QUESTION	RESPONSE
	creates employment opportunities for local people. The Namakwa District IDP pursues economic development through large programmes to build economic infrastructure.
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?	*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 & 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.*
4. Do location factors favour this land use (associated with the activity applied for) at this place?	*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.*
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)?	*Potential impacts associated with the proposed activities have been assessed in detail in Chapter 4.*
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.)?	*Potential impacts associated with the proposed activities have been assessed in detail in Chapter 4.*
7.Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	*No. The socio-economic impacts have been assessed in Chapter 4 and are considered to be acceptable.*
8. Will the proposed land use result in unacceptable cumulative impacts?	*No. Potential cumulative impacts associated with the proposed activities have been assessed in detail in Chapter 4 and are considered to be acceptable.*

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.

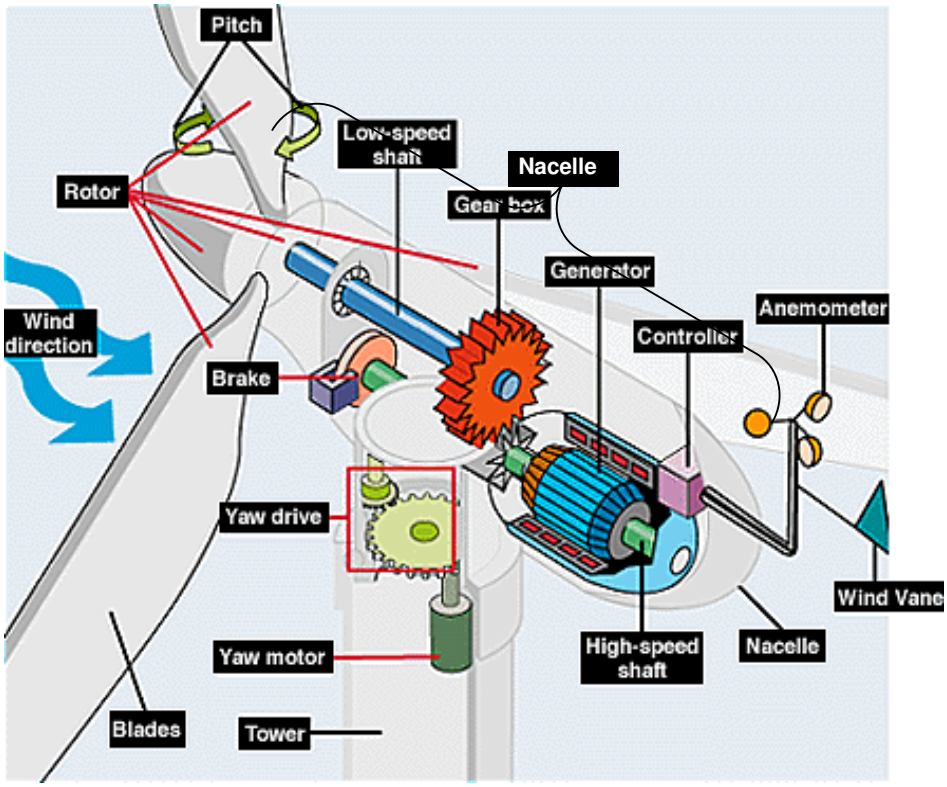
The main components a wind turbine is made up are listed and described below (see **Figure 3.2)**:

- 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[15]



[15] http://en.wikipedia.org/wiki/Wind_power_in_Texas (accessed 14/06/12)

Figure 3.2: Typical components of a horizontal axis wind turbine[16]

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.

[16] Source http://www1.eere.energy.gov/windandhydro/images/illust_large_turbine.gif (accessed 15/11/2010)

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 40~~20~~ m x ~~50~~ 40 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[17]

[17] Source http://www.windpowerninja.com/wind-power-government-industry-news/massive-opportunity-for-wind-turbine-production-in-us-66460/ (accessed 15/11/2010) and http://www.wind-energy-the-facts.org/en/part-i-technology/chapter-3-wind-turbine-technology/technology-trends/transport-and-installation.html (accessed 21/10/11)

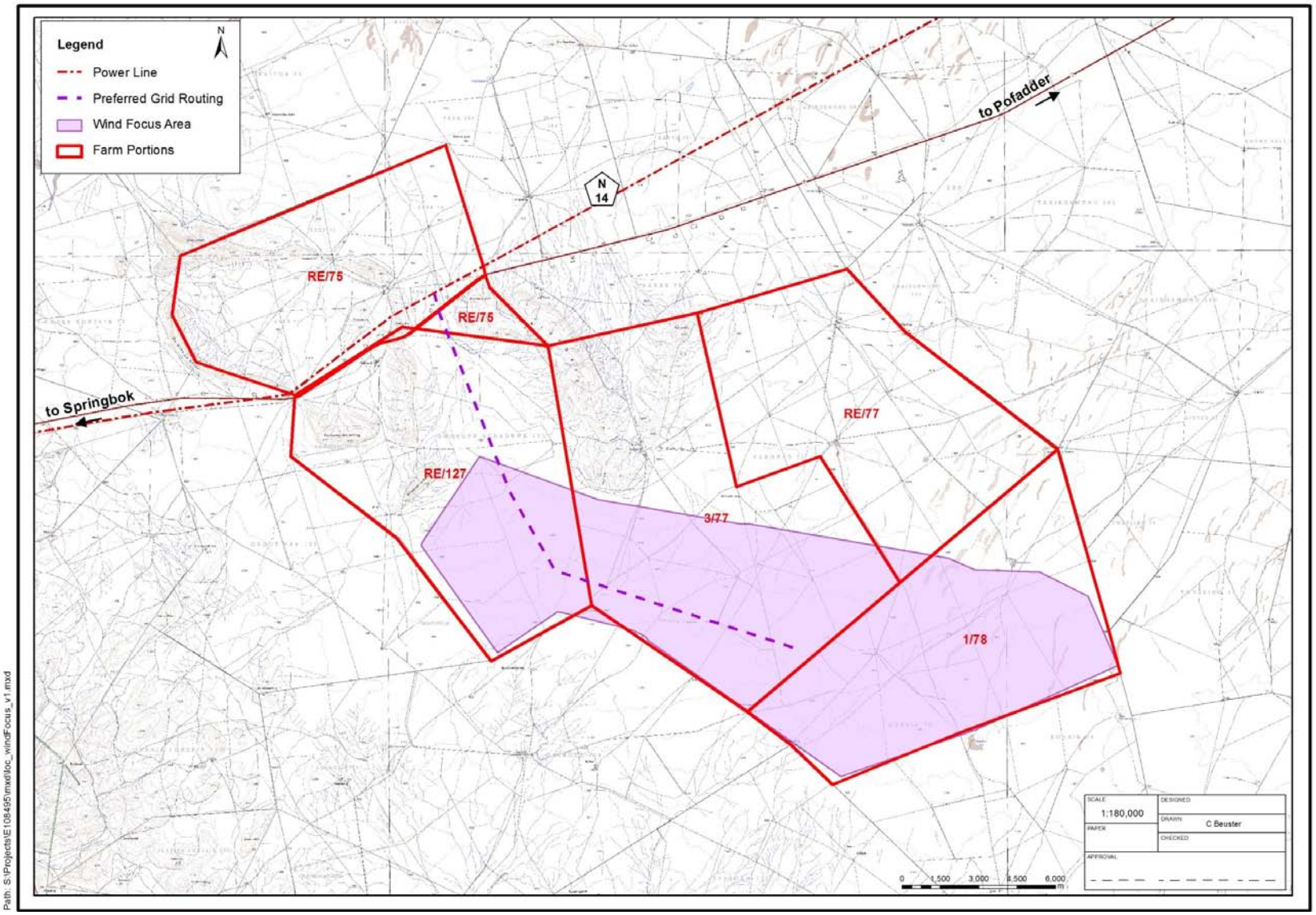


Figure 3.4: Preliminary area within which turbines of the proposed wind energy facility would be located on farms near Springbok in the Northern Cape

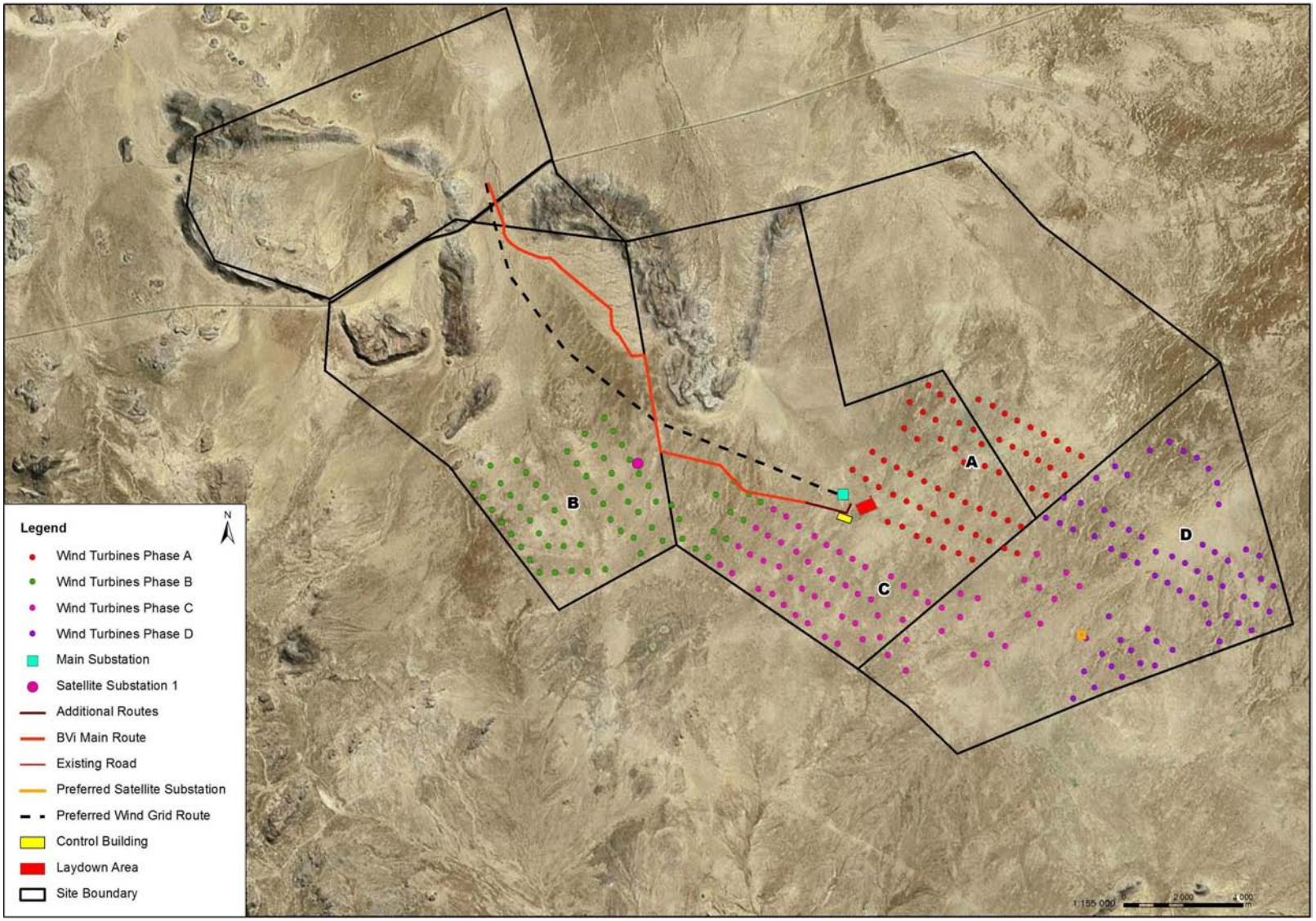


Figure 3.5 Revised area within which turbines of the proposed wind energy facility would be located on farms near Springbok in the Northern Cape

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[18]

PHASE	A	B	C	D	Total
No. of Turbines	±65	±65	±65	±65	±2 60
MW Produced	140	140	140	140	5 60
New Roads (km)	58.5	34	34	33	159.5
Existing roads to be upgraded (km)	25.2	30.5	55.5	33.5	144.7
Cables (km)	83.7	64.5	89.5	66.5	304.2
Footprint (ha)	94.6	74.9	1 00.4	76.9	346.8
Water (construction) (m^3)	64 948	60 809	66 200	61 240	253 197
Water (operation) (m^3/day)	3.4	3.4	3.4	3.4	13.6

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

Phase	Permanent	Highly Skilled	Skilled	Unskilled
Construction	285	71	403	686
Operation	130	0	14	55

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

[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 in 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

Component	Approximate Size (m)	Footprint (m^2)	Land Requirement (ha)
wind turbines	Hub height: max120 Rotor diameter 120m max tip height 180	Per turbine: 25 Total: 4 625 – 12 500	0.4625 – 1.25
Foundation	20 x 20	Per foundation: 400 Total: 74000 - 200000	7.4 – 20
Hard Stand	20 x 50	Per turbine: 1 000 Total: 185 000 – 500 000	18.5 - 50
Existing roads to be upgraded	Width: 6 – 10 Length: ~144.7 km	~868 200 – 1 447 000	86.82 – 144.7 ha
New Roads	Width: 6 – 10 Length: ~159.5 km	~957 000 – 1 595 000	95.7 – 159.5 ha
Main	200 x 200	40 000	4
Satellite substation (2)	Per substation: 100 x 100	Per substation: 10 000 Total: 20 000	2
Cable trenches**	Width: 0.5 Length: 304.2 km	~152 100	15.2 ha
Construction camp and storage area		2 500	0.25
Excavated material per turbine	20 x 20 x 3.5 (1 400 m^3)	-	-

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 re powering (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.

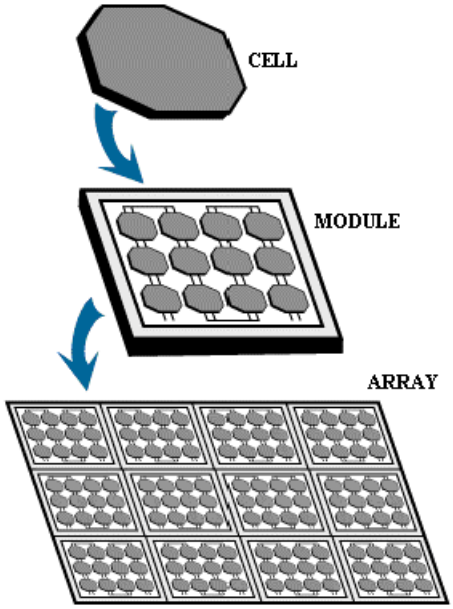
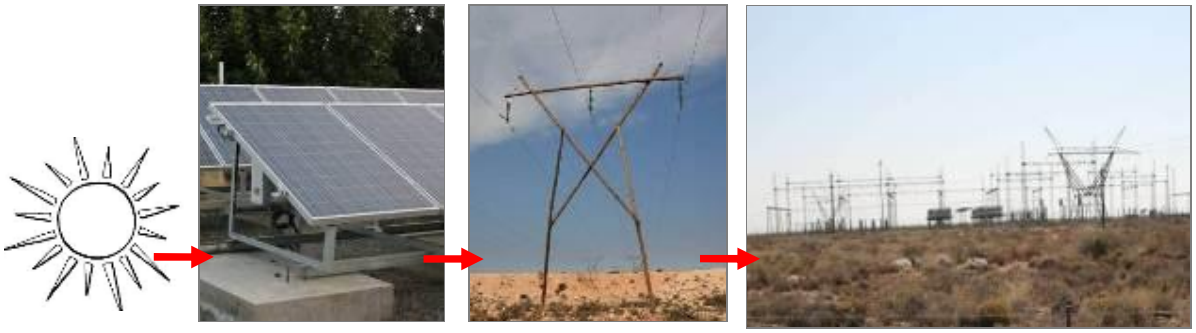


Figure 3.6: Components of PV technology: (i) Solar cell, (ii) module and (iii) array[19]

The proposed solar energy facility (225 MW of PV and/or CPV) would have an approximate maximum footprint of 800 ha ~~793 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.



