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**AGRICULTURAL AND SOILS IMPACT ASSESSMENTFOR PROPOSED 132 kV TRANSMISSION LINE CORRIDOR FROM PROPOSED KOKERBOOM WEF TO EXISTING HELIOS SUBSTATION,
NEAR LOERIESFONTEIN, NORTHERN CAPE**

BASIC ASSESSMENT REPORT

Report by
Johann Lanz

Prepared for Aurecon CONSULTANT
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February 2017

Johann Lanz
Professional profile

Education

• M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1997
• B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
• BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
• Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

- **Soil Science Consultant** | **Self employed** | **2002 - present**

  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:
- Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
- Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.
- I have conducted several recent research projects focused on conservation farming, soil health and carbon sequestration.
- I have project managed the development of soil nutrition software for Farmsecure Agri Science.

- **Soil Science Consultant** | **Agricultural Consultors International (Tinie du Preez)** | **1998 - end 2001**

  Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

- **Contracting Soil Scientist** | **De Beers Namaqualand Mines** | **July 1997 - Jan 1998**

  Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

Specialist Declaration

I, Johann Lanz, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company: Johann Lanz – Soil Scientist

Professional Registration (including number): SACNASP Reg. no. 400268/12

Date: 03 February 2017

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EXECUTIVE SUMMARY

The proposed development is on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed site is on land which is of very low agricultural potential, and which is only suitable as grazing land.

The key findings of this study are:

- Soils across the site are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms.
- The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils.
- As a result of these limitations, the site is unsuitable for cultivation and agricultural land use is limited to low intensity grazing.
- The land capability is classified as Class 7 - non-arable, low potential grazing land. The site has a very low grazing capacity of 41-60 hectares per large stock unit.
- There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.
- The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance is very small in relation to the available grazing land. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing.
- The negative impact is a loss of agricultural production and potential as a result of the following mechanisms:
    - Loss of agricultural land use caused by direct occupation of land by the facilities' footprint.
    - Soil Erosion caused by alteration of the surface characteristics.
    - Generation of dust caused by alteration of the surface characteristics.
    - Loss of topsoil in disturbed areas, causing a decline in soil fertility.
    - Degradation of surrounding grazing land due to vehicle trampling.
- The impact was assessed as having very low significance, which is in fact negligible.
- The following mitigation measures were recommended:
    - Implement an effective system of storm water run-off control;
    - Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas;
    - Control dust during construction through appropriate dust suppression methods;
    - Strip and stockpile topsoil before disturbance and re-spread it on the surface as soon as possible after disturbance;
    - Manage any sub-surface spoils from excavations in such a manner that they will not bury the topsoil agricultural land; and
    - Minimise road footprint and control vehicle access on designated roads only.
- Because of the low agricultural potential, and the very low agricultural impact, there are

no restrictions relating to agriculture which would preclude authorisation of the proposed development.

1 INTRODUCTION

Business Venture Investments No 1788 (Pty) Ltd (BVI) proposes to construct two switching stations and a 132kV overhead transmission line (OHL) from three proposed Kokerboom Wind Energy Facilities (WEFs) to the existing Eskom Helios Main Transmission Substation (MTS). The grid connection infrastructure will also include the construction of access roads, as well as a temporary construction camp. The project area is located approximately 50 kilometres north of the town of Loeriesfontein in the Northern Cape Province (see Figure 1).

The objectives of this study are to identify and assess all potential impacts of the proposed development on agricultural resources, including soils, and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts. Johann Lanz was appointed by Aurecon South Africa as an independent specialist to conduct this Agricultural Impact Assessment.

2 TERMS OF REFERENCE

The terms of reference for the study fulfills the requirements for a soils and agricultural study as described in the National Department of Agriculture's document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011. The study applies an appropriate level of detail for the agricultural suitability and soil variation on site, which, because it is justified (see section 3.1), is less than the standardised level of detail stipulated in the above regulations.

The above requirements may be summarised as:

- Identify and assess all potential impacts (direct, indirect and cumulative) of the proposed development on soils and agricultural potential.
- Describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the site.
- Describe the climate in terms of agricultural suitability.
- Summarise available water sources for agriculture.
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Describe the erosion, vegetation and degradation status of the land.
- Determine the agricultural potential across the site.
- Determine the agricultural sensitivity to development across the site.
- Provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

The report also fulfils the requirements of Appendix 6 of the 2014 EIA Regulations.

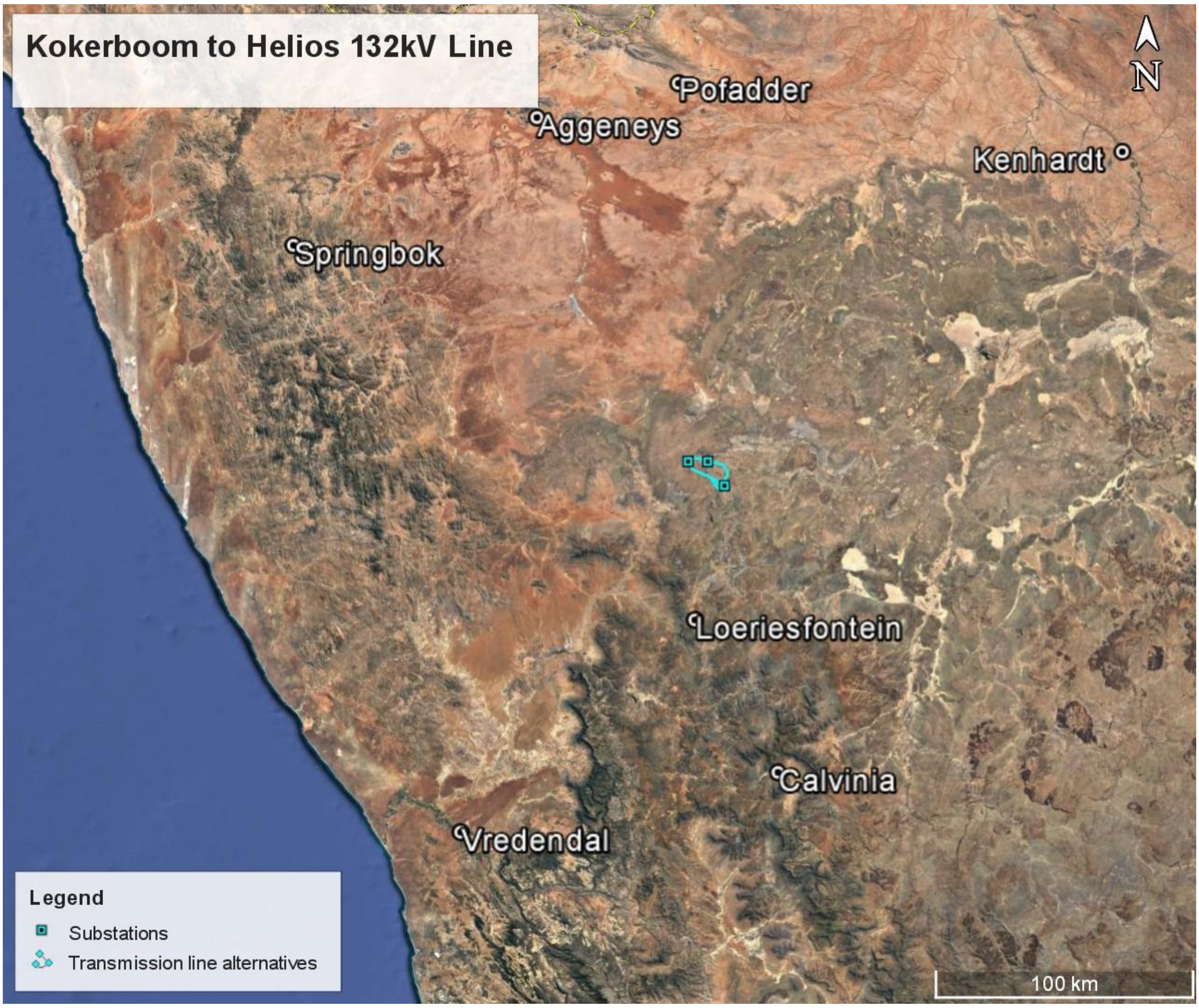

Figure 1. *Location map of the proposed development, north of the town of Loeriesfontein.*

3 METHODOLOGY OF STUDY

3.1 Methodology for assessing soils and agricultural potential

The assessment was based largely on existing soil and agricultural potential data for the site. The source of this data was the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, undated). Satellite imagery of the site available on Google Earth was also used for evaluation.

The AGIS data was supplemented by a field investigation. This was aimed at ground-proofing the AGIS data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the site. The field investigation involved a drive and walk over of the site using assessment of surface conditions and existing cuttings / excavations. The field assessment was done on 6 June 2016.

Soils were classified according to the South African soil classification system (Soil Classification

Working Group, 1991).

It is my opinion that the level of soil mapping detail in the above DAFF requirements is appropriate for arable land only. It is not appropriate for this site. Detailed soil mapping has little relevance to an assessment of agricultural potential in this environment, where cultivation potential is extremely limited, soil conditions are generally poor and the agricultural limitations are overwhelmingly climatic. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. Conducting a soil assessment at the required level of detail would be very time consuming and be a waste of that time, as it would add almost no value to the assessment. The level of soil assessment that was conducted for this report (reconnaissance ground proofing of land type data) is considered more than adequate for a thorough assessment of all agricultural impacts.

An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and therefore the fact that the assessment was done in summer has no bearing on its results.

The field investigation also included a visual assessment of erosion and erosion potential on site, taking into account a potential development layout.

3.2 Methodology for determining impact significance

All potential impacts were assessed in terms of the following criteria:

CRITERIA	**CATEGORY**	**DESCRIPTION**
Extent or spatial influence of impact	Regional	Beyond a 10km radius of the proposed site.
	Local	Within a 10km radius of the proposed site.
	Site specific	On site or within 100m of the proposed site.
Magnitude of impact (at the indicated spatial scale)	High	Natural and/ or social functions and/ or processes are severely altered
	Medium	Natural and/ or social functions and/ or processes are notably altered
	Low	Natural and/ or social functions and/ or processes are slightly altered
	Very low	Natural and/ or social functions and/ or processes are negligibly altered
	Zero	Natural and/ or social functions and/ or processes remain unaltered
Duration of impact	Construction period	Up to 1 year
	Short term	Up to 3 years after construction
	Medium term	3-10 years after construction

CRITERIA	CATEGORY	DESCRIPTION
	Long term	More than 10 years after construction

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	High magnitude with a regional extent and long term duration High magnitude with either a regional extent and medium term duration or a local extent and long term duration Medium magnitude with a regional extent and long term duration
Medium	High magnitude with a local extent and medium term duration High magnitude with a regional extent and construction period or a site specific extent and long term duration High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term Low magnitude with a regional extent and long term duration
Low	High magnitude with a site specific extent and construction period duration Medium magnitude with a site specific extent and construction period duration Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term Very low magnitude with a regional extent and long term duration
Very low	Low magnitude with a site specific extent and construction period duration Very low magnitude with any combination of extent and duration except regional and long term
Neutral	Zero magnitude with any combination of extent and duration

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

4 CONSTRAINTS AND LIMITATIONS OF STUDY

The field investigation for this assessment is considered more than adequate for the purposes of this study (see section 3.1) and is therefore not seen as a limitation.

The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

There are no other specific constraints, uncertainties and gaps in knowledge for this study.

5 LEGISLATIVE REQUIREMENTS

A change of land use (re-zoning) for the development on agricultural land needs to be approved in terms of the Subdivision Of Agricultural Land Act 70 of 1970 (SALA) and an application in this regard must be submitted to the National Department of Agriculture. This is required for long term lease, even if no subdivision is required. The protection and rehabilitation after disturbance of agricultural land is managed by the Conservation of Agricultural Resources Act, 43 of 1983 (CARA). No application is required in terms of CARA, as the EIA process covers the required aspects of this. The Land Use Planning Ordinance 15 of 1985 is also relevant. The Department of Agriculture reviews and approves applications in terms of these Acts according to their *Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011.

6 BASELINE ASSESSMENT OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 1.1 of this report.

All the background data on soils and agricultural potential in this report has been obtained from the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, undated).

A satellite image of the site showing the development layout is given in Figure 3. Photographs of site conditions are given in Figures 4 to 6.

6.1 Climate and water availability

Rainfall for the site is given as a very low 130 mm per annum (The World Bank Climate Change Knowledge Portal, undated). The average monthly distribution of rainfall is shown in Figure 2. One of the most important climate parameters for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. This parameter largely controls what rain fed agriculture (including grazing) is possible within a given environment. Moisture availability is classified into 6 categories across the country (see Table 1). The site falls into the driest 6th category, which is labelled as a very severe limitation to agriculture.

There are wind pumps with stock watering points in several places across the site. Water for irrigation is not available across the site. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.

Table 1. The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

Climate class	Moisture availability (Rainfall/0.25 PET)	Description of agricultural limitation
C1	>34	None to slight
C2	27-34	Slight
C3	19-26	Moderate
C4	12-18	Moderate to severe
C5	6-12	Severe
C6	<6	Very severe

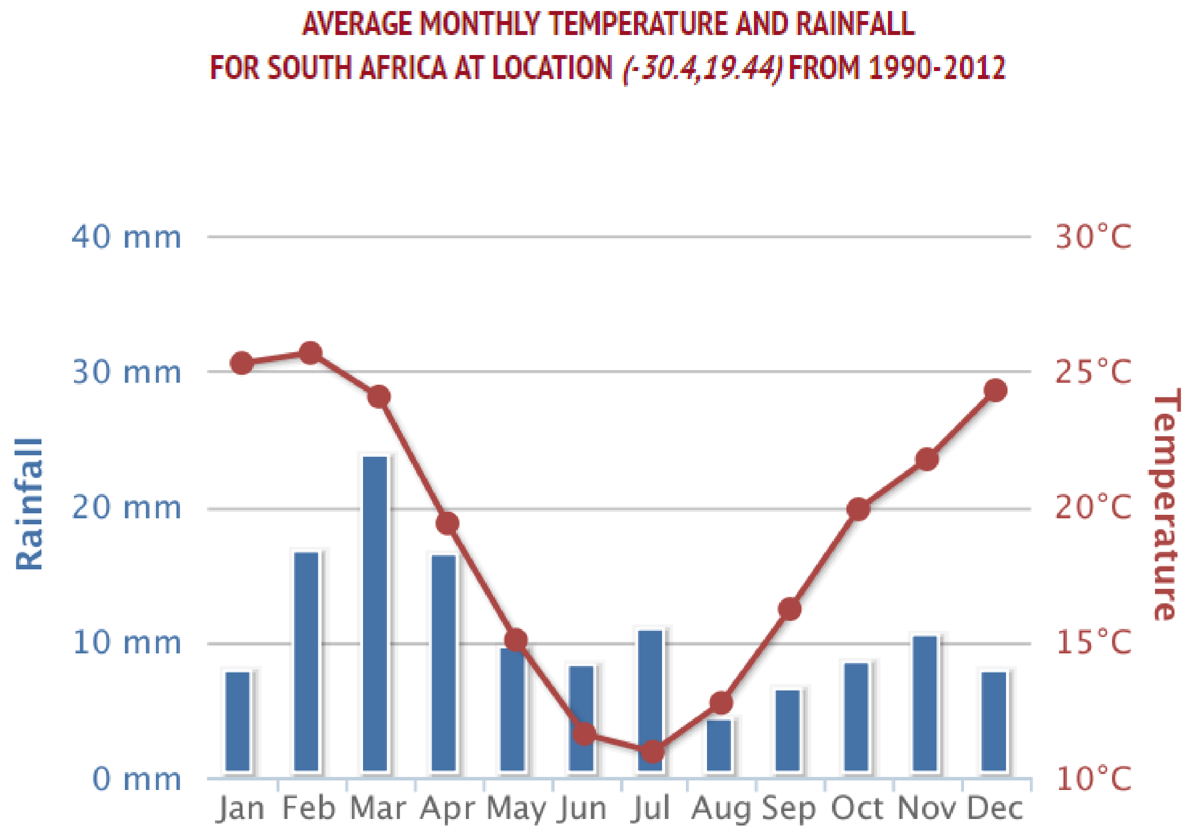

Figure 2. *Average monthly temperature and rainfall for the site (The World Bank Climate Change Knowledge Portal, undated).*

6.2 Terrain, topography and drainage

The proposed development is located on a terrain unit of plains with some relief at an altitude of between 900 and 1,000 metres. Slopes across the site are almost entirely less than 2% but may be greater in a few isolated spots.

The underlying geology is shale of the Ecca and Dwyka Groups of the Karoo Supergroup with dolerite intrusions.

No perennial drainage features occur on the site. There are a few intermittent drainage lines, typical of arid environments that would only flow temporarily after heavy rains.

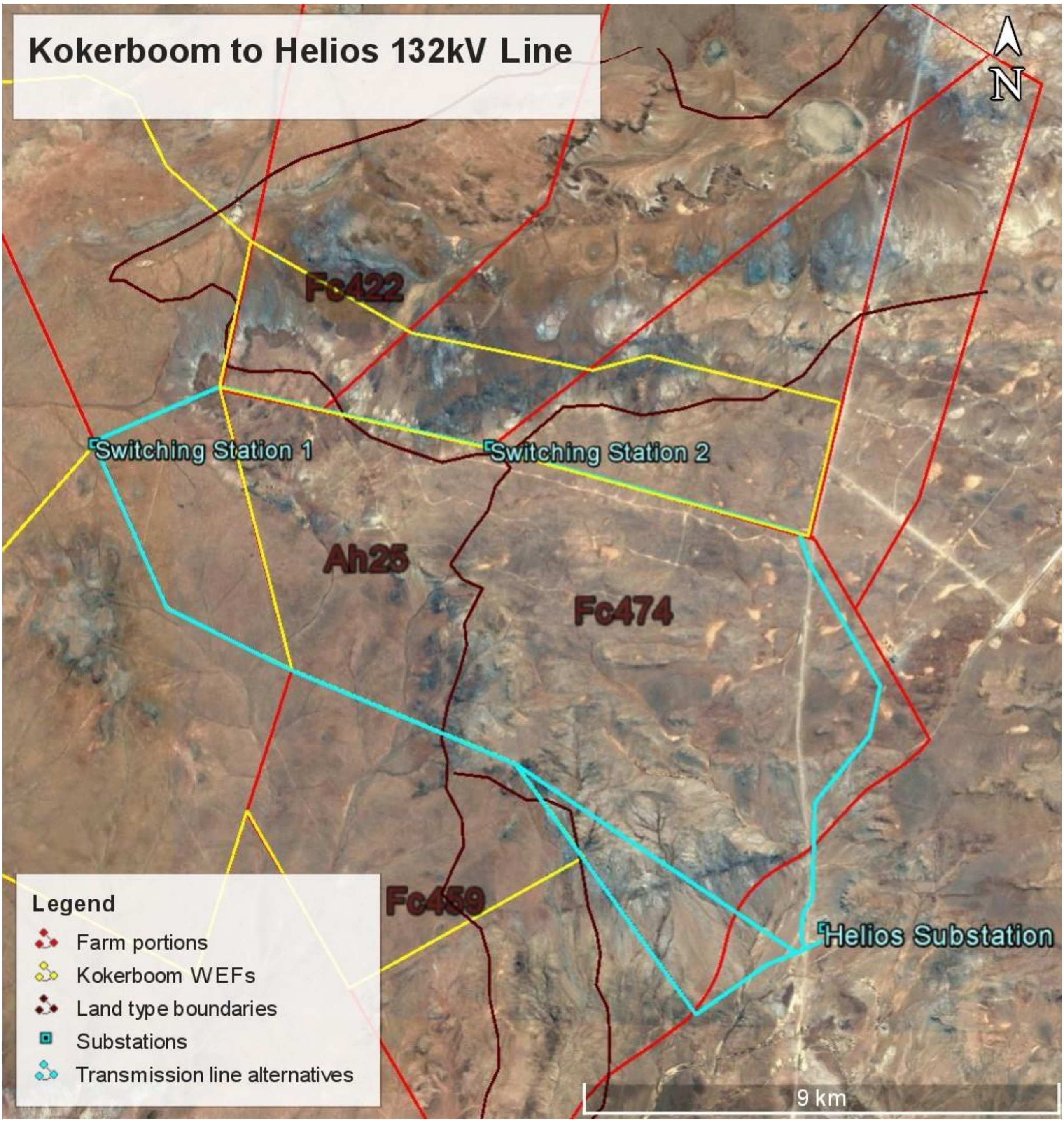

Figure 3. *Satellite image map of the site showing the development layout.*

6.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There are four land types across the study area and its surroundings, Ah25, Fc422, Fc474, and Fc459 (see Figure 3). Soils on these land types are similar and are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. The soils would fall into the Lithic and Calcic soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in Table A1. The field investigation confirmed the occurrence of shallow, sandy soils on underlying rock or hard-pan carbonate across the entire site. The predominant soil forms are Coega, Mispah, Glenrosa and Askham.

Figure 4. *Photograph showing typical landscape and veld conditions on the site.*

Figure 5. *Photograph showing typical landscape and veld conditions on the site.*


Figure 6. *Photograph showing typical soil conditions in burrow excavation on site where a shallow hardpan carbonate horizon occurs, with numerous spherical carbonate concretions present.*

6.4 Agricultural capability

Land capability is defined as the combination of soil suitability and climate factors. The area has a land capability classification, according to the 8 category scale of Class 7 which is non-arable, low potential grazing land. The limitations to agriculture are the extreme aridity and lack of access to water as well as the predominantly shallow, rocky soils. Due to these constraints, agricultural land use is restricted to low intensity grazing only. The natural grazing capacity is given on AGIS as very low, at 41-60 hectares per animal unit. This is the lowest grazing capacity category in the country.

6.5 Land use and development on and surrounding the site

The farm is located in a sheep farming agricultural region, and this is the only agricultural land use on the site and surrounds. There is no agricultural infrastructure in the study area, apart from fencing into camps and wind pumps with stock watering points. There are also no farmsteads within the study area.

6.6 Status of the land

The vegetation classification for the site is Bushmanland Basin Shrubland. The vegetation is grazed. Natural surface erosion, typical of sparsely vegetated, arid environments, is active but there is no evidence of excessive, accelerated erosion, or other land degradation. The land is classified as having a low to moderate water erosion hazard, but it is classified as susceptible to wind erosion because sands, as a soil textural class, are dominant.

6.7 Possible land use options for the site

Due to the extreme aridity constraints as well as the poor soils, agricultural land use is restricted to low intensity grazing only.

6.8 Agricultural sensitivity

Agricultural potential is very uniform across the farm and the choice of placement of facility infrastructure, including access roads, and transmission lines therefore has minimal influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the study area. No parts of the site need to be avoided by the development and there are no required buffers.

7 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

The components of the project that can impact on soils, agricultural resources and productivity are:

- Occupation of the site by the footprint of the facility; and
- Construction activities that disturb the soil profile and vegetation, for example for excavations, etc.

The agricultural impacts of an overhead power line in this kind of an environment are negligible. This is due to the fact that the power line has a very small footprint of impact in relation to the available grazing land on the effected farm portions. The footprint is confined to the pylon bases and substations. All agricultural activities that are viable in this extremely low potential environment can continue unaffected by the overhead power lines.

The assessment of all the transmission lines is identical and results are therefore given only once to represent all lines. The assessment of impacts for the different phases of the development are identical and results are therefore given only once to represent all phases.

The impacts of the power line are assessed as a single integrated impact, namely loss of agricultural production and potential, resulting from the following different mechanisms:

- Loss of agricultural land use caused by direct occupation of land by the facilities' footprint.
- Soil Erosion caused by alteration of the surface characteristics.
- Generation of dust caused by alteration of the surface characteristics.
- Loss of topsoil in disturbed areas, causing a decline in soil fertility.
- Degradation of surrounding grazing land due to vehicle trampling.

Mitigation:

1. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas to stabilise the soil against erosion.
2. Implement an effective system of storm water run-off control using berms (raised, low walls of soil) and ditches, where it is required - that is at points where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.
3. Strip and stockpile topsoil from all areas where soil will be disturbed below surface, for example excavations for cabling and mounting structures. It is not necessary to strip topsoil from the whole development area, if the soil below surface is not being disturbed.
4. All soil above the rock or hardpan, to a maximum depth of 25cm should be stripped and stockpiled. Any additional soil overburden from below that depth must be stripped and stockpiled separately.
5. After cessation of disturbance, re-spread topsoil over the surface and re-vegetate. Any additional overburden must be re-spread below the topsoil layer, not mixed with it.
6. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.

The assessment of the impact is given in table 2 below.

7.1 Cumulative impact

The cumulative regional impact is a loss of agricultural land, as a result of the sum of surrounding developments. Due to the extremely limited agricultural potential of all land in the area, predominantly as a result of climatic limitations, and the fact that there is no particular scarcity of such land in South Africa, the cumulative impact is assessed as being of low significance.

It is preferable to incur a cumulative loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.

7.2 Comparative assessment of alternatives

Impacts associated with the 3 different transmission line alternatives are identical and there is therefore no preferred alternative from an agricultural impact point of view.

The no-go alternative anticipates changes to the agricultural environment that would occur in the absence of the proposed development. No significant changes are anticipated in the no-go scenario, compared to the negligible negative impact for the development.

Table 2. Assessment of all identified impacts associated with the transmission lines.

	Without Mitigation							
Impact Title	**Type**	**Extent**	**Magnitude**	**Duration**	**Probability**	**Confidence**	**Reversibility**	**Significance**
Loss of agricultural potential	Negative	Site specific	Zero	Short term	Probable	Certain	Reversible	Neutral
	With Mitigation							
Impact Title	**Type**	**Extent**	**Magnitude**	**Duration**	**Probability**	**Confidence**	**Reversibility**	**Significance**
Loss of agricultural potential	Negative	Site specific	Zero	Short term	Probable	Certain	Reversible	Neutral

8 ENVIRONMENTAL MANAGEMENT PLAN - MONITORING OF MITIGATION

Only four of the identified impacts have possible mitigation measures and recommended monitoring. All the recommended mitigation measures are listed in the previous section for each of these four impacts. Monitoring recommendations are given below. All monitoring should be done by an environmental control officer.

Soil erosion

Mitigation: Target / Objective	To have no wind and water erosion on and downstream of the site as a result of run-off from the site.
Monitoring	Include site inspection in environmental performance reporting that inspects the effectiveness of the run-off control system and specifically records occurrence or not of any erosion on site or downstream (monthly during construction; quarterly during operation). Photos of surface conditions showing absence or presence of erosion at all spots posing an erosion risk should be included in environmental performance reporting.

Dust generation

Mitigation: Target / Objective	To minimise generation of dust from site.
Monitoring	During construction dust generation must be visually monitored on a daily basis and control measures must be implemented when excessive dust generation occurs.

Loss of topsoil

Mitigation: Target / Objective	Ensure effective topsoil covering on all disturbed areas after rehabilitation.
Monitoring	Establish an effective record keeping system for each area where soil is disturbed below surface for construction purposes. These records should be included in environmental performance reports, and should include all the records below. • Record the GPS coordinates of each area. • Record the date of topsoil stripping. • Record the GPS coordinates of where the topsoil is stockpiled. • Record the date of cessation of construction (or operational) activities at the particular site. • Photograph the area on cessation of construction activities. • Record date and depth of re-spreading of topsoil. • Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.

Degradation of grazing

Mitigation: Target / Objective	To have no vehicular trampling of veld vegetation beyond road footprint.
Monitoring	Include site inspections (monthly during construction) in environmental performance reporting that specifically records occurrence or not of off-road vehicle tracks.

9 CONCLUSIONS

The proposed development is located on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of potentially arable land. The assessment has found that the footprint of disturbance of the development will only impact agricultural land which is of very low agricultural potential and is unsuitable for cultivation.

It has also found that the impact is negligible. This is due to the fact that the proposed grid connection infrastructure has a very small footprint of impact in relation to the available grazing land on the effected farm portions. The footprint is confined to the pylon bases, switching stations and roads. All agricultural activities that are viable in this extremely low potential environment can continue unaffected by the overhead power lines.

There are no agriculturally sensitive areas that need to be avoided by the development. There are no conditions resulting from this assessment that need to be included in the environmental authorisation.

Because of the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development.

10 REFERENCES

Agricultural Research Council. Undated. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at http://sdwebx.worldbank.org/climateportal/

APPENDIX 1: SOIL DATA

Table A1. Land type soil data for the site.

Land type	Land capability class	Soil series (forms)	Depth (cm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Ah25	7	Hutton	5-15	3-6	4-10	ca, R	34
		Clovelly	5-15	3-6	4-10	ca, R	27
		Glenrosa	5-15	3-6	4-10	so, ca	10
		Mispah	10-20	3-6		ca, R	8
		Rock outcrop	0			R	8
		Swartland	15-35	5-10	25-35	so	8
		Dundee	>100	3-6	4-10	R	6
Fc422	7	Rock outcrop	0			R	24
		Mispah	1-15	3-6		ca	14
		Clovelly	15-40	6-10	6-15	ca	12
		Oakleaf / Dundee	50->120	10-45	7-46		10
		Glenrosa	15-35	6-10	10-15	R, so	10
		Oakleaf	20-40	6-15	10-15	ca, R, so	8
		Hutton	15-40	6-10	6-15	ca	8
		Mispah	1-10	5-8		R, ca	8
		Katspruit	30-60	6-15	10-30	ca, R	4
Fc474	7	Glenrosa / Oakleaf	30-40	6-10	6-15	ca, R	29
		Mispah / Glenrosa	10-30	6-10	6-15	R, ca	25
		Clovelly	20-40	3-7	3-10	ca, R	16
		Hutton	20-40	3-7	3-10	ca, R	15
		Oakleaf	40-60	15-25	20-35	R, ca	12
		Rock outcrop	0			R	4
Fc459	7	Rock outcrop	0			R	24
		Mispah	1-10	2-6		ca	19
		Mispah	1-10	2-6		R	19
		Glenrosa	2-15	2-7	3-8	R	17
		Clovelly	30-70	2-8	3-8	R, ca	10
		Hutton	30-70	2-8	3-8	R, ca	9
		Oakleaf / Dundee	>120	4-8	5-10		4

Land capability classes: 7 = non-arable, low potential grazing land;
Depth limiting layers: R = hard rock; ca = hardpan carbonate; so = partially weathered bedrock.

BASIC ASSESSMENT FOR THE PROPOSED GRID CONNECTION FOR THE KOKERBOOM WIND ENERGY FACILITIES (KOKERBOOM 1, 2 AND 3) LOCATED NEAR TO LOERIESFONTEIN IN THE NORTHERN CAPE:

FAUNA & FLORA SPECIALIST BASIC ASSESSMENT REPORT

PRODUCED FOR AURECON

ON BEHALF OF BUSINESS VENTURE INVESTMENTS NO. 1788 (Pty) LTD

SIMON TODD CONSULTING

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February 2017

CONTENTS

LIST OF FIGURES

NEMA 2014 Checklist

Section		*NEMA 2014 Regulations for Specialist Studies*	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	4-5	✓
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;		
	(b)	a declaration that the person is independent in a form as may be specified by the competent authority;		✓
	(c)	an indication of the scope of, and the purpose for which, the report was prepared;	6	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	8-10	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	8	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	10-17	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	20-23	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.		
2		Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

Professional Profile of Consultant:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent experience and relevant projects in the immediate vicinity of the current site include the following:

- Mainstream South Africa Dwarsrug Wind Energy Facility: Fauna & Flora Specialist Impact Assessment Report. Sivest 2014.
- Basic Assessment Process for the Proposed Construction of the Transnet 15km 50 kV Power Line from Eskom Helios Substation to the proposed new Transnet Helios Traction Feeder Substation. Nsovo Environmental Consulting. 2014.
- Loeriesfontein Wind Energy Facility – Substation & Grid Connection. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.
- Proposed Re-Alignment of the Authorised Power Line for The Loeriesfontein 2 Wind Energy Facility.: Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2014.
- Mainstream Loeriesfontein 2 Wind Energy Facility: Fauna and Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.
- Mainstream Khobab Wind Energy Facility: Fauna And Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.

1 INTRODUCTION

Business Venture Investments No. 1788 (Pty) Ltd (herein after referred to as the Proponent) has appointed Aurecon South Africa (Pty) Ltd (Aurecon) to undertake the required environmental authorisation process for the proposed Kokerboom 1;Kokerboom 2 and Kokerboom 3 Wind Energy Facilities (WEFs) located north of Loeriesfontein in the Northern Cape Province. As part of these wind energy facilities, a 132kV grid connection to the Helios substation is required. Each WEF and the grid connection are being assessed under different applications to DEA. Aurecon has appointed Simon Todd Consulting to provide a specialist terrestrial biodiversity impact assessment of the proposed grid connection routes as part of the required Basic Assessment (BA) process.

As part of the above BA process, this ecological specialist study details the ecological characteristics of the route corridors and provides an assessment of the likely ecological impacts associated with the development of the proposed grid connection. Impacts are assessed for the pre-construction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed in Section 1.1 below.

1.1 SCOPE OF STUDY

The scope of the study includes the following activities:

- a description of the environment that may be affected by a specific activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- an assessment of the significance of direct, indirect and cumulative impacts of the development;
- a description and comparative assessment of all alternatives including cumulative impacts;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr);
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;

- a description of any assumptions uncertainties and gaps in knowledge; and
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity; and
    - a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations during the study included the following**:**

- Disclose any gaps in information (and limitations in the study) or assumptions made.
- Identify recommendations for mitigation measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the EMPr for faunal or flora related issues.
- The assessment of the potential impacts of the development and the recommended mitigation measures provided have been separated into the following project phases:
    - Pre-construction
    - Construction
    - Operational
    - Decomissioining

1.2 ASSESSMENT APPROACH & PHILOSOPHY

This assessment will be conducted according to the 2014 EIA Regulations (Government Notice Regulation 982) in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), as well as best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers *et al*. (2005).

In terms of NEMA, this assessment demonstrates how the proponent intends to comply with the principles contained in Section 2 of NEMA, which amongst other things, indicates that environmental management should:

- (In order of priority) aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and

- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making matters that may affect the environment. As such, it is incumbent upon the proponent to show (through the EIA process) how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined in terms of NEMA.

Furthermore, in terms of best practice guidelines as outlined by Brownlie (2005) and De Villiers et al. (2005), a precautionary and risk-averse approach should be adopted for projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (CBAs) (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

- The study includes data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:
- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

Species level

- Species of Conservation Concern (SCC) (giving location if possible using GPS)
- The viability of an estimated population size of the Red Data Book (RDB) species that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of conservation concern (SCC) and that are known to be:
  - endemic to the region;
  - that are considered to be of conservational concern;
  - that are in commercial trade (CITES listed species); or
  - of cultural significance.
- Provide monitoring requirements as input into the EMPr for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified and/or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries).
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

1.3 RELEVANT ASPECTS OF THE DEVELOPMENT

- The Kokerboom 1 WEF will have a capacity of up to 256 MW (64 Turbines), Kokerboom 2 will have up to 240 MW (60 Turbines) and Kokerboom 3 up to 240 MW (60 Turbines)and each will have an on-site substation to evacuate the power via the 132kV line which is part of the current study.
- Three alternatives for the 132kV powerline route are being considered, as illustrated below. Alternative A is one of two southern routes, along with Alternative B which differ only in their latter sections towards the Helios substation. Alternative A is 25km long, while Alternative B is 27km long. Alternative C is a northern route and is 23km long. A 500m wide corridor (~250m either side of the proposed line) for all three powerline Alternatives was assessed in the current study (shown in Figure 1).
- Two switching stations are proposed, which are common to all three route alternatives. Each switching station would be approximately 100m X 100m.
- A service/ access track of approximately 4m wide would be required along the proposed powerline for construction and maintenance purposes.

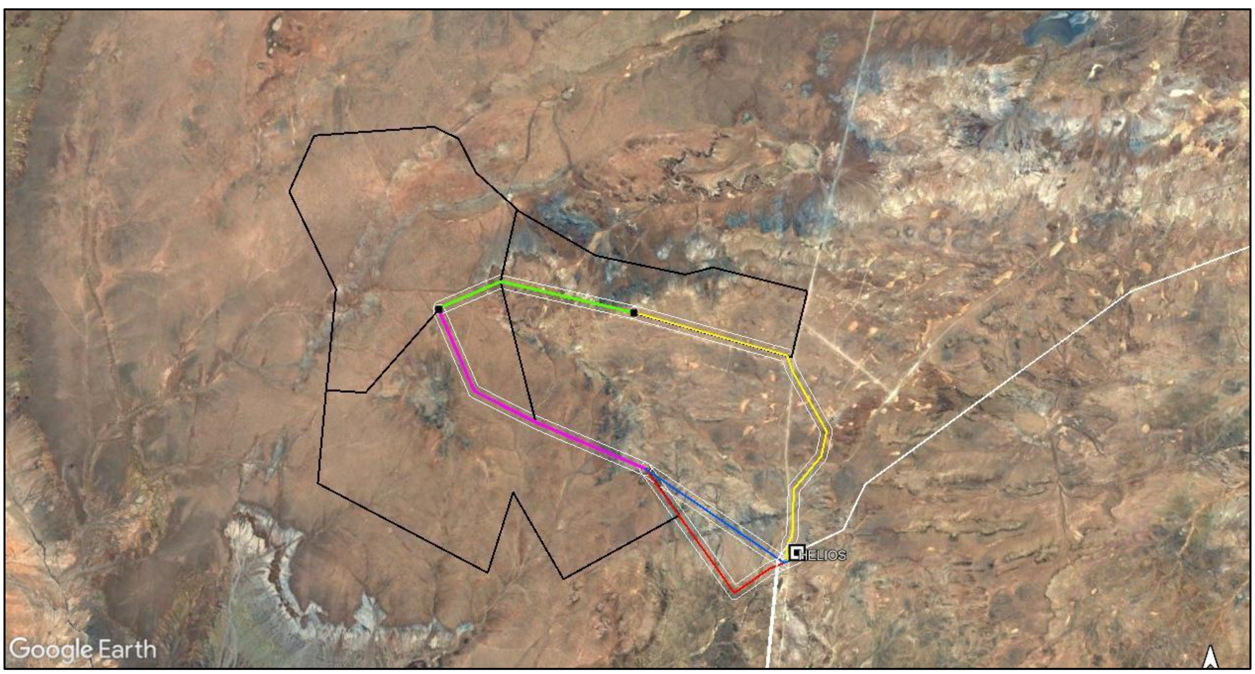

Figure 1. The three proposed grid connection routes are as follows: Green – This section is in common to all three alternatives and connects the two proposed switching stations. Purple - This is common to Option A and Option B until they diverge with Alternative B in red and Alternernantive A in blue. Yellow - Alternative C is the northern route. (i.e. Alternative A = green + pink + blue; Alternative B = green + pink + red; Alternative C = green + yellow). The white polygon denotes the 500m corridor assessed for each grid connection Alternative.

1.4 LIMITATIONS & ASSUMPTIONS

The current study consisted of two site visits as well as a desktop study, which serves to significantly reduce the limitations and assumptions required for the study. As the vegetation was in a good condition for sampling at the time, there are few limitations with regards to the vegetation sampling and the species lists obtained are considered comprehensive. Many fauna are however difficult to observe in the field and their potential presence at the site must be evaluated based on the literature and available databases. In many cases, these databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna and flora present at the site. This is acknowledged as a limitation of the study, however it is substantially reduced by the fact that the consultant has sampled the adjacent properties where the Mainstream wind developments (Loeriesfontein, Khobab and Dwarsrug Wind Farms) are located on multiple occasions across different seasons. In order to further reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature were consulted and used where necessary in the study including the following:

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant and animal species recorded for Quarter Degree Squares (QDS) 3019AD, CB, BC and DA was extracted from the Plants of South Africa (POSA) database hosted by the South African National Biodversity Institute (SANBI). This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- The IUCN conservation status (Figure 2) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2014).

Habitats:

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna:

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 201 (See Figure 2) and where species have not been assessed under these criteria, the CITES status is reported where possible.

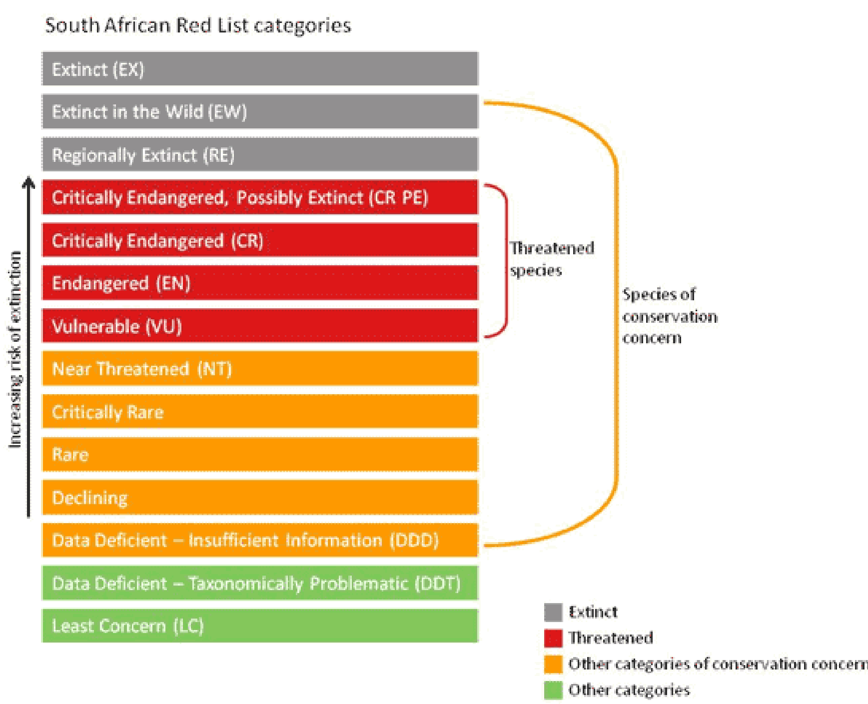

Figure 2. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

2.2 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases as described above. Sensitive features such as wetlands, drainage lines and water bodies were mapped and buffered where appropriate to comply with legislative requirements or ecological considerations. Additional sensitive areas were then identified based on the results of the site visit and delineated. Features that were specifically captured in the sensitivity map include drainage features, wetlands and dams, as well as rocky outcrops and steep slopes. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a low impact on ecological processes and terrestrial biodiversity. This category represents transformed or natural areas where the impact of development is likely to be local in nature and of low significance with standard mitigation measures.
- **Medium** - Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas are not no-go areas, however development within these areas is considered to be undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas were also categorised between the above categories, such as Medium-High, where an area appeared to be of intermediate sensitivity with respect to the two defining categories. However, it is important to note that there are no sensitivities that are identified as "Medium to High" or similar ranged categories because this adds uncertainty to the mapping as it is not clear if an area falls at the bottom or top of such a range.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 BROAD-SCALE VEGETATION PATTERNS

The national vegetation map (Mucina & Rutherford 2006) for the study area is depicted below in Figure 3. The entire site falls within the Bushmanland Basin Shrubland vegetation type. With an extent of 34 690 km^2 this is one of the most extensive vegetation types in South Africa. Bushmanland Basin Shrubland occurs on the extensive basin centered on Brandvlei and Van Wyksvlei, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt in the north to around Williston in the south. The area is characterised by slightly irregular plains dominated by a dwarf shrubland, with succulent shrubs or perennial grasses in places. The geology consists largely of mudstones and shales of the Ecca group and Dwyka tillites with occasional dolerite intrusions. Soils are largely shallow to non-existent, with calcrete present in most areas. Rainfall ranges from 100-200 mm and falls mostly during the summer months as thunder storms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Threatened. There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed by Mucina and Rutherford as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum* subsp *oliverorum* are listed as being endemic to the vegetation type.

However, the national vegetation does not provide a good representation of the vegetation at the site, and it is clear that large parts of the site are more closely allied with Bushmanland Arid Grassland. Bushmanland Arid Grassland is also an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km^2. It extends from the study area around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due to the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list six endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type.

The vegetation of the site is a mosaic of grassy and shrub-dominated areas, which is related to the soil conditions, with sandy soils being dominated by grasses and exposed calcrete or gravel soils dominated by shrubs, with many transitional areas with mixed-shrub-grass communities. The site is described in greater detail, with characteristic and dominant species in the next section.

Other vegetation types which occur in the wider area include Hantam Karoo and Western Bushmanland Klipveld. However, neither of these vegetation types fall within the site and would not be affected by the grid connection. There are also some small pans in the area which fall within the Bushmanland Vloere vegetation type.

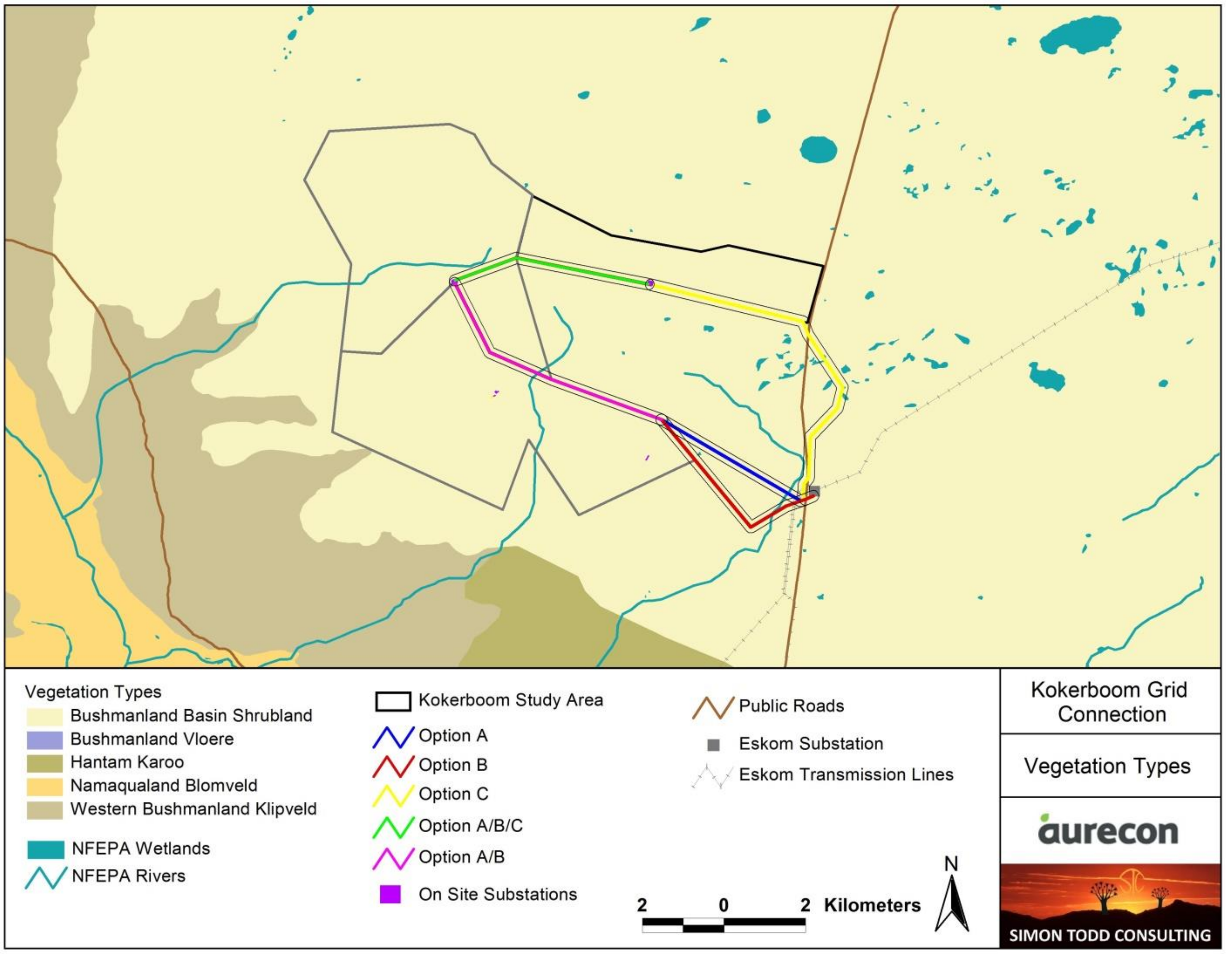

Figure 3. The national vegetation map (Mucina & Rutherford 2006/2012) for the Kokerboom Grid Connection. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011) are also depicted.

3.2 FINE-SCALE VEGETATION PATTERNS

The site consists of flat to gently undulating open plains dominated by low shrubs or arid tussock grasses. It is typical of southwestern Bushmanland and does not contain any remarkable ecological features. The only notable features present are some low hills in the north and south of the site and some poorly developed drainage lines. There are also some small pans in the area, but these are not directly beneath the power line corridor. The vegetation of the site is very homogenous and shifts from shrub-dominated vegetation on gravelly soils to tussock-grass-dominated areas on sandy soils, with large areas also transitional between these extremes. Plant diversity is low and the only areas with moderate levels of diversity are the low ridges along Alternative A and Alternative B.The different features and landscape units of the site are described in detail below.

Gravelly Plains

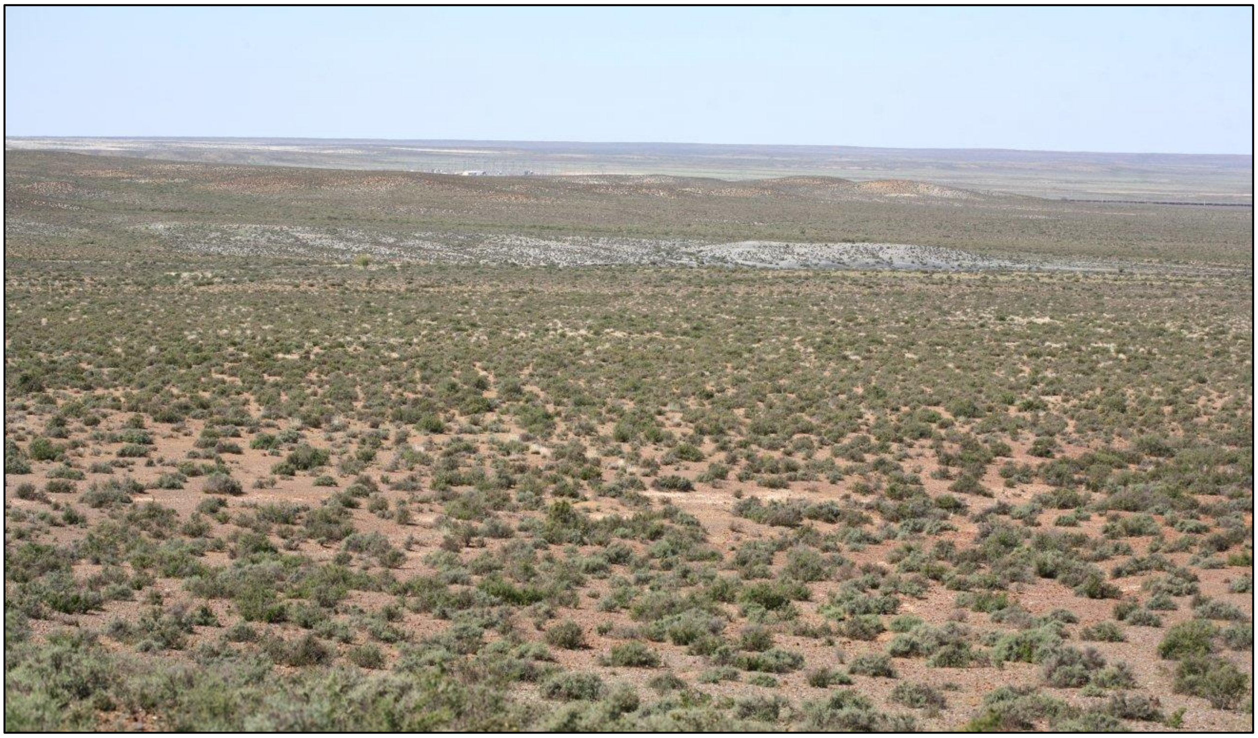

Figure 4. Looking down Alternative A and Alternative B towards the Helios substation, illustrating the typical shrub-dominated gravel plains prevalent across large parts of the Kokerboom Grid Connection routes. This represents typical Bushmanland Basin Shrubland vegetation as described in Mucina & Rutherford (2006). These plains are homogenous and exhibit little variation and as there are few species of concern present, they are not considered highly sensitive.

The gravelly areas are dominated by low shrubs typical of the Bushmanland Basin Shrubland vegetation type (Figure 4, Figure 5). Typical species include the shrubs *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Asparagus capensis*, *Zygophyllum retrofractum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Hermannia spinosa*, *Thesium lineatum*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia mucronata*, *Pteronia sordida*, *Rosenia humilis*, *Galenia fruticosa*, *Lycium pumilum* and *Salsola tuberculata*; succulent shrubs such as *Aridaria noctiflora*, *Ruschia intricata*, *Drosanthemum lique*, *Psilocaulon coriarium* and *Sarcocaulon patersonii* forbs such as *Aptosimum indivisum*, *Hypertelis salsoloides*, *Gazania lichtensteinii*, *Galenia sarcophylla* and *Fockea sinuata*; geophytes including *Drimia intricata* and *Moraea miniata*. Overall diversity within this vegetation type at the site is low, which can be ascribed to the aridity of the area and the poorly developed soils. Areas of higher diversity include exposed calcrete soils which contain specialist species such as *Titanopsis calcarea*, while there are also some low shale-derived hills present which have species such as *Aloinopsis luckhoffii*, *Cephalophyllum fulleri* which is listed as Rare and protected species such as *Aloe falcata*, *Aloe claviflora* and *Hoodia gordonii*.

Figure 5. Looking along Alternative C towards the Helios substation, showing the gravel plains in this area with a minor wash in the foreground dominated by *Lycium pumilum*.

Grassy Plains


Figure 6. Left, looking down Alternative A and Alternative B towards the Switching Station 1, and right, a section of Alternative C, where it passes the Khobab Wind Energy Facility, showing the grassy plains which characterise this area. The grassy plains typically occur on deeper sands across the site, and correspond with the Bushmanland Arid Grassland vegetation type. The vegetation is dominated by *Stipagrostis cilita* or *Stipagrostis brevifolia* with scattered *Lycium pumilum* bushes. These areas are not considered sensitive as the diversity is low and there are very few species of concern present.

The grassy areas of the site (Figure 6) are dominated by grasses such as *Stipagrostis ciliata*, *Stipagrostis brevifolia*, *Stipagrostis anomala* and *Aristida adscenionis*, shrubs including *Lycium pumilum*, *Aptosimum spinescence*, *Melolobium candicans*, *Plinthus karooicus*, *Salsola tuberculata*, with occasional annuals such as *Leysera tenella*, *Arctotis leiocarpa*, *Osteospermum pinnatum*, *Limeum africanum* and *Trianthema parvifolia*. These areas are not considered sensitive and contain few species of conservation concern. As they are homogenous and widely available in the area and in the rest of bushmandland, cumulative impacts on this community would be low.

Drainage Lines & Pans

The drainage lines of the site (Figure 7) are not very well developed and do not have a tall woody component. Typical and dominant species include *Stipagrostis namaquensis*, *Stipagrostis obtusa*, *Osteospermum armatum*, *Arctotis fastuosa*, *Deverra denudata*, *Melianthus comosus*, *Salvia disermas*, *Lycium pumilum*, *Lycium oxycarpum*, *Galenia sarcophylla*, *Salsola aphylla* and *Sesamum capense*. Although the drainage lines are not well developed, which can be ascribed to aridity of the area, they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events. As such disturbance to these areas should be minimised as far as possible.

Figure 7. One of the drainage lines traversed by the common section of Alternative A and Alternative B. Showing the broad bed dominated by *Stipagrostis namaquensis* with occasional *Melianthus comosus* and *Lycium* bushes, and the lack of trees.

Although there are some significant pans in the area, which are considered ecologically significant as they provide habitat for temporary water fauna as well as attract birds such as flamingos when they have water, these are all well outside of the development footprint. The pan features along or near the route occur mostly in the north and east along Alternative C and consist of small depressions which do not hold water for extended periods (Figure 8). They are either bare or contain shrubs such as *Salsola tuberculata*, *Osteospermum armatum* and *Psilocaulon corarium*. Although they are not considered as sensitive as the larger well-developed pan systems, they are vulnerable to disruption from roads etc as these features disrupt the flow of water across the shallow pans. These feaures should be avoided where possible.

Figure 8. Example of the small, shallow pans that are prevalent along the north eastern section of Alternative C. These are small and can easily be spanned by the power line if necessary.

3.3 LISTED PLANT SPECIES

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. According to the SIBIS database, a total of 135 indigenous species are known from the area, of which 89 have been observed by the consultant on the site and an additional 28 species were observed that have not been recorded from the area before. Although some additional species would undoubtedly be discovered with additional sampling, the area is not species-rich and even with intensive sampling the area is not likely to demonstrate exceptional richness. Listed and protected species observed in the area include *Cephalophyllum fulleri* which is classified as Rare and a number of provincially protected species including *Aloe falcata*, *Hoodia gordonii* and *Aloinopsis luckhoffii* and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

3.4 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The recently completed Northern Cape Critical Biodiversity Areas (CBA) map (Oosthuysen & Holness 2016) is depicted below for the study area (Figure 9). This biodiversity assessment identifies CBAs which represent biodiversity priority areas which should be maintained in a natural to near-natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. There are some CBAs and ESAs associated with drainage features present along Alternative A and Alternative B as well as towards the Helios substation. The power line would however not result in significant habitat loss within these areas and is not considered to be a significant threat to the ecological functioning of the CBAs. Cumulative impacts are however a potential concern and are addressed in the next section. The site does not lie within a National Protected Area Expansion Strategy (NPAES) focus area and has therefore not been identified as an important area for future conservation area expansion.

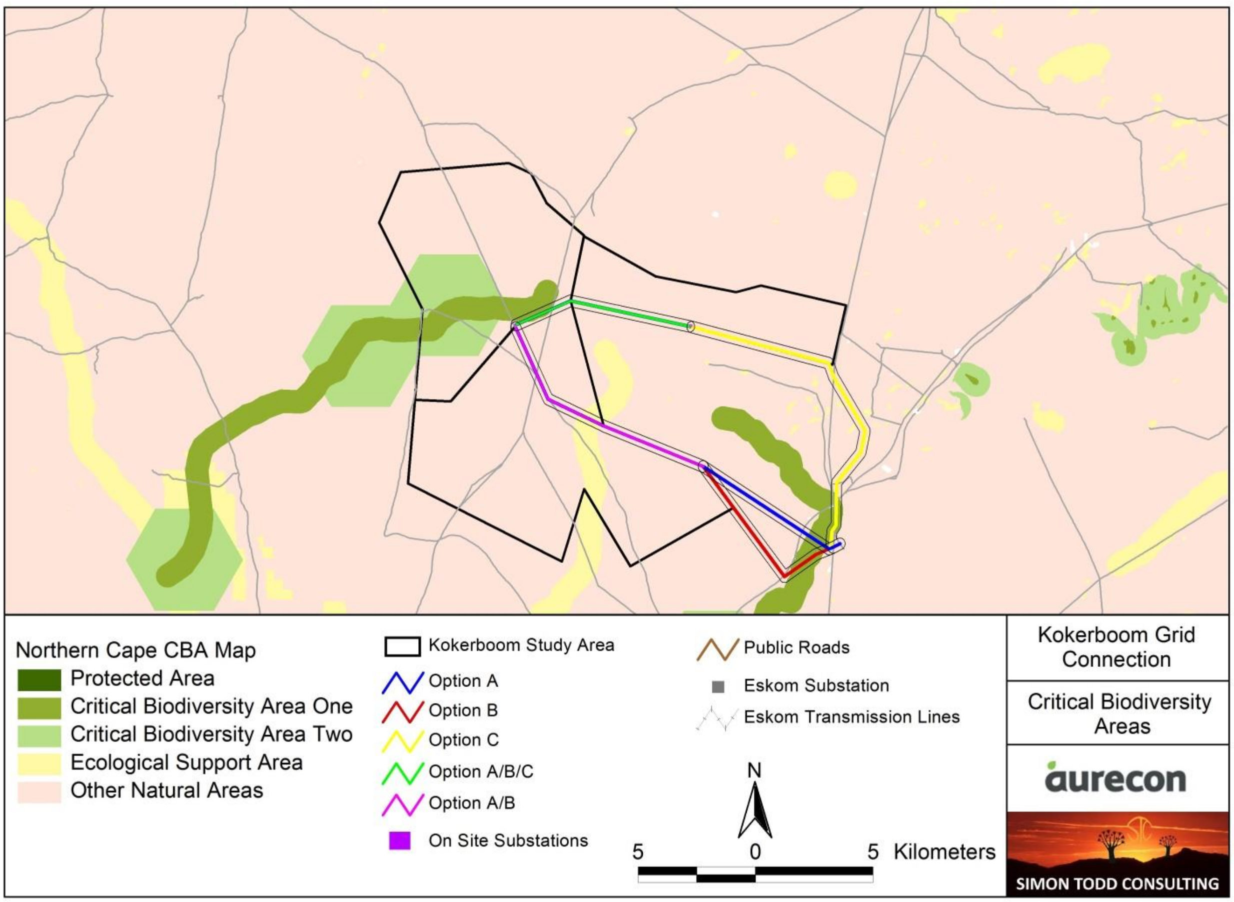

Figure 9. Critical Biodiversity Areas map of the study area, showing some limited tracts of CBA and ESA along the power line routes associated with drainage lines.

3.5 CUMULATIVE IMPACTS

In terms of existing impacts in the area and the potential for the grid connection to contribute to cumulative impacts, the DEA-registered renewable energy projects for the area are depicted below in Figure 10. Although there is not a lot of development in the wider area, there are two wind farm preferred bidders adjacent to to the site that are currently under construction and nearing completion, as well as a solar farm that is a preferred bidder. To the west of the Eskom Helios substation, there is the Dwarsrug WEF, which has authorisation but is not a preffered bidder. Although there are some other developments that are still currently in the authorisation process, these are still uncertain and it is not known which of these projects will be authorised and of those, which would ultimately be built.

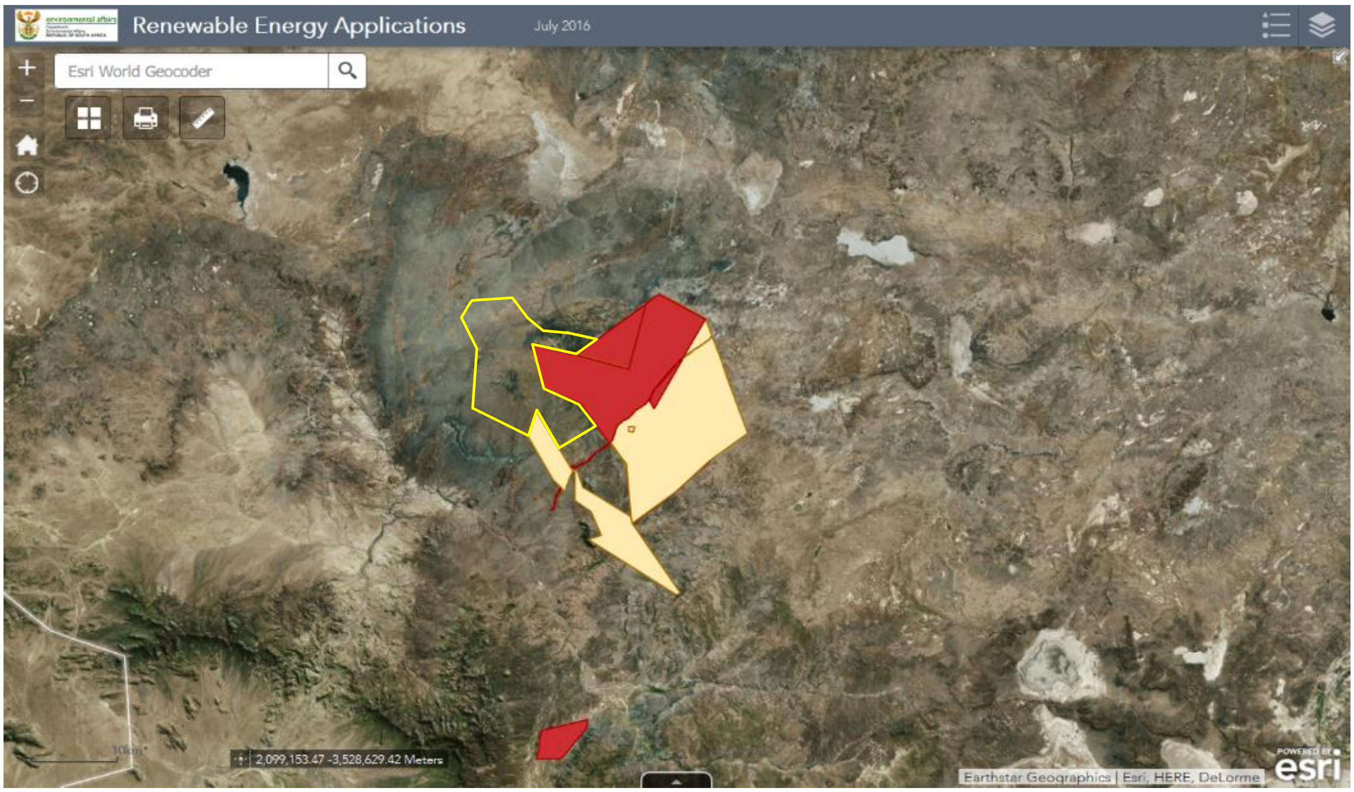

Figure 10. DEA-registered renewable energy projects in the vicinity of the wider Kokerboom study area which is indicated by the yellow outlined polygon. The colours of the map are not correct as red indicates solar development and pale yellow wind energy development, but the properties east of the Kokerboom site are the Mainstream Khobab and Loeriesfontein wind farms. Although there is a node of development around the Helios substation, the broader area has very little development impact.

A node of wind energy development is developing around the Helios Substation which would potentially generate significant local impact. However, there are no specific features of the affected area such as the presence of large drainage corridors, which would indicate that it is likely to be more important than the surrounding areas for faunal movement or landscape connectivity. The contribution of the power line and substations to transformation and habitat loss would be low and would amount to a few hectares only and as such the major contributing factor to transformation in the area would be the wind and solar developments themselves. In the long-term the potential for interaction between the power line and fauna is low and aside from the initial habitat loss no persistent impacts on fauna and flora are likely to result from the power line. Consequently, the contribution of the power line to cumulative impacts in the area is considered to be low. Furthermore, cumulative impacts in the area are further mitigated by the homogenous nature of the landscape in the area and the paucity of species and habitats of conservation concern in the affected areas.

3.6 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 40 terrestrial mammals suggesting that potential mammalian diversity at the site is quite low. Species observed in the area include Steenbok *Raphicerus campestris*, Cape Porcupine *Hystrix africaeaustralis*, Aardvark *Orycteropus afer*, Yellow Mongoose *Cynictis penicillata*, Cape Hare *Lepus capensis,* Cape Fox *Vulpes chama*, Bat-eared Fox *Otocyon megalotis* and Round-eared Elephant Shrew *Macroscelides proboscideus*. In terms of specific habitats which are likely to be of above average significance, the low ridges and drainage lines are likely to contain the highest fauna abundance and diversity.

Listed mammal species which may occur at the site include the Black-footed cat *Felis nigripes* (Vulnerable) and Honey Badger *Mellivora capensis* which is listed as Endangered in the South African Red Data Book of Mammals, but is listed as Least Concern by the IUCN. As these species have a broad distribution across South Africa, the limited footprint of the development is not likely to compromise the local or regional populations of these species, especially given the aridity of the area and the associated very low density of such species in the area.

Reptiles

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3), comprising 5 tortoises, 12 snakes, 15 lizards and skinks, 8 geckos and 1 chameleon. This is a comparatively low total, suggesting that reptile diversity at the site is likely to be low. There are no listed species which are likely to occur at the site. Species which were observed in the area include the Namaqua Sand Lizard *Pedioplanis namaquensis*, Spotted Desert Lizard *Meroles suborbitalis* (Figure 11), Western Sandveld Lizard *Nucras tessellata*, Southern Rock Agama *Agama atra*, Ground Agama *Agama aculeata* subsp. *aculeata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii*. In terms of the likely impacts of the development on reptiles, habitat loss is not likely to be highly significant as the direct footprint of the development is not likely to exceed a few hectares and this would not be significant in context of the relatively homogenous and intact surrounding landscape. In the long-term, there is little scope for persistent impact on reptiles from the power line and as such the major impact would occur at construction, but this would be local in nature and transient.

Figure 11. The Spotted Desert Lizard *Meroles suborbitalis* is the most common reptile at the Kokerboom site and is frequent on the open plains of the site.

Amphibians

Given the aridity of the site and lack of surface water in the area, it is not surprising that only six frog species may occur in the area. Of these only those which are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis* and Tandy's Sand Frog *Tomopterna tandyi* are likely to occur within the site itself. Impacts on amphibians are likely to be low given the limited extent of the development as well as low likely density of amphibians in the area. Although there are some pans present in the area, these are not necessarily available to amphibians as many of the pans are saline and not suitable for amphibians.

3.7 KOKERBOOM GRID CONNECTION SENSITIVITY ASSESSMENT

The sensitivity map for the Kokerboom Grid Connection study area, is depicted below in Figure 12. The majority of the site consists of low open shrublands or arid grasslands on flat plains and gently sloping hills that are not considered highly sensitive. The overall diversity of the vegetation is low and the abundance of listed plant species is also low. The listed species that are present at the site occur at a very low density or in localised environments and would not be significantly affected by the development with the appropriate avoidance.

The affected area does not have a lot of features and the only features of some significance at the site are some poorly developed drainage lines and some low gravelly hills. The low gravel hills which are most extensive along Alternative A and Alternative B are considered high sensitivity as this was one of the few areas present with a significant number of plant species of concern. Although there are a number of minor drainage lines at the site, these are not well developed at all and large buffers (above those required by law) around these features is not necessary. In addition, it is likely that the power line will be able to span the drainage feature at the site with minimal impact to the sensitive areas.

There are no highly sensitive areas considered to be no-go areas at the site and all three alternatives are considered acceptable, although Alternative C is identified as being the preferred alternative as it is likely to have the lowest overall impact.