Short wave sunrays | **PV panels** | **Transmission lines** | **Substation / Grid**

[19] (Source: http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/)

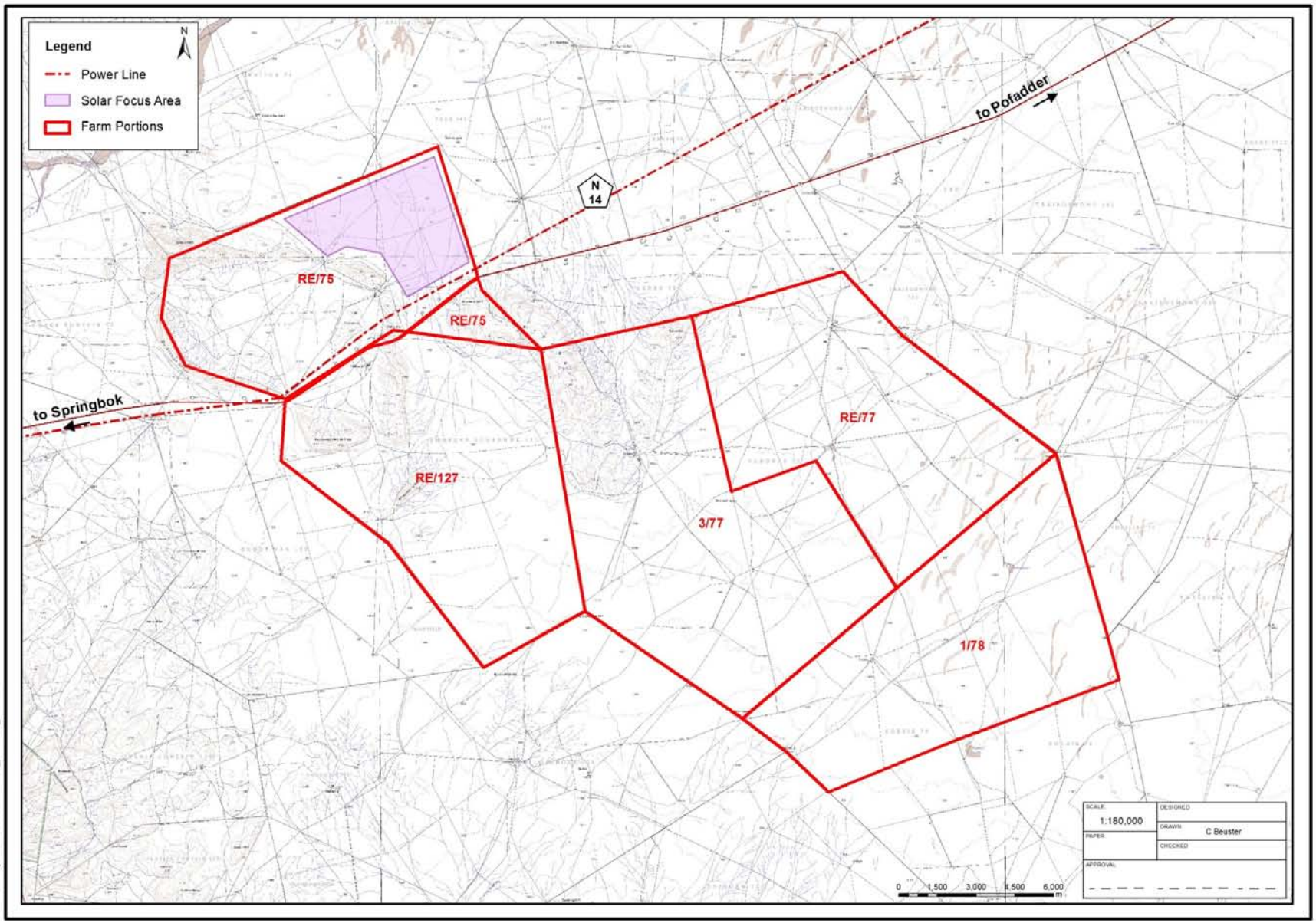


Figure 3.8: Preliminary focus area of the proposed solar energy facility on farms near Springbok in the Northern Cape

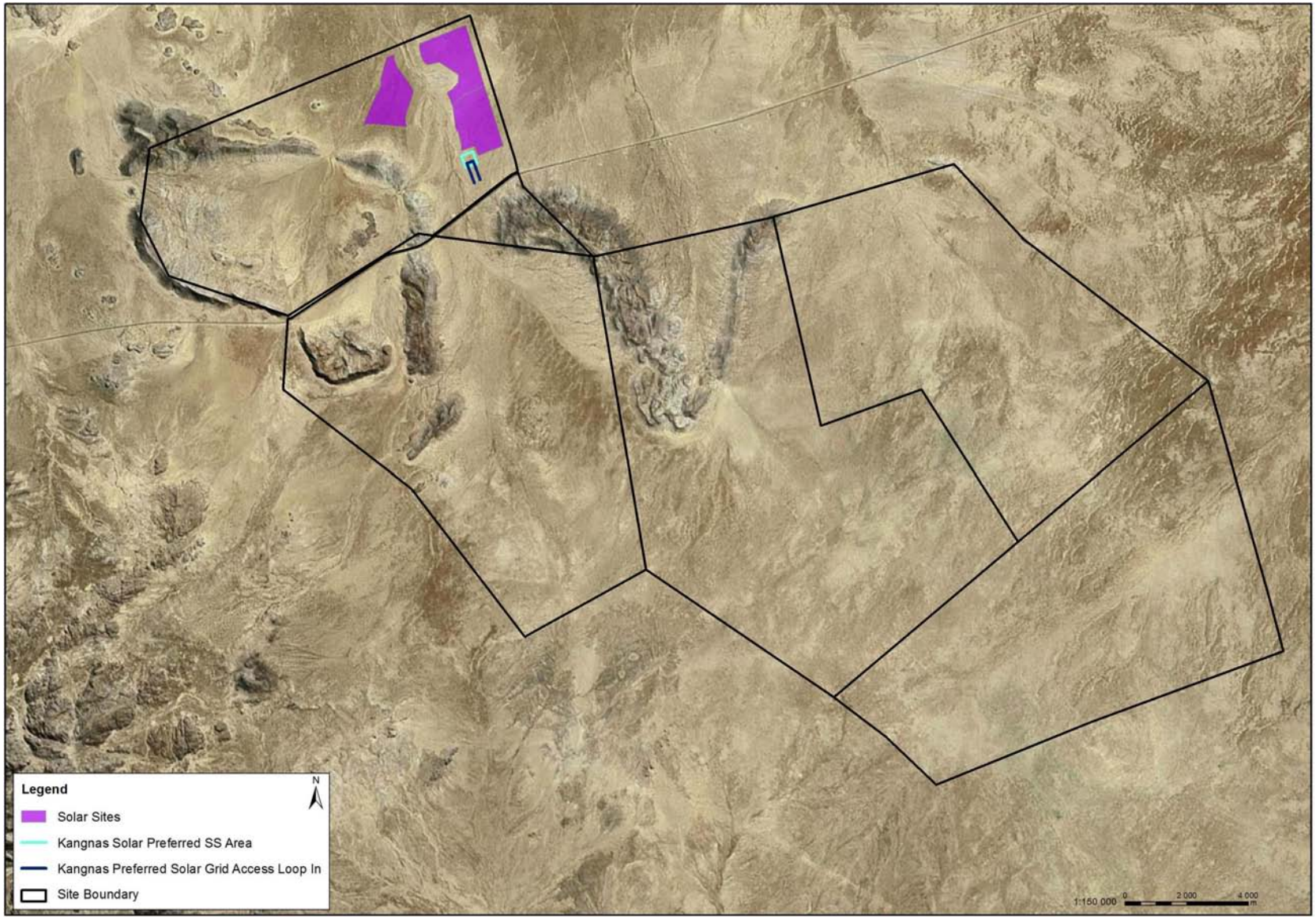


Figure 3.9 Revised focus area of the proposed solar energy facility on farms near Springbok in the Northern Cape

Figure 3.10: PV ground mounted system[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[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.

[20] (Source: http://en.wikipedia.org/wiki/Photovoltaicsystem)
[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

Component	Size (m)	Footprint (m²)	Land Requirement (ha)
1 072 000 x 280 W Panels (estimated) 225 MW	Panel height: 10 or 16	±3-4 hectares per MW	675 – 900
Access Roads	Width: 6-10 Length: ~15 km	Included in above	Included in above
Substation	200 x 200	40 000	4
Operation and maintenance building	50 x 504	2500	0.25
Construction camp and storage area	100 x 100	10 000	1

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 looping 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 3.6: Employment opportunities, and breakdown per skill set, for the proposed solar energy facility, 250 MW figures

Phase	Permanent	Highly Skilled	Skilled	Unskilled
Construction	285	16	101	168
Operation	130	0	15	115

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 in 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 Barichievy, 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.[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.

Table 3.7 Change in buildable areas due to incorporation of environmental considerations

	Initiation Phase (site)	Scoping Phase	EIA Phase	% reduction in land from start to finish
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)

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.

3.4.5 Technology alternatives

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.

3.4.5.2 Solar technology

[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 use 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[23]. These systems are illustrated in **Figure 3.12**.

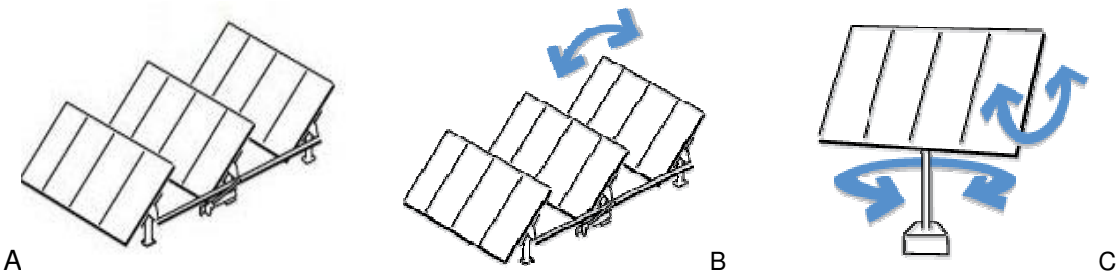


Figure 3.12: Solar panels can be mounted via (a) fixed axis photovoltaic systems, (b) single axis tracking PV systems and (c) dual axis tracking systems[24]

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:

[23] Source: http://en.wikipedia.org/wiki/Solar_tracker#Tracker_type_selection (Accessed on: 24 October 2011)
[24] Source: www.solar-tracking.com/ (Accessed on: 24/10/2011)

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 a maximum 800~~793~~ 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);

- Visual impacts;
- Impact on local economy (employment) and social conditions;
- Impact on transport;
- Noise pollution;
- Storage of hazardous substances on site; and
- 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.

[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[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* (quiver 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.

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)

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 4.3 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)