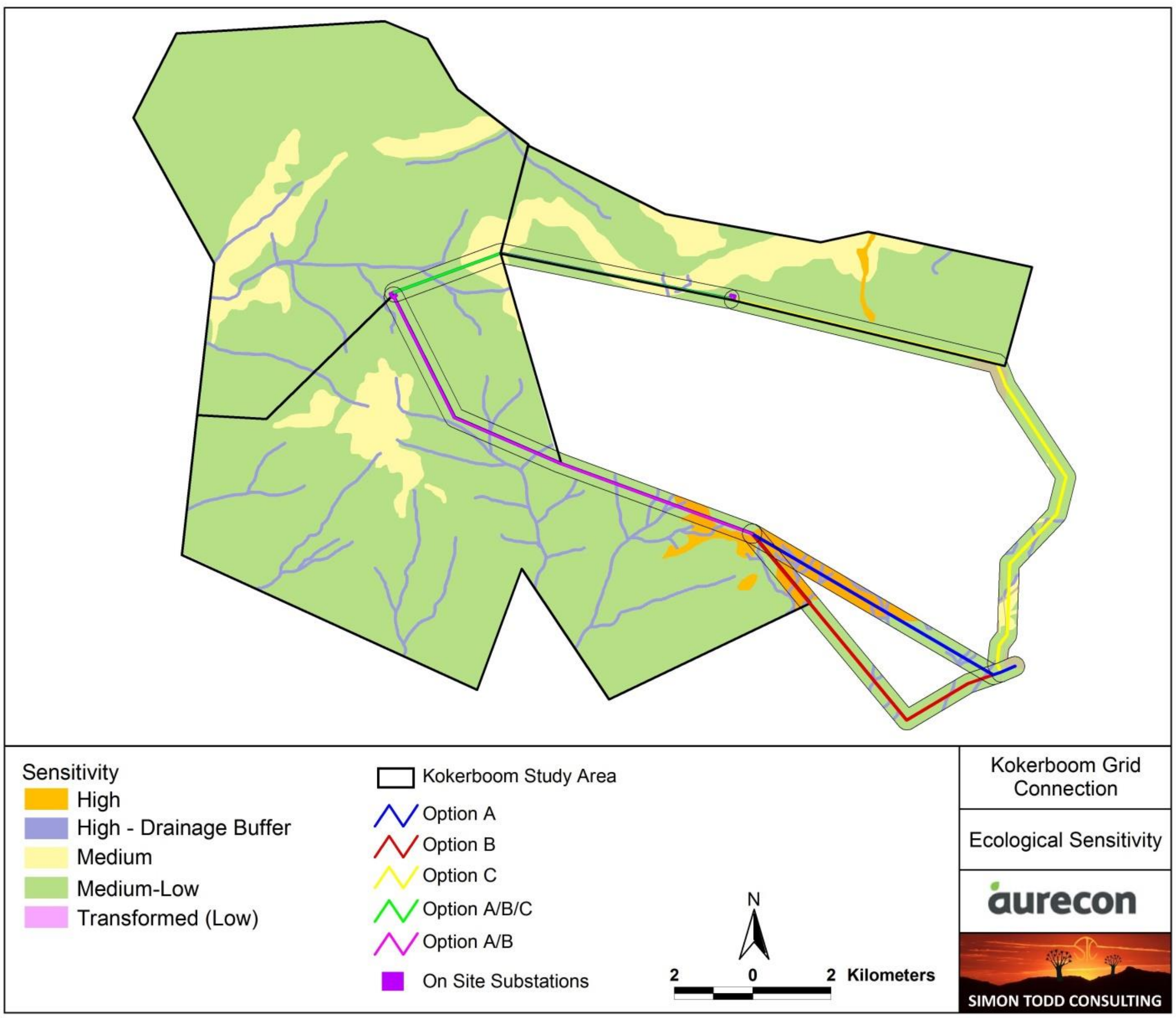

Figure 12. Ecological sensitivity map for the Kokerboom Grid Connection study area. The majority of the site is low open shrubland and arid grassland of medium-low sensitivity.

4 IMPACT ASSESSMENT

5 IMPACTS AND ISSUES IDENTIFICATION

The development of the proposed Kokerboom Grid Connection is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as pylon and switching station foundations and service roads. The following impacts are identified as the major impacts that are likely to be associated with the development and which are assessed for the construction, operational and decommissioning phases of the development.

5.1 IDENTIFICATION OF POTENTIAL IMPACTS

The likely impacts on the terrestrial ecology of the site resulting from the development of the Kokerboom Grid Connection are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed.

Impact 1. Impacts on vegetation and listed or protected plant species

The development would require vegetation clearing for substations, pylons, access roads and other hard infrastructure. Apart from the direct loss of vegetation within the development footprint, listed and protected species would potentially be impacted. These impacts are likely to occur during the construction phase of the development, with additional vegetation impacts during operation likely to be low. This impact is therefore assessed for the power line and associated disturbance, for the construction phase only.

Impact 2. Direct Faunal Impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed if proper management and monitoring is not in place. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity is high. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. During the operational phase, there will be little scope for interaction between the power line and fauna and no significant impacts are expected during this phase. Faunal impacts are therefore assessed for the construction and decommissioning phases of the facility.

Impact 3. Increased Erosion Risk

The disturbance created during construction would leave the affected areas vulnerable to wind and water erosion. Soil disturbance associated with the development will render the impacted areas vulnerable to erosion and measures to limit erosion will need to be implemented. As the construction phase will be of relatively short duration, this impact would manifest largely during the operational phase and decomissioning phases.

Impact 4. Alien Plant Invasion

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Some alien plant invasion is inevitable and regular alien plant clearing activities would be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, these areas will be less vulnerable to alien plant invasion. This impact would manifest during the operational and decomissioning phases.

Cumulative Impact 1. Impacts on broad-scale ecological processes and cumulative habitat loss

The development will contribute to cumulative impacts in the area and potentially affect the ability to meet future conservation targets. However, the total footprint of the development would be less than 10ha and this is not considered to be a highly significant impact. It is however assessed as there are numerous other facilities in the area and the cumulative impact of numerous power lines may generate a significant impact overall.

6 ASSESSMENT OF IMPACTS

An assessment of the identified impacts above is made below for the different phases of the development, for the Kokerboom Grid Connection and associated infrastructure.

For each predicted impact, criteria are applied to establish the significance of the impact based on likelihood and consequence, both without mitigation being applied and with the most effective mitigation measure(s) in place. The criteria that contribute to the consequence of the impact are intensity (at the indicated spatial scale), which also includes the type of impact (being either a positive or negative impact); the duration (length of time that the impact will continue); and the extent (spatial scale) of the impact. The sensitivity of the receiving environment and/or sensitive receptors is incorporated into the consideration of consequence by appropriately adjusting the thresholds or scales of the intensity, duration and extent criteria, based on expert knowledge.

The further details of the assessment approach and the calculation of significance is detailed in the main EIA report and is not repeated in full here.

6.1 PLANNING & CONSTRUCTION PHASE IMPACTS

Impact 1. *Impact on vegetation and listed plant species.*

Impact Phase: Construction							
Impact Description: Impact on vegetation and listed plant species due to transformation within the development footprint							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative **A**							
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Probable	Certain
Alternative **B**							
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Probable	Certain
Alternative **C**							
Without Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Long Term	Very Low	-'tve	**Very Low**	Probable	Certain
Reversibility			High – The footprint is small and if removed, recovery potential is moderate to high.				
Will impact cause irreplaceable loss of resources?			No				
Can impact be avoided, managed or mitigated?			To a large extent through avoidance, but some residual impact is likely due to unavoidable clearing				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are be avoided where possible. 2) Ensure that lay-down and other temporary infrastructure is within low or medium-low sensitivity areas, preferably previously transformed areas if possible. 3) Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development. 4) All roads built for construction should have water diversion and erosion control structures present, especially in steep areas. 5) Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate							

handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. 6) Demarcate all areas to be cleared with construction tape or similar material. However caution should be exercised to avoid using material that might entangle fauna.	
Cumulative Impacts	The development will contribute to cumulative vegetation impacts in the area, but as the affected vegetation types are extensive and still more than 98% intact, this would not be significant, especially given the low contribution of the power line.

Impact 2. Direct faunal impacts due to construction

Impact Phase: Construction							
Impact Description: Direct faunal impacts due to construction phase noise and physical disturbance.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Alternative B							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Alternative C							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Can the impact be reversed?			Construction phase disturbance will be transient, but some habitat loss would be long term.				
Will impact cause irreplaceable loss or resources?			Highly unlikely.				
Can impact be avoided, managed or mitigated?			Noise and construction phase disturbance cannot be entirely avoided or mitigated but are of short duration and no long-term impacts are expected				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Preconstruction walk-through of the power line to identify areas of faunal sensitivity. 2) During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person, or allowed to passively vacate the area.							

3) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. 4) Fires within suitable dedicated containers (i.e. braai drums etc) should only be allowed within the construction camp and similar demarcated and cleared areas and no fires should be allowed in the open veld as there is a risk of runaway veld fires. 5) No fuelwood collection should be allowed on-site. 6) No dogs or cats should be allowed on site apart from that of the landowners or lawful occupants. 7) If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs), which do not attract insects and which should be directed downwards. 8) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 9) No unauthorized persons should be allowed onto the site and site access should be strictly controlled and vehicles which need to roam around the site should be accompanied by the ECO or security personnel. 10) All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. Speed limits should apply within the development footprint as well as on the public gravel access roads to the site. 11) All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition.	
Cumulative Impacts	The development will contribute to cumulative faunal impacts in the area, but the overall development pressure in the region is stil low and there are no specific fauna of concern that would be affected.

6.2 OPERATIONAL PHASE IMPACTS

Impact 2. Soil Erosion Risk During Operation

Impact Phase: Operation							
Impact Description: Following construction, the site will be vulnerable to soil erosion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Site Specific	Medium Term	Medium	-‘tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Medium Term	Low	-‘tve	**Very Low**	Unlikely	Sure
Alternative B							
Without Mitigation	Site Specific	Medium Term	Medium	-‘tve	**Low**	Probable	Certain

With Mitigation	Site Specific	Medium Term	Low	-'tve	**Very Low**	Unlikely	Sure
Alternative C							
Without Mitigation	Site Specific	Medium Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Medium Term	Low	-'tve	**Very Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			With mitigation there will be no irreplaceable loss.				
Can impact be avoided, managed or mitigated?			With appropriate control measures, erosion risk can be mitigated to a very low level				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan or as detailed in the EMPr. 2) All roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. 3) Disturbance near to drainage lines should be avoided and sensitive drainage areas near to the construction activities should demarcated as no-go areas. 4) Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance, as per the Erosion Management and Rehabilitation Plans for the project. 5) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 6) Wind breaks and sediment traps may be necessary to prevent erosion and soil movement if there are topsoil or other soil waste heaps present during the wet season. 7) A low cover of vegetation should be left wherever possible within the construction footprint to bind the soil, prevent erosion and promote post-disturbance recovery of an indigenous ground cover.							
Cumulative Impacts			The development would potentially contribute to cumulative soil erosion problems in the area, but with mitigation, this impact can be mitigated to a very low level.				

Impact 3. Alien Plant Invasion

Impact Phase: Operation							
Impact Description: Following construction, the site will be highly vulnerable to alien plant invasion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative B							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative C							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			With mitigation there would be no irreplaceable loss of resources				
Can impact be avoided, managed or mitigated?			With appropriate control measures, alien plants can be controlled and reduced to very low impact				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented. Problem woody species such as *Prosopis* are already present in the area and are likely to increase rapidly if not controlled. 3) Regular monitoring for alien plants within the development footprint as well as adjacent areas which receive runoff from the facility as there are also likely to be prone to invasion problems. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.							
Cumulative Impacts			The development would potentially contribute to cumulative alien invasion and degradation in the area, but with mitigation, this will be reduced to a low level.				

6.3 DECOMISSIONING PHASE IMPACTS

Impact 1. Direct faunal impacts due to decomissioning

Impact Phase: Decomissioing							
Impact Description: Faunal impacts due to decomissioining phase activities.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Alternative B							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Alternative C							
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Very Low**	Probable	Certain
Can the impact be reversed?			The impact will persist for the duration of decommissioning activities.				
Will impact cause irreplaceable loss or resources?			Unlikely				
Can impact be avoided, managed or mitigated?			Although there may be some transient faunal disturbance, no long term impacts are likely as a result of the decomossioning of the power line.				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decomissioing activities, or allowed to passively vacate the area. 2) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 3) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises. 4) No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped. 5) All above-ground infrastructure such as pylons should be removed from the site. Below-ground infrastructure such as cabling or pylon foundations can be left in place if it does not pose a risk,							

	as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan, and as per the agreements with the land owners concerned.
Cumulative Impacts	Decommissioning may contribute to cumulative fauna impacts in the area, but with mitigation this would be transient and in the long-term the removal of the facility would return the site largely to its previous state in terms of faunal habitats and impacts.

Impact 2. Soil Erosion Risk due to Decommissioning

Impact Phase: Decomissioing

Impact Description: Following decomissioing, the site will be vulnerable to soil erosion

	Extent	Duration	Magnitude	Status	Significance	Probability	Confidence
Alternative A							
Without Mitigation	Site Specific	Medium Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Medium Term	Low	-'tve	**Very Low**	Unlikely	Sure
Alternative B							
Without Mitigation	Site Specific	Medium Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Medium Term	Low	-'tve	**Very Low**	Unlikely	Sure
Alternative C							
Without Mitigation	Site Specific	Medium Term	Medium	-'tve	**Low**	Probable	Certain
With Mitigation	Site Specific	Medium Term	Low	-'tve	**Very Low**	Unlikely	Sure

Can the impact be reversed?	With appropriate mitigation the impact can be ameliorated
Will impact cause irreplaceable loss or resources?	The loss of large amounts to topsoil would potentially be an irreplaceable loss of resources.
Can impact be avoided, managed or mitigated?	With appropriate control measures, erosion risk can be mitigated

Mitigation measures to reduce residual risk or enhance opportunities:

1) Any roads that will not be rehabilitated should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.
2) There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as result of the disturbance, and if they do, to immediately implement erosion control measures.
3) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.

4) All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.	
Cumulative Impacts	Decommissioning would potentially contribute to cumulative erosion problems in the area, but with mitigation this would be largely avoided.

Impact 3. Alien Plant Invasion following decommissioning

Impact Phase: Decomissioing							
Impact Description: Following decommissioning, the site will be highly vulnerable to alien plant invasion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative B							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative C							
Without Mitigation	Site Specific	Medium Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Site Specific	Medium Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Can the impact be reversed?		With appropriate mitigation the impact can be ameliorated					
Will impact cause irreplaceable loss or resources?		With mitigation there would not be loss of resources					
Can impact be avoided, managed or mitigated?		With appropriate control measures, alien plants can be controlled and reduced to very low impact					
Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned. 3) Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are no longer a problem at the site.							

4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	
Cumulative Impacts	Decommissioning would potentially result in increased alien invasive plant problems in the area, but with post-decommissioning mitigation, this can be minimized.

6.4 CUMULATIVE IMPACTS

Impact on Cumulative effects and Broad-Scale Ecological Processes

Impact Phase: Operation							
Impact Description: Cumulative impact on broad scale ecological processes							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Alternative A							
Without Mitigation	Local	Long Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Local	Long Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative B							
Without Mitigation	Local	Long Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Local	Long Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Alternative C							
Without Mitigation	Local	Long Term	Low	-'tve	**Low**	Probable	Sure
With Mitigation	Local	Long Term	Very Low	-'tve	**Very Low**	Unlikely	Sure
Can the impact be reversed?	The impact would last for the lifetime of the development						
Will impact cause irreplaceable loss or resources?	No.						
Can impact be avoided, managed or mitigated?	Yes, residual impacts from the power line would be very low						
Mitigation measures to reduce residual risk or enhance opportunities: 1) Minimise the development footprint within the high sensitivity areas. 2) There should be an integrated environmental management plan for the development area during operation, which is beneficial to fauna and flora.							

7 ASSESSMENT OF ALTERNATIVES

There are three site alternatives considered in the current assessment. Alternative C is considered the preferred alternative as it is the shortest and also traverses the least extent of sensitive habitat. In addition, large sections of the route run adjacent to existing disturbance or next to existing power lines. As a result, this alternative would generate the lowest long-term impact and is the preferred alternative. Alternative A and Alternative B are similar and traverse the gravel hills in the south of the site, where the density of species of concern is higher. Although significant impact to these species can be avoided through careful pylon placement, the overall impact of these two alternatives would be slightly higher than Alternative C, but still Low or Very Low impact overall. Although Alternative C is identified as the most preferred option, both Alternatives A & B are still considered acceptable, with mitigation, from an ecological perspective.

Alternative	**Preference**	**Reasons (incl. potential issues)**
POWER LINE ALTERNATIVES		
Alternative C	Preferred	This power line alternative is the shortest and traverses the least extent of sensitive habitat. In addition the majority of the route is adjacent to existing disturbance or power lines. This is clearly the preferred alternative and would generate less impact than the other alternatives.
Alternative A	Acceptable	This alternative is less preferred because it traverses an area with little current disturbance and includes several areas of where listed and protected plant species were observed to occur. Although these species can likely be avoided, the preferred Alternative C would generate lower long-term impacts. As such this considered an acceptable but not preferred option.
Alternative B	Acceptable	This alternativeis less preferred because it traverses an area with little current disturbance and includes several areas of where listed and protected plant species were observed to occur. Although these species can likely be avoided, the preferred Alternative C would generate lower long-term impacts. As such this considered an acceptable but not preferred alternative.

8 CONCLUSION & RECOMMENDATIONS

The majority of the Kokerboom grid connection routes traverse low open shrubland or grassland on flat plains and gently sloping hills that are medium-low sensitivity and where impact of the power line would be low or very low and of a local nature. The overall diversity of the vegetation is low and the abundance of listed plant species is also very low. The listed species that are present at the site occur at a very low density or in localised environments and would not be significantly affected by the power line with the appropriate preconstruction avoidance.

The low gravel hills along Alternative A and Alternative B are considered moderate to high sensitivity as this was one of the few areas present at the site with a higher number of plant species of concern. Although these species can likely be avoided, overall impacts associated with Alternative A and Alternative B would be slightly higher (but still low impact) than Alternative C, which is identified as the preferred alternative. In terms of the on-site substation locations, these are both considered acceptable and within areas considered to be low sensitivity.

Apart from the ridges and hilly areas, the only other significant feature of the site are the poorly developed drainage lines of the area. These are considered sensitive on account of their vulnerability to disturbance as well as the ecological function that they perform in terms of hydrological regulation and provision of habitat. As these are narrow, it is likely that the power line would be able to traverse these features with minimal impact.

With the application of relatively simple mitigation and avoidance measures, the impact of the Kokerboom grid connection can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the power line that cannot be reduced to a low or very low level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and from a terrestrial ecology perspective the development of the power line is considered acceptable.

9 ACTIVITIES FOR INCLUSION THE DRAFT EMPR

An Environmental Management Programme (EMPr) provides a link between the predicted impacts and mitigation measures recommended within the EIA and the implementation and operational activities of a project. As the construction and operation of the Kokerboom grid connection infrastructure may impact the environment, activities which pose a threat should be managed and mitigated so that unnecessary or preventable environmental impacts do not result. The primary objective of the EMPr is to detail actions required to address the impacts identified in the EIA during the establishment, operation and rehabilitation of the proposed infrastructure. The EMPr provides an elaboration of how to implement the mitigation measures documented in the EIA. As such the purpose of the EMPr can be outlined as follows:

- To outline mitigation measures and environmental specifications which are required to be implemented for the planning, establishment, rehabilitation and operation/maintenance phases of the project in order to minimise and manage the extent of environmental impacts.
- To ensure that the establishment and operation phases of the wind farm do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- To identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- To propose mechanisms for monitoring compliance, and preventing long-term or permanent environmental degradation.
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation that were not considered in the EIA process

Below are the ecologically-orientated measures that should be implemented as part of the EMPr for the development to reduce the significance or extent of the above impacts. The measures below do not exactly match with the impacts that have been identified, as certain mitigation measures, such as limiting the loss of vegetation may be effective at combating several different impacts, such as erosion, faunal impact etc.

9.1 CONSTRUCTION PHASE ACTIVITIES

Objective: Limit disturbance of vegetation and loss of protected flora during construction			
Project component/s	All infrastructure and activities which result in vegetation loss or clearing including: » Clearing and excavation for establishment of infrastructure. » Construction camps & other temporary infrastructure. » Access roads.		
Potential Impact	Loss of plant cover leading to erosion as well as loss of faunal habitat and loss of specimens of protected plants.		
Activity/risk source	Vegetation clearing for the following » Clearing for infrastructure establishment. » Access roads. » Laydown areas. » Construction Camps.		
Mitigation: Target/Objective	» Low footprint and low impact on terrestrial environment. » Low impact on protected plant species.		
Mitigation: Action/control		Responsibility	Timeframe
» Preconstruction walk-through of facility footprint and support structure positions and use micro-siting to reduce local impact where possible. » Obtain relevant permits from the Department of Agriculture, Forestry and Fisheries (DAFF) and the Northern Cape Department of Environment and Nature Conservation (DENC) prior to any construction activities at the site. » Affected individuals of protected species which cannot be avoided should be translocated to a safe area on the site prior to construction. This does not include trees which cannot be translocated and where these are protected by DAFF and permit for their destruction would be required. » Erosion control measures should be implemented in areas where slopes have been disturbed. » Revegetation of cleared areas or monitoring to ensure that recovery is taking place. » Alien plant clearing where necessary.		Management/ECO	Construction & Operation
Performance Indicator	» Vegetation loss restricted to infrastructure footprint. » Low impact on protected plant species. » Permit obtained to destroy or translocate affected individuals of protected species.		

Monitoring	ECO to monitor construction to ensure that: » Vegetation is cleared only within essential areas. » Erosion risk is maintained at an acceptable level through flow regulation structures where appropriate and the maintenance of plant cover wherever possible.

Objective: Limit direct and indirect terrestrial faunal impacts during construction		
Project component/s	Construction activities especially the following: » Vegetation clearing. » Human presence. » Operation of heavy machinery.	
Potential Impact	Disturbance of faunal communities due to construction as well as poaching and hunting risk from construction staff.	
Activity/risk source	» Habitat transformation during construction. » Presence of construction crews. » Operation of heavy vehicles.	
Mitigation: Target/Objective	Low faunal impact during construction.	
Mitigation: Action/control	Responsibility	Timeframe
» Environmental induction for all construction staff » ECO to monitor and enforce ban on hunting, collecting etc. of all plants and animals or their products. » Any fauna encountered during construction should be removed to safety by the ECO or other suitably qualified person, or allowed to passively vacate the area. » All vehicles to adhere to low speed limits (40km/h max) on the site, to reduce risk of faunal collisions as well as reduce dust. » All night-lighting should use low-UV type lights (such as most LEDs), which do not attract insects. The lights should also be of types which are directed downward and do not result in large amounts of light pollution.	Management/ECO	Construction
Performance Indicator	» Low mortality of fauna due to construction machinery and activities. » No poaching etc of fauna by construction personnel during construction. » Removal to safety of fauna encountered during construction.	
Monitoring	Monitoring for compliance during the construction phase. All incidents to be noted.	

9.2 Operation Phase Activities

OBJECTIVE: Limit the ecological footprint of the Facility			
Project component/s	Presence and operation of the facility including » Movement of maintenance vehicles along the access and service roads. » Vegetation management within the site. » Faunal management within the facility.		
Potential Impact	» Alien plant invasion » Erosion » Pollution		
Activity/risk source	» Alien plant invasion in and around the grid connection infrastructure. » Unregulated runoff from the facility area as well as access roads. » Human presence during vegetation clearing or plant maintenance activities » Pollution from maintenance vehicles due to oil or fuel leaks etc. » Maintenance activities which may lead to negative impacts such as pollution, herbicide drift etc.		
Mitigation: Target/Objective	Low ecological footprint of the facility during operation.		
Mitigation: Action/control		Responsibility	Timeframe
Vegetation control should be by manual clearing and herbicides should not be used except to control alien plants in the prescribed manner.		Management/ Contractor	Operation
Annual monitoring for alien plant species - with follow up clearing as needed – or as per the frequency stated in the alien invasive management plan to be developed for the site.		Management/ Contractor	Operation
Annual site inspection for erosion or water flow regulation problems – with follow up remedial action where problems are identified.		Management/ Contractor	Operation
Performance Indicator	» No erosion problems within the facility or along access roads. » Low abundance of alien plants within the site. » Maintenance of a ground cover of perennial grasses and forbs (herbaceous plants) that resist erosion.		
Monitoring	» Annual monitoring with records of alien species presence and clearing actions. » Annual monitoring with records of erosion problems and mitigation actions taken with photographs.		

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11 ANNEX 1. LIST OF PLANTS

List of plant species known from the vicinity of the Kokerboom study site, based on the SANBI SIBIS database, supplemented wih additional species not on the list and showing which species were observed at the site. IUCN conservation status is from the South African Red Data List of Plants 2016.

Family	Species	IUCN	Obs.	Family	Species	IUCN	Obs.
ACANTHACEAE	*Acanthopsis disperma*	LC		ACANTHACEAE	*Blepharis furcata*	LC	
ACANTHACEAE	*Blepharis mitrata*	LC		ACANTHACEAE	*Monechma spartioides*	LC	
AIZOACEAE	*Aizoon canariense*	LC	1	AIZOACEAE	*Galenia africana*	LC	1
AIZOACEAE	*Galenia fruticosa*	LC	1	AIZOACEAE	*Galenia sarcophylla*	LC	1
AIZOACEAE	*Galenia squamulosa*	LC		AIZOACEAE	*Plinthus cryptocarpus*	LC	
AIZOACEAE	*Plinthus karooicus*	LC	1	AIZOACEAE	*Tetragonia arbuscula*	LC	
AIZOACEAE	*Tetragonia fruticosa*	LC	1	AIZOACEAE	*Tetragonia microptera*	LC	
AIZOACEAE	*Trianthema parvifolia*	LC	1	AMARANTHACEAE	*Amaranthus praetermissus*	LC	
AMARANTHACEAE	*Sericocoma avolans*	LC		AMARANTHACEAE	*Sericocoma pungens*	LC	
AMARYLLIDACEAE	*Brunsvigia comptonii*	LC		APIACCEAE	*Deverra denudata*	LC	1
APOCYNACEAE	*Fockea sinuata*	LC	1	APOCYNACEAE	*Gomphocarpus filiformis*	LC	1
APOCYNACEAE	*Hoodia gordonii*	DDD	1	APOCYNACEAE	*Microloma armatum var. armatum*	LC	
APOCYNACEAE	*Microloma incanum*	LC		APOCYNACEAE	*Microloma longitubum*	LC	
APOCYNACEAE	*Quaqua incarnata*	LC	1	APOCYNACEAE	*Sarcostemma viminale subsp. viminale*	LC	
ASPARAGACEAE	*Asparagus africanus*	LC		ASPARAGACEAE	*Asparagus capensis var. capensis*	LC	1
ASPHODELACEAE	*Aloe claviflora*	LC	1	ASPHODELACEAE	*Aloe falcata*	LC	1
ASPHODELACEAE	*Aloe variegata*	LC	1	ASTERACEAE	*Amellus microglossus*	LC	
ASTERACEAE	*Amellus strigosus subsp. pseudoscabridus*	LC		ASTERACEAE	*Arctotis fastuosa*	LC	1
ASTERACEAE	*Arctotis leiocarpa*	LC	1	ASTERACEAE	*Athanasia minuta subsp. minuta*	LC	
ASTERACEAE	*Berkheya annectens*	LC		ASTERACEAE	*Berkheya spinosissima subsp. namaensis var. namaensis*	LC	1
ASTERACEAE	*Cotula microglossa*	LC		ASTERACEAE	*Dicoma capensis*	LC	
ASTERACEAE	*Didelta carnosa var. carnosa*	LC		ASTERACEAE	*Didelta spinosa*	LC	
ASTERACEAE	*Dimorphotheca polyptera*	LC		ASTERACEAE	*Eriocephalus ericoides subsp. ericoides*	LC	
ASTERACEAE	*Eriocephalus microphyllus var. pubescens*	LC	1	ASTERACEAE	*Eriocephalus spinescens*	LC	1
ASTERACEAE	*Felicia clavipilosa subsp. clavipilosa*	LC	1	ASTERACEAE	*Felicia hyssopifolia subsp. hyssopifolia*	LC	
ASTERACEAE	*Foveolina dichotoma*	LC		ASTERACEAE	*Gazania jurineifolia*	LC	1
ASTERACEAE	*Gazania lichtensteinii*	LC	1	ASTERACEAE	*Helichrysum herniarioides*	LC	
ASTERACEAE	*Kleinia longiflora*	LC		ASTERACEAE	*Lasiopogon glomerulatus*	LC	

ASTERACEAE	*Osteospermum armatum*	LC	1	ASTERACEAE	*Osteospermum pinnatum var. pinnatum*	LC	1
ASTERACEAE	*Osteospermum spinescens*	LC	1	ASTERACEAE	*Pegolettia retrofracta*	LC	1
ASTERACEAE	*Pentzia globosa*	LC	1	ASTERACEAE	*Pentzia lanata*	LC	
ASTERACEAE	*Pentzia pinnatisecta*	LC		ASTERACEAE	*Pentzia spinescens*	LC	1
ASTERACEAE	*Pteronia adenocarpa*	LC		ASTERACEAE	*Pteronia glauca*	LC	
ASTERACEAE	*Pteronia glomerata*	LC	1	ASTERACEAE	*Pteronia inflexa*	LC	
ASTERACEAE	*Pteronia leucoclada*	LC	1	ASTERACEAE	*Pteronia mucronata*	LC	1
ASTERACEAE	*Pteronia oblanceolata*	LC		ASTERACEAE	*Pteronia sordida*	LC	
ASTERACEAE	*Rosenia humilis*	LC	1	ASTERACEAE	*Senecio abbreviatus*	LC	1
ASTERACEAE	*Senecio niveus*	LC	1	ASTERACEAE	*Tripteris sinuata var. linearis*	LC	
ASTERACEAE	*Tripteris sinuata var. sinuata*	LC	1	ASTERACEAE	*Ursinia nana subsp. nana*	LC	1
BIGNONIACEAE	*Rhigozum trichotomum*	LC	1	BRASSICACEAE	*Heliophila arenosa*	LC	1
BRASSICACEAE	*Heliophila trifurca*	LC		BRASSICACEAE	*Lepidium desertorum*	LC	1
BRASSICACEAE	*Sisymbrium burchellii var. burchellii*	LC		CAPPARACEAE	*Cleome angustifolia subsp. diandra*	LC	
CARYOPHYLLACEAE	*Dianthus namaensis var. dinteri*	LC		CHENOPODIACEAE	*Atriplex cinerea subsp. bolusii var. adamsonii*	LC	
CHENOPODIACEAE	*Atriplex lindleyi subsp inflata*	Alien	1	CHENOPODIACEAE	*Atriplex semibaccata*	Alien	1
CHENOPODIACEAE	*Atriplex vestita var. appendiculata*	LC	1	CHENOPODIACEAE	*Bassia salsoloides*	LC	1
CHENOPODIACEAE	*Exomis microphylla var. axyrioides*	LC	1	CHENOPODIACEAE	*Salsola aellenii*	LC	
CHENOPODIACEAE	*Salsola aphylla*	LC	1	CHENOPODIACEAE	*Salsola glabrescens*	LC	
CHENOPODIACEAE	*Salsola henriciae*	LC		CHENOPODIACEAE	*Salsola procera*	LC	
CHENOPODIACEAE	*Salsola rabieana*	LC		CHENOPODIACEAE	*Salsola tuberculata*	LC	1
CHENOPODIACEAE	*Sasola kali*	Alien	1	CHENOPODIACEAE	*Suaeda fruticosa*	LC	
CHENOPODIACEAE	*Suaeda merxmuelleri*	LC		COLCHICACEAE	*Ornithoglossum viride*	LC	
CRASSULACEAE	*Crassula corallina subsp. corallina*	LC	1	CUCURBITACEAE	*Cucumis africanus*	LC	
CUCURBITACEAE	*Cucumis myriocarpus subsp. leptodermis*	LC		CYPERACEAE	*Cyperus capensis*	LC	
EUPHORBIACEAE	*Euphorbia aequoris*	LC	1	EUPHORBIACEAE	*Euphorbia decussata*	LC	1
EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*	LC		EUPHORBIACEAE	*Euphorbia multiceps*	LC	1
EUPHORBIACEAE	*Euphorbia rectirama*	LC		EUPHORBIACEAE	*Euphorbia rudis*	LC	
FABACEAE	*Indigastrum argyraeum*	LC		FABACEAE	*Indigofera hololeuca*	LC	
FABACEAE	*Lebeckia spinescens*	LC	1	FABACEAE	*Lessertia macrostachya var. macrostachya*	LC	
FABACEAE	*Lessertia pauciflora var. pauciflora*	LC		FABACEAE	*Lotononis leptoloba*	LC	
FABACEAE	*Melolobium candicans*	LC	1	FABACEAE	*Parkinsonia africana*	LC	1
FABACEAE	*Prosopis glandulosa*	Alien	1	FABACEAE	*Sutherlandia frutescens*	LC	
FABACEAE	*Tephrosia capensis var. acutifolia*	LC		FRANKENIACEAE	*Frankenia pulverulenta*	LC	
GERANIACEAE	*Monsonia umbellata*	LC		GERANIACEAE	*Pelargonium minimum*	LC	1

GERANIACEAE	*Sarcocaulon patersonii*	LC	1	GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*	LC	
HYACINTHACEAE	*Albuca concordiana*	LC	1	HYACINTHACEAE	*Albuca cooperi*	LC	1
HYACINTHACEAE	*Dipcadi gracillimum*	LC		HYACINTHACEAE	*Drimia elata*	LC	1
HYACINTHACEAE	*Drimia intricata*	LC		HYACINTHACEAE	*Drimia physodes*	LC	
HYACINTHACEAE	*Ledebouria undulata*	LC		IRIDACEAE	*Moraea pallida*	LC	
IRIDACEAE	*Moraea speciosa*	LC		IRIDACEAE	*Tritonia karooica*	LC	
LAMIACEAE	*Salvia disermas*	LC	1	LOPHIOCARPACEAE	*Lophiocarpus polystachyus*	LC	
LORANTHACEAE	*Septulina glauca*	LC		MALVACEAE	*Hermannia cueneifolia*	LC	1
MALVACEAE	*Hermannia erodioides*	LC		MALVACEAE	*Hermannia grandiflora*	LC	
MALVACEAE	*Hermannia johanssenii*	LC		MALVACEAE	*Hermannia paucifolia*	LC	
MALVACEAE	*Hermannia spinosa*	LC	1	MALVACEAE	*Hermannia vestita*	LC	
MALVACEAE	*Radyera urens*	LC	1	MELIANTHACEAE	*Melianthus comosus*	LC	1
MESEMBRYANTHEMACEAE	*Aloinopsis luckhoffii*	DDT	1	MESEMBRYANTHEMACEAE	*Antimima evoluta*	LC	
MESEMBRYANTHEMACEAE	*Aridaria noctiflora subsp. straminea*	LC	1	MESEMBRYANTHEMACEAE	*Brownanthus ciliatus*	LC	1
MESEMBRYANTHEMACEAE	*Cephalophyllum fulleri*	Rare		MESEMBRYANTHEMACEAE	*Cephalophyllum rigidum*	LC	1
MESEMBRYANTHEMACEAE	*Conophytum uviforme subsp. uviforme*	LC		MESEMBRYANTHEMACEAE	*Drosanthemum lique*	LC	1
MESEMBRYANTHEMACEAE	*Lampranthus haworthii*	LC		MESEMBRYANTHEMACEAE	*Lampranthus uniflorus*	LC	1
MESEMBRYANTHEMACEAE	*Lithops otzeniana*	VU		MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum*	LC	1
MESEMBRYANTHEMACEAE	*Mesembryanthemum stenandrum*	LC	1	MESEMBRYANTHEMACEAE	*Prenia tetragonia*	LC	1
MESEMBRYANTHEMACEAE	*Psilocaulon articulatum*	LC		MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	LC	1
MESEMBRYANTHEMACEAE	*Psilocaulon junceum*	LC	1	MESEMBRYANTHEMACEAE	*Ruschia abbreviata*	LC	1
MESEMBRYANTHEMACEAE	*Ruschia robusta*	LC	1	MESEMBRYANTHEMACEAE	*Ruschia spinosa*	LC	1
MESEMBRYANTHEMACEAE	*Sceletium tortuosum*	LC	1	MESEMBRYANTHEMACEAE	*Stoeberia frutescens*	LC	
MESEMBRYANTHEMACEAE	*Stomatium mustellinum*	LC		MOLLUGINACEAE	*Hypertelis salsoloides var. salsoloides*	LC	1
MOLLUGINACEAE	*Limeum aethiopicum*	LC	1	MOLLUGINACEAE	*Limeum africanum*	LC	1
MOLLUGINACEAE	*Limeum argute-carinatum var. argute-carinatum*	LC		MOLLUGINACEAE	*Limeum rhombifolium*	LC	
MOLLUGINACEAE	*Mollugo cerviana var. cerviana*	LC		NEURADACEAE	*Grielum humifusum var. parviflorum*	LC	1
NYCTAGINACEAE	*Phaeoptilum spinosum*	LC	1	OXALIDACEAE	*Oxalis beneprotecta*	LC	
OXALIDACEAE	*Oxalis lawsonii*	LC		PEDALIACEAE	*Sesamum capense*	LC	1
PLUMBAGINACEAE	*Dyerophytum africanum*	LC	1	POACEAE	*Aristida adscensionis*	LC	1
POACEAE	*Aristida congesta subsp. barbicollis*	LC		POACEAE	*Ehrharta calycina*	LC	
POACEAE	*Enneapogon cenchroides*	LC		POACEAE	*Enneapogon desvauxii*	LC	1
POACEAE	*Enneapogon scaber*	LC	1	POACEAE	*Eragrostis annulata*	LC	
POACEAE	*Fingerhuthia africana*	LC	1	POACEAE	*Schismus barbatus*	LC	
POACEAE	*Stipagrostis anomala*	LC	1	POACEAE	*Stipagrostis brevifolia*	LC	1
POACEAE	*Stipagrostis ciliata var. capensis*	LC	1	POACEAE	*Stipagrostis namaquensis*	LC	1

POACEAE	*Stipagrostis obtusa*	LC	1	POACEAE	*Stipagrostis uniplumis var. neesii*	LC	
POACEAE	*Tragus berteronianus*	LC		POLYGALACEAE	*Polygala pungens*	LC	
POLYGALACEAE	*Polygala seminuda*	LC	1	PORTULACACEAE	*Talinum arnotii*	LC	
RUTACEAE	*Agathosma virgata*	LC		SANTALACEAE	*Thesium hystricoides*	LC	
SANTALACEAE	*Thesium hystrix*	LC	1	SANTALACEAE	*Thesium lineatum*	LC	1
SCROPHULARIACEAE	*Aptosimum elongatum*	LC		SCROPHULARIACEAE	*Aptosimum indivisum*	LC	1
SCROPHULARIACEAE	*Aptosimum marlothii*	LC		SCROPHULARIACEAE	*Aptosimum procumbens*	LC	1
SCROPHULARIACEAE	*Aptosimum spinescens*	LC	1	SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. atropurpurea*	LC	1
SCROPHULARIACEAE	*Nemesia calcarata*	LC		SCROPHULARIACEAE	*Peliostomum leucorrhizum*	LC	1
SCROPHULARIACEAE	*Polycarena filiformis*	Rare		SCROPHULARIACEAE	*Selago albida*	LC	
SCROPHULARIACEAE	*Selago pinguicula*	LC	1	SOLANACEAE	*Lycium cinereum*	LC	1
SOLANACEAE	*Lycium oxycarpum*	LC	1	SOLANACEAE	*Lycium pumilum*	LC	1
SOLANACEAE	*Solanum burchellii*	LC	1	SOLANACEAE	*Solanum capense*	LC	
URTICACEAE	*Forsskaolea candida*	LC		VERBENACEAE	*Chascanum incisum*	LC	
VERBENACEAE	*Chascanum pumilum*	LC		ZYGOPHYLLACEAE	*Augea capensis*	LC	1
ZYGOPHYLLACEAE	*Tribulus pterophorus*	LC		ZYGOPHYLLACEAE	*Tribulus terrestris*	LC	1
ZYGOPHYLLACEAE	*Tribulus zeyheri*	LC	1	ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	LC	
ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*	LC	1	ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	LC	1
ZYGOPHYLLACEAE	*Zygophyllum simplex*	LC	1				

12 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the Kokerboom study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2013. Species observed on the adjacent wind farm property are assumed present on the current site as well.

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	Confirmed
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Low
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	Low
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Confirmed
Rodentia (Rodents):				
Cryptomys hottentotus	African Mole Rat	LC	Wide diversity of substrates, from sandy soils to heavier compact substrates such as decomposed schists and stony soils	High
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	Confirmed
Mus minutoides	Pygmy Mouse	LC	Wide habitat tolerance	High
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	High
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High

Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Otomys unisulcatus	Bush Vlei Rat	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Confirmed
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	Low
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	Confirmed
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Confirmed
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	Confirmed
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	Confirmed
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Confirmed

Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	Low
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	Confirmed
Pelea capreolus	Grey Rhebok	LC	Associated with rocky hills, rocky mountainsides, mountain plateaux with good grass cover.	Low
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Confirmed
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	V.Low

13 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur in the broad vicinity of the Kokerboom site, based on records from the SARCA database, conservation status is from Bates et al. 2013.

Type	Family	Genus	Species	Subspecies	Common name	Red list category
Chameleon	*Chamaeleonidae*	*Chamaeleo*	*namaquensis*		Namaqua Chameleon	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern
Geckos	*Gekkonidae*	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*capensis*		Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*labialis*		Western Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*weberi*		Weber's Gecko	Least Concern
Geckos	*Gekkonidae*	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern
Lizards	*Agamidae*	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern
Lizards	*Agamidae*	*Agama*	*atra*		Southern Rock Agama	Least Concern
Lizards	*Cordylidae*	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern
Lizards	*Cordylidae*	*Namazonurus*	*peersi*		Peers' Girdled Lizard	Least Concern
Lizards	*Gerrhosauridae*	*Cordylosaurus*	*subtessellatus*		Dwarf Plated Lizard	Least Concern
Lizards	*Lacertidae*	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern
Lizards	*Lacertidae*	*Nucras*	*tessellata*		Western Sandveld Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*laticeps*		Karoo Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern
Lizards	*Scincidae*	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*variegata*		Variegated Skink	Least Concern
Snakes	*Colubridae*	*Boaedon*	*capensis*		Brown House Snake	Least Concern
Snakes	*Colubridae*	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern
Snakes	*Colubridae*	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern
Snakes	*Colubridae*	*Lamprophis*	*guttatus*		Spotted House Snake	Least Concern

Snakes	*Colubridae*	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern
Snakes	*Colubridae*	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern
Snakes	*Colubridae*	*Pseudaspis*	*cana*		Mole Snake	Least Concern
Snakes	*Colubridae*	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern
Snakes	*Elapidae*	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed
Snakes	*Elapidae*	*Naja*	*nivea*		Cape Cobra	Least Concern
Snakes	*Typhlopidae*	*Rhinotyphlops*	*lalandei*		Delalande's Beaked Blind Snake	Least Concern
Snakes	*Viperidae*	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern
Tortoises	*Testudinidae*	*Chersina*	*angulata*		Angulate Tortoise	Least Concern
Tortoises	*Testudinidae*	*Homopus*	*signatus*	*signatus*	Namaqua Speckled Padloper	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*subsp. ?*	Tent Tortoise (subsp. ?)	Least Concern
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*tentorius*	Karoo Tent Tortoise	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed

14 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in in the broad vicinity of the Kokerboom site. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the Minter et al. 2004.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Vandijkophrynus gariepensis	Karoo Toad	Least Concern	Karoo Scrub	Widespread	High
Xenopus laevis	Common Platanna	Least Concern	Any more or less permanent water	Widespread	Very Low
Amietia fuscigula	Cape River Frog	Least Concern	Large still bodies of water or permanent streams and rivers.	Widespread	Very Low
Cacosternum namaquense	Namaqua Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Cacosternum boettgeri	Common Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Tomopterna tandyi	Tandy's Sand Frog	Least Concern	Nama karoo grassland and savanna	Widespread	High

Kokerboom Wind Energy Facilities

Loeriesfontein, Northern Cape

Bird Impact Assessment Report for proposed 132kV Grid Connection

February 2017


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Chris van Rooyen

Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Pr.Sci.Nat)

Albert has an M. Sc. in Conservation Biology from the University of Cape Town, and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Aurecon was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with the Basic Assessment for the Kokerboom Wind Energy Facilities Grid Connection.

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Full Name: Chris van Rooyen

Title / Position: Director

EXECUTIVE SUMMARY

The Proponent, Business Venture Investments No. 1788 (Pty) Ltd (BVI), proposes to construct three wind energy facilities (WEF) and associated infrastructure on adjacent farms near Loeriesfontein in the Northern Cape. The three WEFs, known as Kokerboom 1, 2 and 3 would have a maximum generation capacity of up to 240-256 MW each.

The proposed sites are located approximately 50 kilometres (km) north of Loeriesfontein, 85 km west of Brandvlei and 160 km southeast of Springbok in the Northern Cape. The site can be reached via the main road, R357 (see Figure 1 below).

Energy generated by the Kokerboom WEFs will be evacuated from the site via a proposed 132 kilovolt (kV) overhead transmission line (single or double circuit) two switching stations (each ±100m X 100m) and associated infrastructure. This would feed into the existing national electricity grid at the Helios Main Transmission Substation. The impacts of this overhead transmission line on avifauna are investigated in this report as part of a Basic Assessment as required in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), as amended.

The proposed Kokerboom grid connection, switching stations and associated infrastructure will have several potential impacts on avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss;
- Electrocution in the switching station; and
- Collisions with the earthwire of the 132kV grid connection

Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace priority species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in September 2016, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs (currently under construction). While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. All the potential alignments are >1.2km from the nest at their closest point, which means the potential for disturbance is likely to be low.

The risk of displacement due to disturbance during the construction phase is rated as low which could be reduced to very low through appropriate mitigation.

Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of priority species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at both the proposed Kokerboom switching station sites is common in the greater study area and the transformation of one hectare of habitat should not impact any of the priority species significantly.

The risk of displacement through habitat destruction during construction is rated as low which could be reduced to very low through appropriate mitigation.

Electrocution of priority species in the switching station

Electrocutions within the proposed Kokerboom switching stations are possible, but should not affect the more sensitive Red List bird species as these species are unlikely to use the infrastructure within the switching station yards for perching or roosting. No electrocution risk is envisaged on the HV lines.

The risk of electrocution in the switching stations is rated as very low, with no pro-active mitigation required.

Collisions of priority species with the earthwire of the 132kV grid connection

The most likely candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, Northern Black Korhaan and Secretarybird.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as medium which can be reduced to low through appropriate mitigation.

Concluding statement

The proposed Kokerboom grid connection will have several impacts on avifauna, ranging from medium (negative) to very low (negative), prior to the implementation of mitigation. With the implementation of mitigation measures, the impacts could be reduced to low and very low. Provided the recommended mitigation measures are strictly applied, any of the three alternative powerline routes is acceptable from an avifaunal impact perspective and the project could proceed, with Alternative C the preferred alternative from an avifaunal impact perspective by a slender margin.

Contents

DEFINITIONS

Greater study area: This refers to the area that comprises the three proposed Kokerboom WEFs study area plus a control area and immediate environs.

Powerline study area: This refers to a 2km zone around the proposed alignments.

1. INTRODUCTION

The Proponent, Business Venture Investments No. 1788 (Pty) Ltd (BVI), proposes to construct three wind energy facilities (WEF) and associated infrastructure on adjacent farms near Loeriesfontein in the Northern Cape. The three WEFs, known as Kokerboom 1, 2 and 3 would have a maximum generation capacity of up to 240-256 MW each.

The proposed sites are located approximately 50 kilometres (km) north of Loeriesfontein, 85 km west of Brandvlei and 160 km southeast of Springbok in the Northern Cape. The site can be reached via the main road, R357 (see Figure 1 below). Energy generated by the Kokerboom WEFs will be evacuated from the site via a proposed 132 kilovolt (kV) overhead transmission line (single or double circuit). This would feed into the existing national electricity grid at the Helios Main Transmission Substation (Eskom). The impacts of this overhead transmission line, two switching stations (each ±100m X 100m) and associated infrastructure (including narrow access tracks where necessary) on avifauna are investigated in this report as part of a Basic Assessment as required in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), as amended.

See Figure 1 for a map indicating the location of the proposed Kokerboom WEFs and the proposed alignments for the 132kV grid connection.

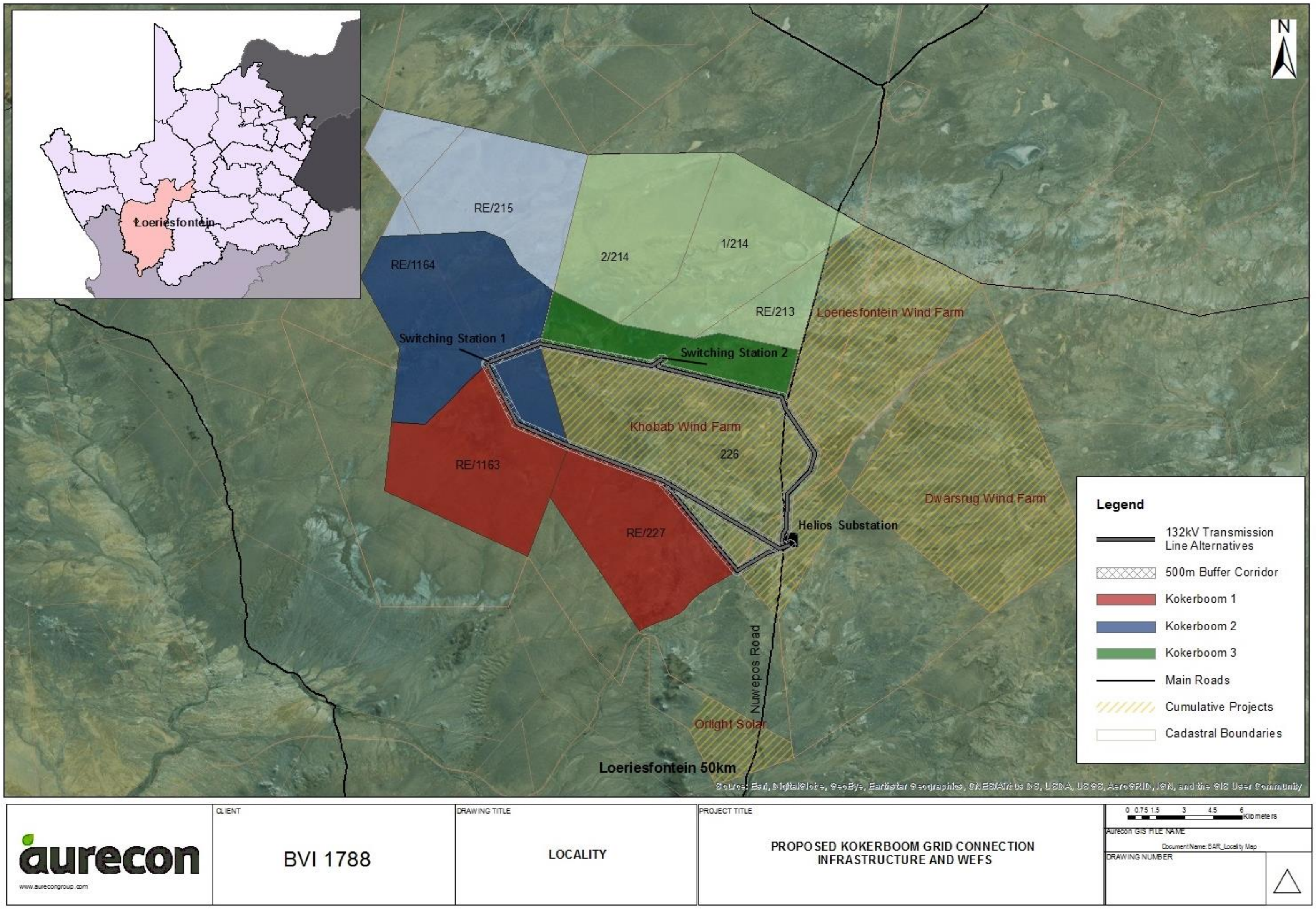

Figure 1: Location of the proposed Kokerboom WEFs in relation to the proposed 132kV Transmission Line and associated infrastructure

1.1 Terms of reference

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts; and
- Recommend mitigation measures to reduce the expected impacts.

1.2 Sources of information

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e. within an area consisting of nine pentad grid cells within which the proposed alignments are situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between June 2010 and August 2016, a total of 47 full protocol cards (i.e. 47 surveys lasting a minimum of two hours or more each) have been completed for this area (see Figure 2).

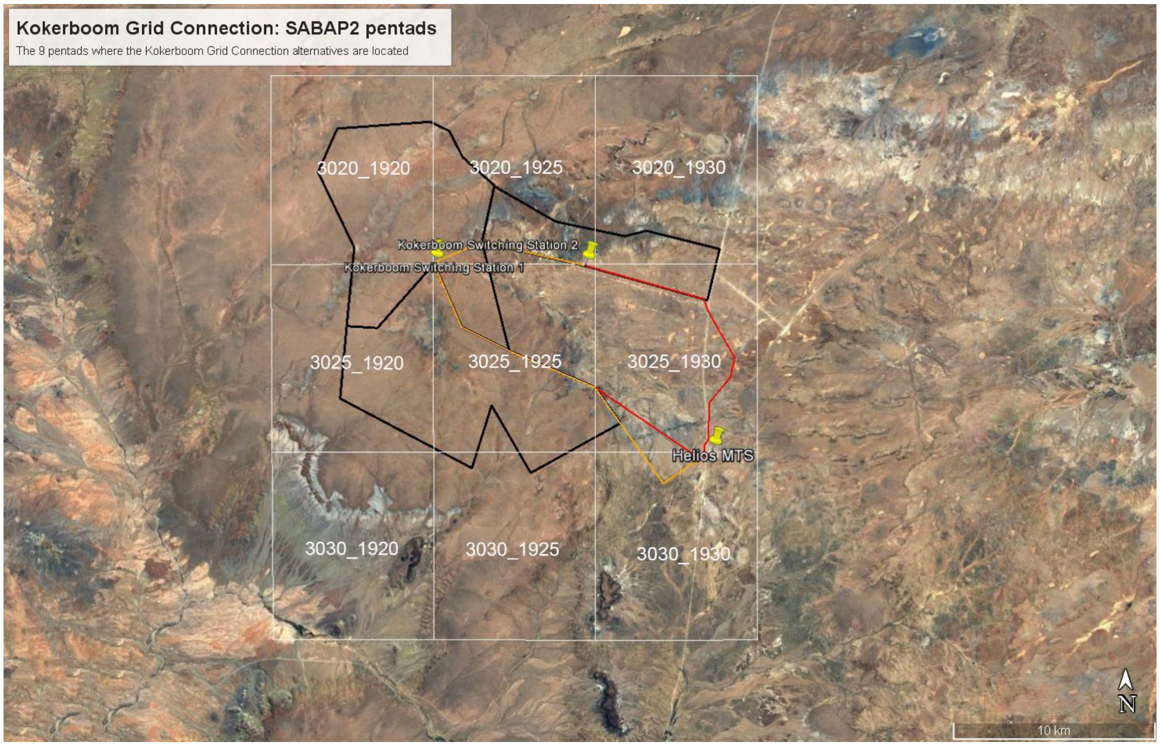

Figure 2: The block of nine pentads where the proposed alignments are located.

- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the IUCN Red List of Threatened Species Version 2016.2.[1]
- A classification of vegetation types was obtained from Southern African Bird Atlas 1 (Harrison *et al.* 1997) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird Areas of Southern Africa (Barnes 1998; Marnewick *et al*. 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery obtained from Aurecon was used in order to view the broader powerline study area on a landscape level and to help identify bird habitat on the ground.
- Information on the micro habitat level was obtained through a pre-construction monitoring programme for the proposed WEFs which was conducted in the greater study area over four seasons between November 2015 and September 2016.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of the pre-construction monitoring programme in

[1] http://www.iucnredlist.org/

the greater study area which was implemented between November 2015 and September 2016. The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **APPENDIX A** for a detailed explanation of the monitoring methods).

- Information gained from previous Environmental Impact Assessments at three neighbouring sites in close proximity to the current site, namely Khobab WEF (under construction), Loeriesfontein WEF (under construction), and Dwarsrug WEF (authorised in 2015) assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area (see Figure 1).

1.3 Assumptions

This study made the basic assumption that the sources of information used are reliable. However, the following must be noted:

- A total of 47 full protocol lists has been completed to date for the 9 pentads where the powerline study area is located (i.e. listing surveys lasting a minimum of two hours each). This is a fairly comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed powerline study area. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, SABAP1 records (Harrison *et al.* 1997) and the results of the 12-months pre-construction monitoring.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. However, bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- Priority species were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012). Specific emphasis was placed on powerline sensitive Red Data species.

2 LEGISLATIVE CONTEXT

2.1 Agreements and conventions

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[2]

[2] (BirdLife International (2016) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south africa. Checked: 2016-04-02).

Table 2-1: Agreements and conventions which South Africa is party to and which are relevant to the conservation of avifauna

Convention name	**Description**	**Geographic scope**
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

2.2 Best Practice Guidelines

There are currently no best practice guidelines for the assessment of electricity infrastructure impacts on birds.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Natural environment

The proposed powerline study area is located on a vast, arid, topographically uniform plain. The habitat is very uniform, and consists of Bushmanland Basin Shrubland. Bushmanland Basin Shrubland consists of dwarf shrubland dominated by a mixture of low, sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also abundant annual flowering plants such as species of *Gazania* and *Leysera* (Mucina & Rutherford 2006). A number of ephemeral drainage lines flow through the powerline study area, but they only hold water for brief periods after exceptional rainfall events, which are rare events. The greater study area is extremely arid with a mean annual rainfall of 170.5mm, with peak rainfall between March and July[3]. The temperatures are highest on average in January, at around 22.8 °C. The lowest average temperatures in the year occur in July, when it is around 9.9 °C.[4] The powerline study area is situated in an ecological transitional zone between the Nama Karoo and Succulent Karoo biomes (Harrison *et al.* 1997). In comparison with Succulent Karoo, the Nama Karoo has higher proportions of grass and tree cover. The ecotonal nature of the greater study area is apparent from the presence of typical avifauna of both Succulent and Nama Karoo e.g. Karoo Eremomela *Eremomela gregalis* (Succulent Karoo) and Red Lark *Calendulauda burra* (Nama Karoo). The two Karoo vegetation types support a particularly high diversity of bird species endemic to Southern Africa, particularly in the family *Alaudidae* (Larks). Its avifauna typically comprises ground-dwelling species of open habitats (Harrison *et al* 1997). Because rainfall in the Nama Karoo falls mainly in summer, while peak rainfall in the Succulent Karoo occurs mainly in winter, it provides opportunities for birds to migrate between the Succulent and Nama Karoo, to exploit the enhanced conditions associated with rainfall. Many typical karroid species are nomads, able to use resources that are patchy in time and space (Barnes 1998).

A feature of the greater study area where the proposed site is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows

[3] South African Rain Atlas http://wsopuppenkiste.wiso.uni-goettingen.de/rainfall
[4] http://en.climate-data.org/location/27137/

in from small catchments but with no outflow from the pan basins themselves. They are typical of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison *et al.* 1997). Although the proposed powerline study area itself does not contain any pans, there are several larger pans situated north and east of the powerline study area (e.g. Kareedoringpan, Boegoefonteinpan, Bitterputspan, Brakpan and several smaller unnamed ones). When these pans hold water (which is only likely after exceptional rainfall events), waterbird movement to and from these pans is possible, including Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoenicopterus minor*. It is possible that nocturnal flamingo movement might take place over the powerline study area between coast and the abovementioned pans, although this should be sporadic rather than regularly.

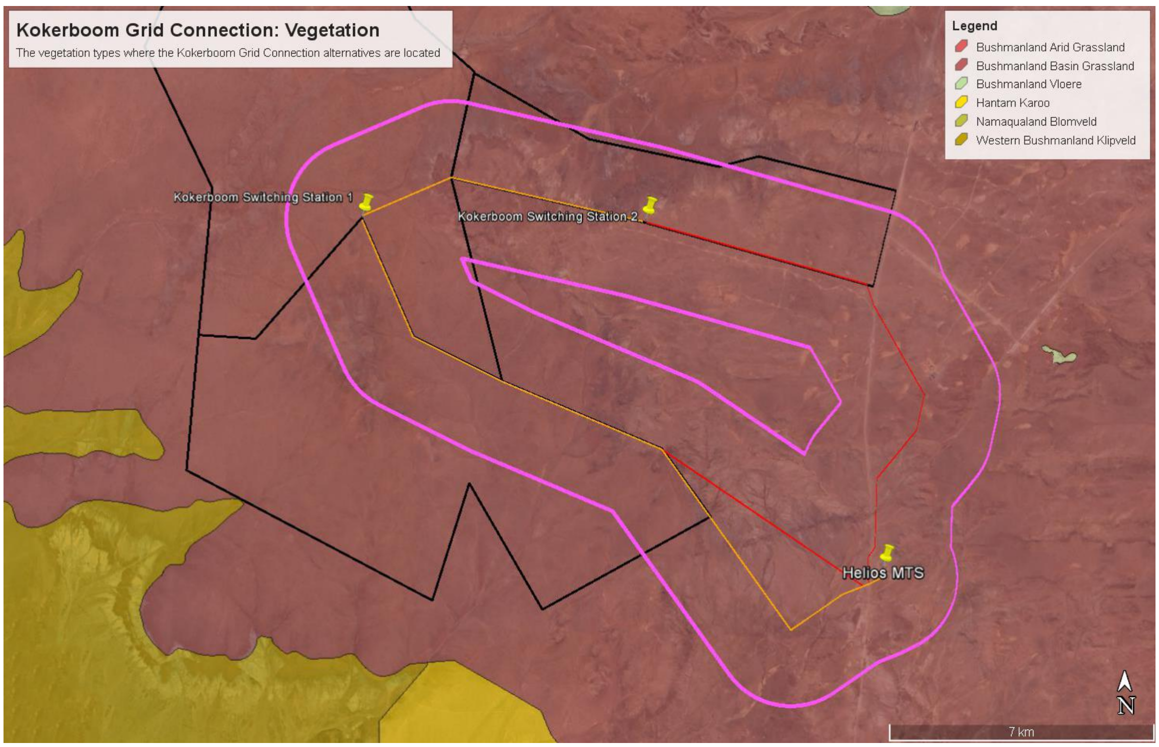

Figure 3: Vegetation types in the greater study area, indicating the homogenous character of the habitat at the powerline study area (Mucina & Rutherford 2006). The powerline study area is indicated by the pink polygon.

3.2 Modified environment

Whilst the distribution and abundance of the bird species in the greater study area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine the few external modifications to the environment that have relevance for birds.

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the powerline study area:

- **Water points:** The land use in the powerline study area is mostly small stock farming. The entire powerline study area is divided into grazing camps, with several boreholes with associated water reservoirs and drinking troughs. In this arid environment, open water is a big draw card for several bird species, including priority species such as Martial Eagle and Sclater's Lark that use the open water troughs to bath and drink.
- **Transmission lines:** The Aries - Helios 400kV transmission line bisects the eastern portion of the powerline study area. The transmission towers are used by raptors for perching and roosting, and also for breeding. Three Martial Eagle nests were recorded on the Aries - Helios 400kV transmission line, one of which falls within the powerline study area (see Figure 4 and Figure 9).

APPENDIX B provides a photographic record of the habitat at the powerline study area and the greater study area. A map of the greater study area, indicating the location of water points and the Martial Eagle nests is shown in Figure 4.

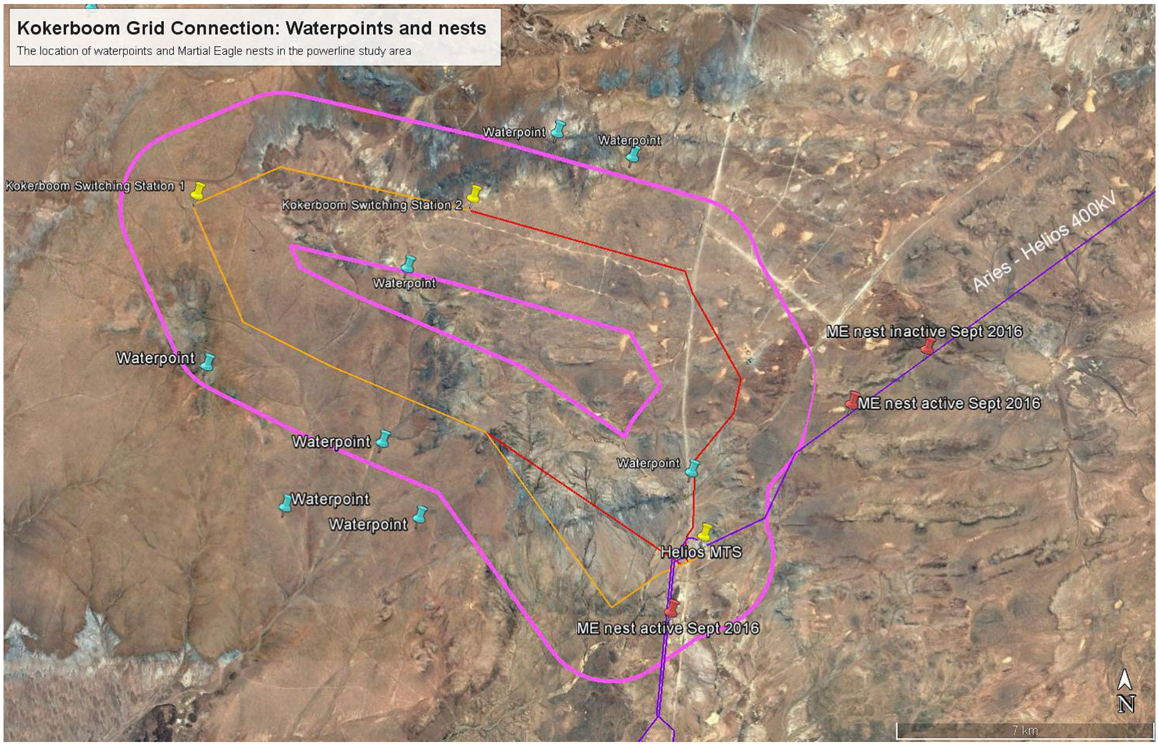

Figure 4: Location of water points and Martial Eagle nests in the powerline study area.

4. AVIFAUNA

Tables 4-1 lists priority species[5] that could potentially occur at the proposed powerline study area. The list is based on a combination of the pre-construction monitoring that was conducted in the greater study area, supplemented with other data sources e.g. SABAP1, SABAP2 and environmental impact assessments conducted for other wind farms in the same habitat.

Table 4-2 lists all species that were recorded through pre-construction monitoring in the greater study area. Data was collected by means of drive transect counts, walk transect counts, vantage point (VP) watches and incidental sightings.

4.1 Transect counts in the greater study area

The **drive** transects were surveyed three times per seasonal survey. A total of 3 797 individual birds were recorded during drive transect counts at the proposed powerline study areas, of which 172 were priority species and 3 625 were non-priority species, belonging to 45 species (9 priority species and 36 non-priority species). At the control area, a total of 770 birds were recorded during drive transect counts, of which 27 were

[5] Priority species were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief et al. 2012).

priority species and 743 non-priority species, belonging to 42 species (6 priority species and 36 non-priority species).

The **walk** transects were counted 32 times, i.e. 8 times per season. A total of 6 535 individual birds were recorded at the proposed powerline study areas, of which 223 were priority species and 6 312 non-priority species, belonging to 54 species (10 priority species and 44 non-priority species). At the control area, a total of 1 119 birds were recorded, of which 4 were priority species and 1 115 non-priority species, belonging to 41 species (3 priority species and 38 non-priority species).

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species, and also for all priority species combined recorded during transect counts. This was done separately for drive transects and walk transects. Figures 5 and 6 shows the relative abundance of priority species recorded during the pre-construction monitoring through drive and walk transects.

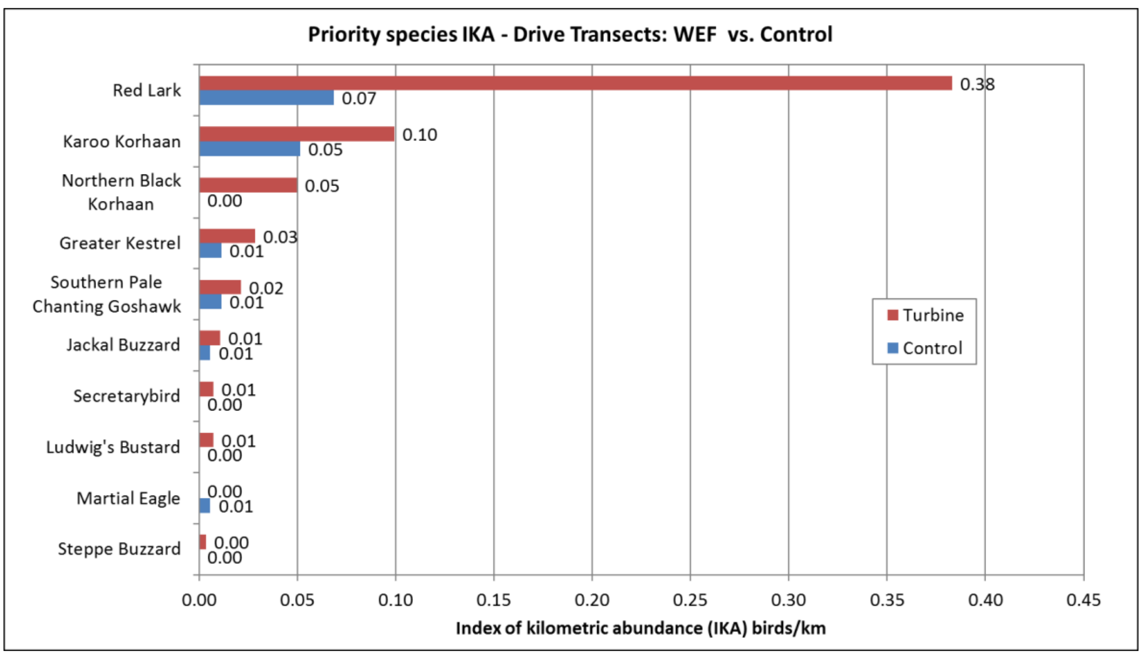

Figure 5: Priority species recorded at the proposed powerline study areas and control area through drive transect surveys. “Turbine” refers to the Greater Study Area, while “Control” is the control site.