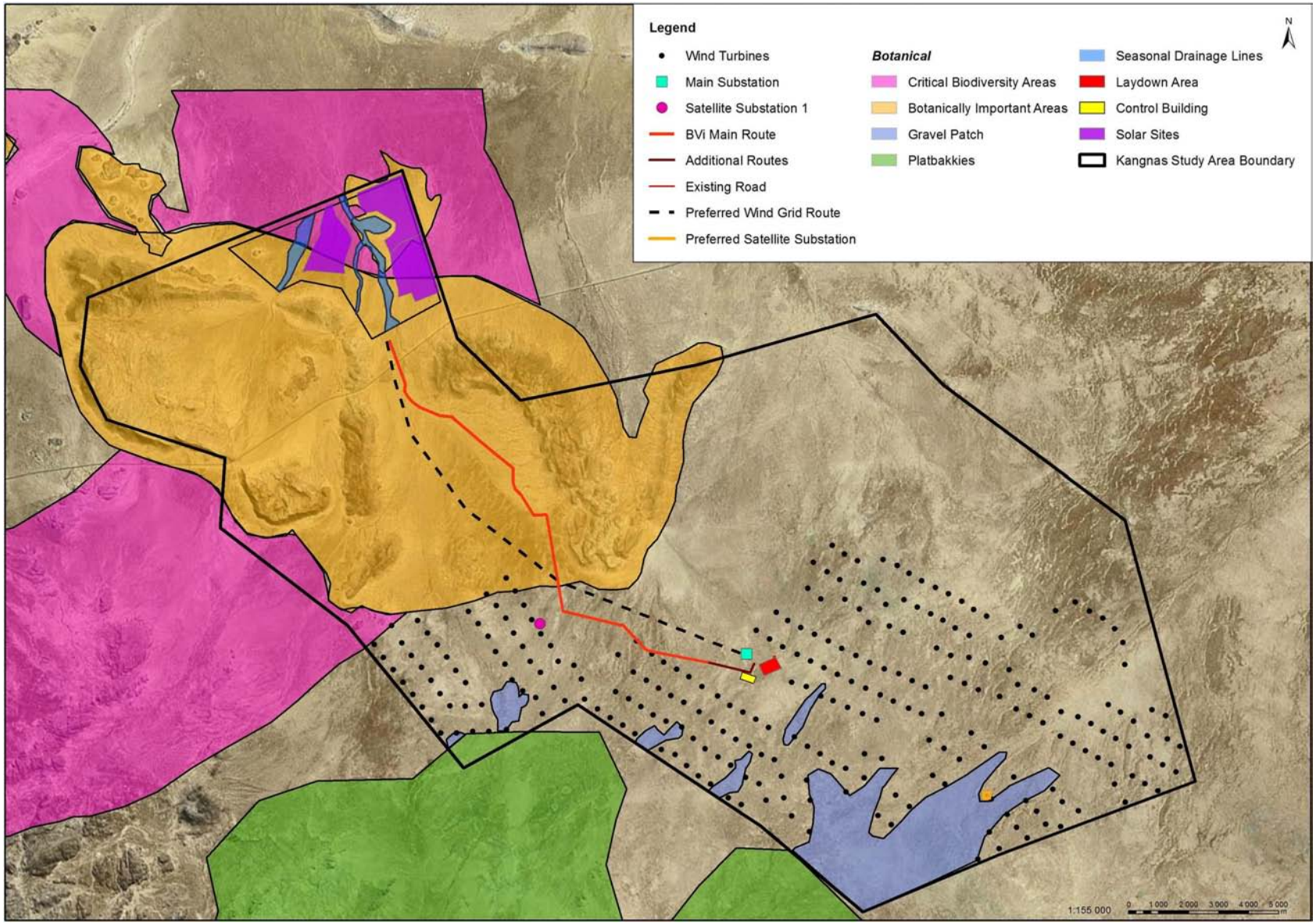

Figure 4.5: **Vegetation of the Kangnas study area**

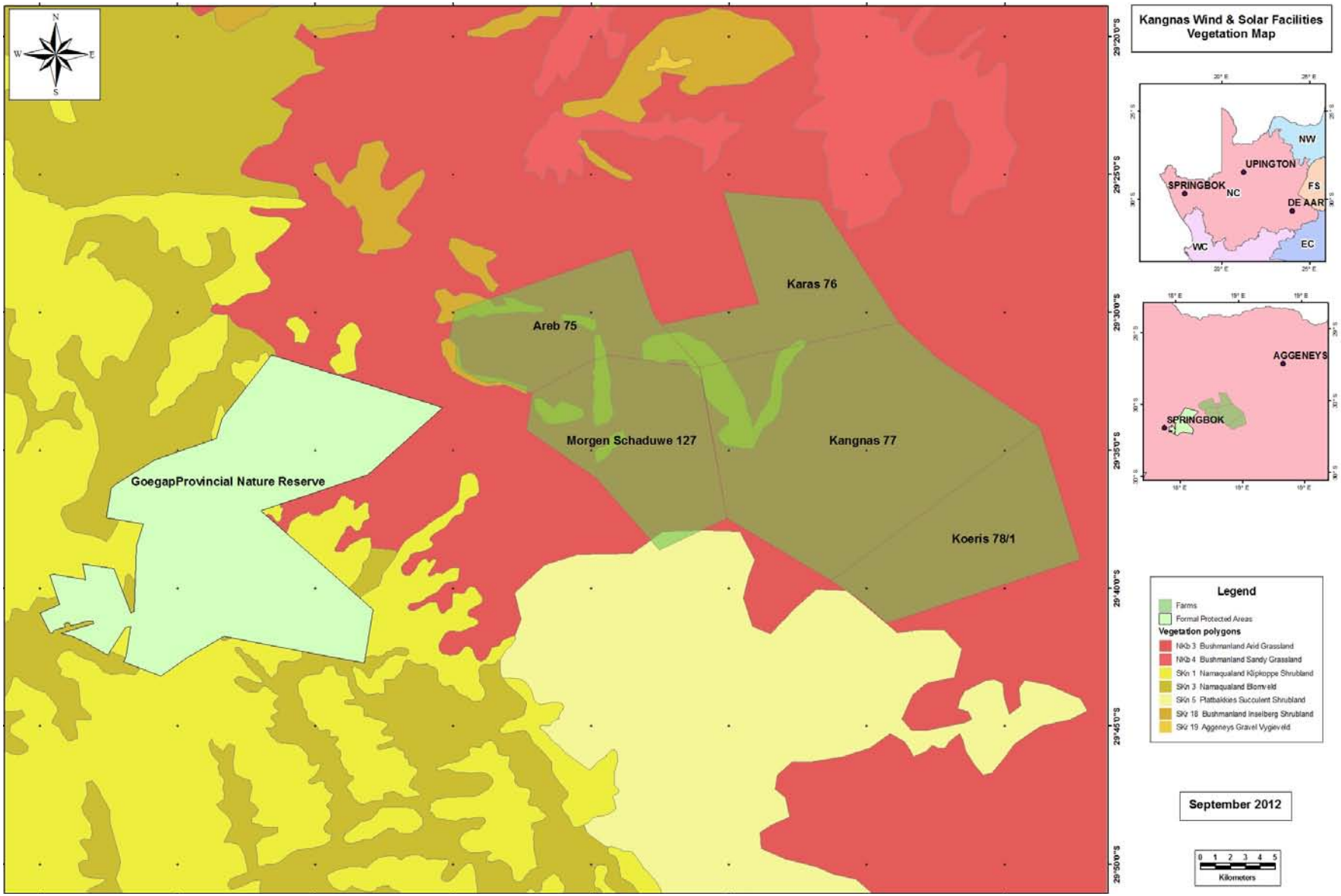

Figure 4.6: Vegetation types of the area

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 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.

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 ~~705~~800ha 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). Flight paths were noted for Verreaux's

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[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

[27] Perching birds and songbirds.

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 sae 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.[28]

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 Kannikwavlakte 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

[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.

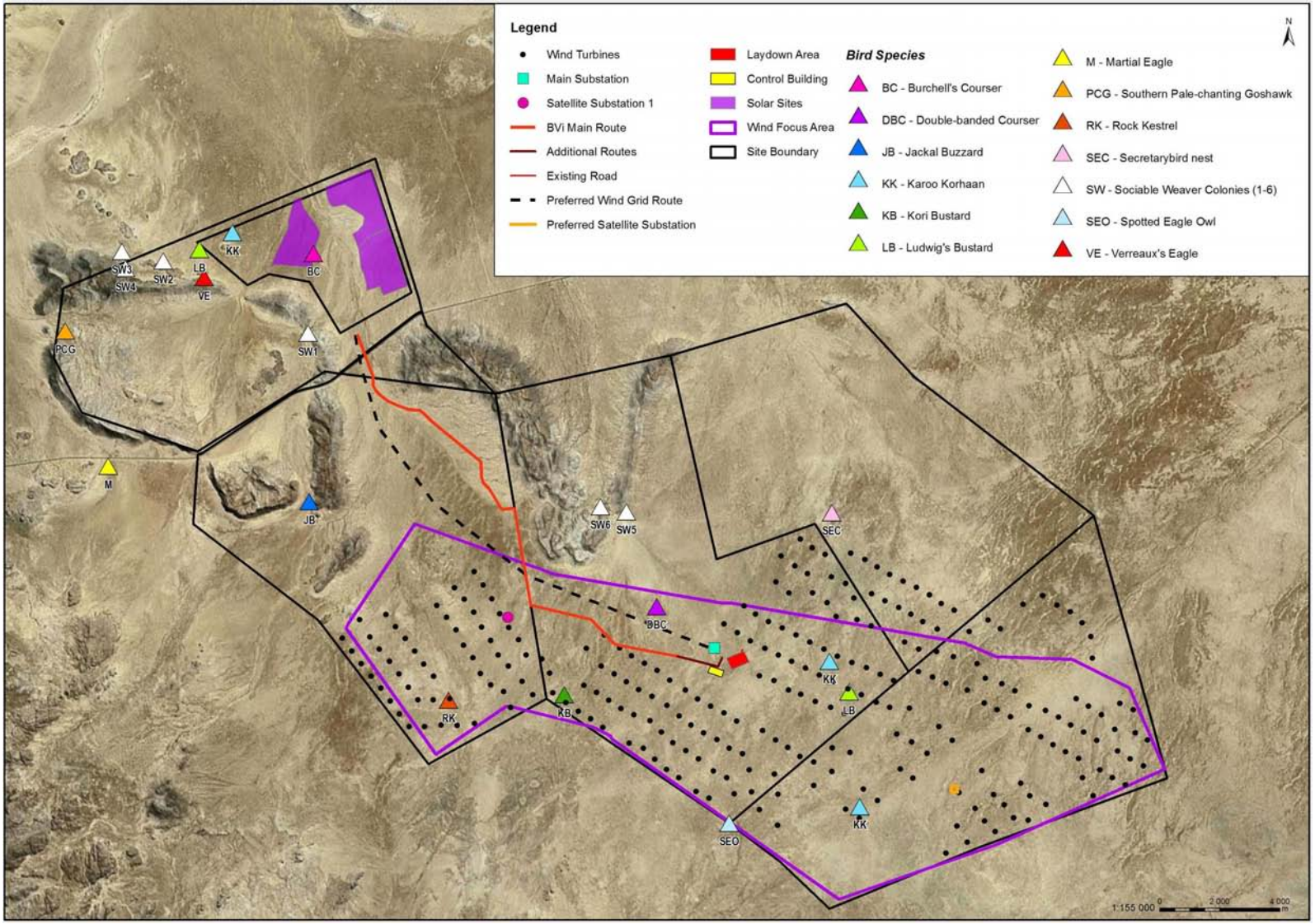

Figure 4.7: Locations of important bird species at the proposed wind and solar energy facility sites. (Source: D Harebottle, 2012)

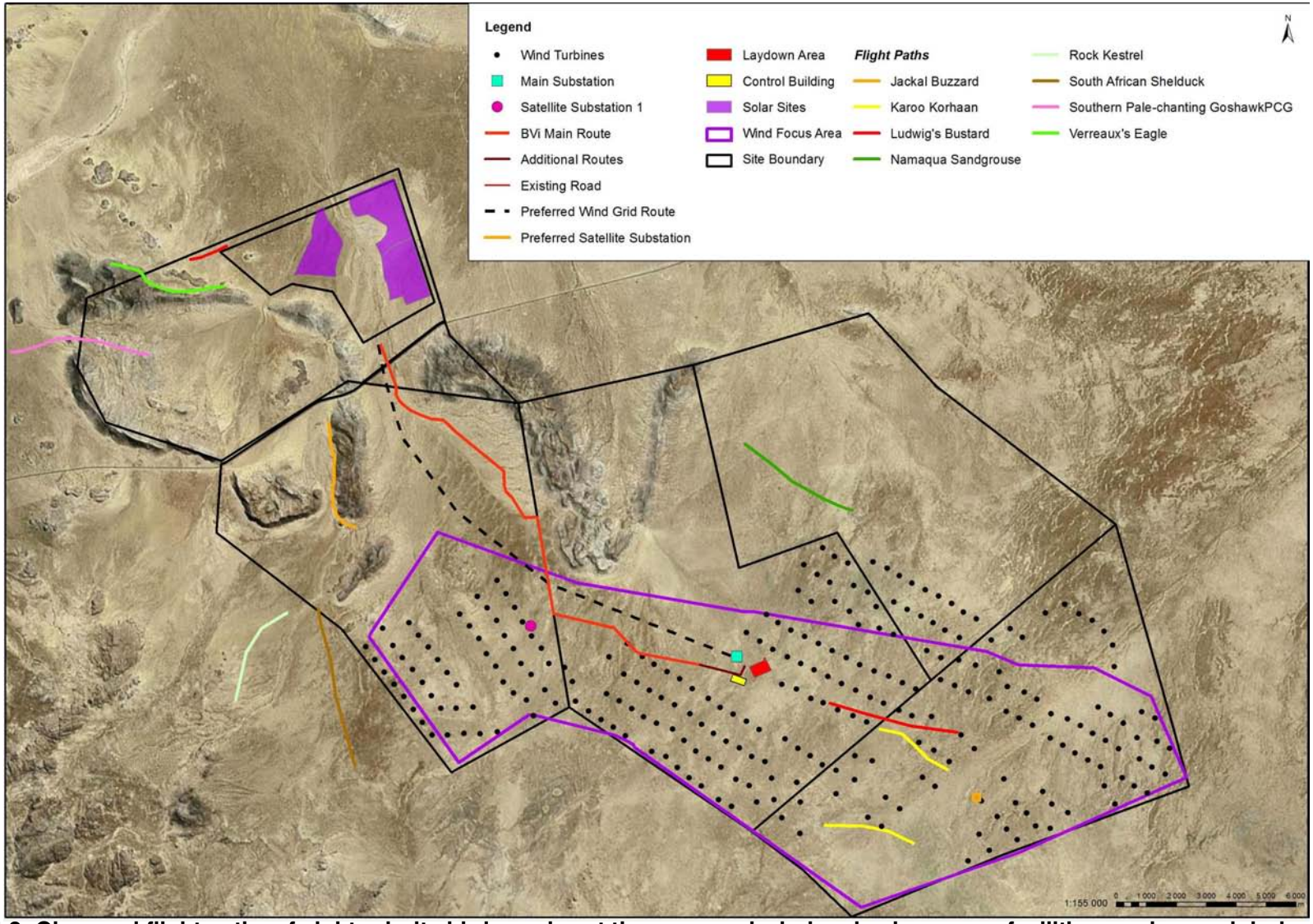

Figure 4.8: Observed flight paths of eight priority bird species at the proposed wind and solar energy facilities as observed during a field survey from 24-28 June 2012. (Source: D Harebottle, 2012)

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 re commendations 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**. <u>However Mainstream is currently undertaking pre-construction monitoring.</u> 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, curtail[29] 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.

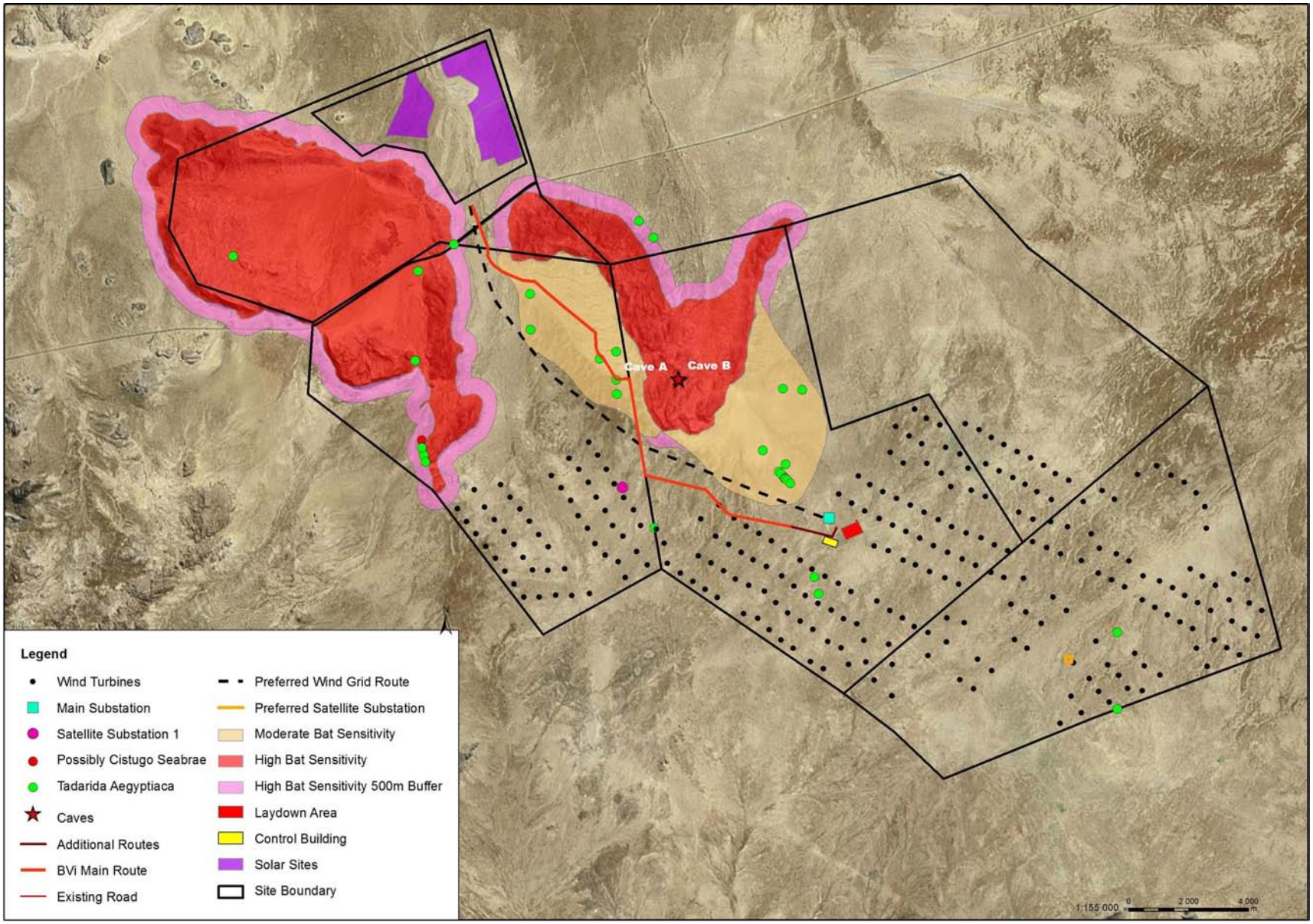

Figure 4.9: Bat sensitivity map

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.