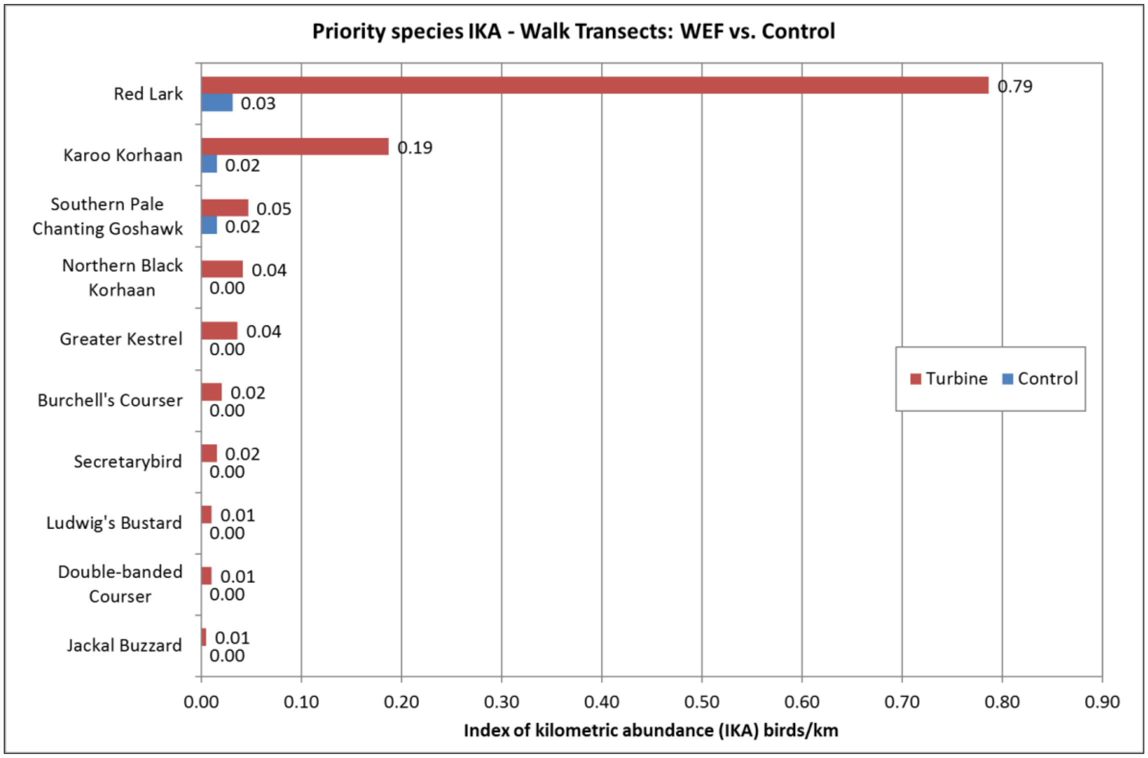

Figure 6: Priority species recorded at the proposed powerline study areas and control area through walk transect surveys

4.1.1 Overall species composition

The greater study area supports a relatively low diversity and abundance of avifauna, which is to be expected in an arid area like Bushmanland.

4.1.2 Abundance

The abundance of priority species in the greater study area is low to moderate, with 0.76 birds/km recorded on drive transects, and 1.22 birds/km recorded during walk transects. Red Lark and Karoo Korhaan consistently emerged as the two most abundant priority species during both walk and drive transect counts. Red Lark, Karoo Korhaan and Northern Black Korhaan definitely breed in the greater study area, and Ludwig’s Bustard, Burchell’s Courser and Double-banded Courser potentially too, although no evidence of bustard display areas or nests were recorded. Raptors were generally sparse with Southern Pale Chanting Goshawk and Greater Kestrel the most frequently recorded species in the greater study area during both the drive and walk transects. Other raptors were recorded sporadically in very low numbers.

4.1.3 Spatial distribution of transect records and incidental sightings in the greater study area

Figure 7 below indicates the spatial distribution of priority species recorded during transect counts and incidental sightings in the greater study area.

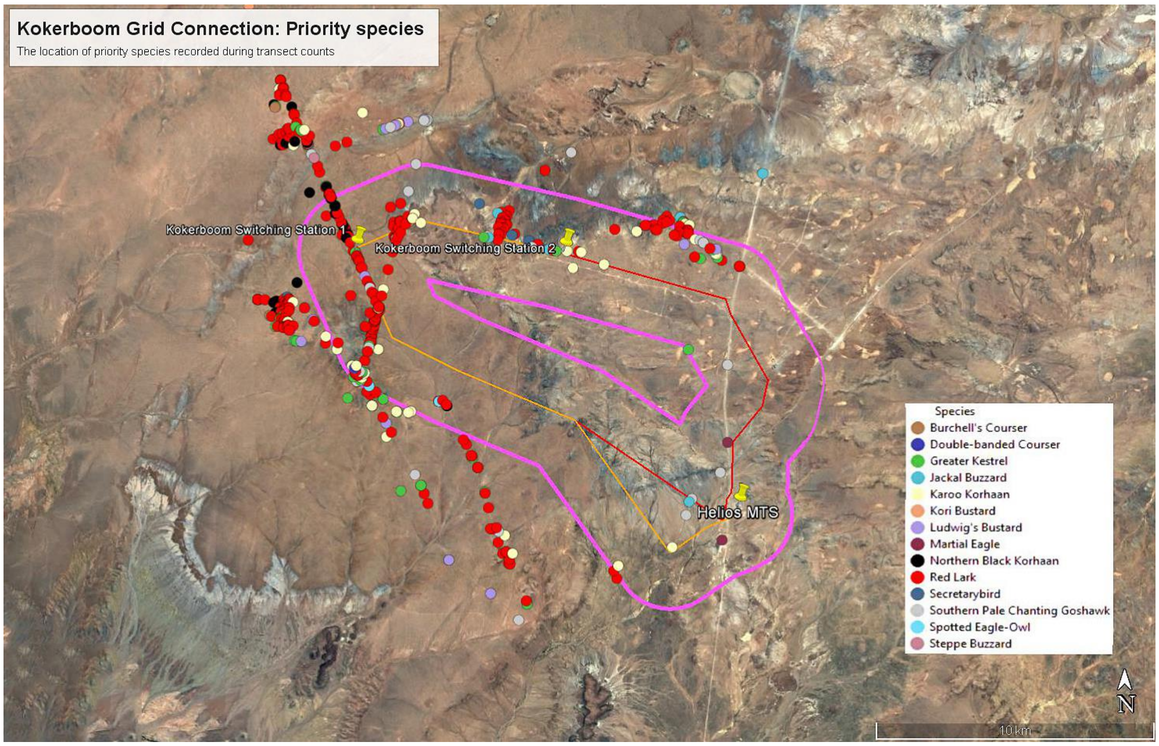

Figure 7: Spatial distribution of sightings of priority species recorded during transect counts (includes incidental sightings).

No clear distribution patterns emerged from the sightings data for priority species with Red Lark, Karoo Korhaan and Northern Black Korhaan sightings more or less randomly distributed along all the transects. The rest of the priority species were generally recorded in low numbers with no clear indications of bird/habitat associations, with random sightings scattered all over the greater study area. This is to be expected given the uniformity of the habitat.

Table 4-1 below lists all the priority species that could **potentially** occur at the proposed powerline study area, based on pre-construction monitoring and other sources of data e.g. SABAP1 and 2, and impact assessment studies conducted in similar habitat. Priority species recorded during pre-construction surveys are shaded. The following abbreviations and acronyms are used:

VU	Vulnerable
NT	Near threatened
EN	Endangered
SAE	Southern African endemic or near endemic
Dd	Displacement through disturbance
Dh	Displacement through habitat transformation
Cp	Collisions with grid connection
Ep	Electrocutions in the switching station

Table 4-2 lists all the species recorded during the pre-construction surveys and incidental counts in the greater study area.

Table 4-1: Priority species (Retief *et al.* 2012) potentially occurring in the powerline study area. Species recorded during pre-construction monitoring in the greater study area are in bold and shaded.

Name	Taxonomic name	Regional threatened status (Taylor *et al.* 2015)	Global threatened status (IUCN 2016)	BLSA/EWT Priority rating (on scale of 170 – 405)	Terrestrial	Soaring	Likelihood of occurrence	Potential impact
Martial Eagle	***Polemaetus bellicosus***	**EN**	**NT**	**350**		**x**	**Confirmed. Two active nests and one inactive nest were recorded on the Helios - Aries 400kV. Could also be attracted to water troughs.**	**Dd,**
Ludwig's Bustard	***Neotis ludwigii***	**SAE, EN**	**EN**	**320**	**x**		**Confirmed. Occurrence likely to be linked to habitat conditions. The species is nomadic and a partial migrant and may occur sporadically.**	**Cp**
Secretarybird	***Sagittarius serpentarius***	**VU**	**VU**	**320**	**x**	**x**	**Confirmed. Occurs sparsely.**	**Cp**
Kori Bustard	*Ardeotis kori*	NT	Least concern	260	x		Low. The species is generally associated with dry riverbeds with trees, but also occur in open dune veld. May occur sporadically. One incidental sighting outside the powerline study areas.	Cp
Lanner Falcon	*Falco biarmicus*	VU	Least concern	300		x	May occur sporadically. Most likely to perch on utility lines, but may also be attracted to the water points where it hunts small birds.	Dd

Name	Taxonomic name	Regional threatened status (Taylor *et al.* 2015)	Global threatened status (IUCN 2016)	BLSA/EWT Priority rating (on scale of 170 – 395)	Terrestrial	Soaring	Likelihood of occurrence	Potential impact
Red Lark	***Calendulauda burra***	**SAE, VU**	**VU**	**260**	**x**		**Confirmed. Recorded regularly, at low densities. The powerline study area is probably not optimal for the species, as it is most often associated with red sand dunes and sandy plains with large-seeded grasses e.g. the Koa Valley to the north.**	**Dd**
Sclater's Lark	*Spizocorys sclateri*	SAE, NT	NT	240	x		Not recorded but the species was recorded in low numbers during monitoring at the nearby Dwarsrug WEF (~9km east of the site). Large sections of the habitat seem suitable, i.e. stony arid to semi-arid plains with scattered shrubs, grasses and extensive bare patches. The species is nomadic and may occur sporadically.	Dd
Black-chested Snake-Eagle	***Circaetus pectoralis***	**Not threatened**	**Least concern**	**230**		**x**	**Confirmed. Recorded During VP watches. Most likely to perch on utility lines, but may also be attracted to the water points.**	**Dd**
Booted Eagle	*Aquila pennatus*	Not threatened	Least concern	230		x	Most likely to be encountered foraging on the wing over the site, and coming down to water points to bath and drink.	Dd

Name	Taxonomic name	Regional threatened status (Taylor 2014)	Global threatened status (IUCN 2014)	BLSA/EWT Priority rating (on scale of 170 – 395)	Terrestrial	Soaring	Likelihood of occurrence	Potential impact
Southern Pale Chanting Goshawk	***Melierax canorus***	**SAE**	**Least concern**	**200**	**x**	**x**	**Confirmed. Habitat is very suitable for the species.**	**Dd,**
Karoo Korhaan	***Eupodotis vigorsii***	**SAE, NT**	**Least concern**	**190**	**x**		**Confirmed. Most commonly recorded terrestrial species. Occurs all over the powerline study area.**	**Dd, Cp**
Northern Black Korhaan	***Afrotis afraoides***	**Not threatened**	**Least concern**	**180**	**x**		**Confirmed. Frequently recorded terrestrial species. Occurs all over the powerline study area.**	**Dd, Cp**
Greater Kestrel	***Falco rupicoloides***	**Not threatened**	**Least concern**	**174**		**x**	**Confirmed. Encountered all over the powerline study area, but most likely to be associated with utility lines and fences which are used for perching.**	**Dd, Ep**
Spotted Eagle-Owl	***Bubo africanus***	**Not threatened**	**Least concern**	**170**	**Nocturnal raptor but not a soaring species**		**Confirmed. Recorded as an incidental sighting. May be attracted to trees at farm yards, also in dry riverbeds with extensive shrub.**	**Dd, Ep**
Jackal Buzzard	***Buteo rufofuscus***	**SAE**	**Least concern**	**250**		**x**	**Confirmed. Most likely to be associated with utility lines and fence lines.**	**Dd, Ep**
Burchell's Courser	***Cursorius rufus***	**SAE, VU**	**Least concern**	**204**	**x**		**Confirmed.**	**Dd**

Name	Taxonomic name	Regional threatened status (Taylor 2014)	Global threatened status (IUCN 2014)	BLSA/EWT Priority rating (on scale of 170 – 395)	Terrestrial	Soaring	Likelihood of occurrence	Potential impact
Double-banded Courser	*Rhinoptilus africanus*	NT	Least concern	154	x		Confirmed.	Dd
Steppe Buzzard	*Buteo vulpinus*	Not threatened	Least concern	210		x	Confirmed. Most likely to be associated with utility lines and fence lines. Likely to occur sporadically.	Dd, Ep
Yellow-billed Kite	*Milvus aegyptius*	Not threatened	Least Concern	220		x	Confirmed. Likely to occur sporadically.	Dd

Table 4-2: List of all species recorded during pre-construction surveys and incidental counts in the greater study area.

Priority Species	**Taxonomic Name**
Black-chested Snake-eagle	*Circaetus pectoralis*
Burchell's Courser	*Cursorius rufus*
Double-banded Courser	*Rhinoptilus africanus*
Greater Kestrel	*Falco rupicoloides*
Jackal Buzzard	*Buteo rufofuscus*
Karoo Korhaan	*Eupodotis vigorsii*
Kori Bustard	*Ardeotis kori*
Ludwig's Bustard	*Neotis ludwigii*
Martial Eagle	*Polemaetus bellicosus*
Northern Black Korhaan	*Afrotis afraoides*
Red Lark	*Calendulauda burra*
Secretarybird	*Sagittarius serpentarius*
Southern Pale Chanting Goshawk	*Melierax canorus*
Spotted Eagle-Owl	*Bubo africanus*
Steppe Buzzard	*Buteo vulpinus*
Yellow-billed Kite	*Milvus aegyptius*
Total: 16	
Non-Priority Species	**Taxonomic Name**
Acacia Pied Barbet	*Tricholaema leucomelas*
Anteating Chat	*Myrmecocichla formicivora*
Banded Martin	*Riparia cincta*
Barn Swallow	*Hirundo rustica*
Black-eared Sparrowlark	*Eremopterix australis*
Black-headed Canary	*Serinus alario*
Bokmakierie	*Telophorus zeylonus*
Cape Bunting	*Emberiza capensis*
Cape Crow	*Corvus capensis*
Cape Penduline-tit	*Anthoscopus minutus*
Cape Sparrow	*Passer melanurus*
Cape Turtle-dove	*Streptopelia capicola*
Capped Wheatear	*Oenanthe pileata*
Chat Flycatcher	*Bradornis infuscatus*
Common Fiscal	*Lanius collaris*
Common Swift	*Apus apus*
Eastern Clapper Lark	*Mirafra [apiata] fasciolata*
Egyptian Goose	*Alopochen aegyptiaca*
European Bee-eater	*Merops apiaster*
Familiar Chat	*Cercomela familiaris*
Grey Tit	*Parus afer*
Grey-backed Cisticola	*Cisticola subruficapilla*
Grey-backed Sparrowlark	*Eremopterix verticalis*
Karoo Chat	*Cercomela schlegelii*

Karoo Eremomela	*Eremomela gregalis*
Karoo Long-billed Lark	*Certhilauda subcoronata*
Karoo Prinia	*Prinia maculosa*
Karoo Scrub-Robin	*Cercotrichas coryphoeus*
Large-billed Lark	*Galerida magnirostris*
Lark-like Bunting	*Emberiza impetuani*
Laughing Dove	*Streptopelia senegalensis*
Layard's Tit-Babbler	*Parisoma layardi*
Little Swift	*Apus affinis*
Long-billed Crombec	*Sylvietta rufescens*
Long-billed Pipit	*Anthus similis*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Pied Crow	*Corvus albus*
Pied Starling	*Spreo bicolor*
Red-capped Lark	*Calandrella cinerea*
Red-headed Finch	*Amadina erythrocephala*
Rock Kestrel	*Falco rupicolus*
Rock Martin	*Hirundo fuligula*
Rufous-eared Warbler	*Malcorus pectoralis*
Sabota Lark	*Calendulauda sabota*
Southern Masked-weaver	*Ploceus velatus*
Speckled Pigeon	*Columba guinea*
Spike-heeled Lark	*Chersomanes albofasciata*
Tractrac Chat	*Cercomela tractrac*
White-rumped Swift	*Apus caffer*
White-throated Canary	*Crithagra albogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-bellied Eremomela	*Eremomela icteropygialis*
Total: 54	

4.2 Vantage point watches

Eleven priority species were recorded during vantage point (VP) watches in the greater study area. A total of 288 hours of vantage point watches (12 hours per sampling period per vantage point) was completed at 6 VPs in order to record flight patterns of priority species. In the four sampling periods, priority species were recorded for a total of 2 hours, 13 minutes and 20 seconds. A total of 97 individual flights were recorded. Of these, 4 (4.1%) flights were at high altitude (>190m), 37 (38.1%) were at medium altitude (between 30m and 190m) and 56 (57.7%) were at a low altitude i.e. potentially at powerline height (<30m). The passage rate for priority species (all flight heights) was 0.3 birds/hour[6]. See Figure 8 below for the duration of flights for each species, at each height class[7].

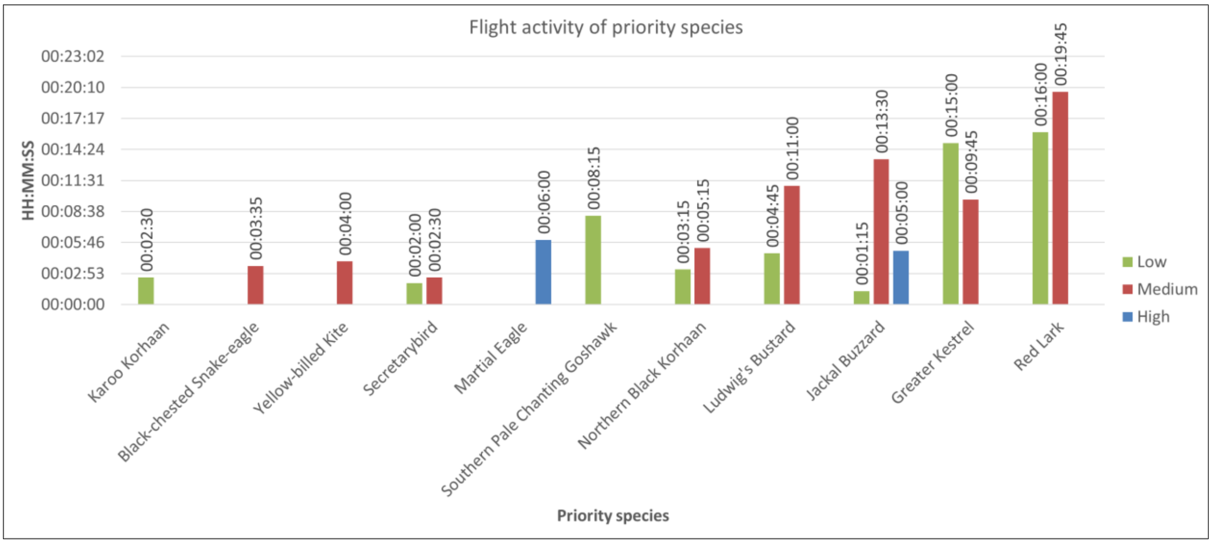

Figure 8: Flight duration and heights recorded for priority species within the greater study area (Y axis = hours: minutes: seconds). Duration (hours: minutes: seconds) are indicated on the bars.

4.3 Focal points

Two potential focal points of bird activity were identified in the powerline study area (see Figure 9). Focal Point 1 (FP1) is a borehole which was monitored to get an indication of the avifaunal activity around artificial surface water in this arid environment. Focal Point 2 (FP2) is a Martial Eagle nest on the Aries – Helios 400kV line.

[6] For calculating the passage rate, a distinction was drawn between passages and flights. A passage may consist of several flights e.g. every time an individual bird changes height or mode of flight; this was recorded as an individual flight, although all the flights still form part of the same passage.

[7] Flight duration was calculated by multiplying the flight time with the number of individuals in the flight e.g. if the flight time was 30 seconds and it contained two individuals, the flight duration was 30 seconds x 2 = 60 seconds.

4.3.1 Focal Point 1 (FP1)

Southern Pale Chanting Goshawk and Greater Kestrel were recorded perching on the windmill itself.

4.3.2 Focal Point 2 (FP2)

The Martial Eagle nest was active in September 2016, with a small chick on the nest.

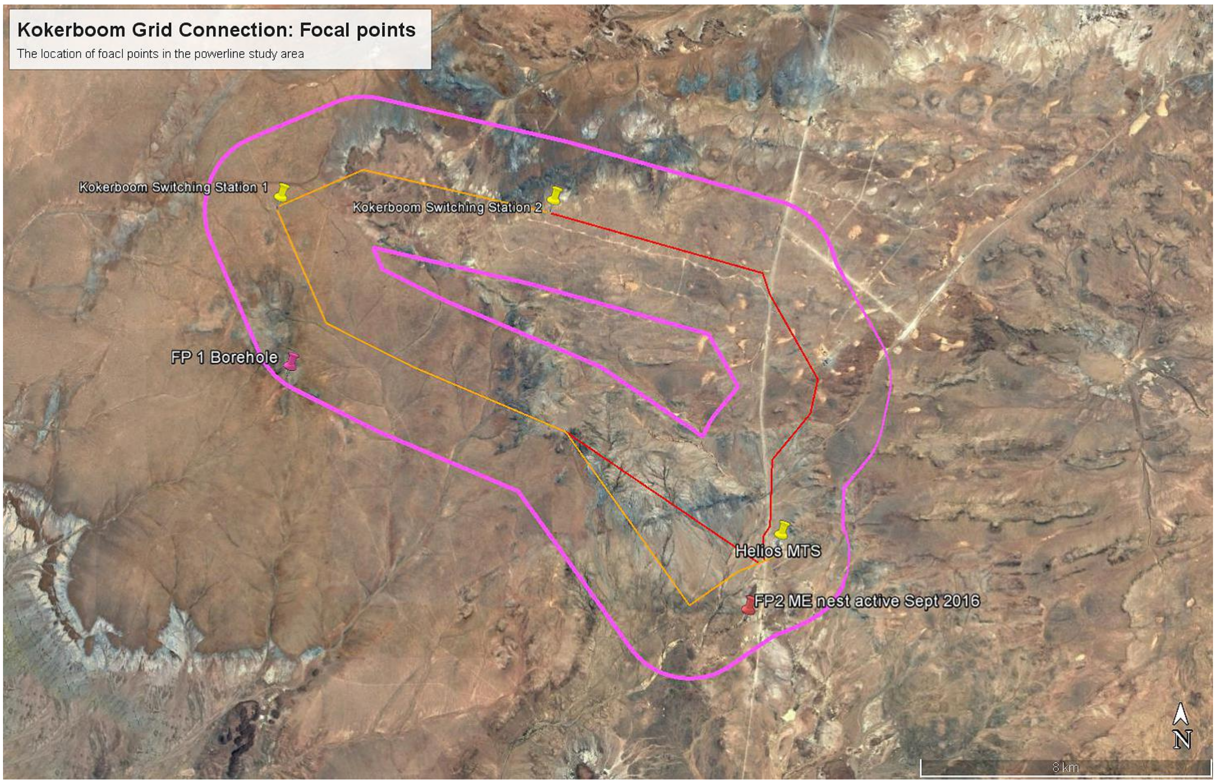

Figure 9: The location of the focal points in the powerline study area.

5. POTENTIAL IMPACTS ON AVIFAUNA

Because of their size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines. (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013). Other problems include electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen *et al.* 2002), and displacement through disturbance and habitat destruction during construction and maintenance activities.

5.1 Electrocution of priority species on the HV powerlines and in the switching station

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. The exact pylon design will be confirmed during the detailed design phase, however it is anticipated that monopoles (stayed or self-supporting) will be utilised. A typical steel monopole, representative of the structures proposed, is shown in **APPENDIX C**.

Clearance between phases on the same side of the 132kV pole structure is approximately 2.2m for this type of design, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of birds on the towers to negligible. The length of the stand-off insulators is approximately 1.6m. If a very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole, which is an unlikely occurrence, except occasionally with vultures. Vultures are unlikely to occur within the study area; therefore, it can be concluded that the risk of electrocutions on the proposed 132kV power lines is practically non-existent. This impact is therefore not assessed further in this report.

Electrocutions within the proposed Kokerboom switching stations are possible, but should not affect the more sensitive Red List bird species as these species are unlikely to use the infrastructure within the switching station yards for perching or roosting.

5.2 Collisions of priority species with the earthwire of the 132kV grid connection

Collisions are probably the bigger threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001). In a recent PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini *et al.* 2005, Jenkins *et al.* 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin *et al.* 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown *et al.* 1987, Henderson *et al.* 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown *et al.* 1987, APLIC 2012).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins *et al.* 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown *et al.* 1987, Faanes 1987, Alonso *et al.* 1994a, Bevanger 1994)."

Power line collisions are generally accepted as a key threat to bustards (Raab *et al.* 2009; Raab *et al.* 2010; Jenkins & Smallie 2009; Barrientos *et al.* 2012, Shaw 2013). In a recent study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

A potential impact of the proposed 132kV grid connection power line is collisions with the earth wire. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 10 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

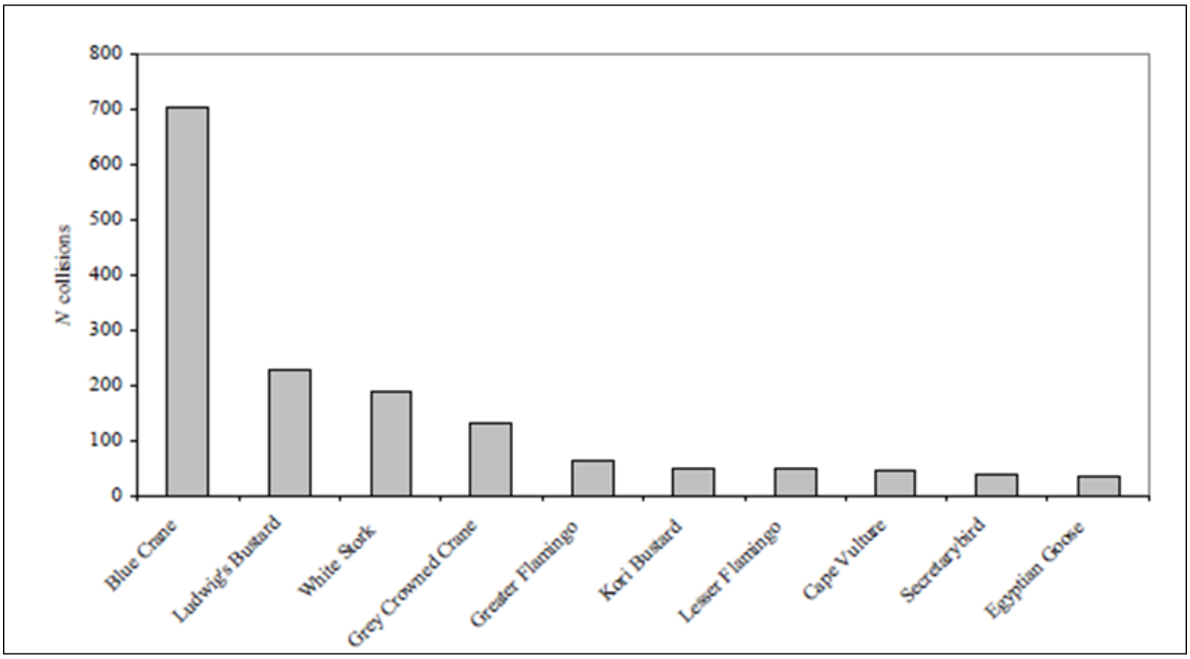

Figure 10: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom-EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins et al. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Barrientos *et al.* 2011; Jenkins *et al.* 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al.* 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

<u>Kokerboom Grid Connection</u>
The most likely candidates for collision mortality on the proposed 132kV grid connection are Ludwig’s Bustard, Karoo Korhaan, Northern Black Korhaan and Secretarybird.

5.3 Displacement due to habitat destruction and disturbance

During the construction phase and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

<u>Kokerboom Grid Connection</u>
In the present instance, the risk of displacement of priority species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at both the proposed Kokerboom switching station sites is common in the greater study area and the transformation of one hectare of habitat should not impact any of the priority species significantly.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities could also potentially displace priority species through **disturbance**; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in September 2016, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. All the potential alignments are >1.2km from the nest at their closest point, which means the potential for disturbance is likely to be low.

6. ASSESSMENT OF IMPACTS ON AVIFAUNA

This section outlines the proposed method for assessing the significance of the potential environmental impacts. For each impact, the **EXTENT** (spatial scale), **MAGNITUDE** (severity of impact) and **DURATION** (time scale) is described.

These criteria are used to ascertain the **SIGNIFICANCE** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described represents the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.

The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Table 6-1: Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10km radius of the proposed site.
	Local	Within a 10km radius of the proposed site.
	Site specific	On site or within 100m of the proposed site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 2 years
	Short Term	Up to 3 years after construction
	Medium Term	3-10 years after construction
	Long Term	More than 10 years after construction

The **SIGNIFICANCE** of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in p2.

Table 6-2: Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration

Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the **PROBABILITY** of this impact occurring as well as the **CONFIDENCE** in the assessment of the impact would be determined using the rating systems outlined in Table 6-3 and Table 6-4, respectively.

It is important to note that the significance of an impact should always be considered in conjunction with the probability of that impact occurring. Lastly, the **REVERSIBILITY** of the impact is estimated using the rating system outlined in Table 6-5.

Table 6-3: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 5-4: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 5-5: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

6.1 Impact tables

6.1.1 Construction phase

IMPACT TABLE 1: DISPLACEMENT DUE TO DISTURBANCE DURING CONSTRUCTION OF POWERLINE (ALTERNATIVES A, B AND C[8])		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during construction of the powerline.	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Probable.** Estimated 5 to 95 % chance of the impact occurring.	
Reversibility	**Reversible.** The construction activities will inevitably cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, re-colonisation should happen naturally.	
Duration	**Short term** – up to 3 years after construction. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, re-colonisation should happen naturally.	
Magnitude	**Medium**. Natural and/ or social functions and/ or processes are *notably* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Medium	Low
Confidence	Sure	Sure
Significance rating	**Low (negative)**	**Very Low (negative)**
Mitigation measures	• Restrict the construction activities to the construction footprint area. • Do not allow any access to the remainder of the property during the construction period.	

[8] Due to the homogenous nature of the habitat and the similarity in length of the different powerline alternatives, the impacts are expected to be similar in nature and extent.

IMPACT TABLE 2: DISPLACEMENT DUE TO DISTURBANCE DURING CONSTRUCTION OF SWITCHING STATIONS		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during construction of the switching station.	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Unlikely.** Estimated less than 5% chance of the impact occurring.	
Reversibility	**Reversible.** The construction activities could cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, re-colonisation should happen naturally.	
Duration	**Short term** – up to 3 years after construction. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, re-colonisation should happen naturally.	
Magnitude	**Low**. Natural and/ or social functions and/ or processes are *slightly* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Low	Very low
Confidence	Sure	Sure
Significance rating	**Low (negative)**	**Very Low (negative)**
Mitigation measures	• Restrict the construction activities to the construction footprint area. • Do not allow any access to the remainder of the property during the construction period.	

IMPACT TABLE 3: DISPLACEMENT DUE TO HABITAT DESTRUCTION DURING CONSTRUCTION OF POWERLINE (ALTERNATIVES A, B AND C)		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to habitat transformation during **construction** phase (pre-mitigation)	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Probable.** Estimated 5 to 95 % chance of the impact occurring.	
Reversibility	**Reversible**. Due to the nature of the vegetation, very little (if any) vegetation clearing will have to be performed. The vegetation that was damaged during the construction phase will recover naturally with time.	
Duration	**Short term.** The habitat transformation will be temporary and should recover to pre-construction levels.	
Magnitude	**Low**. Natural and/ or social functions and/ or processes are *slightly* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Low	Very low
Significance rating	**Low (negative)**	**Very low (negative)**
Mitigation measures	• To prevent unnecessary habitat destruction (i.e. more than is inevitable), the recommendations of the specialist ecological study must be strictly adhered to. It is especially important that maximum use is made of existing roads, where feasible.	

IMPACT TABLE 4: DISPLACEMENT DUE TO HABITAT DESTRUCTION DURING CONSTRUCTION OF SWITCHING STATION		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to habitat transformation during **construction** phase (pre-mitigation)	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Unlikely.** Estimated less than 5% chance of the impact occurring.	
Reversibility	**Irreversible**. The vegetation in the one hectare footprint of the switching station will be permanently destroyed.	
Duration	**Long term.** The vegetation in the one hectare footprint of each switching station will be permanently destroyed.	
Magnitude	**Low**. Natural and/ or social functions and/ or processes are *slightly* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Low	Very low
Significance rating	**Low (negative)**	**Very low (negative)**
Mitigation measures	• To prevent unnecessary habitat destruction (i.e. more than is inevitable), the recommendations of the specialist ecological study must be strictly adhered to.	

6.1.2 Operational phase

IMPACT TABLE 5: ELECTROCUTION OF PRIORITY SPECIES IN THE SWITCHING STATION		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Mortality of priority species due to electrocutions in the switching station	
Extent	**Local** - Within a 10km radius around the site.	
Probability	**Unlikely.** Estimated less than 5 % chance of the impact occurring.	
Reversibility	**Irreversible**. Once a bird is killed it cannot be reversed.	
Duration	**Long term.** The risk of electrocution will be present for the life-time of the development.	
Magnitude	**Very low**. Natural and/ or social functions and/ or processes are *negligibly* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Local	Local
Probability	Unlikely	Unlikely
Reversibility	Irreversible	Irreversible
Duration	Long term	Long term
Magnitude	Very low	Very low
Significance rating	**Very low (negative)**	**Very low (negative)**
Mitigation measures	The electrical hardware in the switching station is too complicated for comprehensive pro-active mitigation to be implemented. Electrocutions of priority species in the switching station should be reported to the Eskom-EWT Strategic Partnership for an investigation to ensure site specific anti-electrocution measures are implemented if necessary.	