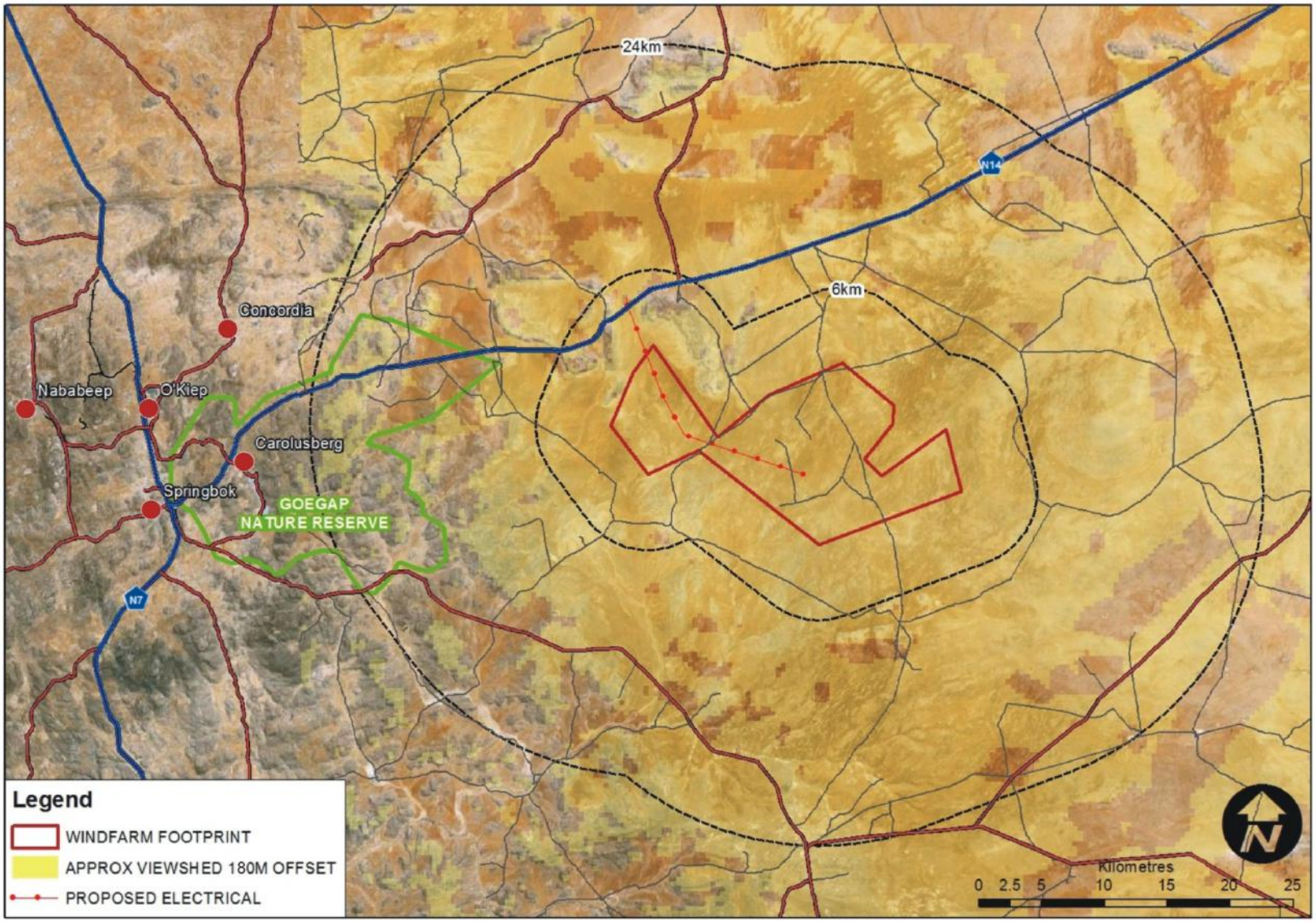

Figure 4.10: Viewshed of proposed wind turbines with offset of 180 m (tallest alternative) above ground.

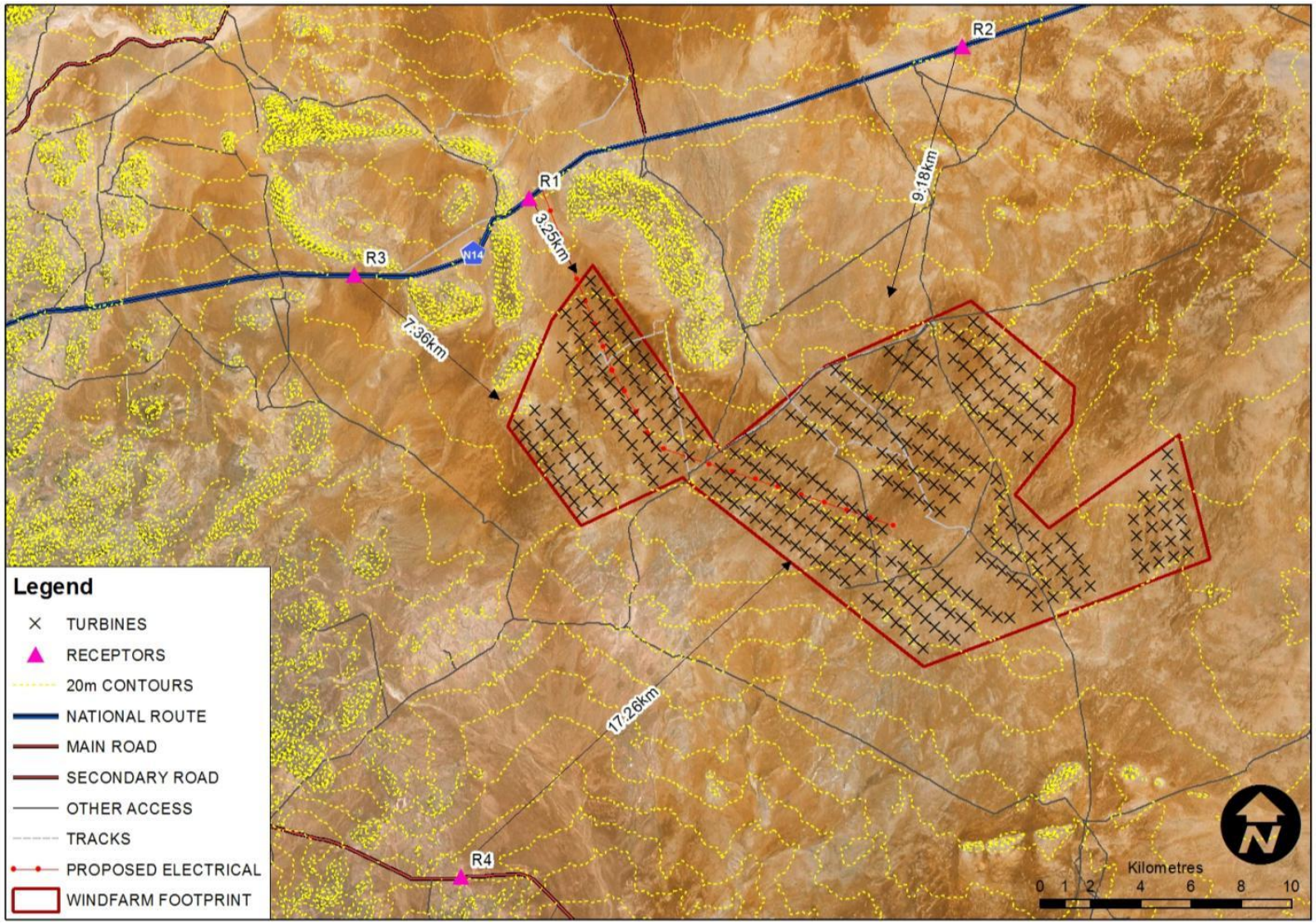

Figure 4.11: The location of key observation points and their distance from the proposed site of the proposed wind turbines.

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 inFigure 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.

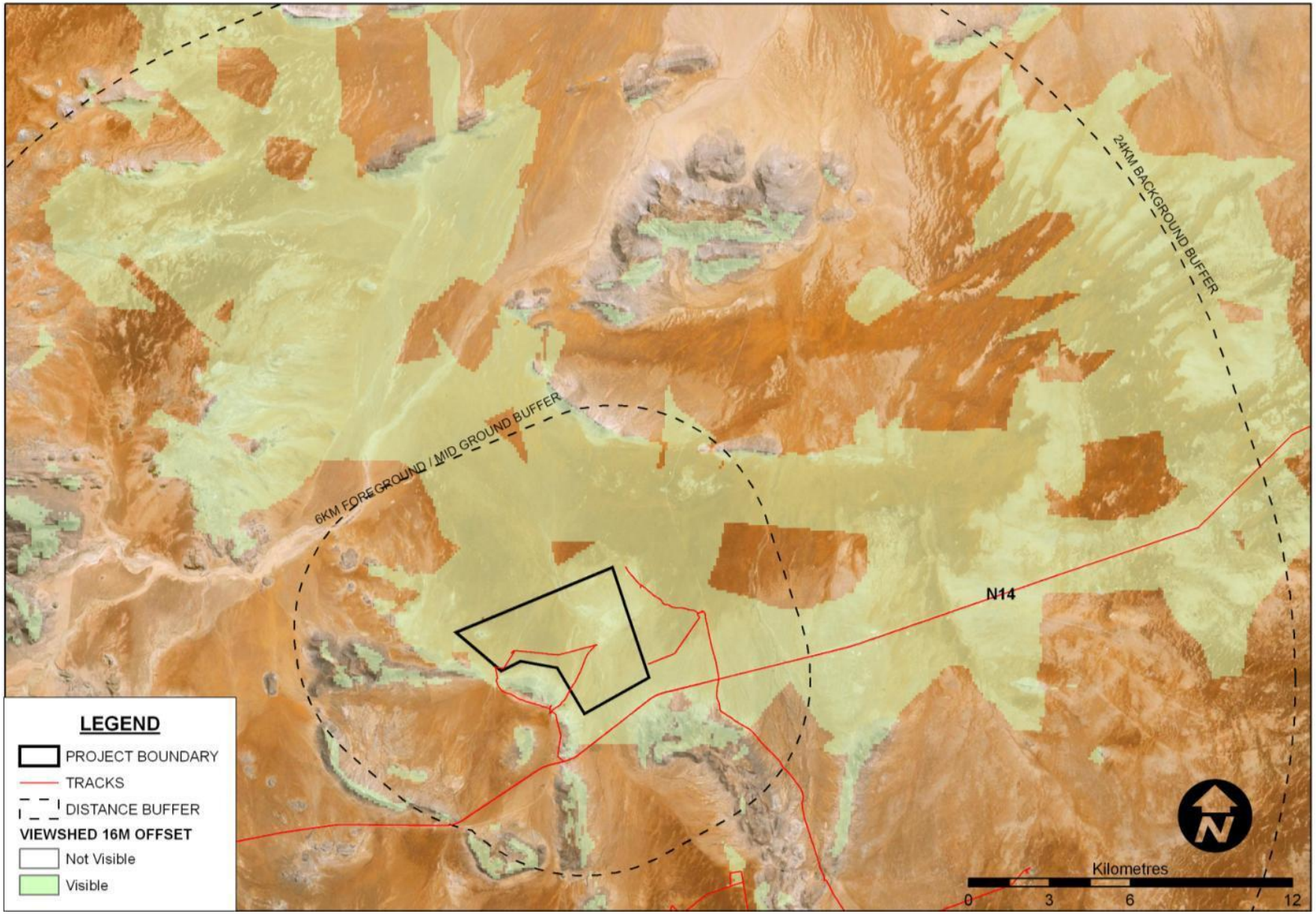

Figure 4.14: Viewshed of proposed PV panels with offset of 16m above ground level.

Figure 4.15: View of the proposed PV site from the N14 eastbound.

b) Mitigation measures

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.

c) 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, chloroflurocarbons (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_2O). 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.

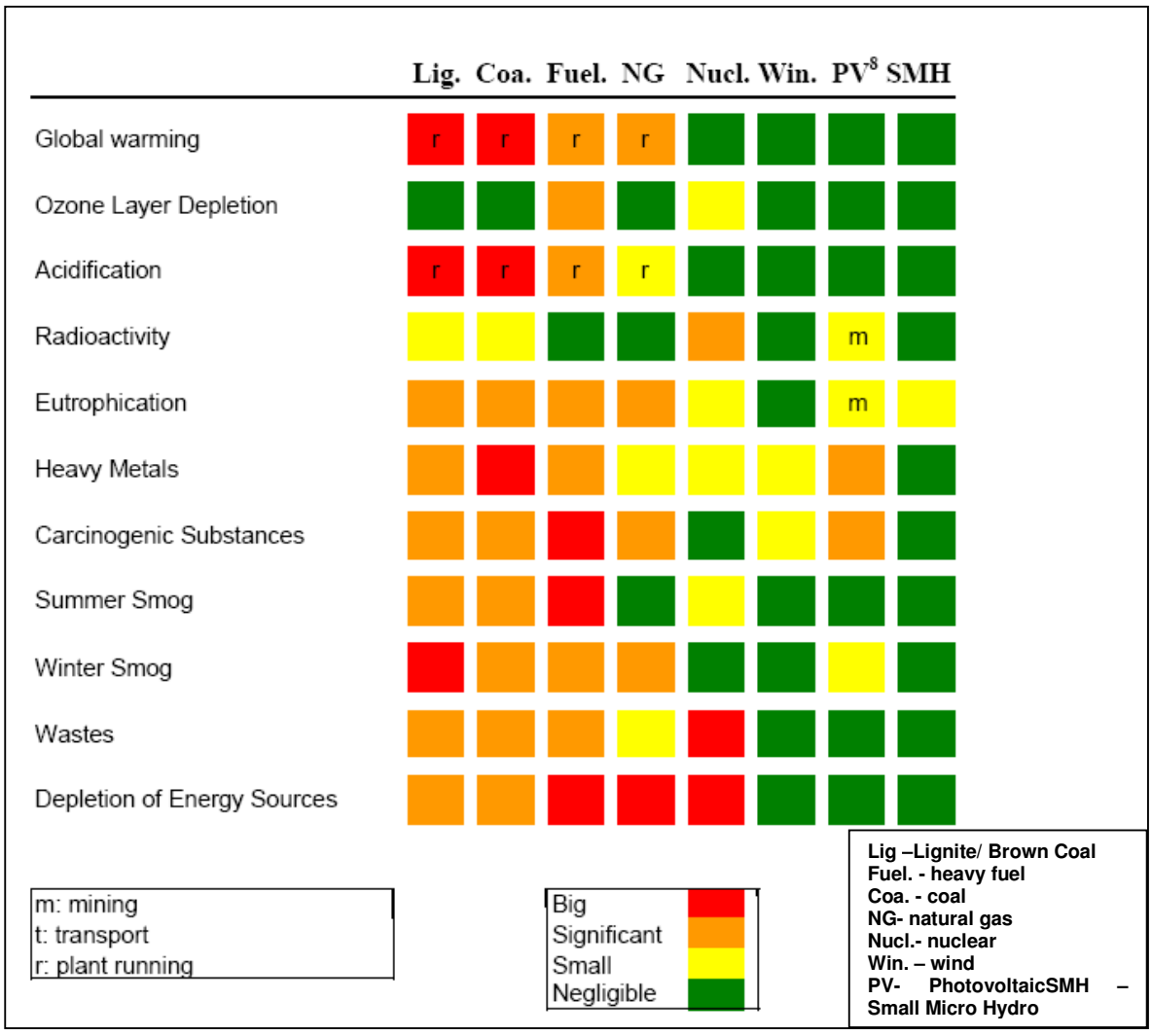

Figure 4.16: Matrix of environmental impacts by categories (AUMA, 2000)