<table>
<tr><th colspan="3">IMPACT TABLE 6: MORTALITY DUE TO COLLISIONS OF PRIORITY SPECIES WITH THE EARTHWIRE OF THE PROPOSED 132kV GRID CONNECTION (ALTERNATIVES A, B AND C)</th></tr>
<tr><td>Environmental Parameter</td><td colspan="2">Avifauna</td></tr>
<tr><td>Issue/Impact/Environmental Effect/Nature</td><td colspan="2">Mortality of priority species due to collisions with the earthwire of the 132Kv grid connection.</td></tr>
<tr><td>Extent</td><td colspan="2">Local - Within a 10km radius around the site.</td></tr>
<tr><td>Probability</td><td colspan="2">Probable. Estimated 5 to 95 % chance of the impact occurring.</td></tr>
<tr><td>Reversibility</td><td colspan="2">Irreversible. Once a bird is killed it cannot be reversed.</td></tr>
<tr><td>Duration</td><td colspan="2">Long term. The risk of collision will be present for the life-time of the development.</td></tr>
<tr><td>Magnitude</td><td colspan="2">Medium. Natural and/ or social functions and/ or processes are notably altered.</td></tr>
<tr><td>Confidence</td><td colspan="2">Sure. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td></td><td>Pre-mitigation impact rating</td><td>Post mitigation impact rating</td></tr>
<tr><td>Extent</td><td>Local</td><td>Local</td></tr>
<tr><td>Probability</td><td>Probable</td><td>Probable</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td><td>Irreversible</td></tr>
<tr><td>Duration</td><td>Long term</td><td>Long term</td></tr>
<tr><td>Magnitude</td><td>Medium</td><td>Low</td></tr>
<tr><td>Significance rating</td><td>Medium (negative)</td><td>Low (negative)</td></tr>
<tr><td>Mitigation measures</td><td colspan="2">The powerline should be marked with BFDs for its entire length on the earth wire of the line, 5m apart, alternating black and white. See APPENDIX D for the type of BFD which is recommended.</td></tr>
</table>

6.1.3 Decommissioning phase

IMPACT TABLE 7: DISPLACEMENT DUE TO DISTURBANCE DURING DE-COMMISIONING OF POWERLINE (ALTERNATIVES A, B AND C[9])		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during de-commissioning of the powerline.	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Probable.** Estimated 5 to 95 % chance of the impact occurring.	
Reversibility	**Reversible.** The de-commissioning activities will inevitably cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the de-commissioning activities, re-colonisation should happen naturally.	
Duration	**Short term** – up to 3 years after de-commissioning. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the de-commissioning activities, re-colonisation should happen naturally.	
Magnitude	**Medium**. Natural and/ or social functions and/ or processes are *notably* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Medium	Low
Confidence	Sure	Sure
Significance rating	**Low (negative)**	**Low (negative)**
Mitigation measures	• Restrict the de-commissioning activities to the minimum footprint area required to accommodate decommissioning activities. • Do not allow any access to the remainder of the property during the de-commissioning period.	

[9] Due to the homogenous nature of the habitat and the similarity in length of the different powerline alternatives, the impacts are expected to be similar in nature and extent.

IMPACT TABLE 2: DISPLACEMENT DUE TO DISTURBANCE DURING DE-COMMISIONING OF THE SWITCHING STATIONS		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during de-commissioning of the switching station.	
Extent	**Site specific.** The impact will only affect the site and immediate surroundings.	
Probability	**Unlikely.** Estimated less than 5% chance of the impact occurring.	
Reversibility	**Reversible.** The de-commissioning activities could cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the de-commissioning activities, re-colonisation should happen naturally.	
Duration	**Short term** – up to 3 years after construction. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the de-commissioning activities, re-colonisation should happen naturally.	
Magnitude	**Low**. Natural and/ or social functions and/ or processes are *slightly* altered.	
Confidence	**Sure**. Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	Site specific	Site specific
Probability	Probable	Probable
Reversibility	Reversible	Reversible
Duration	Short term	Short term
Magnitude	Low	Very low
Confidence	Sure	Sure
Significance rating	**Low (negative)**	**Very Low (negative)**
Mitigation measures	• Restrict the de-commissioning activities to the minimum footprint area required to accommodate decommissioning activities. • Do not allow any access to the remainder of the property during the de-commissioning period.	

7 CUMULATIVE IMPACTS

A cumulative impact, in relation to an activity, is the impact of an activity that may not be significant on its own but may become significant when added to the existing and potential impacts arising from similar or other activities in the area.

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors. The Scottish Natural Heritage (2005) recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or 'search area' of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the study area.

7.1 Species to be considered

The potential cumulative impacts on the priority species listed in Table 4-1 were considered.

7.2 Area considered in the cumulative assessment

The Helios Main Transmission Substation (MTS) approximately 50km north of the town of Loeriesfontein forms the hub of a proposed renewable energy node which is situated within a 30km radius around the MTS (See Figure 17 below). Within this 30km radius around the MTS, the habitat (Bushmanland Basin Shrubland) and land-use (small-stock farming) is very uniform.

Table 7-1 below lists the renewable energy projects which are currently approved or under construction within a 30km radius around Helios MTS.

Table 7-1: List of proposed and existing renewable projects within a 30km radius around Helios MTS

Proposed Development	Current Status of Project	Proponent	Capacity	Footprint
Loeriesfontein Wind Farm	Under construction	Mainstream Renewable Power	140MW, 61 turbines	3 453 ha
Khobab Wind Farm	Under construction	Mainstream Renewable Power	140MW, 61 turbines	3 200 ha
Dwarsrug Wind Farm	Approved	Mainstream Renewable Power	140MW 70 turbines approved	6 800 ha
Orlight Loeriesfontein PV	Approved	Orlight SA (Pty) Ltd	70MW	334.5 ha

7.3 Current impacts

Below is a summary of the typical threats currently facing avifauna in the Karoo environment (Marnewick *et al*. 2015):

7.3.1 Overgrazing

This results in a depletion of palatable plant species, erosion, and encroachment by Karoo shrubs. The result is loss of suitable habitat and a decrease in the availability of food for large terrestrial birds.

7.3.2 Poisoning

Strychnine poison was used extensively in the past to control damage-causing predators, such as Black-backed Jackal *Canis mesomelas* and Caracal *Caracal caracal*, and reduced scavenging raptor populations. The use of poison may be continuing, and the potential impacts on threatened raptor species has not been confirmed or quantified.

7.3.3 Road-kills

Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl.

7.3.4 Renewable energy developments

Several wind and solar developments have been approved for development within a 25km radius around Helios MTS (see Table 7-1). The combined footprint of these proposed developments is approximately 13 787.5 hectares[10]. This has implications for several priority species, both in terms of collision mortality for some species, especially raptors, and displacement due to permanent habitat transformation, which affects most of the priority species to some degree.

7.3.5 Powerlines

Numerous existing and new power lines are significant threats to large terrestrial priority species in the Karoo. Power lines kill substantial numbers of all large terrestrial bird species in the Karoo, including threatened species such as Karoo Korhaan, Kori Bustard and Ludwig's Bustard (Jenkins *et al*. 2010; Shaw, J. 2013) There is currently no completely effective mitigation method to prevent collisions. There are currently approximately 95km of Eskom HV lines within a 25km radius around Helios MTS. This figure will increase by approximately 70km if all proposed renewable energy developments get to be developed, including the Kokerboom WEFs.

7.3.6 Climate change

Climate change scenarios for the region predict slightly higher summer rainfall by 2050, and increased rainfall variability. Droughts are expected to become more severe. The climate change is predicted to have both positive and negative consequences for priority species. Increased summer rainfall could improve survival, and conversely drought years can lower long-term average survival. Large, mainly resident species dependent on rainfall are also more vulnerable to climate change. This would include the slow-breeding Martial Eagle, which also exhibit extended parental care. Severe hailstorms kill many priority species and could become more frequent.

7.3.7 Shale gas fracking

There is a potential threat of shale gas fracking throughout the Karoo. Populations of bird species may be locally reduced through disturbance caused by lights, vibration, vehicles and dust, and may be affected by pollutants in ponds containing contaminated water produced by returned fracking fluids.

7.3.8 Persecution

Although it is difficult to prove, the direct persecution of raptors such as Verreaux's Eagle and Martial Eagle for stock predation is still taking place (R. Visagie pers. comm).

[10] This figure refers to the actual infrastructure footprint and not the land parcels, which are naturally much bigger than the area that will be actually developed. This information was obtained through internet searches.

7.4 Methods

The cumulative impact of the proposed grid connection was assessed individually for each priority species (see Table 7-2 below).

The factors considered in assessing the potential species-specific impacts are:

- Level of current impact on priority species in study area (all impacts);
- Susceptibility to WEF impacts i.e. collisions with turbines and displacement through habitat transformation and disturbance;
- The percentage of habitat which is likely to be impacted by the proposed WEF grid connection.

Table 7-2 below sets out the criteria applied to rank potential cumulative impacts:

Table 7-2: Framework for assessing significance of cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account because the receptor/resource is irretrievably compromised, resulting in a fatal flaw.
Major	Effects that may become a key decision-making issue, potential fatal-flaw.
Moderate	Effects that are unlikely to affect the viability of the project, but mitigation might be required.
Minor	Effects which might be locally/site significant, but probably insignificant for the greater study area.
Not Significant	Effects that are within the ability of the resource to absorb such change both at local/site level and within the greater study area.

7.5 Assumptions and limitations: cumulative impacts

The information on proposed WEFs in the study area was received from Aurecon and from various websites. The assessment was made on this basis, but it cannot be guaranteed that these are the only proposed WEF developments.

7.6 Assessment

See Table 7-3 below for a systematic exposition of the expected cumulative impacts of the proposed Kokerboom grid connection on priority species.

Table 7-3: The expected cumulative impact of the Kokerboom Grid Connection on priority species within the 25km development node.

Priority species	Taxonomic name	Level of current and future impacts on species	Susceptibility to powerline impacts	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Pre-mitigation	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Post-mitigation
Karoo Korhaan	*Eupodotis vigorsii*	Low: Powerlines, solar, overgrazing, climate change	Medium	Moderate	Minor
Northern Black Korhaan	*Afrotis afraoides*	Low: Powerlines, solar, overgrazing, climate change	Medium	Moderate	Minor
Kori Bustard	*Ardeatis kori*	High: Powerlines,solar, overgrazing, climate change	High	High	Moderate
Lanner Falcon	*Falco biarmicus*	Low: Powerlines, poisoning, road kills, solar, WEF	Low	Low	Not significant
Ludwig's Bustard	*Neotis ludwigii*	High: Powerlines, solar, overgrazing, climate change	High	High	Moderate
Martial Eagle	*Polemaetus bellicosus*	High: Powerlines, persecution, solar, overgrazing, WEFs, climate change	High	Moderate	Minor
Secretarybird	*Sagittarius serpentarius*	High: Powerlines, solar , overgrazing, WEFs, climate change	High	High	Moderate
Booted Eagle	*Aquila pennatus*	Medium: Solar, overgrazing, WEFs, climate change	Low	Minor	Not significant
Sclater's Lark	*Spizocorys sclateri*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Red Lark	*Calendulauda burra*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant

Priority species	Taxonomic name	Level of current and future impacts on species	Susceptibility to powerline impacts	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Pre-mitigation	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Post-mitigation
Black-chested Snake-Eagle	*Circaetus pectoralis*	Medium: Solar, overgrazing, WEFs, climate change	Medium	Moderate	Minor
Southern Pale Chanting	*Melierax canorus*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Greater Kestrel	*Falco rupicoloides*	Low: Solar, overgrazing, climate change	Low	Minor	Not significant
Spotted Eagle-Owl	*Bubo africanus*	Medium: Powerlines, solar, overgrazing, WEFs, climate change,	Medium	Moderate	Minor
Jackal Buzzard	*Buteo rufofuscus*	Medium: Solar, overgrazing, WEFs, climate change	Medium	Moderate	Minor
Burchell's Courser	*Cursorius rufus*	Medium: Solar, overgrazing, WEFs, climate change	Low	Not significant	Not significant
Double-banded Courser	*Rhinoptilus africanus*	Medium: Solar, overgrazing, WEFs, climate change	Low	Not significant	Not significant
Steppe Buzzard	*Buteo vulpinus*	Medium: Solar, overgrazing, WEFs, climate change	Medium	Moderate	Minor
Yellow-billed Kite	*Milvus aegyptius*	Medium: Solar, overgrazing, WEFs, climate change	Low	Minor	Not significant

Overall, the combined cumulative impacts of the proposed Kokerboom grid connection and the existing and proposed HV networks, assuming implementation of appropriate mitigation measures, are expected to be minor to moderate (within the 25km development node). The overall cumulative assessment has been produced with a moderate to high level of certainty.

7.7 No-Go Alternative

The no-go alternative will result in the current status quo being maintained as far as the avifauna is concerned. Overall, the very low human population in the study area is definitely advantageous to avifauna in general. The no-go option would be advantageous for the ecological integrity of the study area as far as avifauna is concerned.

8. SELECTING A PREFERRED ALIGNMENT

All three of the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the three respective alignments, Alternative C emerges as slightly more preferred above the other two alignments. The reasons are as follows:

- It is slightly shorter than the other two alignments;
- It follows existing tracks for most of the way, thereby reducing the impact of habitat fragmentation; and
- It is furthest away (app. 1.7km) from the active Martial Eagle nest on the Aries – Helios 400kV line.

All three alternatives (A, B & C) are however considered acceptable from an avifauna perspective.

9. SUMMARY OF FINDINGS AND CONCLUDING STATEMENT

The proposed Kokerboom grid connection and associated switching stations will have several potential impacts on avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss;
- Electrocution in the switching station; and
- Collisions with the earthwire of the 132kV grid connection

9.1 Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace priority species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in September 2016, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. All the potential alignments are >1.2km from the nest at their closest point, which means the potential for disturbance is likely to be low.

The risk of displacement due to disturbance during the construction phase is rated as low which could be reduced to very low through appropriate mitigation.

9.2 Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of priority species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at both the proposed Kokerboom switching station sites is common in the greater study area and the transformation of one hectare of habitat should not impact any of the priority species significantly.

The risk of displacement through habitat destruction during construction is rated as low which could be reduced to very low through appropriate mitigation.

9.3 Electrocution of priority species in the switching station

Electrocutions within the proposed Kokerboom switching stations are possible, but should not affect the more sensitive Red List bird species as these species are unlikely to use the infrastructure within the switching station yards for perching or roosting. No electrocution risk is envisaged on the HV lines.

The risk of electrocution in the switching stations is rated as very low, with no pro-active mitigation required.

9.4 Collisions of priority species with the earthwire of the 132kV grid connection

The most likely candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, Northern Black Korhaan and Secretarybird.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as medium which can be reduced to low through appropriate mitigation.

9.5 Concluding statement

The proposed Kokerboom grid connection will have several impacts on avifauna, ranging from medium to very low, prior to the implementation of mitigation. With the implementation of mitigation measures, the impacts could be reduced to low and very low. Provided the recommended mitigation measures are strictly applied, any of the three alternatives is acceptable from an avifaunal impact perspective and the project could proceed, with Alternative C the preferred alternative from an avifaunal impact perspective by a slender margin.

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APPENDIX A

Avifaunal pre-construction monitoring at the proposed Kokerboom Wind Energy Facilities:

Overview of methodology

1. Introduction

The pre-construction monitoring protocol was designed in accordance with the *"Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa"* (Jenkins *et al.* 2011) which was published by the Endangered Wildlife Trust (EWT) and BirdLife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

2. Objectives

The objectives of the avifaunal pre-construction monitoring programme in the greater study area[11] were as follows:

- To establish which species regularly occur in the area;
- To gather baseline data on the diversity of avifauna and specifically abundance of priority species to measure potential **displacement** due to the construction and operation of the wind farms. This is primarily done through transect surveys (see 4.1 below).
- To record flight behaviour of priority species to assess the risk of potential mortality due to **collision** with the turbines. This is primarily done through vantage point counts (see 4.2 below).

3. Assumptions and limitations

The basic assumption is that the sources of information used are reliable enough to allow for meaningful interpretation. However, it must be noted that there are certain limitations:

- It is inevitable that observations at vantage points are biased towards those species that are more visible (i.e. larger species), and flights that are closer to the observer. It must therefore be accepted that both the accuracy and frequency of observations decrease with distance from the observer. It should also be noted that the survey method i.e. an observer using binoculars is inherently not very accurate when it comes to judging flight height, therefore flight height should be seen as an approximation only.
- The best practice guidelines state that "monitoring data should be collected over at least a 12-month period (at both WEF and control sites), and include sample counts representative of the full spectrum of prevailing environmental conditions likely to occur on each site in a year". Whereas the sampling periods in this study aim to be broadly representative of seasonal environmental conditions which prevailed during the monitoring period, it must be borne in mind that environmental conditions may vary significantly on an annual basis, especially in an arid environment like Bushmanland. Furthermore, it is not always realistically possible to

[11] There were originally four powerline study areas proposed. The habitat in the greater study area is highly homogenous and therefore the results of the pre-construction monitoring is applicable to all the powerline study areas.

schedule monitoring to coincide with the full spectrum of environmental conditions, due to practical constraints.

- In circumstances where there is uncertainty and the precautionary principle may be relevant, evidence, expert opinion, best practice guidance and professional judgment were applied.
- For purposes of monitoring, priority species were defined as species included on the list of priority species of the Avian Wind Farm Sensitivity Map of South Africa compiled by Birdlife South Africa (Retief *et al.* 2012).
- The survey transects, focal points and vantage points were selected based on a potential powerline study area which was provided at the commencement of the monitoring in November 2015.

4. Methods

Monitoring was implemented during the following periods:

- Spring/early summer: 18 – 23 November 2015
- Mid-Summer: 23 - 29 February 2016
- Late autumn/early winter: 23 – 30 May 2016
- Late winter: 28 August – 1 September 2016

4.1 Transects and vantage points

The monitoring protocol for the site was designed according to the latest version (2012) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

The monitoring was conducted by five field monitors.

Monitoring was conducted in the following manner:

- Four drive transects were identified on the original Kokerboom WEF study area totalling 23.5km and one drive transect in the control area with a total length of 13.7km.
- Two observers travelling slowly (± 10km/h) in a vehicle recorded all species on both sides of the drive transect. The observers stopped at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- In addition, six walk transects of 1km each were identified in the original Kokerboom WEF study area, and four at the control area, and counted 8 times per sampling season. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (estimated Beaufort scale);

- o Weather (sunny; cloudy; partly cloudy; rain; mist);
- o Temperature (cold; mild; warm; hot);
- o Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
- o Co-ordinates (priority species only).

- Six vantage points (VPs) were identified in the original Kokerboom WEF study area, to record the flight altitude and patterns of priority species. Two VPs were also identified at the control area. The following variables were recorded for each flight:
  - o Species;
  - o Number of birds;
  - o Date;
  - o Start time and end time;
  - o Wind direction;
  - o Wind strength (estimated Beaufort scale 1-7);
  - o Weather (sunny; cloudy; partly cloudy; rain; mist);
  - o Temperature (cold; mild; warm; hot);
  - o Flight altitude (high i.e. >190m; medium i.e. 30m – 190m; low i.e. <30m);
  - o Flight mode (soar; flap; glide; kite; hover); and
  - o Flight time (in 15 second-intervals).

The aim of the drive transects was primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects were primarily aimed at recording small passerines. The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the latest BLSA list (November 2014) of priority species for wind farms.

Three potential focal points were identified in the original Kokerboom WEF study area, namely:

- A borehole (FP1)
- A Southern Pale Chanting Goshawk nest (FP2)
- An ephemeral pan (FP3)

Figure 1 below indicates the original Kokerboom WEF study area and control areas where monitoring was conducted.

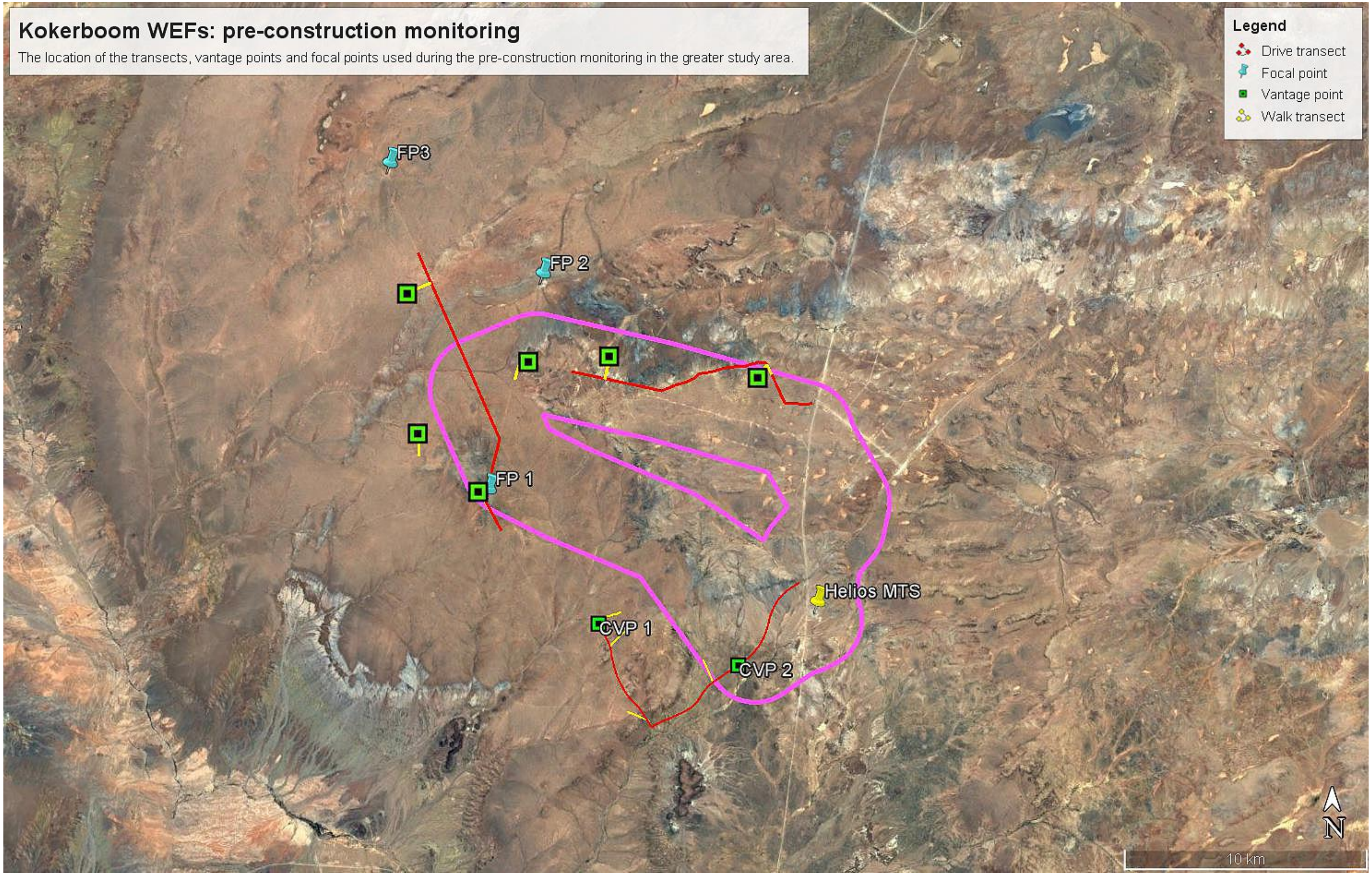


Figure 1: The greater study area where the pre-construction monitoring was conducted for the proposed Kokerboom WEFs. The pink polygon indicate the boundaries of the powerline study area.

APPENDIX B: BIRD HABITAT

Figure 1: An example of Bushmanland Arid Shrubland at the powerline study area. This is also the dominant habitat in the greater study area.

Figure 2: A typical water point in the greater study area.

Figure 3: The habitat at the control area, indicating the homogenous nature of the habitat in the greater study area.

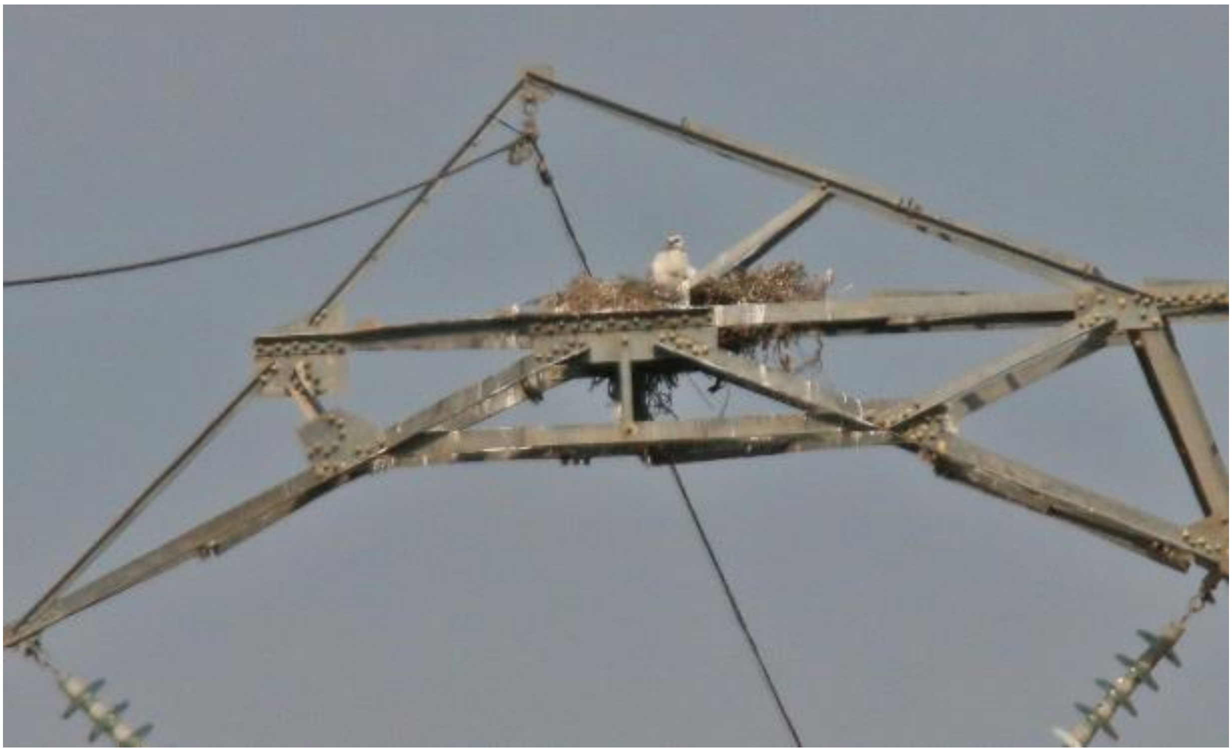
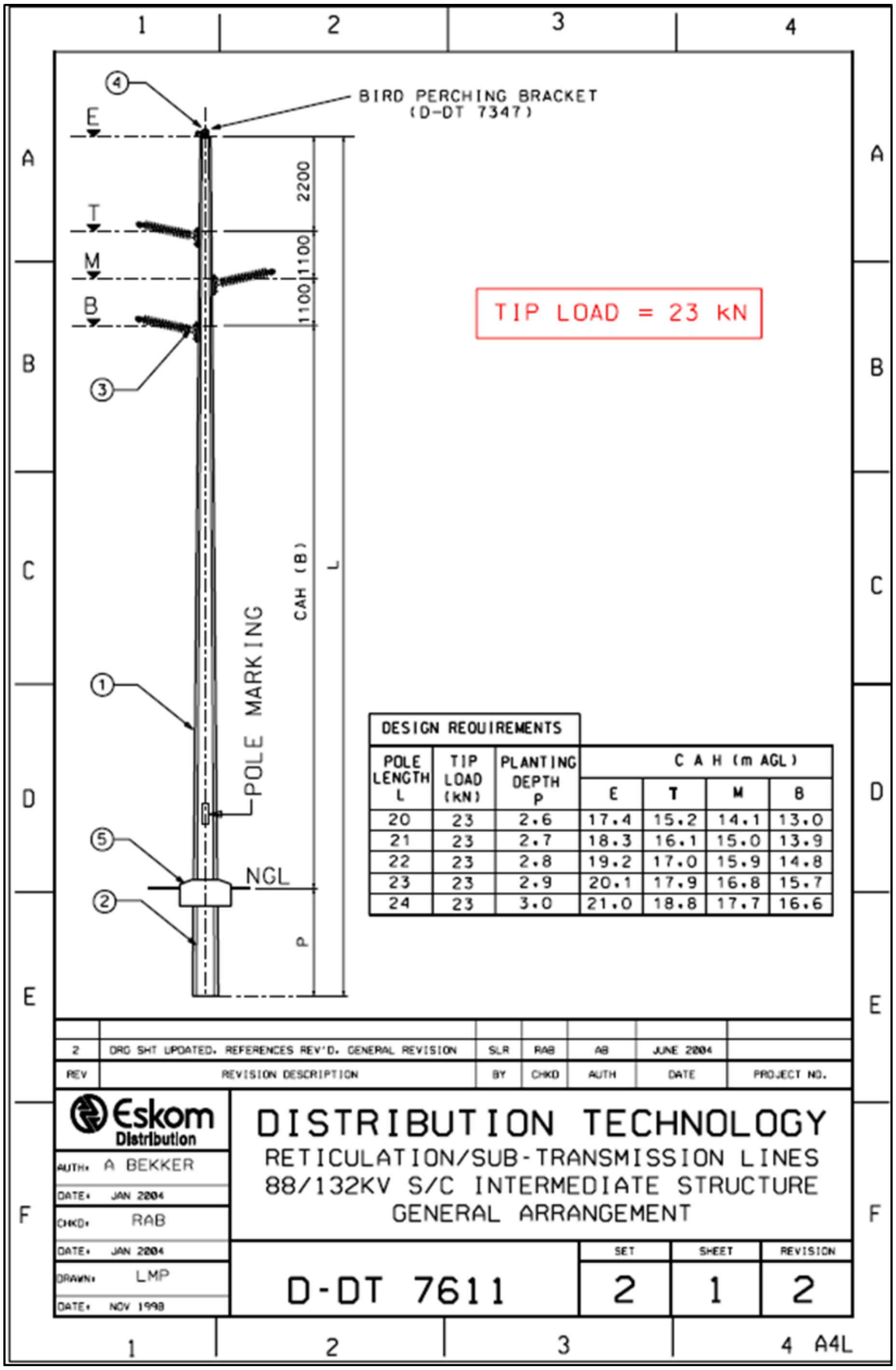


Figure 4: An active Martial Eagle nest on the Aries – Helios 400kV transmission line.

APPENDIX C: POWERLINE DESIGN[12]



[12] This image provides an indication of the type of structures that may be utilised, but the final pylon design will only be confirmed during the detail design phase – in accordance with Eskom requirements, as well as geotechnical, topographic and other environmental conditions.

APPENDIX D: BIRD FLIGHT DIVERTERS[13]

DISTRIBUTION
TECHNICAL BULLETIN

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TECHNICAL BULLETIN: 09 TB – 01
PART: 4 - MV

APPROVED BIRD FLIGHT DIVERTERS TO BE USED ON ESKOMS LINES (MITIGATING DEVICES)

This Technical Bulletin replaces all other Technical Bulletins that were published previously.

The following two flight diverters (mitigating devices) have been successfully installed and successfully tested on an active line in the Colesberg area.

1) EBM Flapper

Buyers guide number DDT 3053

The EBM bird flapper tested for the following:

- Pull down test (spirally moving along the conductor) for squirrel and hare conductor
- Testing for radio interference at 27kv on fox conductor
- Testing for corona at 27kv on fox conductor
- Salt fog test for 1000 hours.

The flapper was installed live line on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device.

From field experience and the testing of the flapper it was decided at the Envirotech work group meeting that this EBM flapper can be used on conductors ranging from 6mm to 24mm on ACSR, AAAC conductors and shield wires.

The EBM Flapper can be attached with a link stick and a standard attachment or by hand from a bucket live line or under dead conditions.

Contact Roger Martin: EBM Tel 011 288 0000

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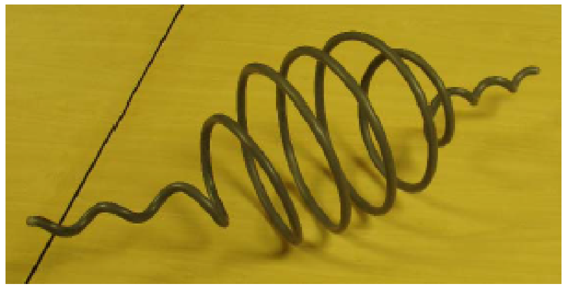
[13] The devices in this appendix are the current (February 2017) recommended devices, but that at the time of construction the most current, Eskom approved devices should be used.

2) Tyco Flight Diverter.



Buyers guide number DDT 3107

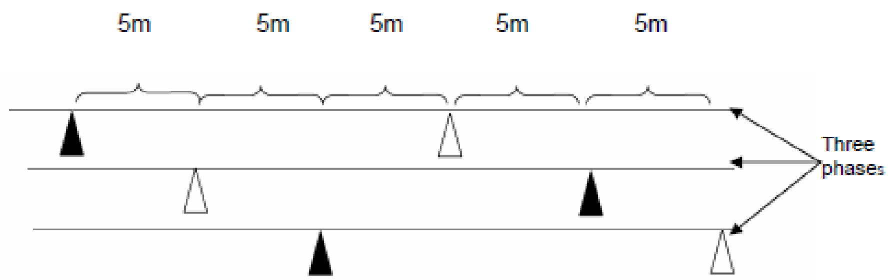
The TYCo flight diverter has been used successfully in many places around the world and has been installed on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device. The device is supplied in colours white and grey.

Contact person: Mr Silas Moloko: TIS Tel 011 635 8000

3) Installing Flight Diverters

- Spacing of the bird diverters are to be 5m apart alternating on each phase, for single phase lines the colours would alternate 5m apart on the two lines.
- The flight diverters are to be installed with alternating colours,

Figure 1



Signed

COMPILED BY:

DATE: **April 2009**
B P Hill
Chief Engineer
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Signed

APPROVED BY:

DATE: **April 2009**
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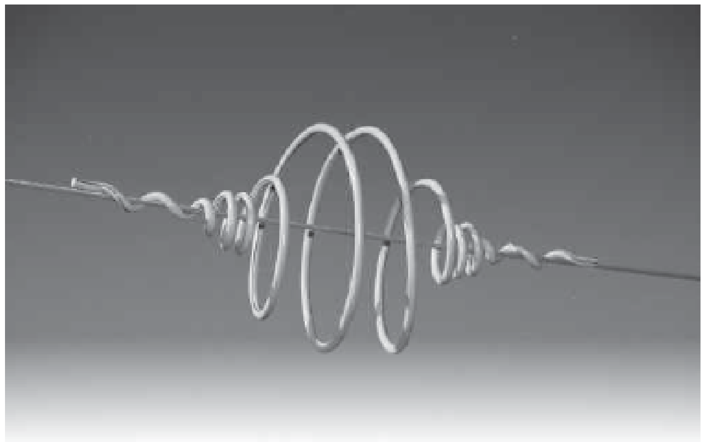
Double Loop Bird Flight Diverter



General Recommendation

The Bird Flight Diverter is designed to make overhead lines visible to birds and provides and economic means of reducing the hazard to both lines and birds. For low and medium voltage construction (up to 40kV) it is applied to the phase conductors (bare or jacketed). For high voltage it is used on the earth wire.

The fitting is light in weight, offers little wind resistance and is easily and quickly applied. The positive grip of the fitting on the conductor ensures that it remains in the applied position and cannot move along the span under vibration.

Visibility: The diverter section increases the visibility profile of the cable or conductor to a degree necessary to ensure safety, but avoids undesirably bulky outline.

Spacing: Spacing distances are not critical and will depend upon local conditions. Since wind resistance is very limited, sufficient fittings can be used to ensure adequate visibility without creating stresses on the line. When marking adjacent spans, overall visibility is improved by staggering the application.