~~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~~

~~4 788 MW~~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 km^2 which is approximately 12 % of Namakwa District Municipality. The municipality has a population density of 3.9 people per $km^2$and a household density of 1.1 households per km^2 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 once 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

Sector Impacted	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Agriculture	R0	R460, 000	R930, 000	R1, 390, 000
Mining	R0	R2, 630, 000	R120, 000	R2, 740, 000
Manufacturing	R0	R2, 270, 000	R2, 210, 000	R4, 480, 000
Utilities	R124, 920, 000	R1, 360, 000	R420, 000	R126, 710, 000
Construction	R0	R5, 570, 000	R50, 000	R5, 620, 000
Trade and accommodation	R0	R10, 340, 000	R2, 550, 000	R12, 890, 000
Transport	R0	R4, 950, 000	R3, 900, 000	R8, 860, 000
Financing	R0	R7, 370, 000	R4, 160, 000	R11, 530, 000
Business services	R0	R3. 720, 000	R330, 000	R4, 050, 000
Services	R0	R2, 320, 000	R5, 200, 000	R7, 520, 000
Total	**R124, 920, 000**	**R41, 010, 000**	**R19, 860, 000**	**R185, 800, 000**
Photovoltaic Plant				
Agriculture	R0	R140, 000	R1, 080, 000	R1, 210, 000
Mining	R0	R100, 000	R130, 000	R230, 000
Manufacturing	R0	R1, 090, 000	R2, 610, 000	R3, 690, 000
Utilities	R86, 000, 000	R180, 000	R480, 000	R86, 660, 000
Construction	R0	R120, 000	R60, 000	R180, 000
Trade and accommodation	R0	R23, 530, 000	R2, 960, 000	R26, 500, 000
Transport	R0	R5, 730, 000	R4, 520, 000	R10, 260, 000
Financing	R0	R15, 430, 000	R4, 630, 000	R20, 060, 000
Business services	R0	R680, 000	R380, 000	R1, 060, 000
Services	R0	R2, 650, 000	R5, 770, 000	R8.41
Total	**R86, 000, 000**	**R49, 650, 000**	**R22, 610, 000**	**R158, 260, 000**
No-Go Alternative				
Agriculture	R0	R0	R0	R0
Mining	R0	R0	R0	R0
Manufacturing	R0	R0	R0	R0
Utilities	R0	R0	R0	R0
Construction	R0	R0	R0	R0
Trade and accommodation	R0	R0	R0	R0
Transport	R0	R0	R0	R0
Financing	R0	R0	R0	R0
Business services	R0	R0	R0	R0
Services	R0	R0	R0	R0
Total	**R0**	**R0**	**R0**	**R0**

- *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

Sector Impacted	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Agriculture	R0	R210, 000	R430, 000	R640, 000
Mining	R0	R1, 440, 000	R60, 000	R1, 500, 000
Manufacturing	R0	R600, 000	R460, 000	R1, 060, 000
Utilities	R13, 500, 000	R650, 000	R170, 000	R14, 320, 000
Construction	R0	R1, 440, 000	R10, 000	R1, 460, 000
Trade and accommodation	R0	R4, 760, 000	R1, 140, 000	R5, 900, 000
Transport	R0	R1, 820, 000	R1, 430, 000	R3, 260, 000
Financing	R0	R4, 090, 000	R2, 330, 000	R6, 420, 000
Business services	R0	R1, 390, 000	R120, 000	R1, 520, 000
Services	R0	R1, 120, 000	R2, 540, 000	R3, 660, 000
Total	**R13, 500, 000**	**R17, 540, 000**	**R8, 700, 000**	**R39, 730, 000**
Photovoltaic Plant				
Agriculture	R0	R60, 000	R50, 000	R560, 000
Mining	R0	R50, 000	R70, 000	R120, 000
Manufacturing	R0	R260, 000	R540, 000	R800, 000
Utilities	R12, 040, 000	R80, 000	R200, 000	R12, 310, 000
Construction	R0	R30, 000	R10, 000	R40, 000
Trade and accommodation	R0	R10, 830, 000	R1, 330, 000	R12, 160, 000
Transport	R0	R2, 110, 000	R1, 660, 000	R3, 770, 000
Financing	R0	R8, 570, 000	R2, 590, 000	R11, 150, 000
Business services	R0	R250, 000	R140, 000	R400, 000
Services	R0	R1, 330, 000	R2, 820, 000	R4, 150, 000
Total	**R12, 040, 000**	**R23, 570, 000**	**R9, 850, 000**	**R45, 470, 000**
No-Go Alternative				
Agriculture	R0	R0	R0	R0
Mining	R0	R0	R0	R0
Manufacturing	R0	R0	R0	R0
Utilities	R0	R0	R0	R0
Construction	R0	R0	R0	R0
Trade and accommodation	R0	R0	R0	R0
Transport	R0	R0	R0	R0
Financing	R0	R0	R0	R0
Business services	R0	R0	R0	R0
Services	R0	R0	R0	R0
Total	**R0**	**R0**	**R0**	**R0**

- *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

Sector Impacted	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Agriculture	0	3	7	10
Mining	0	4	0	4
Manufacturing	0	6	4	10
Utilities	69	1	0	70
Construction	0	22	0	22
Trade and accommodation	0	39	10	49
Transport	0	5	3	7
Financing	0	6	2	9
Business services	0	13	1	14
Services	0	9	21	30
Total	**69**	**108**	**49**	**226**
Photovoltaic Plant				
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				
Agriculture	0	0	0	0
Mining	0	0	0	0
Manufacturing	0	0	0	0
Utilities	0	0	0	0
Construction	0	0	0	0
Trade and accommodation	0	0	0	0
Transport	0	0	0	0
Financing	0	0	0	0
Business services	0	0	0	0
Services	0	0	0	0
Total	**0**	**0**	**0**	**0**

- *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 Kannikwavlakte 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

Impact Indicator	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Alternative Layout 1: Wind Farm				
Employment	**69**	**107**	**46**	**222**
Alternative 1: Photovoltaic Farm				
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**

- *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**

Assumptions	Entire Project
Wind Farm	
Project Size	750 MW
Project Operating Expenditure	R124, 900, 000
Local Expenditure	R67, 500, 000
% of local expenditure in Total Project cost	54%
Photovoltaic Plant	
Project Size	250 MW[30]
Project operating expenditure	R86, 000, 000
Local Expenditure	R60, 200, 000
% of local expenditure in total project costs	70%

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.

[30] 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 Barichievy 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 Apedal (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.

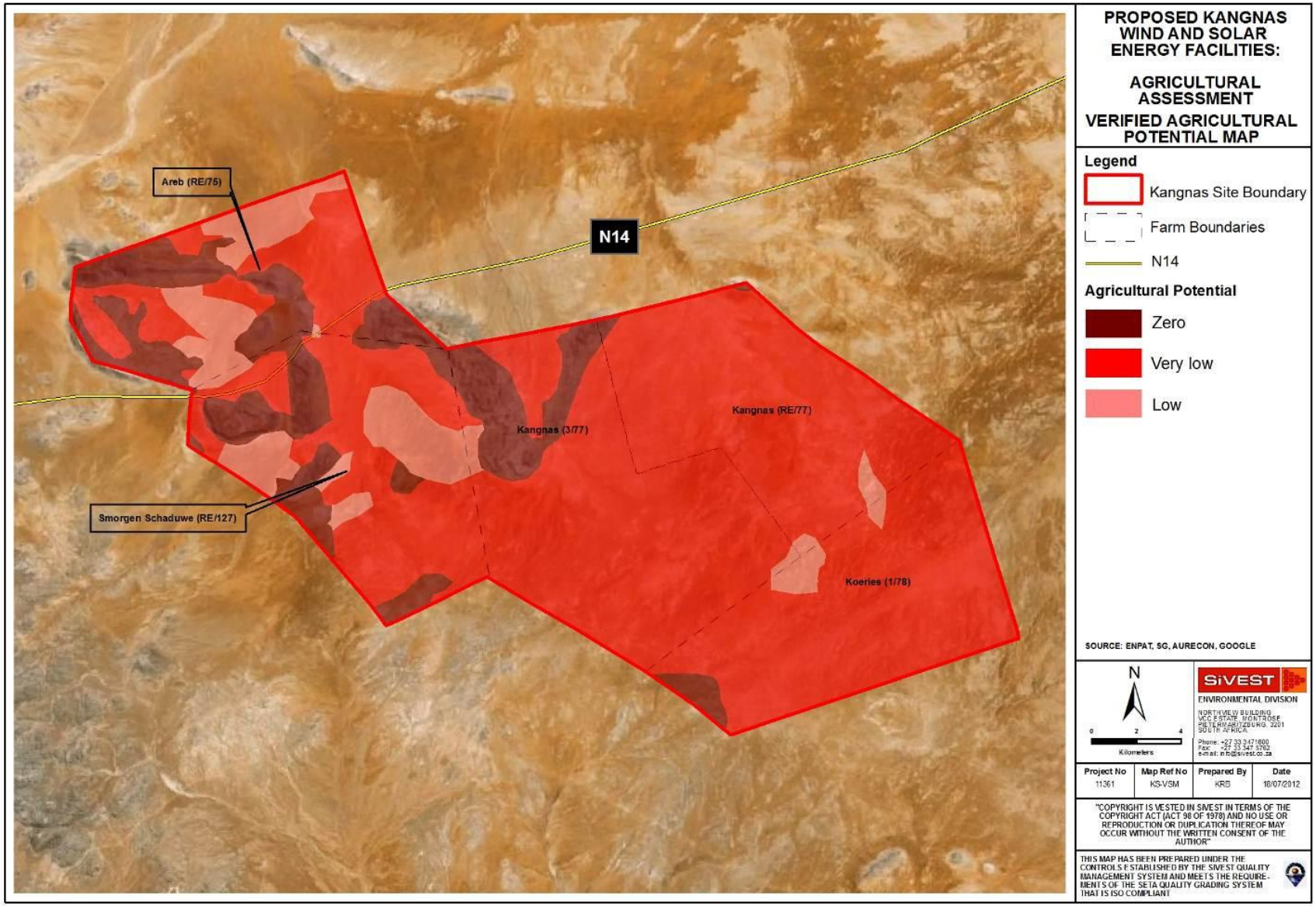

Figure 4.17: Agricultural potential map (source: SIVEST, 2012)

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 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)** FEPAs 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.

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.

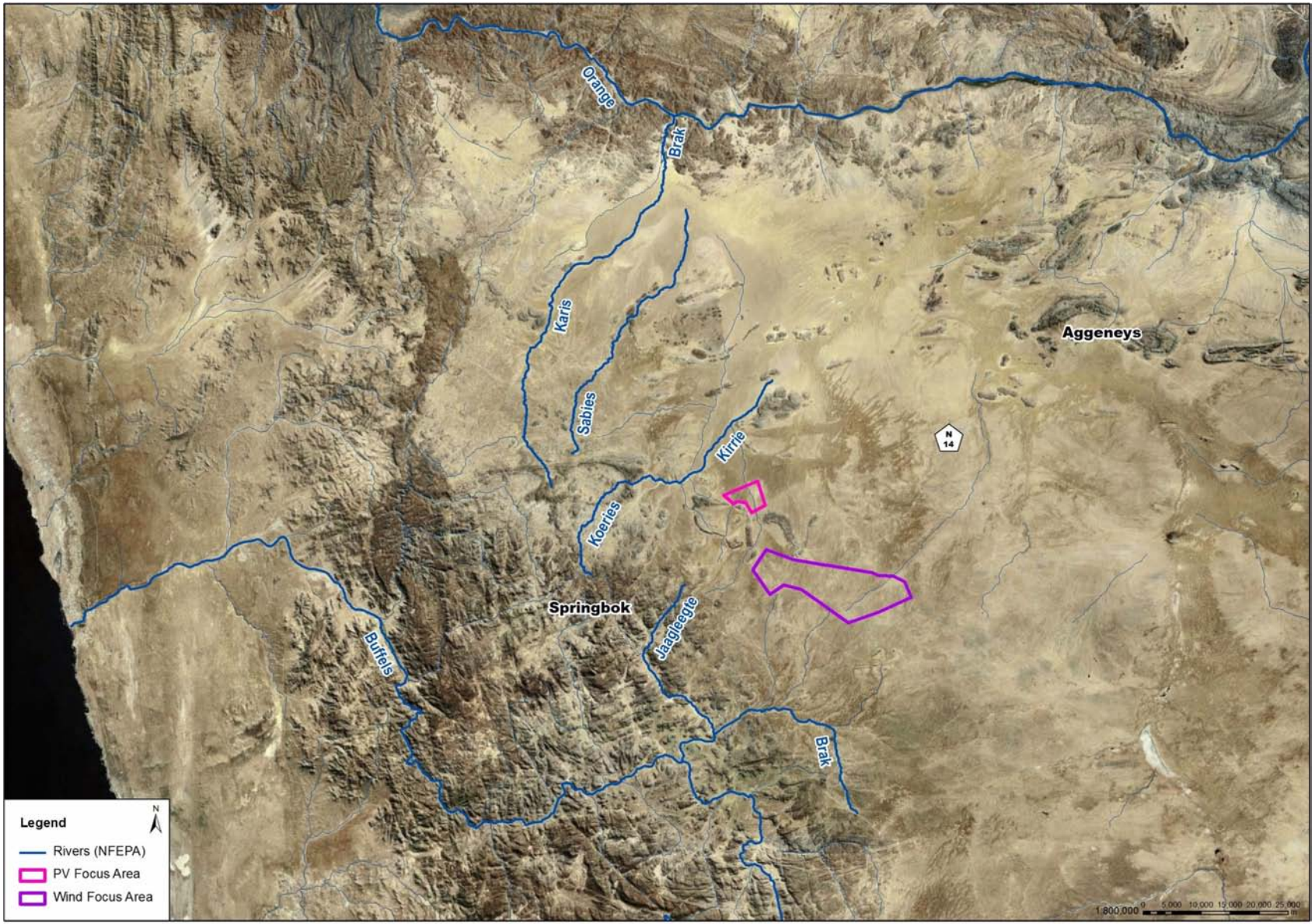

Figure 4.19: Water features in the study area

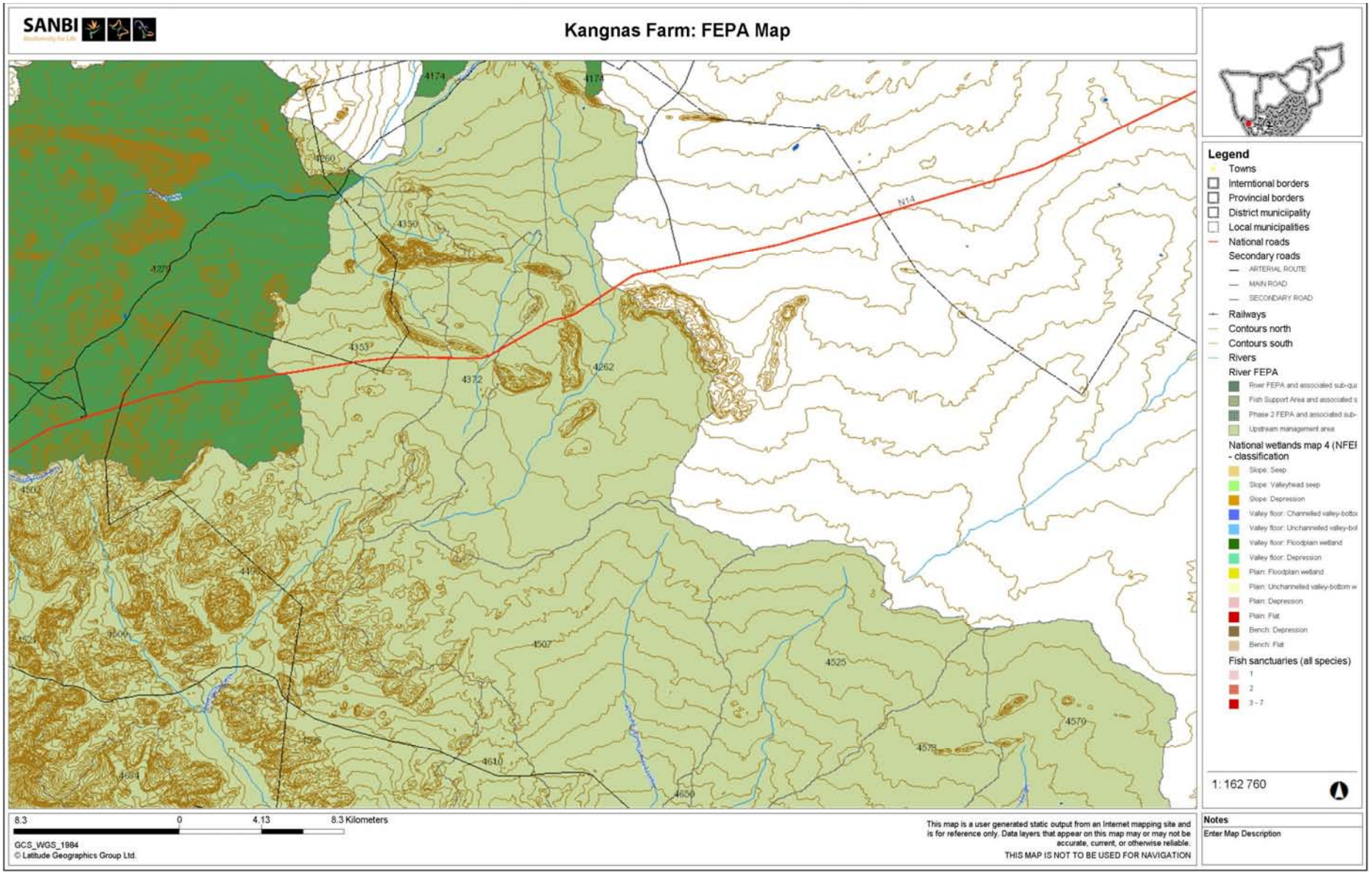

Figure 4.20: Freshwater Ecosystem Priority Areas for the study area (SANBI, 2012), general site area encircled (source: Belcher, 2012)

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 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. 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 M^2 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 km^2 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.

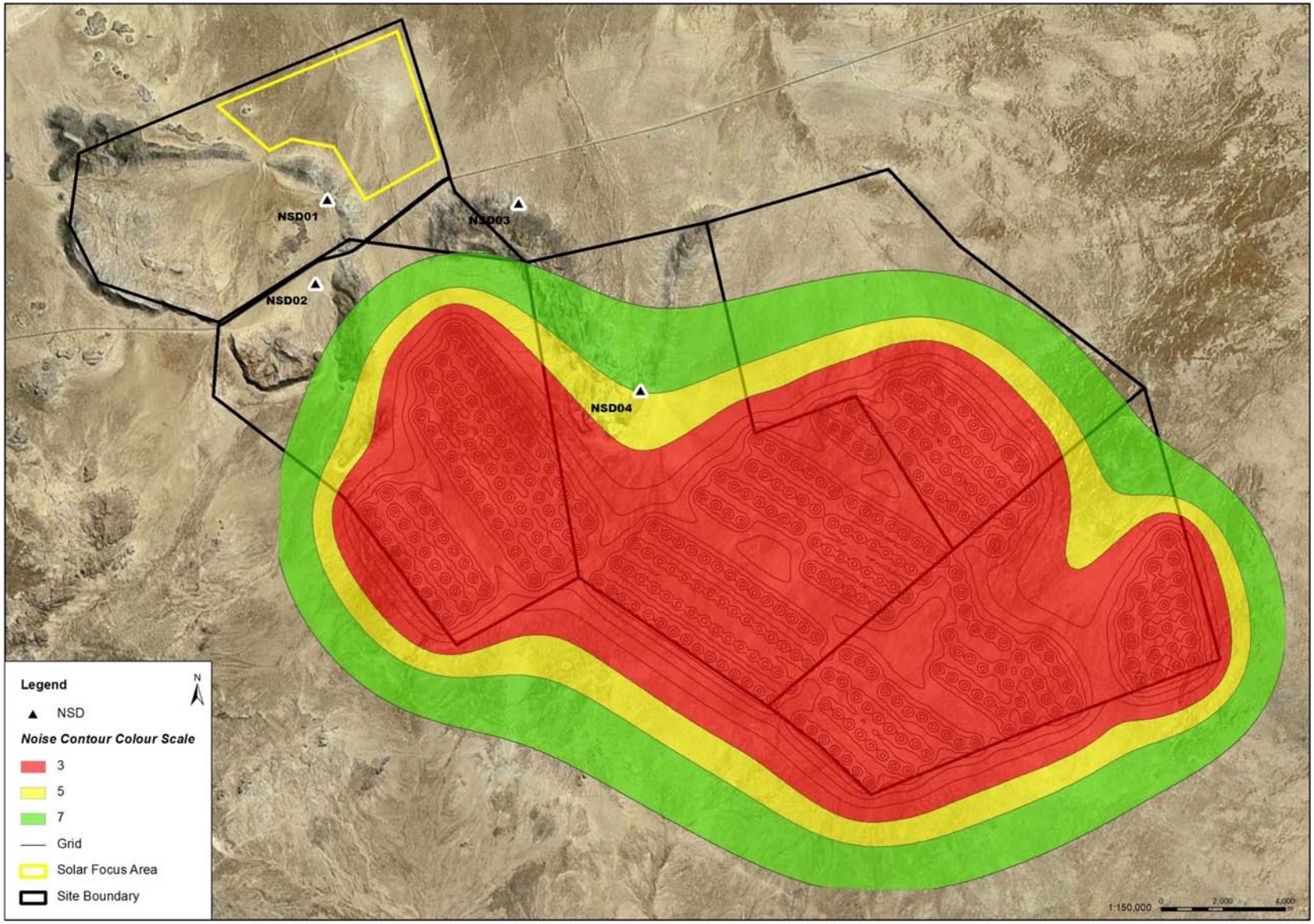

Figure 4.21: Projected change in ambient sound levels (ISO model) showing contours of constant sound levels for a 5 m/s wind

- 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)**)

Figure 4.22: Stone artefacts that occurred near the base of hill on the western side of the site (J Orton, 2012)

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).**

Figure 4.23: Stone artefacts, pottery and ostrich eggshell fragments (J Orton, 2012)

Figure 4.24: Stone artefacts found at Gobees se Pan (J Orton, 2012)

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.

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

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**).

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

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 4.27: 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**).

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

Cultural landscapes[31]

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**).

[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).

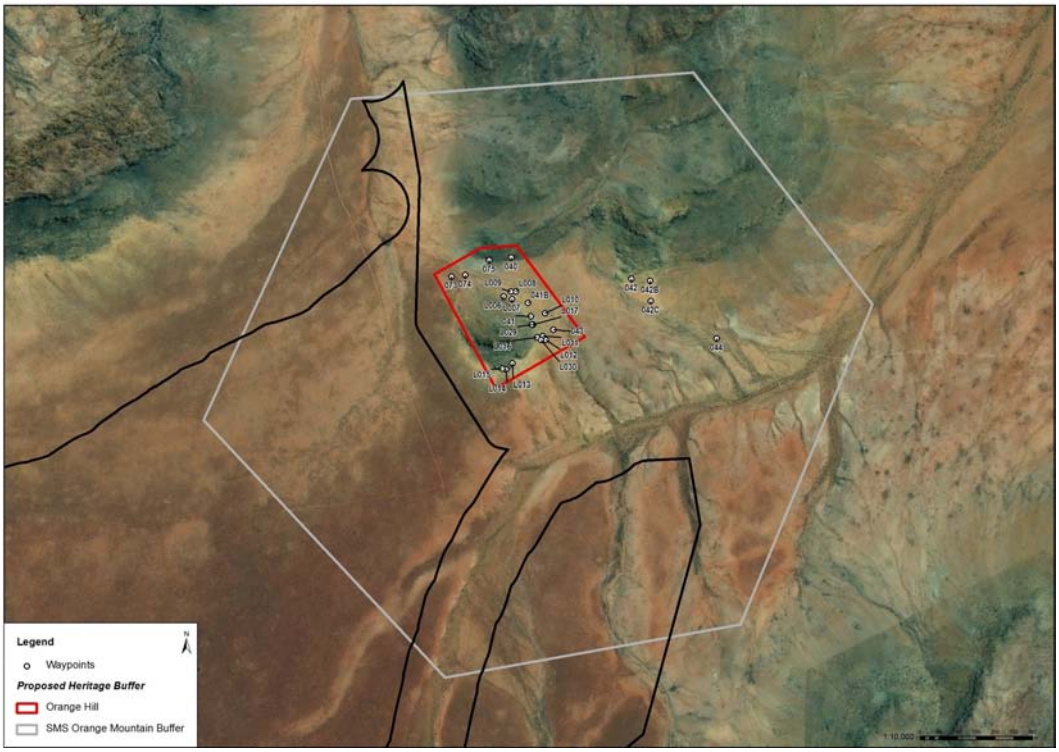

Figure 4.32: (i) 'Orange Hill' on farm Smorgenschaduwe appears to be geologically different to the surrounding landscape and has a clearly orange hue. There are a large number of archaeological sites on and around this hill, including six of the eight ground 'cupule' sites described above. There are many scatters of stone artefacts, including one with a preserved hearth that may be a recent Khoekhoen stockpost.

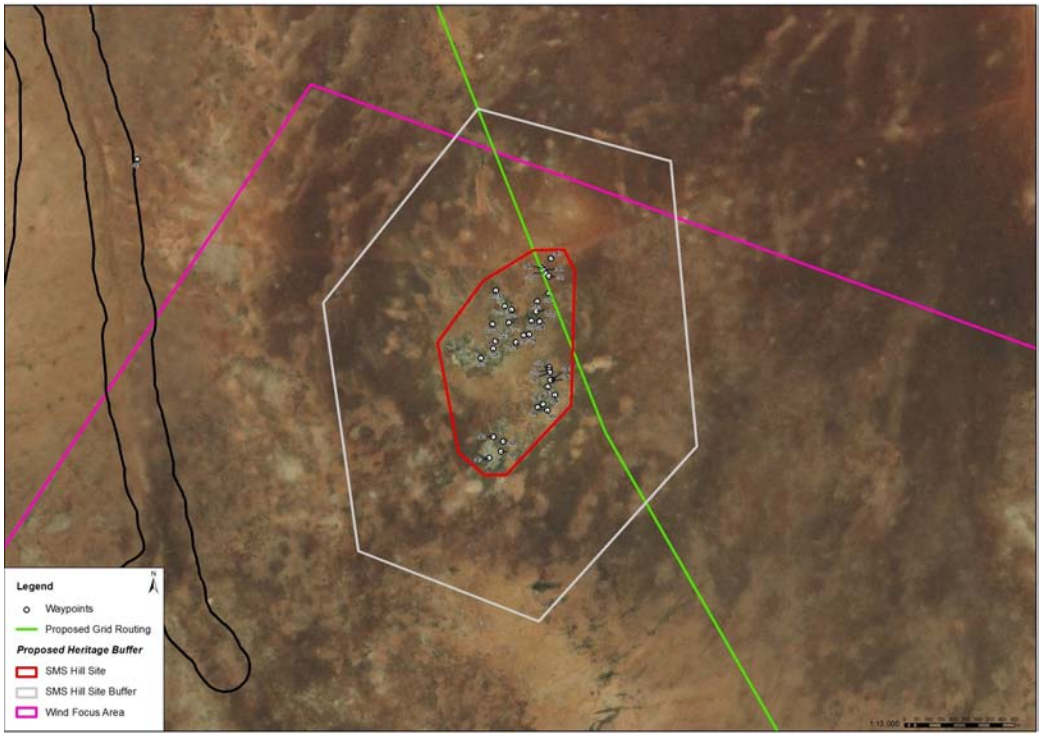

Figure 4.33: (ii) A large number of archaeological occurrences are present on 'SMS Hill' on farm Smorgenschaduwe and, although none are of very high significance, the sheer number of finds shows the importance ascribed to this hill in both pre-colonial and historical times.

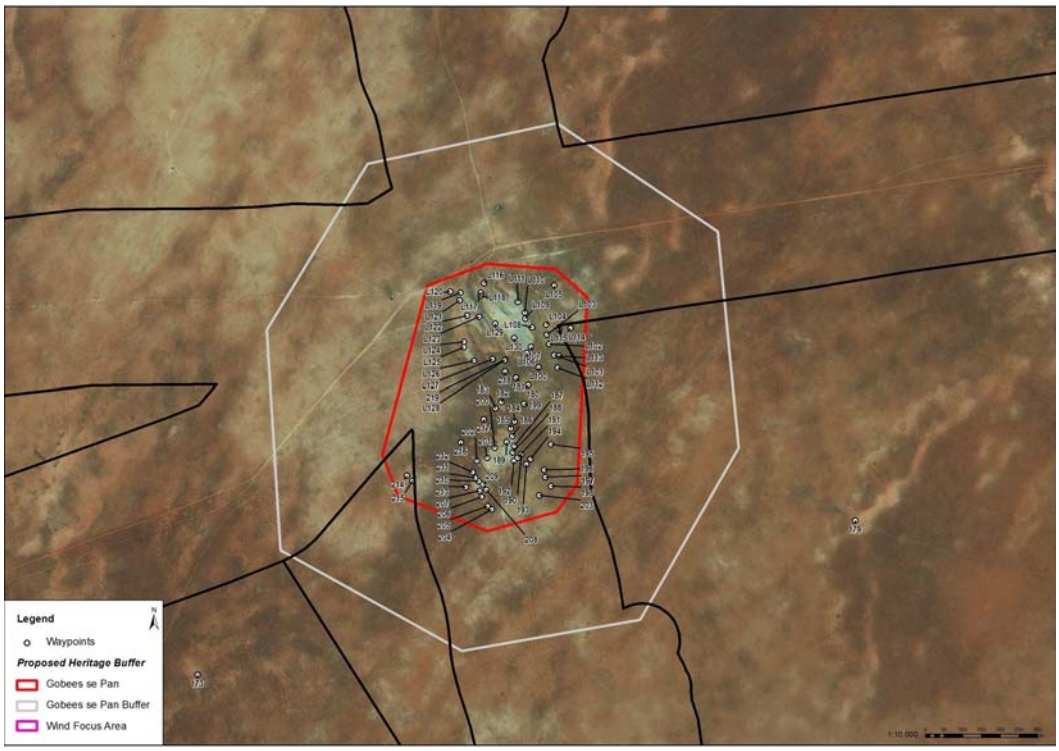

Figure 4.34: (iii) 'Gobeesvlei' with extensive granite bedrock outcrops is home to a large number of archaeological sites and more may be preserved beneath the surface of the ground.