We recommend generally a spacing of 10 or 15 metres.

INDEX

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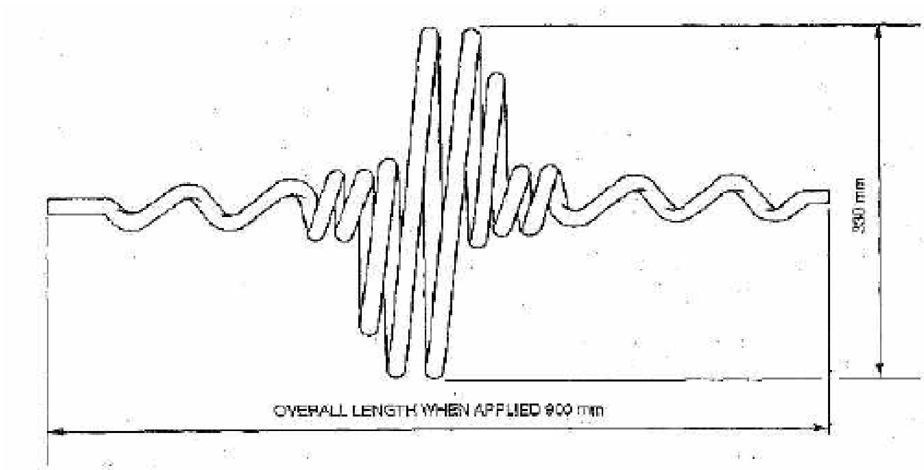
Website: www.preformedsa.co.za

Double Loop Bird Flight Diverter



Material Used: Manufactured from rigid solid high impact polyvinyl chloride, possessing excellent chemical and strength properties and which will retain good physical characteristics within the range of extreme temperatures. Outdoor aging tests indicate that the material does not deteriorate in function or appearance from the effects of severe weather conditions. Industrial fumes and salt water cannot seriously degrade the properties of rigid PVC.

Colour: White or Black

Lay Direction: Bird Flight Diverters are supplied right hand lay for both right hand and left hand lay bare conductors and insulated cables.

CATALOGUE NO.	CONDUCTOR/ E/WIRE DIA. RANGE
BFD 0914/LD2*	9 mm – 14 mm

*Add B or W to denote colour

INDEX

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KOKERBOOM WIND ENERGY FACILITY GRID CONNECTION ALTERNATIVE ASSESSMENT

AQUATIC ASSESSMENT

Prepared for:

AURECON
CAPE TOWN

Prepared by:

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Scherman Colloty and Associates cc
Environmental and Aquatic Management Consulting
(CK 2009/112403/23)

August 2017

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographic Information System
HGM	Hydrogeomorphic Unit
NEMA	National Environmental Management Act (Act 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, *et al*. 2011).
NWCS	National Wetland Classification System
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SC&A	Scherman Colloty & Associates
SQ	Subquaternary catchment
WEF	Wind Energy Facility
WUL	Water Use License
WULA	Water Use License Application

1 EXECUTIVE SUMMARY

Scherman Colloty & Associates (SC&A) was appointed by Aurecon South Africa (Pty) Ltd to conduct an aquatic impact assessment for the proposed Kokerboom Wind Energy Facilities north of Loeriesfontein in the Northern Cape. These will in turn require high voltage grid connections, of which three alternatives routes have been proposed. This report will include delineating any natural waterbodies, as well as assessing the potential consequences of the alternative alignments on the surrounding water courses and or wetlands known to occur within the region. This was based on information collected during site visits in late August 2012, July 2014 within the adjacent farms and a site-specific visit in September 2016, which coincided with late winter rainfall within the region. The assessment criteria contained in the DWAF 2005 / 2007 delineation manuals and the National Wetland Classification System found in the Appendix 1 were used as the basis of this assessment.

The study area catchments (D53F & E31C) are characterised by small / narrow perennial water courses and drainage lines. Only the E31C catchment systems are associated with the mainstem systems listed below while the systems within the D53F catchment are disconnected watercourses some of which flow into endorheic pans / depressions that would be traversed by Alternative C. The D53F water courses within the study area are not connected to any main stem rivers (e.g. Sak River, ca. 100km east of the site).

Overall, except for impacts such as present day farm tracks and grazing, the aquatic environments are largely natural. This assessment thus focuses on those watercourses which have a direct connection with the larger systems towards the south of the study area or are alluvial systems, characterised by natural sediment transport mechanisms within the regional environment. The Klein / Rooiberg rivers nearer Loeriesfontein, 30km from the site also contain sedge dominated wetlands. The pans, mostly associated with Alternative C, are also discussed.

The Present Ecological State (PES) scores for the drainage lines and the watercourses in the study area were rated as follows (DWS, 2014 – where B= Largely natural), i.e. only those with a connection with a mainstem system (E31C):

Subquaternary Catchment Number	Present Ecological State	Ecological Importance	Ecological Sensitivity
5165 Groot / Hartbeeslaagte	B	Medium	Medium
5300 Krom	B	Medium	Medium
5271Leeuberg	B	Medium	Medium
5349 Krom	B	Medium	Medium
5281Klein / Rooiberg	B	Medium	High

It is thus evident that the study area systems are largely functional and / or have limited impacts because of current land use practices. This was confirmed for each of the affected reaches located within the development footprint and the areas that would be crossed by the proposed road layout. In other words, the systems observed are largely natural, with small or narrow riparian zones, dominated by non-obligate Karoo scrub. Thus, the DWS 2014 assessment for each of the study area systems is supported and the current ratings can be upheld.

Per the National Freshwater Ecosystems Priority Area (NFEPA) wetland data, several large natural wetlands could occur within the study area, i.e. within 500m of the WEF boundary. The natural wetlands observed within the study area are natural endorheic pans or depressions that are located within 500m of the development site boundary. These are Largely Natural (PES = B), while all have a High-Medium Ecological Importance and Sensitivity rating

Portions of the proposed project are however located within NEFPAs, as these areas contain potential habitat that may act as refugia and/ or supports an important aquatic ecosystem downstream. No obligate aquatic species was observed within the site during the time of the survey, thus these NFEPAs must be related to the lower portions of the catchments that have been mentioned above.

Any activities within the identified watercourses including the 32m buffer or within 500m of a wetland / pan boundary will require a Water Use license (possible General Authorisation) under Section 21 c & i. For the purposes of this report it has been assumed that all overhead transmission line towers will be placed outside any of the buffer areas. However, some areas along the alignment will require access tracks, thus crossing the water courses, but no solid infrastructure e.g. culverts will be placed within these systems.

The following indirect impacts were assessed with regard to the riparian areas and water courses:

- Impact 1: Loss of riparian systems and disturbance of the alluvial water courses in the construction, operational and decommissioning phases
- Impact 2: Increase in sedimentation and erosion in the construction, operational and decommissioning phases
- Impact 3: Potential impact on localised surface water quality during the construction and decommissioning phases
- Impact 4: Storage of hazardous substances particularly in the construction and operational phase related to the switching substations
- Impact 5: Loss of wetlands
- Impact 6: The No-go Alternative
- Impact 7: Cumulative impacts for the overall project due to the high number of projects surrounding this application

<u>The proposed alignments for the facilities would seem to have limited impact on the aquatic environment as the proposed structures for the most part can avoid the delineated watercourses. Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities inclusive of the alternatives is made</u>.

Further, no aquatic protected species or species of special concern (flora) were observed during the site visit. Therefore, based on the site visit the significance of the impacts assessed for the aquatic systems after mitigation would be LOW (negative).

2 INTRODUCTION

Scherman Colloty & Associates (SC&A) was appointed by Aurecon South Africa (Pty) Ltd to conduct an aquatic impact assessment for the proposed 132 kV overhead transmission line (single or double circuit) and two switching stations to link the proposed Kokerboom WEFs to the existing Eskom Helios Substation. Three alternatives routes have been proposed. This report will include delineating any natural waterbodies occurring on the properties in question, as well as assessing the potential consequences of the alternative alignments on the surrounding water courses and/ or wetlands known to occur within the region. This was based on information collected during site visits in late August 2012, July 2014 within the adjacent farms and a site-specific visit in September 2016, which coincided with late winter rainfall within the region. The assessment criteria contained in the DWAF 2005 / 2007 delineation manuals and the National Wetland Classification System found in the Appendix 1 were used as the basis of this assessment.

The relevant delineations and Present Ecological State (PES) status assessment of the observed waterbodies together with an analysis of the potential impact of the proposed facilities on the aquatic environment is provided, following from the results obtained in a survey of the regional literature and observations made during the site visit conducted in 2016. These analyses were based on the models developed by the Department of Water and Sanitation (DWS), with the results producing ratings (A – F) and comment on the potential impact of the proposed development areas based on any constraints due to the presence of any sensitive terrestrial and aquatic habitats.

Several important national, provincial and municipal scale conservation plans were also reviewed, with the results of those studies being included in this report. Most conservation plans are produced at a coarse scale so it is thus important to verify the actual status of the study area during this initial phase, prior to the final development plan being produced.

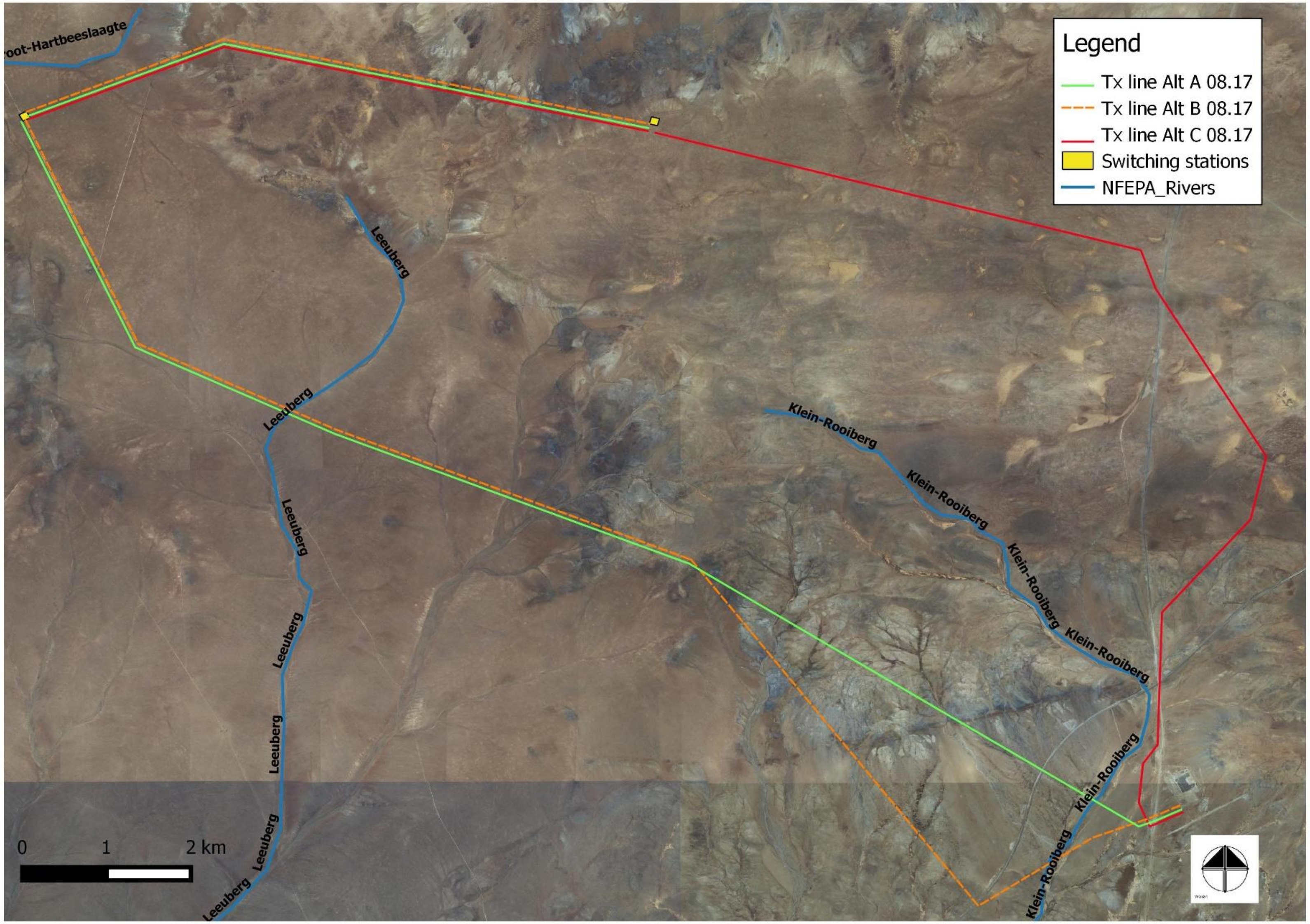

Figure 1: Proposed project alignment alternatives and switching station locations in relation to main stem water courses (note alignments are offset to indicate individual routes for each in this figure)

3 PROJECT DESCRIPTION

Business Venture Investments No. 1788 (Pty) Ltd (BVI) (the Proponent) proposes to evacuate the power generated from three proposed wind energy facilities (WEFs) (Kokerboom 1, 2 and 3) to the national grid, via the existing Eskom Helios Substation. It is anticipated that each of the proposed WEFs will have an output capacity of up to 240-256MW. The proponent therefore proposes to construct a 132kV overhead transmission line (single or double circuit) and two switching stations from the proposed Kokerboom WEFs to the existing Eskom Helios Substation, east of the WEF sites. Three alternative transmission corridors have been proposed and range in length from approximately 23km to 27km. Service roads will be required along the length of the servitude. Where possible these will consider existing routes, however narrow jeep tracks less than 4m wide may be developed where no access or service roads exist.

This aquatic assessment therefore provides a specialist assessment of the freshwater systems and associated ecology of the proposed area to be affected by the proposed grid connection infrastructure. This report will be used to inform a Basic Assessment process undertaken by Aurecon South Africa (PTY) Ltd in its application for environmental authorisation from the Department of Environmental Affairs.

4 APPROACH TO STUDY

4.1 Study terms of reference

SC&A based this study on the following scope of work:

- Identify and delineate any aquatic systems and associated biota that may be impacted upon by the proposed project based on the DWS wetland and riparian delineation methodology (DWAF, 2005/2007);
- Identify and rate potential environmental impacts on these systems and associated biota;
- Provide a significance rating of surface water impacts which includes a rating of the ecological sensitivity of the site, and the effect of the development on the aquatic ecology of the site; and
- Identify mitigation measures for negative and enhancement measures for positive impacts.

Based on our understanding of these requirements, SC&A would produce the following:

- Riparian and /or wetland area delineation supplied together with an analysis of the potential aquatic sensitivity (including any wetlands should they occur).
- Present Ecological State (PES) assessment of any watercourses after a short site visit has been conducted, in line with the DWS requirements should any Section 21 c & i water use licenses be required.
- Recommend buffer zones and No-go areas around any delineated wetland areas based on the relevant legislation, e.g. Conservation Plan guidelines or best practice.
- Assess the potential impacts, based on the supplied methodology
- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated aquatic areas.
- Provide the relevant aspects with regard compiling the Environmental Management / Monitoring Plans.
- Supply the client with geo-referenced GIS shape files of the aquatic areas.

4.2 Study methods

This assessment was initiated with a survey of the pertinent literature, including past reports that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain which portions of the proposed development could have the greatest impact on the water courses and associated habitats.

A site visit was conducted during September 2016 to ground-truth the above findings, thus allowing critical comment on the possible impacts. Information was also collected to determine the PES and Ecological Importance and Sensitivity (EIS). These analyses were based on the models developed by the DWS, with the results producing ratings (A – F), descriptions for which are summarised in Table 1.

Table 1: Description of A – F ecological categories based on Kleynhans *et al*., (1999).

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Mediumly modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	**Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality**
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

Several terms and definitions are used in this report and the reader is referred to the box below for additional detail.

Definition Box

Present Ecological State (PES) is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

Ecological Importance and Sensitivity (EIS) are the terms used to describe the rating of the any given wetland or river reach that provides an indication of the ecological importance of the aquatic system using criteria such as conservation needy habitat or species, protected ecosystems or unique habitat observed. The sensitivity is then derived by assessing the resilience the habitat exhibits under stress as a result of changes in flow or water quality.

Due to the nature of the wetlands and watercourses observed during this study, it was decided that the newly accepted National Wetlands Classification System (NWCS) be adopted. This classification approach has integrated aspects of the Hydrogeomorphic (HGM) approached used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers. A detailed description of this methodology is contained in the Appendices of this report, but in essence this classification system distinguishes riparian from wetland systems, while determining the type and functionality of the wetlands observed.

The NWCS (Ollis *et. al*, 2013) uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (SANBI, 2009).

The classification system used in this study is thus based on SANBI (2009) and is summarised below:

The NWCS has a six tiered hierarchical structure, with four spatially nested primary levels of classification. The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular systems has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

(i) Landform – shape and localised setting of wetland
(ii) Hydrological characteristics – nature of water movement into, through and out of the wetland
(iii) Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for the inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses of six descriptors to characterise the wetland types on the basis of biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

(i) Geology;
(ii) Natural vs. Artificial;
(iii) Vegetation cover type;
(iv) Substratum;
(v) Salinity; and

(vi) Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, thus are nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

4.3 Relevant legislation and policy

Nationally, the South African Constitution and seven (7) Acts, as well as one (1) international treaty promote the protection of rivers and water courses. These systems are thus protected from destruction or pollution in accordance with the following statutes:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act, 2004 (Act 10 of 2004);
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- National Forest Act (No. 84 of 1998); and
- National Heritage Resources Act (No. 25 of 1999).

In addition to the Basic Assessment Process under NEMA, this report will be used as part of the relevant submissions to the DWS in terms of the registration / licensing (as required) for Section 21 c & i water uses should they be required.

Provincial legislation and policy

Presently there are no prescribed aquatic buffers proposed in the Northern Cape, thus the recommendations by Desmet and Berliner (2007) will be applied as these are becoming more widely accepted (Table 2). These are stated below so that the engineers and contractors are aware of these buffers during the planning phase. Associated batch plants, stockpiles, lay down areas and construction camps should avoid these buffer areas.

Table 2 provides recommended buffers for rivers to provide a form of consistent appraisal for this project as well as others being conducted by the author within the greater Northern and Western Cape areas. A 50m buffer is proposed for any wetlands found in the region.

Table 2: Recommended buffers for rivers (the predominant buffer for the study region is highlighted in blue) (Berliner & Desmet, 2007)

River criterion used	Buffer width (m)	Rationale
Mountain streams and upper foothills of all 1:500 000 rivers	50	These longitudinal zones generally have more confined riparian zones than lower foothills and lowland rivers and are generally less threatened by agricultural practices.
Lower foothills and lowland rivers of all 1:500 000 rivers	100	These longitudinal zones generally have less confined riparian zones than mountain streams and upper foothills and are generally more threatened by development practices.
All remaining 1:50 000 streams	32	Generally smaller upland streams corresponding to mountain streams and upper foothills, smaller than those designated in the 1:500 000 rivers layer. They are assigned the riparian buffer required under South African legislation.

4.4 Specialist details

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments.

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Certified EAP / Member SAIEES and SASAqS.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), Ph.D Botany Conservation Importance rating (Estuaries) and interior wetland / riverine assessment consultant from 1996 to present.

I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs.

Signed:… ……………… Date:…7 February 2017…………

5 ASSUMPTIONS AND LIMITATIONS

In order to obtain a comprehensive understanding of the dynamics of both the flora and fauna of both the aquatic communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints these long-term studies are not feasible and are mostly based on instantaneous sampling. This site was assessed after a period of spring rainfall, while the adjacent farms have been visited during other years and seasons. Thus the author of this report as an understanding of the region and the aquatic environment.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

For the purposes of this report it is assumed that the transmission lines can avoid or span (Figure 3) the observed water courses and wetlands (pans). However, some areas along the alignment will require access tracks, thus crossing the water courses, but no solid infrastructure e.g. culverts will be placed within these systems.

A further assumption is that water will be sourced from a licensed resource and not illegally abstracted from any surrounding water courses, particularly if dust suppression is required.

6 BASELINE DESCRIPTION

The proposed alignments occur within the E31C and D53F Quaternary catchments, within the Nama Karoo ecoregion, while located in the Berg / Oliphant's (WMA9) and Orange (WMA6) Water Management Areas (Figure 2).

The study area catchments (D53F & E31C) are characterised by small / narrow perennial water courses and drainage lines (Plate1 and Figure 3). Only the E31C catchment systems are associated with the mainstem systems listed below while the systems within the D53F catchment are disconnected watercourses some of which flow into endorheic pans to the north and north east of the site. The D53F systems associated with the study area are thus not connected to any main stem rivers (e.g. Sak River, ca. 100km east of the site) and this western portion of the catchment aside the pans contain very few riverine / water course areas.

Overall, except for impacts such as present day farm tracks and grazing, the aquatic environments are largely natural. This assessment thus focuses on those watercourses which have a direct connection with the larger systems towards the south of the study area or are alluvial systems, characterised by natural sediment transport mechanisms within the regional environment. The Klein / Rooiberg rivers nearer Loeriesfontein, 30km from the site also contain sedge dominated wetlands. The pans, mostly associated with Alternative C are also discussed.

The Present Ecological State (PES) scores for the drainage lines and the watercourses in the study area were rated as follows (DWS, 2014 – where B= Largely natural), i.e. only those with a connection with a mainstem system (E31C):

Subquaternary Catchment Number	Present Ecological State	Ecological Importance	Ecological Sensitivity
5165 Groot / Hartbeeslaagte	B	Medium	Medium
5300 Krom	B	Medium	Medium
5271Leeuberg	B	Medium	Medium
5349 Krom	B	Medium	Medium
5281Klein / Rooiberg	B	Medium	High

It is thus evident that the study area systems are largely functional and/ or have limited impacts as a result of current land use practices. This was confirmed for each of the affected reaches located within the development footprint and the areas that would be crossed by the proposed road layout shown in Figure 3. In other words, the systems observed are largely natural, with small or narrow riparian zones, dominated by non-obligate Karoo scrub. Thus, the DWS 2014 assessment for each of the study area systems is supported and the current ratings can be upheld within the E31C catchment. However, the subquaternary catchment located within D53F was not rated by DWS due to lack on any mainstem systems. In this assessment, a number of these were studied during the site visit and the PES – EI – ES scores for all the systems within the study area would also be rated as PES = B and EI and ES High respectively (as these can feed some of the pans to the north).

Per the National Freshwater Ecosystems Priority Area (NFEPA) wetland data, several large natural wetlands could occur within the study area (Figure 3), i.e. within 500m of the WEF boundary. The natural wetlands observed within the study area are natural endorheic pans or depressions that are located within 500m of the development site boundary. These are Largely Natural (PES = B), while all have a High-Medium Ecological Importance and Sensitivity rating

Figure 4 indicates that portions of the proposed project are however located within NFEPAs, due to contain potential habitat that may act as refugia and/ or supports an important aquatic ecosystem downstream. No direct aquatic species was observed within the site during the time of the survey, thus these NFEPAs must be related to the lower portions of the catchments that have been mentioned above.

Figure 5 indicates significant watercourses observed within the site, i.e. distinct natural channels that convey surface water run-off or have mobile alluvial characteristics due to the concentrated surface water runoff. Any activities within these areas or the 32m buffer or within 500m of a wetland boundary will require a Water Use license (possible General Authorisation) under Section 21 c & I, and it has been assumed all the towers can be placed outside of the water courses (incl 32m buffer). However, some areas along the alignment will require access tracks, thus crossing the water courses, but no solid infrastructure (e.g. culverts will be placed within these systems).

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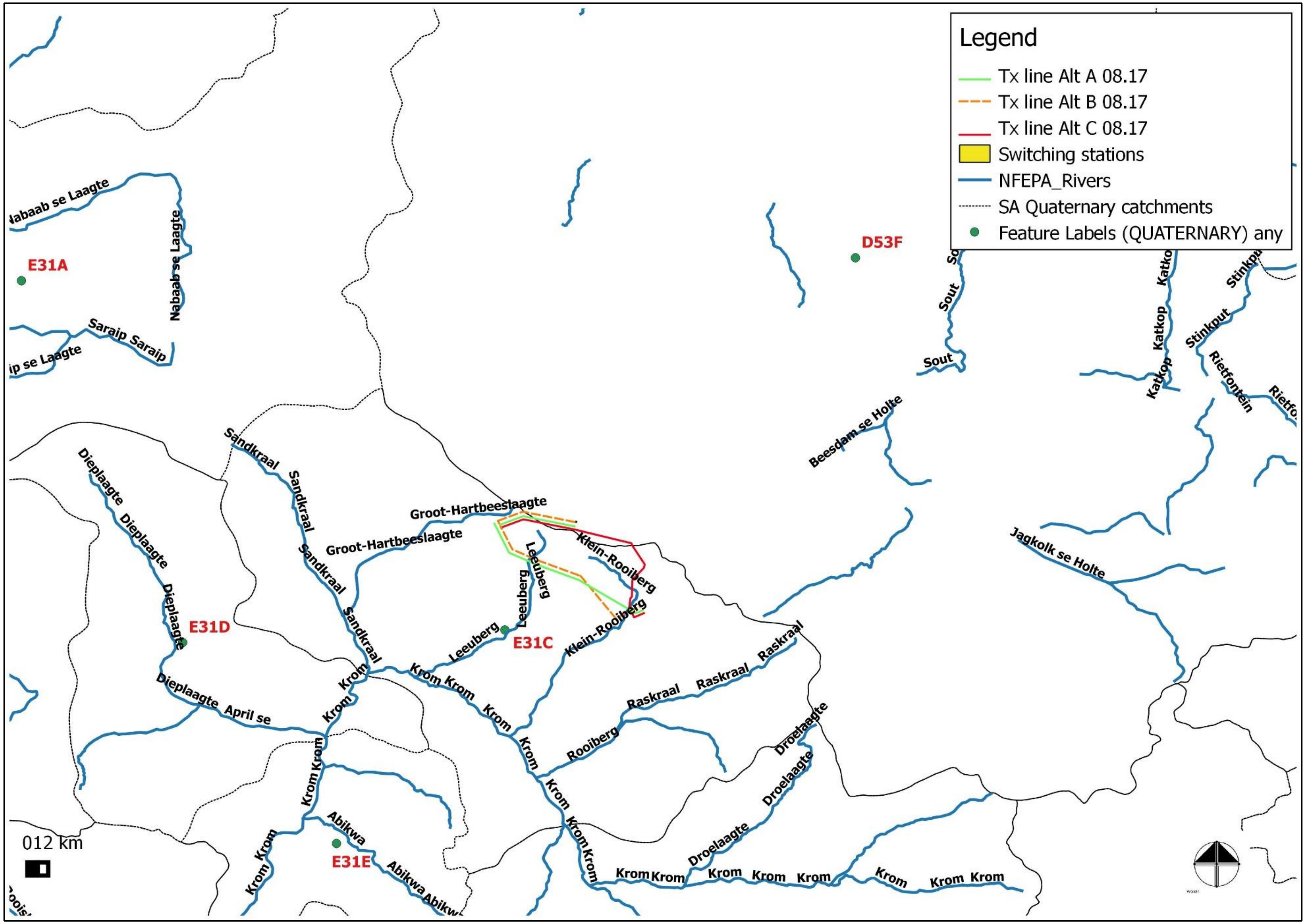

Figure 2: The project locality in relation to the various Quaternary Catchments and mainstem rivers as shown by NFEPA

Plate 1: The only significant water course is that of the Klein-Rooiberg / Krom systems, located approximately 20 – 30 km south of the proposed site

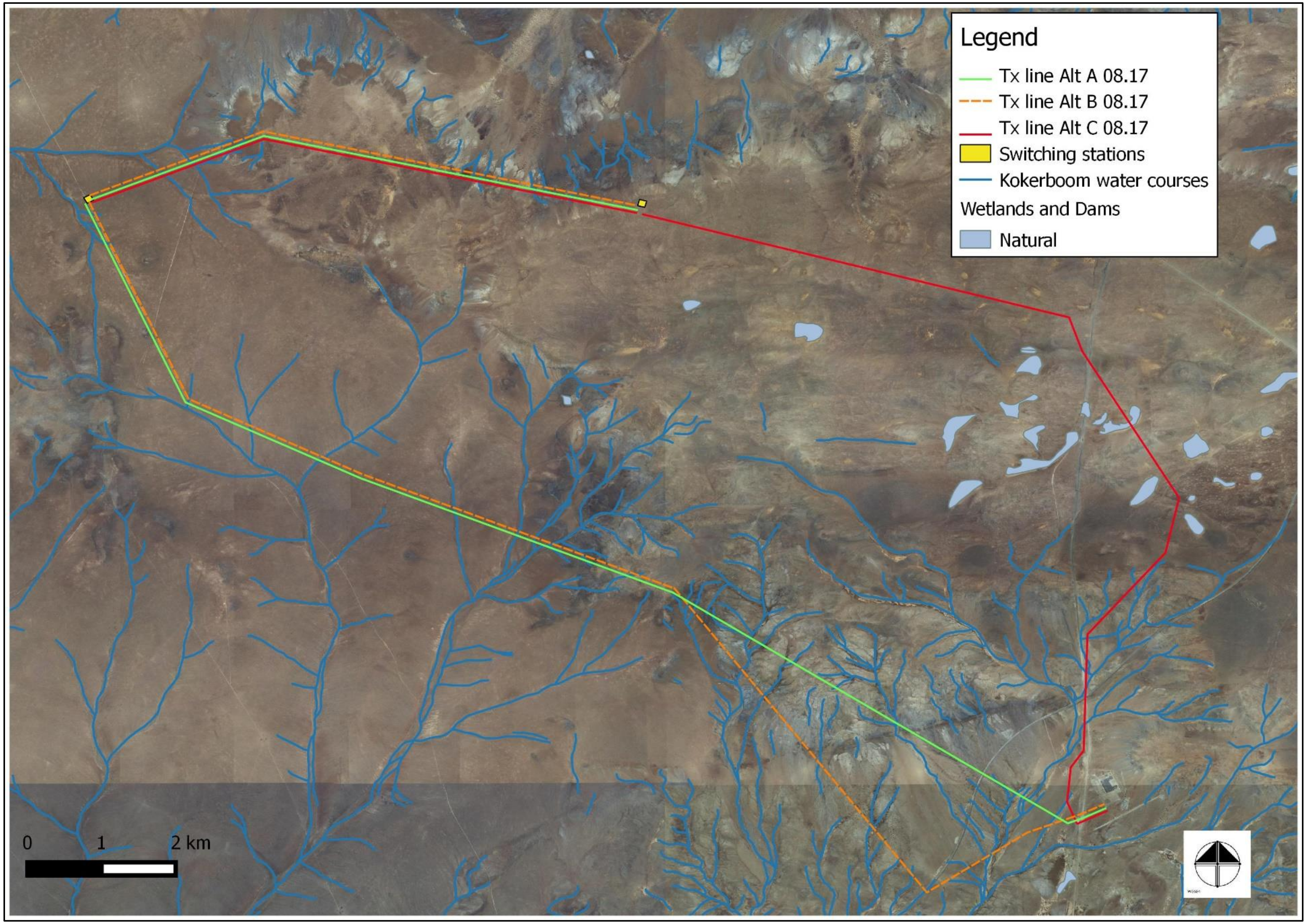

Figure 3: The project locality in relation to the known watercourses and/or wetlands within the study area

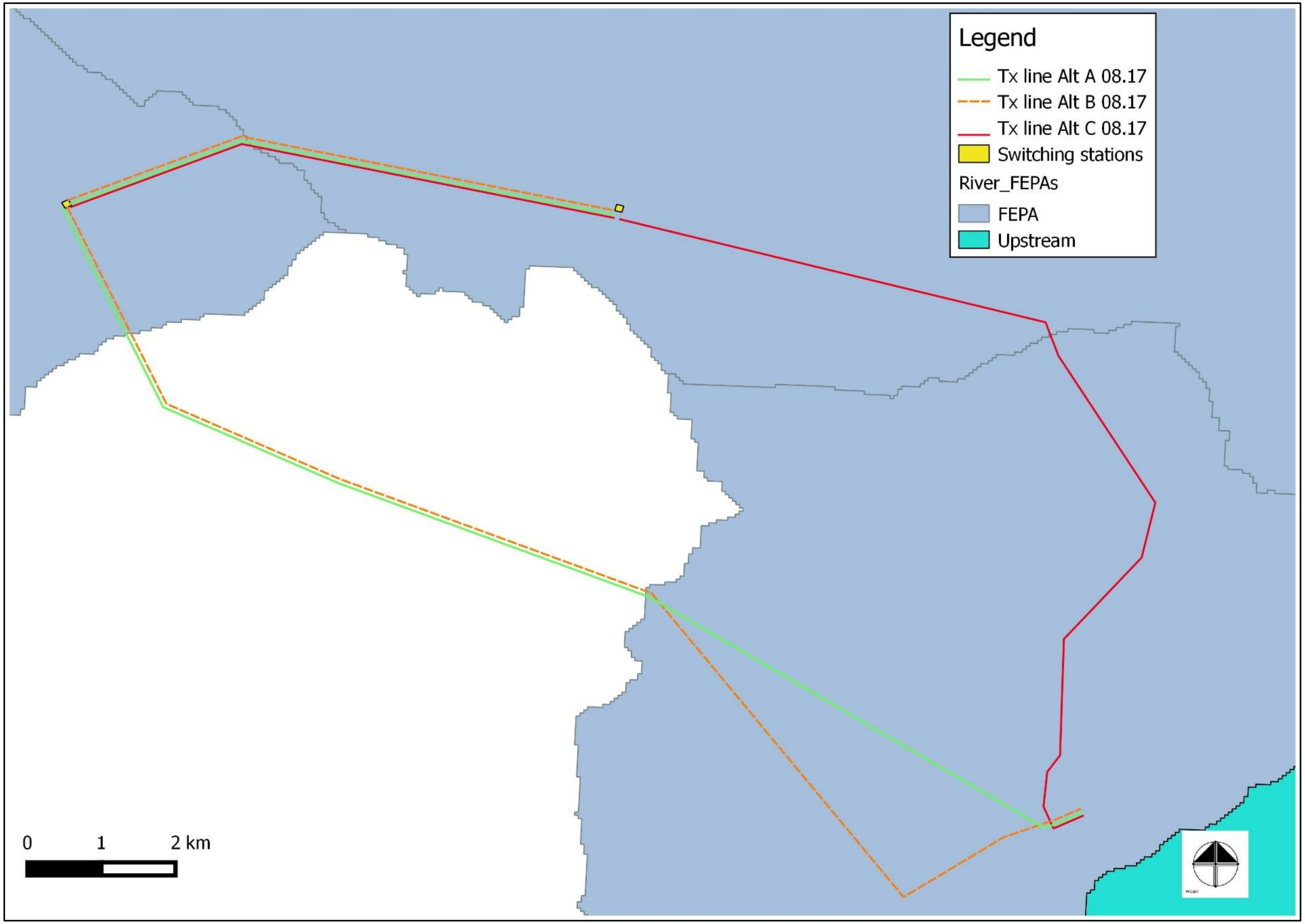

Figure 4: The project locality in relation the Freshwater Ecosystems Priority Areas (Nel *et al.*, 2011)