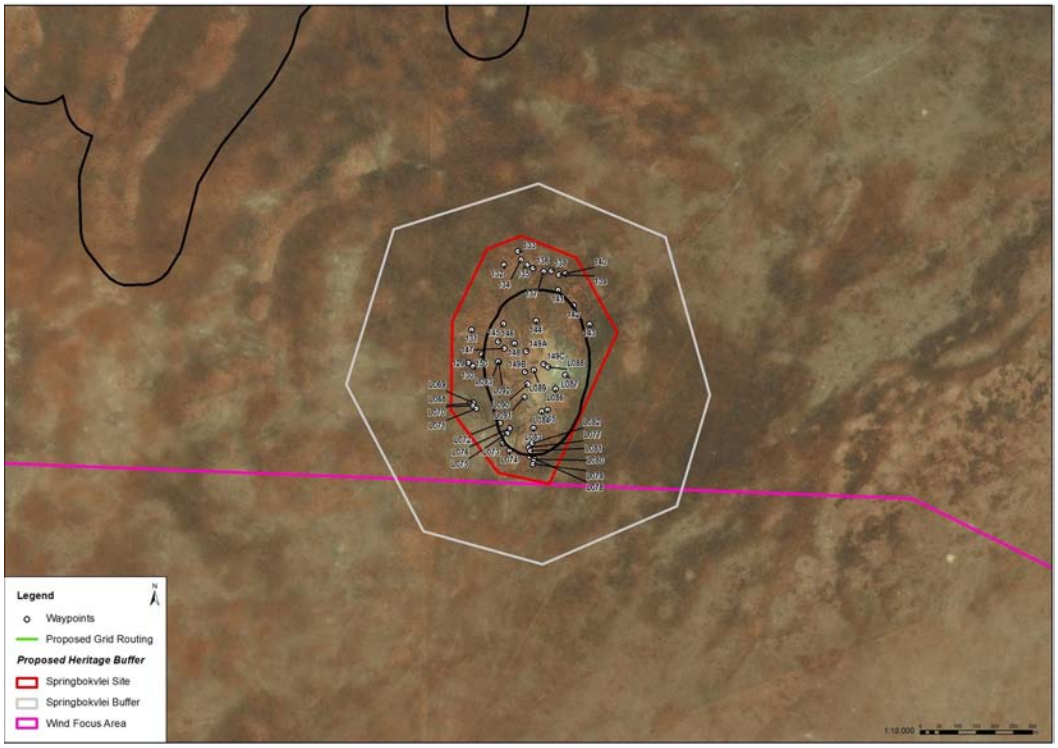

Figure 4.35: (iv) 'Springbokvlei' is a large pan located on farm Koeris. Some of the bedrock is exposed and water frequently collects within this pan. Many archaeological sites were located on the surface. There is a possibility that further sites may be fully preserved beneath the ground.

Figure 4.36: (v) Site KNG2012/007 is not of very high significance but nonetheless has value as, being a pan, the chances of subsurface deposits occurring around it are still relatively high. It therefore should not be developed.

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 9 00 m east/west and 1 000 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, 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 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 Goebeesvlei 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.

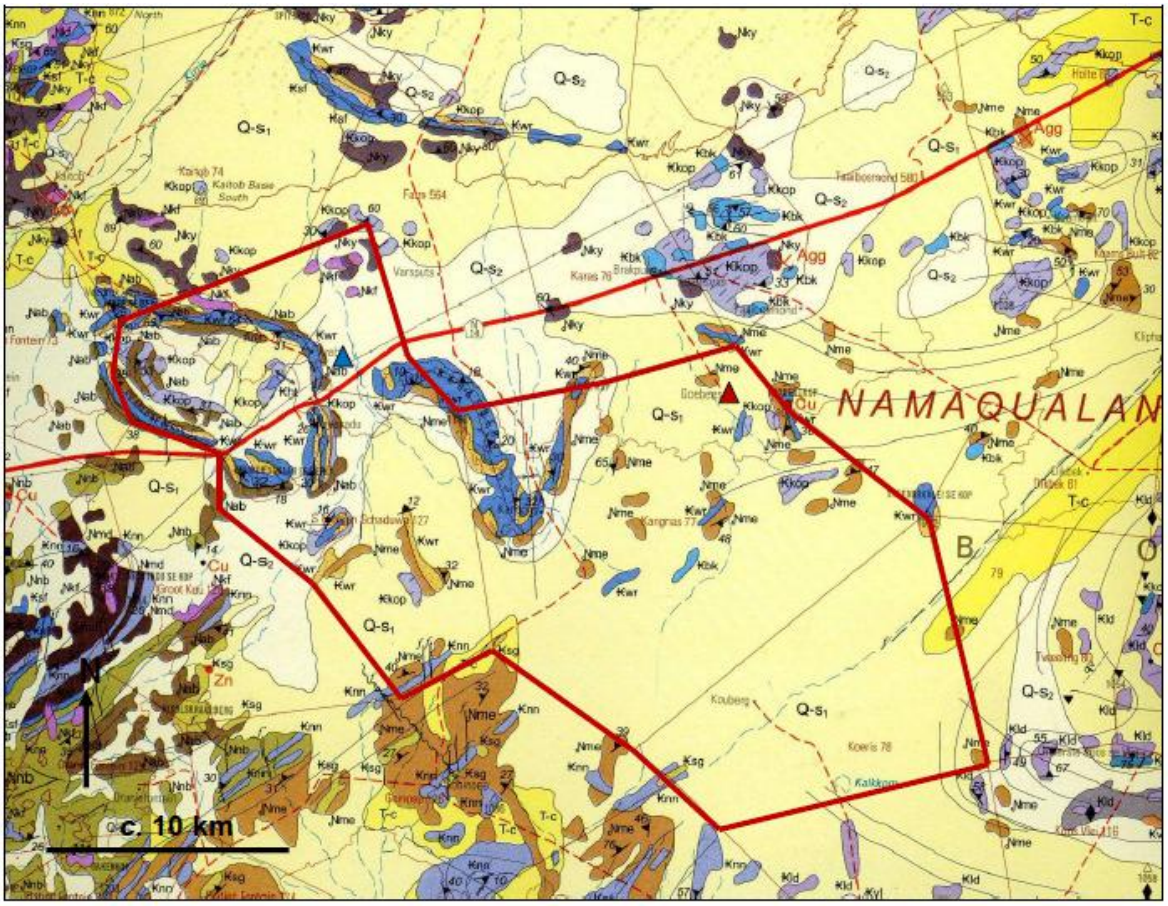

Figure 4.37: Geological map of the region *c.* 50km east of Springbok, Northern Cape, showing the outcrop areas of the main rock units represented within the site, outlined in dark red (Map abstracted from 1: 250 000 geology sheet 2918 Pofadder, Council for Geoscience, Pretoria). The red triangle indicates the site of the *Kangnasaurus* Cretaceous dinosaur fossil site at the Goebees farmstead and the blue triangle the Miocene fossil horse locality at Areb (approximate position only). (Source: Natura Viva).

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 Goebees 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, herbivorous 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.

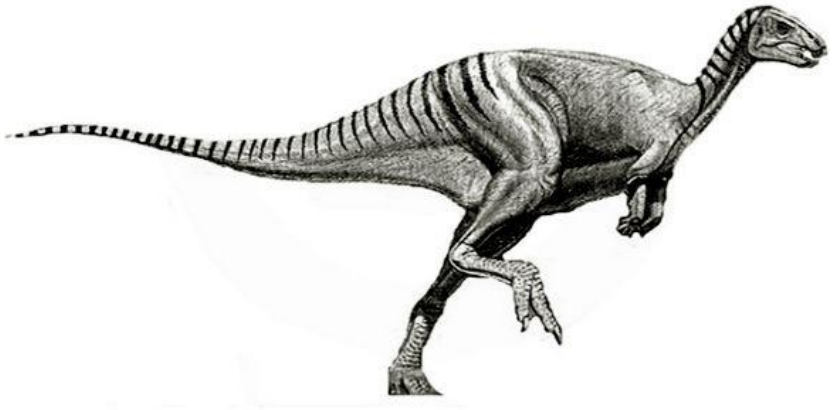

Figure 4.38: Reconstruction of a bipedal iguanodontian dinosaur similar to *Kangnasaurus* from the Late Cretaceous Bushmanland (source: Natura Viva).

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 Caenozoic 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). 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**).

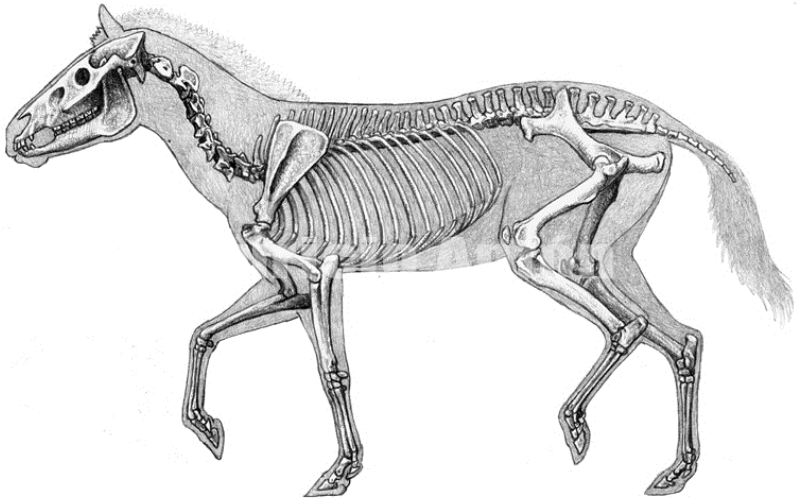

Figure 4.39: Reconstruction of an extinct Miocene three-toed horse, *Hipparion*. Fossil remains or related fossil horses are recorded from Areb in Bushmanland (Northern Cape) as well as Langebaanweg (West Coast Fossil Park, W. Cape) (Source: Natura Viva).

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 melilitie 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[32] whose axis trends east-west.

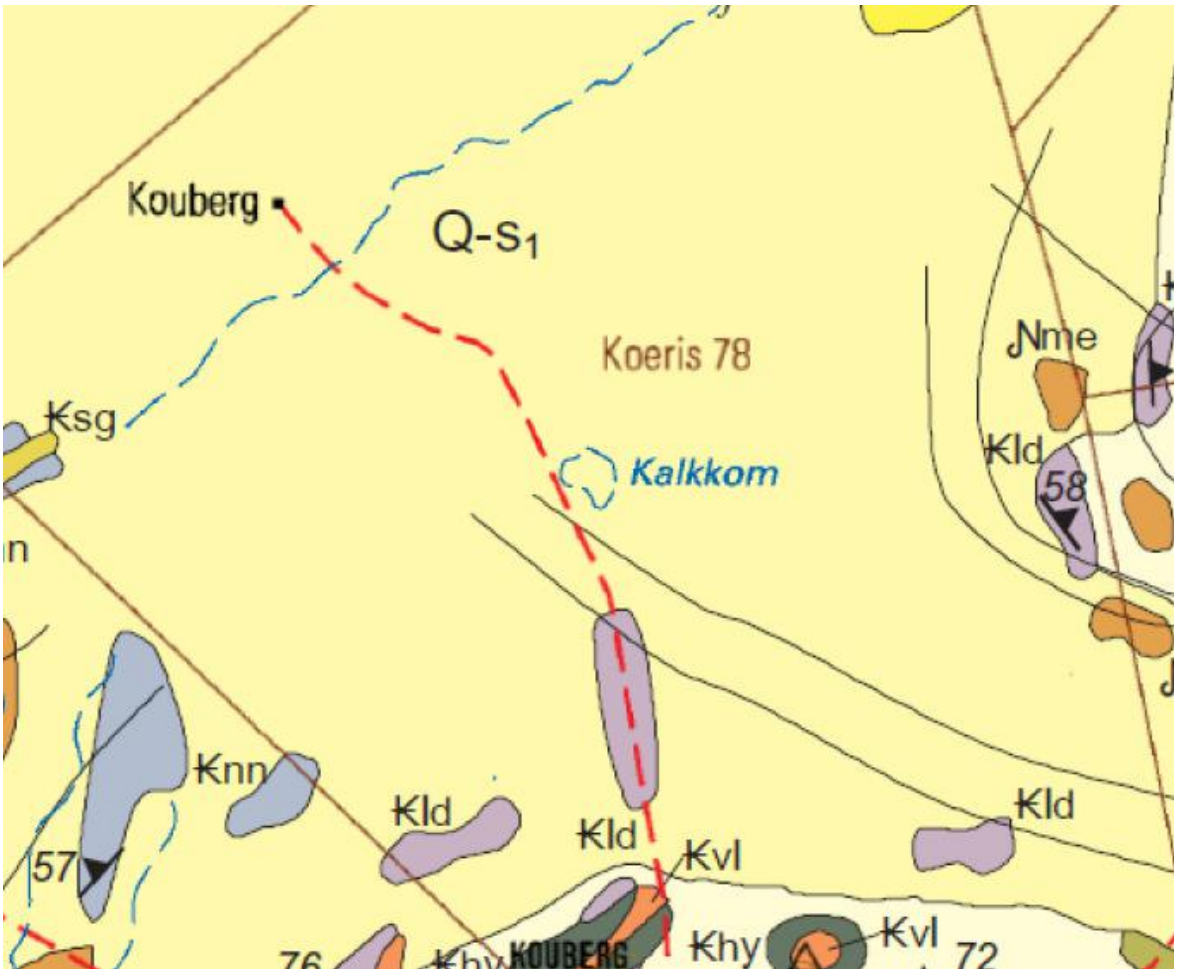

Figure 4.40: Geological map indicating the "crater'' Kalkom

[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 calcrete 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 calcrete covering. According to Mr van Niekerk, the calcrete 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 calcrete 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 m[33]) 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. vertebrate 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.

Assumptions	Entire Project	Each Phase of Project
Wind Farm		
Project Size	750 MW	140 MW
Project Cost (R's millions) in 2012	R11, 131, 000, 000	R2, 078, 000, 000
Local Expenditure	R4, 783, 000, 000	R893, 000, 000
District Expenditure	R901, 000, 000	N/A
Rest of Country Expenditure	R3, 881, 000, 000	N/A
% of local expenditure in Total Project cost	43%	43%
Average Duration	8 years	1.5 years

Photovoltaic Plant		
Project Size	250 MW[34]	N/A
Project Turnover	N/A	N/A
Project operating expenditure	R4, 700, 000, 000	N/A
Local Expenditure	R2, 115, 000, 000	N/A
% of local expenditure in total project costs	45%	N/A

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

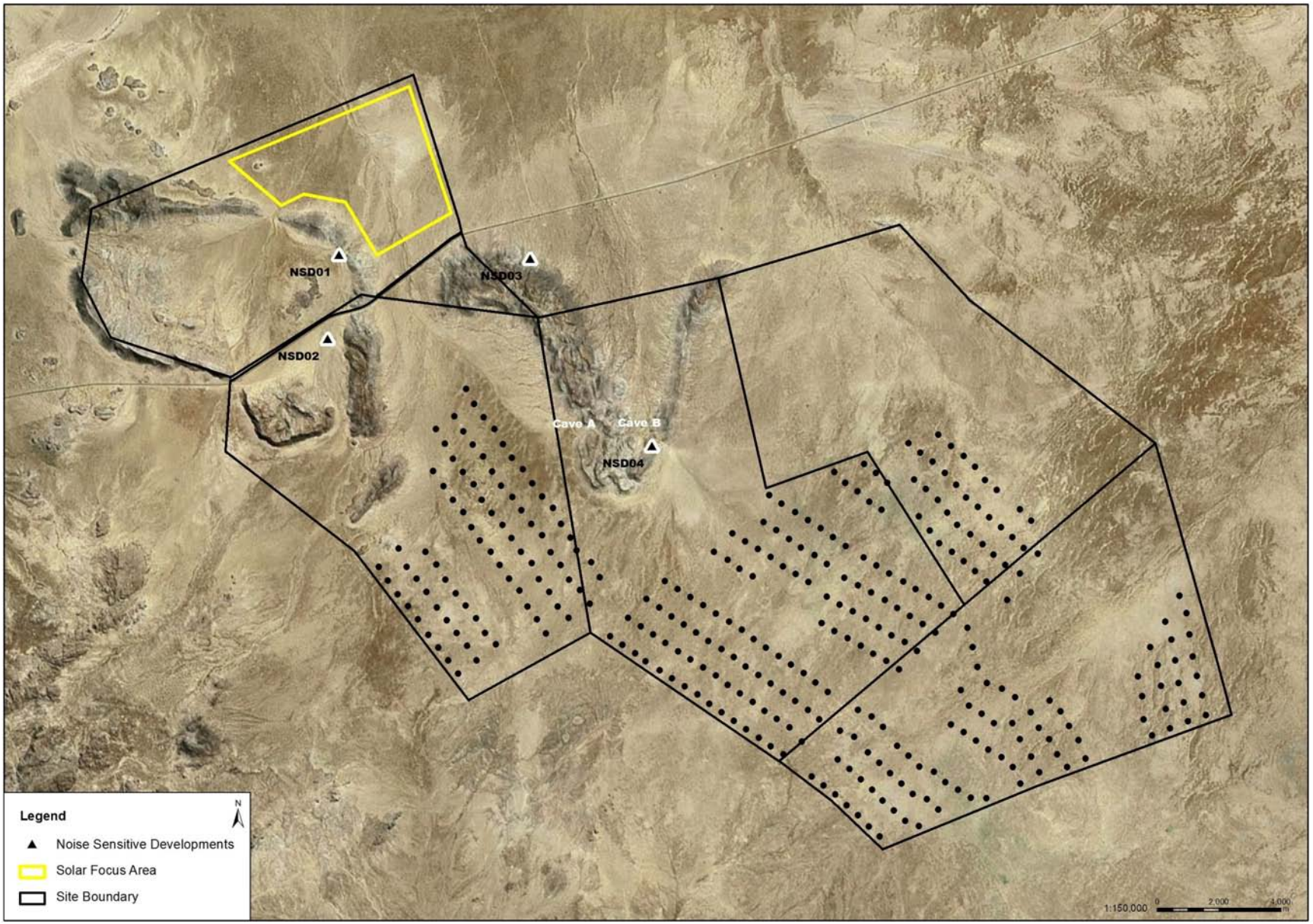

Figure 4.41: Identified and confirmed Noise-sensitive Developments in the vicinity of the proposed wind energy facility

- 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

Potential impact	No mit/Mit[35]	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Conf.[36]	Reversibility
OPERATIONAL PHASE								
Impact on Botany:	No mit	Local	Low - High	Long term	**Low - High (-)**	Definite	Sure	Irreversible
Preferred layout	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Irreversible
No-go alternative	No mit	Local	Low	Long term	**Low (-)**	Definite	Sure	Irreversible
	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Irreversible
Impact on fauna	No mit	Local	Low	Short term	**Very Low (-)**	Probable	Sure	Reversible
	Mit	Local	Low	Short term	**Very Low (-)**	Probable	Sure	Reversible
Impact on birds	No mit	Regional	Medium-High	Long term	**Medium - High (-)**	Probable	Sure	Irreversible
	Mit	Local	Medium	Long term	**Medium (-)**	Probable	Sure	Irreversible
Impact on bats	No mit	Regional	Low	Long term	**Low (-)**	Probable	Low	Irreversible
	Mit	Regional	Low	Long term	**Low (-)**	Probable	Sure	Reversible
Impact on freshwater	No mit	Local	Low	Long term	**Very Low (-)**	Probable	Low	Reversible
	Mit	Local	Low	Long term	**Very Low (-)**	Probable	Low	Reversible
Impact on climate change	No mit	Regional	Very Low	Long Term	**Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Very Low	Long Term	**Low (+)**	Probable	Sure	Reversible
Visual aesthetics	No mit	Regional	Low	Long term	**Low (-)**	Probable	Sure	Reversible
	Mit	Regional	Low	Long term	**Low (-)**	Probable	Sure	Reversible
Impact on energy production	No mit	Regional	Low	Long term	**Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Low	Long term	**Low (+)**	Probable	Sure	Reversible
Impact on local economy	No mit	Regional	Very Low - Low	Medium term	**Very Low - Low (+)**	Probable	Sure	Reversible
(employment)	Mit	Regional	Very Low - Low	Medium term	**Very Low - Medium(+)**	Probable	Sure	Reversible
Impact on social conditions	No mit	Regional	Very Low - Low	Medium term	**Very Low - Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Very Low - Low	Medium term	**Low - Medium(+)**	Probable	Sure	Reversible
Impact on agricultural land	No mit	Local	Very Low	Long term	**Very Low (-)**	Probable	Sure	Reversible
	Mit	Local	Very Low	Long term	**Very Low (-)**	Probable	Sure	Reversible
Impact of noise	No mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Reversible
CONSTRUCTION PHASE								
Impacts on flora	No mit	Local	High	Long term	**Low-High (-)**	Definite	Sure	Irreversible

[35] Note that this refers to No mitigation and Mitigation.
[36] Conf.=Confidence in the assessment of the potential impact.

Potential impact	No mit/Mit[35]	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Conf.[36]	Reversibility
	Mit	Local	High	Long term	**Low (-)**	Probable	Sure	Irreversible
Impacts on avifauna	No mit	Local	Medium	Medium term	**Medium**	Probable	Sure	Reversible
	Mit	Local	Medium	Medium term	**Medium**	Probable	Sure	Reversible
Impacts on bats	No mit	Local	Low	Short term	**Very Low (-)**	Probable	Sure	Reversible
	Mit	Local	Low	Short term	**Very Low (-)**	Probable	Sure	Reversible
Sedimentation and erosion	No mit	Local	Medium - High	Short term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Medium- High	Short term	**Very Low (-)**	Probable	Sure	Reversible
Impact on heritage resources:	No mit	Local	Low - Medium	Long term	**Low - Medium (-)**	Definite	Low	Irreversible
Archaeology	Mit	Local	Low - Medium	Long term	**Low - Medium (-)**	Probable	Sure	Irreversible
Cultural heritage	No mit	-	-	-	**-**	-	-	-
Palaeontology	No mit	Local	Low	Long term	**Low (-)**	Unlikely	Low	Reversible
	Mit	Local	Low	Long term	**Low (-)**	Unlikely	Sure	Reversible
Visual aesthetics	No mit	Regional	Low	Long term	**Medium (-)**	Probable	Sure	Reversible
	Mit	Regional	Low	Long term	**Low (-)**	Probable	Sure	Reversible
Impact on local economy (employment) and social conditions	No mit	Regional	Medium	Short term	**Medium (+)**	Probable	Sure	Reversible
	Mit	Regional	Medium	Short term	**Medium (+)**	Probable	Sure	Reversible
Impact on agriculture	No mit	Local	Low	Short term	**Very Low (-)**	Definite	Sure	Reversible
	Mit	Local	Low	Short term	**Very Low (-)**	Definite	Sure	Reversible
Impact on transport	No mit	Regional	Medium	Short term	**Medium (-)**	Probable	Sure	Reversible
	Mit	Regional	Medium	Short term	**Medium (-)**	Probable	Sure	Reversible
Noise pollution	No mit	Local	High	Short term	**Low (-)**	Probable	Sure	Reversible
	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
	Mit	Local	High	Short - Medium term	**Low - Medium (-)**	Unlikely	Sure	Irreversible
Impact of dust	No mit	Local	Medium	Short term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Medium	Short term	**Very Low (-)**	Probable	Sure	Reversible

Table 4.8:Summary of potential impacts of the proposed solar project

Potential impact	No mit/Mit[37]	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Conf.[38]	Reversibility
OPERATIONAL PHASE								
Impact on Botany:	No mit	Local	Low- High	Long term	**Low (-)**	Definite	Sure	Irreversible
Preferred layout	Mit	Local	Low	Long term	**Low(-)**	Probable	Sure	Irreversible
No-go alternative	No mit	Local	Low	Long term	**Low (-)**	Definite	Sure	Irreversible
	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Irreversible
Impact on fauna	No mit	Local	Low	Short term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Low	Short term	**Low (-)**	Probable	Sure	Reversible
Impact on birds	No mit	Local	Low - Medium	Long term	**Low- Medium (-)**	Probable	Sure	Irreversible
	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Irreversible
Impact on bats	No mit	-	-	-	**-**	-	-	-
	Mit	-	-	-	**-**	-		-
Impact on freshwater	No mit	Local	Moderate - Low	Long term	**Very Low (-)**	Probable	Low	Reversible
	Mit	Local	Moderate - Low	Long term	**Very Low (-)**	Probable	Low	Reversible
Impact on climate change	No mit	Regional	Very Low	Long Term	**Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Very Low	Long Term	**Low (+)**	Probable	Sure	Reversible
Visual aesthetics	No mit	Regional	Medium	Long term	**Medium (-)**	Probable	Sure	Reversible
	Mit	Regional	Medium	Long term	**Medium(-)**	Probable	Sure	Reversible
Impact on energy production	No mit	Regional	Low	Long term	**Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Low	Long term	**Low (+)**	Probable	Sure	Reversible
Impact on local economy	No mit	Regional	Very Low - Low	Medium term	**Very Low -Low (+)**	Probable	Sure	Reversible
(employment)	Mit	Regional	Very Low- Low	Medium term	**Very Low - Medium(+)**	Probable	Sure	Reversible
Impact on social conditions	No mit	Regional	Very Low - Low	Medium term	**Very Low -Low (+)**	Probable	Sure	Reversible
	Mit	Regional	Very Low - Low	Medium term	**Low - Medium(+)**	Probable	Sure	Reversible
Impact on agricultural land	No mit	Local	Very Low	Long term	**Very Low (-)**	Probable	Sure	Reversible
	Mit	Local	Very Low	Long term	**Very Low (-)**	Probable	Sure	Reversible
CONSTRUCTION PHASE								
Impacts on flora	No mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Low	Long term	**Low (-)**	Probable	Sure	Reversible
Impacts on avifauna	No mit	Local			**Low - Medium (-)**	Probable	Sure	Reversible

[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[37]	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Conf.[38]	Reversibility
	Mit	Local			**Low (-)**	Probable	Sure	Reversible
Impacts on bats	No mit	Local			**Low (-)**	Probable	Sure	Reversible
	Mit	Local			**Low (-)**	Probable	Sure	Reversible
Sedimentation and erosion	No mit	Local	Moderate	Short term	**Very Low (-)**	Probable	Sure	Reversible
	Mit	Local	Moderate	Short term	**Very Low (-)**	Probable	Sure	Reversible
Impact on heritage resources:	No mit	Local	Low - Medium	Long term	**Low - Medium (-)**	Definite	Low	Irreversible
Archaeology	Mit	Local	Low - Medium	Long term	**Low - Medium (-)**	Probable	Sure	Irreversible
Cultural heritage	No mit	-	-	-	**-**	-	-	-
Palaeontology	No mit	Local	Low	Long term	**Low (-)**	Unlikely	Low	Reversible
	Mit	Local	Low	Long term	**Low (-)**	Unlikely	Sure	Reversible
Visual aesthetics	No mit	Regional	Low	Long term	**Medium (-)**	Probable	Sure	Reversible
	Mit	Regional	Low	Long term	**Low (-)**	Probable	Sure	Reversible
Impact on local economy (employment) and social conditions	No mit	Regional	Medium	Short term	**Medium (+)**	Probable	Sure	Reversible
	Mit	Regional	Medium	Short term	**Medium (+)**	Probable	Sure	Reversible
Impact on agriculture	No mit	Local	Low	Short term	**Very Low (-)**	Definite	Sure	Reversible
	Mit	Local	Low	Short term	**Very Low (-)**	Definite	Sure	Reversible
Impact on transport	No mit	Regional	High	Short term	**Medium (-)**	Probable	Sure	Reversible
	Mit	Regional	High	Short term	**Medium (-)**	Probable	Sure	Reversible
Noise pollution	No mit	Local	High	Short term	**Low (-)**	Probable	Sure	Reversible
	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
	Mit	Local	High	Short- Medium term	**Low – Medium(-)**	Unlikely	Sure	Irreversible
Impact of dust	No mit	Local	Medium	Short term	**Low (-)**	Probable	Sure	Reversible
	Mit	Local	Medium	Short term	**Very 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 ~~wind turbines of~~ from1.5-4 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 800~~793~~ 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

IMPACT			Preferred Layout solar site		Preferred Layout wind site	
			No Mit	With Mit	No Mit	With Mit
OPERATIONAL PHASE IMPACTS						
1.1	Impact on flora:	Preferred layout	L	L	L-H	L
1.2		No-go alternative	L	L	L	L
2	Impact on fauna		L	L	VL	VL
3	Impact on avifauna		L-M	L	M-H	M
4	Impact on bats		N	N	VL	VL
5	Impact on climate change		L+	L+	L+	L+
6	Visual aesthetics		M	M	L	L
7	Impact on fresh water		VL	VL	VL	VL
8	Impact on energy production		L+	L+	L+	L+
9	Impact on local economy (employment)		VL-L+	VL+-M+	VL-L+	VL+-M+
10	Impact on social conditions		VL-L+	L-M+	VL-L+	L-M+
11	Impact of noise		N	N	L	L
12	Impact on agricultural land		VL	VL	VL	VL
CONSTRUCTION PHASE IMPACTS						
13	Impacts on flora		L	L	L-H	L
14	Impacts on avifauna		L-M	L	M	M
15	Impacts on bats		L	L	L	L
16	Sedimentation and erosion		VL	VL	L	VL
17.1	Impact on heritage resources:	Archaeology	L-M	L-M	L-M	L-M
17.2		Palaeontology	L	L	L	L
17.3		Cultural heritage	N	N	N	N
18	Visual aesthetics		M	L	M	L
19	Impact on local economy (employment) and social conditions		M+	M+	M+	M+
20	Impact on agriculture		VL	VL	VL	VL
21	Impact on transport		M	M	M	M
22	Noise pollution		L	L	L	L
23	Storage of hazardous substances on site		L-M	L-M	L-M	L-M
24	Impact of dust		L	VL	L	VL

Table 5.1: Summary of the significance of the environmental impacts associated with the proposed developments

KEY		
	H	High Significance
	M-H	Medium to High Significance
	L-H	Low to High Significance
	M	Medium Significance
	L-M	Low to Medium Significance
	VL-M	Very Low to Medium Significance
	L	Low Significance
	VL-L	Very Low to Low Significance
	VL	Very Low Significance
	N	Neutral Significance
	H+	High positive significance
	M+	Medium positive significance
	L+	Low positive significance

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, t**he 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.

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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