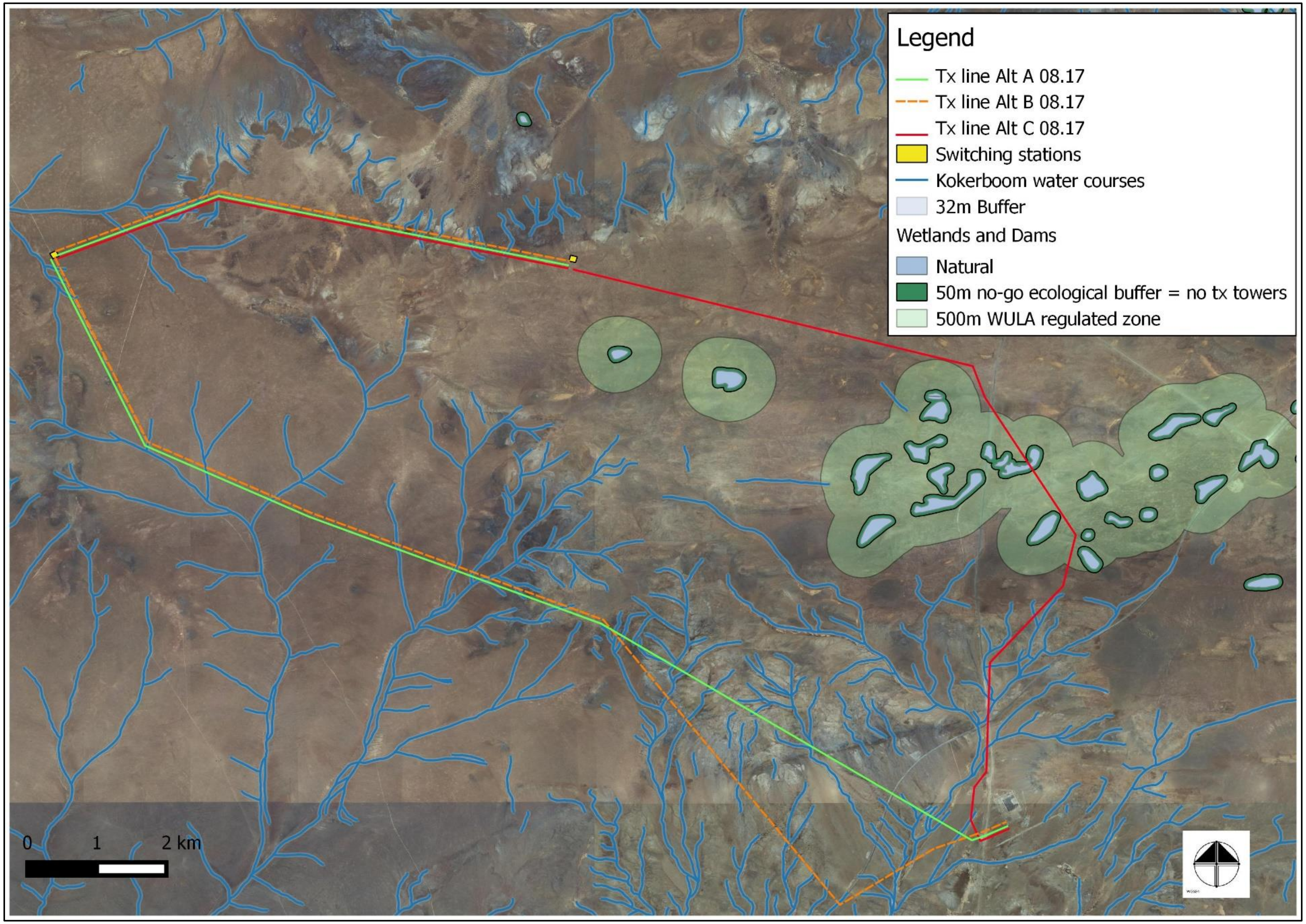

Figure 5: The project components in relation the respective Water Use License regulated zones i.e. watercourse crossings and 500m WULA regulated zone

7 IMPACT ASSESSMENT

During the impact assessment study, several potential key issues / impacts were identified and these were assessed based on the impact methodology supplied by Aurecon. The following direct and indirect impacts were assessed with regard to the riparian areas and water courses for each of the alternatives:

- Impact 1: Loss of riparian systems and disturbance of the alluvial water courses in the construction, operational and decommissioning phases
- Impact 2: Increase in sedimentation and erosion in the construction, operational and decommissioning phases
- Impact 3: Potential impact on localised surface water quality during the construction and decommissioning phases
- Impact 4: Storage of hazardous substances particular in the construction and operational phase related to the switching substations
- Impact 5: Loss of wetlands
- Impact 6: The No-go Alternative
- Impact 7: Cumulative impacts for the overall project due to the high number of projects surrounding this application

The impacts were assessed as follows:

Nature: Impact 1 - Loss of riparian systems and disturbance to alluvial water courses in the construction, operational and decommissioning phases for all three alternatives The physical removal of the riparian zones and disturbance of any alluvial watercourses would only occur should towers be placed directly within the water course and its buffer or through the creation of access tracks where required. These disturbances will be the greatest during the construction and again in the decommissioning phases as the related disturbances could result in lost or damaged vegetation and disturbance of bed / banks of the water courses		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes	
Mitigation: • All towers should be placed outside of the delineated waterbodies and their ecological buffers (32m and 50m) as shown in Figure 5. Note the 500m regulated zone only applies to the need for a water use license should any activities take places within these areas • Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise impacts when rainfall does occur. • It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the management of disturbed areas. • All alien plant re-growth, which is currently limited within the greater region must be monitored and should it occur these plants should be eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.		
Cumulative impacts: Due to the size of the foundations and the annual rainfall figures are low and this impact is not anticipated if the mitigation measures listed above are properly implemented.		
Residual impacts: Possible impact on the remaining catchment due to changes in run-off characteristics in the development site is unlikely.		

Nature: Impact 2 - Increase in sedimentation and erosion within the development footprint for all three alternatives i.e., impacts to the hydrological regime such as alteration of surface run-off patterns which could occur during the construction, operational and decommissioning phases. This would only occur should towers or other hard surfaces (culverts) be placed directly within the water course and its buffer		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes	
Mitigation: • All towers should be placed outside of the delineated waterbodies and their ecological buffers (32m and 50m) as shown in Figure 5. • Any stormwater within the site must be handled in a suitable manner, i.e. trap sediments and reduce flow velocities.		
Cumulative impacts: Erosion and sedimentation of the downstream systems and farming operations could result in cumulative impacts. However due to low mean annual runoff within the region this is not anticipated due to the nature of the development together with the proposed layout.		
Residual impacts: During flood events, any unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream could be remobilised. However due to low mean annual runoff within the region this is not anticipated due to the nature of the development together with the proposed layout.		

Nature: Impact 3 – Impact on localized surface water quality (all three alternatives) During both construction and to a limited degree the operational and decommissioning activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) associated with site-clearing machinery and construction & operation activities could be washed downslope via the ephemeral systems.		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes (high)	
Mitigation: • Strict use and management of all hazardous materials used on site. • Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.). • Containment of all contaminated water by means of careful run-off management on the development site. • Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility. • Strict control over the behaviour of construction workers, as relates to the use, storage and disposal of hazardous substances and other pollutants when any work is required within any of the proposed crossings.		

• Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Environmental Management Programme (EMPr) for the project and strictly enforced.
Cumulative impacts: Cumulative impacts can be avoided by implementing the abovementioned mitigation measures at the proposed wind farm and through other developments adhering to their EMPrs.
Residual impacts: Residual impacts will be negligible after appropriate mitigation.

Nature: Impact 4 – Impact on localized aquatic systems due to the storage of hazardous substances related to the switching substations. During the construction and to a limited degree the operational / decommissioning activities, hazardous substances mostly associated with the substations could be washed downslope via the ephemeral systems. This impact would be similar for all substation options. This would only occur should substations, be placed directly within the water course / wetlands and their respective buffers		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes (high)	
Mitigation: • Strict use and management of all hazardous materials used on site. • Strict management of potential sources of pollution. • Containment of all contaminated water by means of careful run-off management on the development site. • Working protocols incorporating pollution control measures (including approved method statements and emergency procedures by the contractor) should be clearly set out in the EMPr for the project and strictly enforced.		
Cumulative impacts: None as the use of such substances will be in low volumes and widespread over the greater region.		
Residual impacts: Residual impacts will be negligible after appropriate mitigation.		

Nature: Impact 5 - Loss of wetland (pans / depressions) associated with Alternative C The physical removal of the wetlands would only occur should any of the towers or access/service tracks be placed within the wetland features or the 50m ecological buffer (Figure 5). These disturbances will be the greatest during the construction and again in the decommissioning phases as the related disturbances could result in lost or damaged vegetation.		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes	
Mitigation: • Where new water course crossings are required, the engineering team must provide an effective means to minimise the potential upstream and downstream effects of sedimentation and erosion (erosion protection) as well minimise the loss of riparian vegetation (reduce		

footprint as much as possible). DWS has recommended in the past that low level causeways be used as these limit the potential impacts on erosion / sedimentation.

- During the operational and decommissioning phase, monitor culverts (if used) to see if erosion issues arise and if any erosion control is required.
- Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise impacts when rainfall does occur.
- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the management of disturbed areas.
- All alien plant re-growth, which is currently limited within the greater region must be monitored and should it occur these plants should be eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.

Cumulative impacts:
The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is likely to occur considering that the site is near the main drainage channels, however the annual rainfall figures are low and this impact is not anticipated if the mitigation measures listed above are properly implemented.

Residual impacts:
Possible impact on the remaining catchment due to changes in run-off characteristics in the development site is Low.

Nature: Impact 7 – No-go alternative.

Should the project not proceed the current conditions together with the present-day impacts would prevail, leading to a slow but limited deterioration of the aquatic systems as they were classified as "Largely Natural".

	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Not Applicable – no project related activities will take place and current land use practices will prevail
Duration	▪ Long-term	
Magnitude	▪ Medium	
Probability	▪ Probable	
Significance	▪ **Medium**	
Type (positive or Negative)	▪ Negative	
Reversibility	▪ Yes	
Confidence	▪ Sure	
Can impacts be mitigated	▪ Yes (high)	

Recommendations:

- Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region
- Install properly sized culverts with erosion protection measures at the present road / track crossings.
- Manage grazing or exclude livestock from watercourses that are showing signs or erosion or bank instability.

Cumulative impacts:
Cumulative impacts can be avoided by implementing the abovementioned mitigation measures by the farmers in the region.

Residual impacts:
Residual impacts will be negligible after appropriate mitigation.

Nature: Impact 8 – Overall cumulative impact.

In the assessment of this project, the surrounding projects and their associated grid connections within a 30km radius of the site were assessed. These include the Khobab Wind Farm and Loeriesfontein Wind Farm which are currently under construction, as well as the Dwarsrug Wind Farm and Orlight PV Solar Farm which have been granted environmental authorisation, but have not yet been awarded preferred bidder status.

Of these potential projects, this report author has been involved in the initial EIA aquatic assessments or has managed / assisted with the Water Use License process for 5 projects. The author has also reviewed the outcomes of the remaining projects as part of this EIA or other EIAs / WULs is the region.

All of the projects have indicated that this is also their intention with regard mitigation, i.e. selecting the best possible routes to minimise the local and regional impacts, and improving the drainage or hydrological conditions with these rivers so that the cumulative impact would be negligible. However, the worse-case scenario has been assessed below, i.e. only the minimum of mitigation be implemented by the other projects, noting only a small number of projects ever reach the construction phase and that flows within these systems are sporadic.		
	Without mitigation	**With mitigation**
Extent	▪ Local	▪ Local
Duration	▪ Long-term	▪ Long-term
Magnitude	▪ Medium	▪ Very Low
Probability	▪ Probable	▪ Probable
Significance	▪ **Medium**	▪ **Low**
Type (positive or negative)	▪ Negative	▪ Negative
Reversibility	▪ Yes	▪ Yes
Confidence	▪ Sure	▪ Sure
Can impacts be mitigated	▪ Yes (high)	

Mitigation:

- Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region that will be used as access (in collaboration with relevant authorities)
- Install properly sized culverts with erosion protection measures at the present road / track crossings if any within the project area

Cumulative impacts:
Cumulative impacts can be avoided by implementing the abovementioned mitigation measures by the farmers and other projects in the region.

Residual impacts:
Residual impacts will be negligible after appropriate mitigation.

8 ENVIRONMENTAL MANAGEMENT PLAN

Pertains to all three alternatives

Note ECO refers to the ECO, ESO and /or auditing team particularly in the operational phase as required

Construction and Operation Phase					
Objective	**Potential Impact**	**Mitigation Measures**	**Indicator**	**Responsibility**	**Timeframes**
Soil erosion control, water quality management at potential road crossings	» Erosion and soil loss within **watercourses** » Disturbance to or loss of **watercourses** » Sedimentation of **watercourse areas** » Loss of indigenous vegetation cover, particularly in **watercourse areas** » Increased runoff into rivers potentially associated with accelerated erosion in **watercourses**	» Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling) » Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. All stockpiles must be positioned at least 30 m away from water courses, unless agreed otherwise with the ECO. Limit the height of stockpiles as far as possible in order to reduce compaction. » Any excavation, including those for cables, must be supervised by the ECO where necessary when near (32m) or within any watercourses. Disturbance of vegetation and topsoil must be kept to a practical minimum. » Rehabilitate disturbance areas as soon as construction in an area is completed.	» No activity in identified no-go areas » Acceptable level of activity within disturbance areas, as determined by ECO » Acceptable level of soil erosion around site, as determined by ECO » Acceptable level of increased siltation in water courses, as determined by ECO » Acceptable level of soil degradation, as determined by ECO » Acceptable state of excavations, as determined by Resident Engineer & ECO	Construction phase: ECO Contractor Operational phase: Wind Farm Operator	During site establishment, construction and operational phase

Construction and Operation Phase					
Objective	**Potential Impact**	**Mitigation Measures**	**Indicator**	**Responsibility**	**Timeframes**
Successful waste and pollutant management	» The watercourse areas could be impacted via: 1. Release of contaminated water from contact with spilled chemicals 2. Generation of contaminated wastes from used chemical containers 3. Inefficient use of resources resulting in excessive waste generation 4. Litter or contamination of the site or water through poor waste management practices	» Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling). » Any excavation, including those for cables, must be supervised by the ECO where necessary when near (32m) or within any watercourses » Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. All stockpiles must be positioned at least 30 m away from water courses. Limit the height of stockpiles as far as possible in order to reduce compaction. » Storage areas must be located more than 50 m away from the watercourse, unless agreed otherwise with the ECO. » The storage of flammable and combustible liquids such as oils must be in designated areas which are appropriately bunded, and stored in compliance with material safety datasheet (MSDS) files, as defined by the safety, health and environment (SHE) Representative / ECO. » Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals must be complied with. » Routine servicing and maintenance of vehicles is not to take place on-site (except for emergency situations or large cranes which cannot be moved off-site). If repairs of vehicles must take place on site, an appropriate drip tray must be used to contain any fuel or oils.	» No chemical spills outside of designated storage areas » No water or soil contamination by chemical spills » No complaints received regarding waste on site or indiscriminate dumping » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately » Provision of all appropriate waste manifests for all waste streams » Firefighting equipment and training provided before the construction phase commences » No activity in identified no-go areas » Acceptable level of activity within disturbance areas, as determined by ECO » Acceptable level of soil erosion around site, as determined by ECO » Acceptable level of increased siltation in water courses, as determined by ECO » Acceptable level of soil degradation, as determined by ECO » Acceptable state of excavations, as determined by Resident Engineer & ECO	ECO Contractor	During site establishment, construction and operational phase

		» Transport of all hazardous substances must be in accordance with the relevant legislation and regulations. » Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors. » Waste disposal records must be available for review at any time. Documentation (waste manifest) must be maintained detailing the quantity, nature and fate of any hazardous waste. » Construction contractors must provide specific detailed waste management plans to deal with all waste streams. » Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap) and contaminated waste. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage and vermin control. » Where possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection, separation and storage of waste streams (such as wood, metals, general refuse etc.). Supply waste collection bins at construction equipment and construction crew camps. » Under no circumstances may solid waste be burnt or buried on site. » Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area. » Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal. » Hazardous and non-hazardous waste must be separated at source. Separate waste collection bins must be provided for this purpose. These bins must be clearly marked and appropriately covered. » Construction equipment must be refuelled within designated refuelling locations, or where remote refuelling is required, appropriate drip trays must be utilised. » All stored fuels to be maintained within a bund and on a sealed surface. Fuel storage areas must be inspected regularly to ensure bund stability, integrity and function. » Construction machinery must be stored in an appropriately sealed area. » An incident/complaints register must be established and maintained on-site. » Corrective action must be undertaken immediately if a complaint is received, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing preventive measures. » Appropriate emergency training (e.g. firefighting) must be given to team prior to the construction period. » Any spills must receive the necessary clean-up action. If required, bioremediation kits are to be kept on-site and used to remediate any spills that may occur. Appropriate arrangements to be made for appropriate collection and disposal of all cleaning materials, absorbents and contaminated soils (in accordance with a waste management plan).			

		» Oily water from bunds at the substation must be removed from site by licensed contractors. » Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility. » Spilled cement or concrete must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site. » In the event of a major spill or leak of contaminants, the relevant administering authority must be immediately notified as per the notification of emergencies/incidents. » Upon the completion of construction, the area will be cleared of potentially polluting materials. » Rehabilitate disturbance areas as soon as construction in an area is completed.			

9 CONCLUSION AND RECOMMENDATIONS

The following indirect impacts were assessed with regard the riparian areas and water courses:

- Impact 1: Loss of riparian systems and disturbance of the alluvial water courses in the construction, operational and decommissioning phases
- Impact 2: Increase in sedimentation and erosion in the construction, operational and decommissioning phases
- Impact 3: Potential impact on localised surface water quality during the construction and decommissioning phases
- Impact 4: Storage of hazardous substances particular in the construction and operational phase related to the switching substations
- Impact 5: Loss of wetlands
- Impact 6: The No-go Alternative
- Impact 7: Cumulative impacts for the overall project due to the high number of projects surrounding this application

The proposed alignments for the facilities would seem to have limited impact on the aquatic environment as the proposed structures for the most part can avoid the delineated watercourses. Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities inclusive of the alternatives is made. Further, no aquatic protected or species of special concern (flora) were observed during the site visit. Therefore, based on the site visit the significance of the impacts assessed for the aquatic systems after mitigation would be LOW (negative).

Any activities within the identified watercourses including the 32m buffer or within 500m of a wetland / pan boundary will require a Water Use license (possible General Authorisation) under Section 21 c & i. However, for the purposes of this report it has been assumed that all overhead transmission line towers will be placed outside any of the buffer areas, while the transmission line will span these systems. However, some of the areas will require the provision of access tracks, and although no hard surfaces or culverts are proposed Alternative B has been identified as the preferred alternative. This alignment will avoid all wetland areas, and cross fewer water courses than Alternative A. Alternative C will need to span several pans (wetlands) making this the least favorable alignment. However, despite Alternative B being identified as the preferred option, it is noted that the impacts associated with all three alternatives can be mitigated to a low level, and all three alternatives are considered acceptable from a freshwater perspective.

As the proposed activities have the potential to create erosion the following recommendations and assumptions are reiterated:

- Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination. Washing and cleaning of equipment should also be done in berms or bunds, in order to trap any cement and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel. It is therefore suggested that all construction camps, lay down areas, batching plants or areas and any stores should be more than 30m from any demarcated water courses, unless agreed otherwise with the ECO.
- It is also advised that an Environmental Control Officer, with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas, using selected species detailed in this report.

- All alien plant re-growth must be monitored and should it occur these plants should be eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.

Detailed mitigation measures were also listed in Section 8: Environmental Management Plan.

This is based on the assumption that following conditions will be adhered to:

- No transmission line towers, substations and construction camps may be placed within the delineated water courses /wetlands as well as their respective buffers without obtaining the required approvals.
- It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset within areas of disturbance (inclusion of buffers) to ensure a net benefit to the aquatic environment. This should from part of the suggested walk down as part of the final EMPr preparation

10 REFERENCES

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APPENDIX 1 – WETLAND ASSESSMENT METHODOLOGY

The assessment was initiated with a survey of the pertinent literature, past reports and the various conservation plans that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain, which portions of the proposed development, could have the greatest impact on the wetlands and associated habitats.

A one-day site visit was then conducted to ground-truth the above findings, thus allowing critical comment of the development when assessing the possible impacts and delineating the wetland areas.

Wetland and riparian areas were then assessed on the following basis:

- Vegetation type – verification of type and its state or condition based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended) and the South African Biodiversity Information Facility (SABIF) database.
- Plant species were further categorised as follows:
    - Terrestrial: species are not directly related to any surface or groundwater base-flows and persist solely on rainfall
    - Facultative: species usually found in wetlands (inclusive of riparian systems) (67 – 99% of occurrences), but occasionally found in terrestrial systems (non-wetland) (DWAF, 2005/2007)
    - Obligate: species that are only found within wetlands (>99% of occurrences) (DWAF, 2005/2007)
- Assessment of the wetland type based on the National Wetland Classification System (NWCS) method discussed below and the required buffers
- Mitigation or recommendations required

National Wetland Classification System (Ollis et al., 2013)

Since the late 1960s, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects.

The South African National Biodiversity Institute (SANBI) in collaboration with a number of specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (NWCS, 2014). This system comprises a hierarchical classification process of defining a wetland based on the principles of the Hydrogeomorphic (HGM) approach at higher levels, including structural features at the finer or lower levels of classification.

Wetlands developed in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005/2007). It is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regard the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water and Sanitation (DWS). The Ecological Reserve of a wetland or river is used by DWS to assess the water resource allocations when assessing water use license applications (WULA).

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the Reserve Template

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

Wetland definition

Although the National Wetland Classification System (2014) is used to classify wetland types it is still necessary to understand the definition of a wetland. Wetland definitions as with classification systems have changed over the years. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as **"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"** (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised seaward boundary of the shallow photic zone (Lombard *et al*., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows:

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a water course (NWCS, 2014). The DWS is however reconsidering this position with regard the management of estuaries due to the ecological needs of these systems with regard to water allocation. Table 1 provides a comparison of the various wetlands included within the main sources of wetland definition used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (NWCS, 2014).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005/2007):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines.

Table 1: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems are included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	▪ YES	▪ NO	▪ NO
Estuarine	▪ YES	▪ NO	▪ NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often describes as lakes or dams)	▪ YES	▪ NO	▪ NO
Rivers, channels and canals	▪ YES	▪ NO[1]	▪ NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	▪ YES	▪ YES	▪ YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	▪ YES	▪ YES	▪ YES[3]
Riparian[2] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	▪ NO	▪ NO	▪ YES[3]

Wetland importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act

[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[3] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.

- Trap sediments; and
- Reduce the number of water borne diseases.

In the past wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 2 summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 2: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al.*, 2008.

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">▪ Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>▪ Sediment trapping</td></tr>
<tr><td>▪ Phosphate assimilation</td></tr>
<tr><td>▪ Nitrate assimilation</td></tr>
<tr><td>▪ Toxicant assimilation</td></tr>
<tr><td>▪ Erosion control</td></tr>
<tr><td colspan="2">▪ Carbon storage</td></tr>
<tr><td colspan="3">▪ Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">▪ Provision of water for human use</td></tr>
<tr><td colspan="3">▪ Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">▪ Provision of cultivated foods</td></tr>
<tr><td colspan="3">▪ Cultural significance</td></tr>
<tr><td colspan="3">▪ Tourism and recreation</td></tr>
<tr><td colspan="3">▪ Education and research</td></tr>
</table>

National Wetland Classification System method

During this study due to the nature of the wetlands and watercourses observed, it was decided that the newly accepted National Wetlands Classification System (NWCS) be adopted. This classification approach has integrated aspects of the HGM approached used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (SANBI, 2009) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (SANBI, 2009).

The classification system used in this study is thus based on SANBI (2009) and is summarised below:

The NWCS has a six tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 1). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular systems has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

(iv) Landform – shape and localised setting of wetland
(v) Hydrological characteristics – nature of water movement into, through and out of the wetland
(vi) Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for the inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses of six descriptors to characterise the wetland types on the basis of biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

(vii) Geology;
(viii) Natural vs. Artificial;
(ix) Vegetation cover type;
(x) Substratum;
(xi) Salinity; and
(xii) Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, thus are nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 2 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

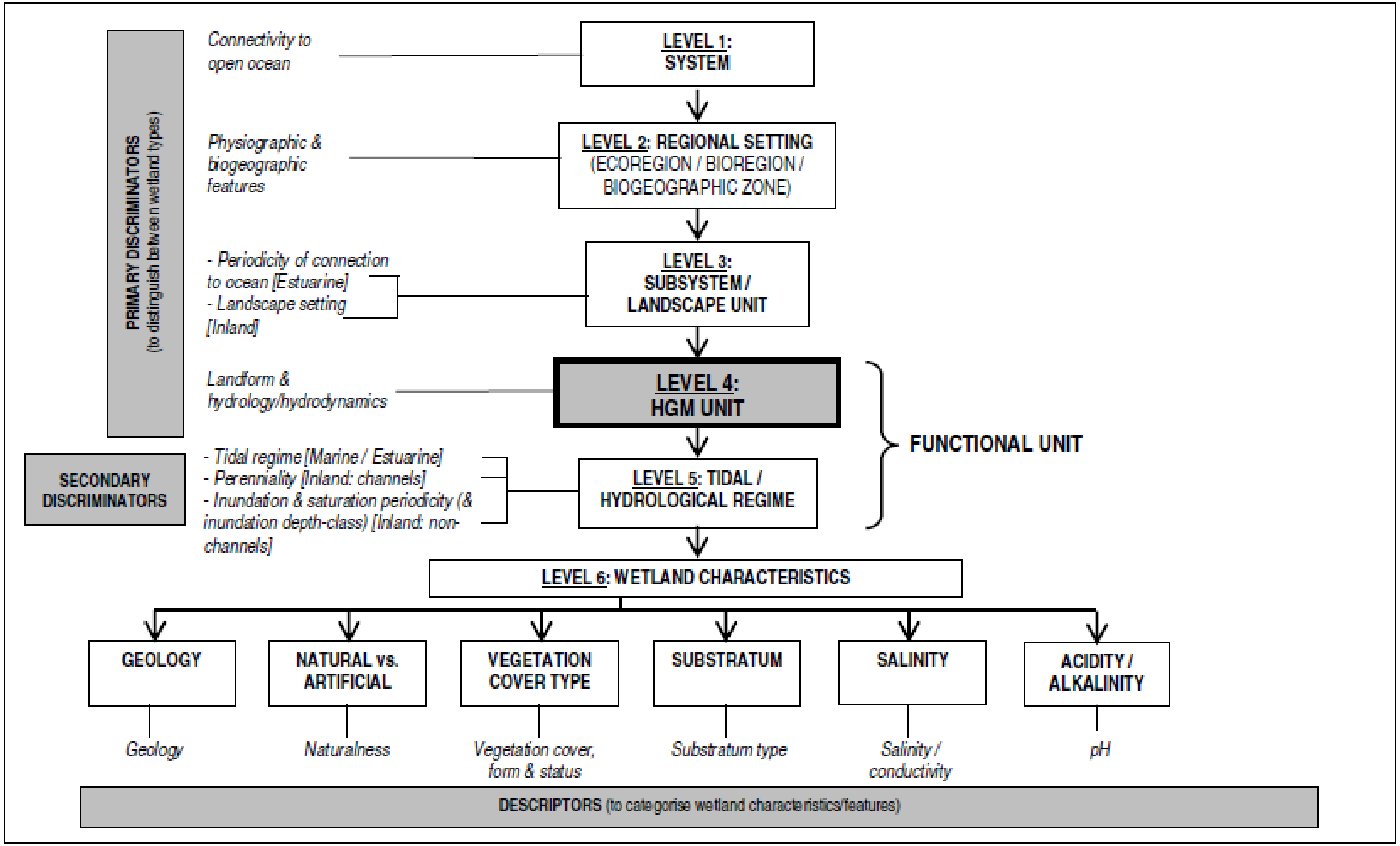

Figure 1: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From SANBI, 2009).

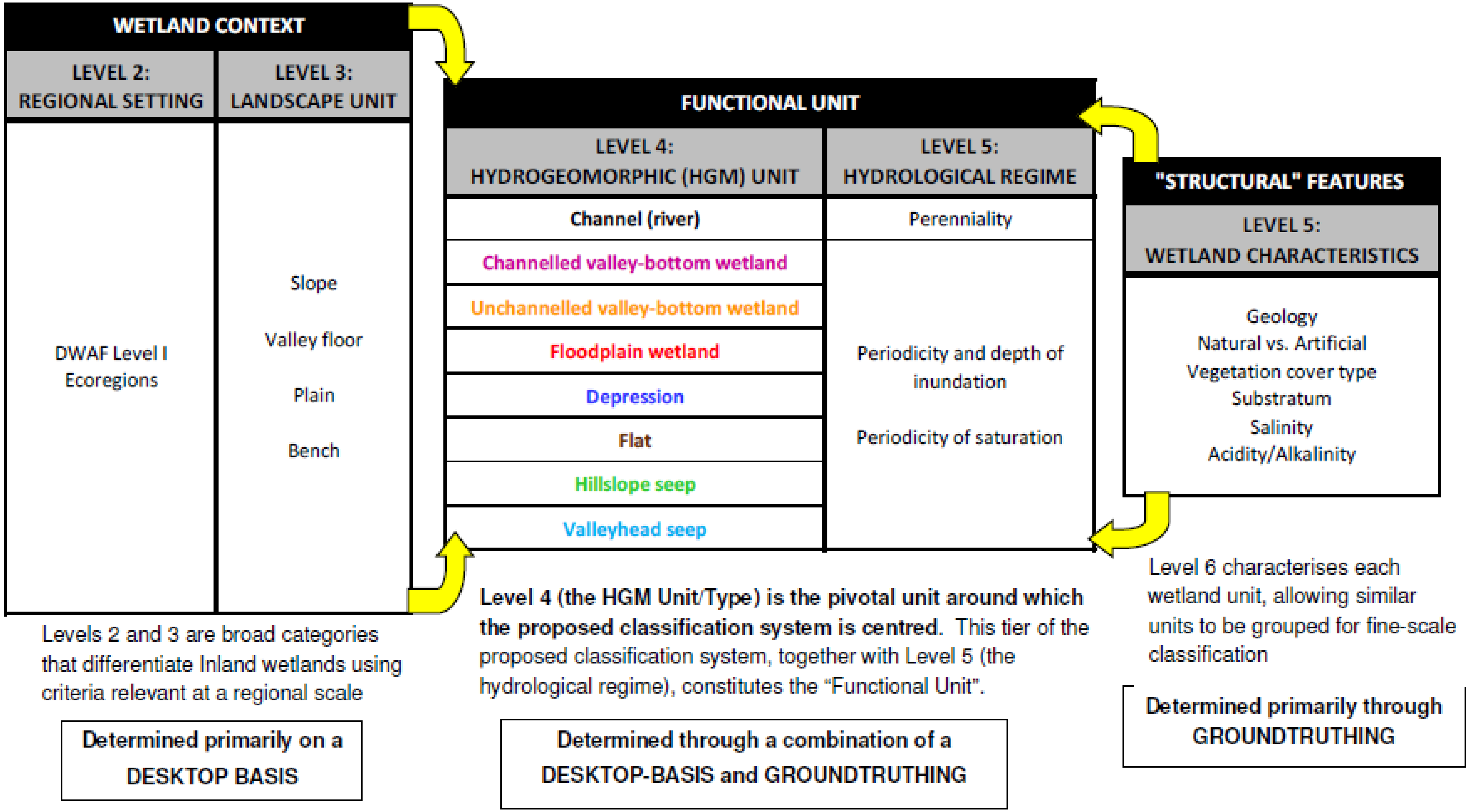

Figure 2 Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from SANBI, 2009).

Wetland condition and conservation importance assessment

To assess the Present Ecological State (PES) or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 4), and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind, and is not always suitable for impact assessments. This coupled to degraded state of the wetlands in the study area, a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 4: Description of A – F ecological categories based on Kleynhans *et al*., (2005).

<table>
<tr><th>ECOLOGICAL CATEGORY</th><th>ECOLOGICAL DESCRIPTION</th><th>MANAGEMENT PERSPECTIVE</th></tr>
<tr><td>A</td><td>Unmodified, natural.</td><td>Protected systems; relatively untouched by human hands; no discharges or impoundments allowed</td></tr>
<tr><td>B</td><td>Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.</td><td>Some human-related disturbance, but mostly of low impact potential</td></tr>
<tr><td>C</td><td>Mediumly modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.</td><td rowspan="2">Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation</td></tr>
<tr><td>D</td><td>Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.</td></tr>
<tr><td>E</td><td>Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.</td><td rowspan="2">Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality</td></tr>
<tr><td>F</td><td>Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.</td></tr>
</table>

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary ***driving processes*** behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human landuse activities on the wetland surface itself and how these may have ***modified*** the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a rapid site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWAF's River EcoStatus models which are currently used for the assessment of PES in riverine environments.

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness
- Species of conservation concern
- Habitat fragmentation with regard ecological corridors
- Ecosystem service (social and ecological)

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of conservation concern was observed (HIGH). Any systems that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Wetlands which receive a LOW conservation importance rating could be included into stormwater management features, but should not be developed so as to retain the function of any ecological corridors.

HERITAGE IMPACT ASSESSMENT FOR PROPOSED TRANSMISSION LINES & ASSOCIATED INFRASTRUCTURE NORTH OF LOERIESFONTEIN, CALVINIA MAGISTERIAL DISTRICT, NORTHERN CAPE

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

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On behalf of:

BUSINESS VENTURE INVESTMENTS NO. 1788 (PTY) LTD

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1st draft: 19 December 2016
2nd draft: 31 January 2017
Final report: 02 August 2017.

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Aurecon South Africa (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction of overhead power lines and associated infrastructure in an area to the north of Loeriesfontein, Calvinia Magisterial District, Northern Cape. The power lines are intended to link the proposed Kokerboom 1, 2 and 3 Wind Energy Facilities to the national grid via the Eskom Helios Substation. Three alternative routes have been proposed.

The study area is comprised of gently undulating topography with low, scrubby vegetation. The ground is variably sandy or gravelly and a few streams cross the site. Standing rock outcrops are rare, although the ground is rocky in places.

Heritage resources were found to be most common in close proximity to the Klein Rooiberg River and on the crests of a cluster of hills where the Alternative A and B corridors separate from one another. The majority were Stone Age archaeological sites, but a historic structure with an associated dump was also located. The intervening landscape tends to be devoid of heritage resources. Some of the sites located have medium or medium-high cultural significance and, as such, should be avoided or mitigated as necessary.

It is recommended that the development be allowed to proceed but subject to the following conditions which should be incorporated into the environmental authorisation should one be issued:

- The final alignment of the powerline within the chosen corridor should be considered by an archaeologist to ensure that known sites are safe from harm and to check whether a follow-up survey may be required in certain areas. Such survey should be carried out and any further resulting requirements (e.g. archaeological mitigation, including of the sites at waypoints 393 and/or 20 as appropriate) should be met prior to the start of construction; and
- If any archaeological material or human burials are uncovered during the course of development then the find should be protected from further disturbance and work in the immediate area should be halted if necessary. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CCS: Crypto-crystalline silica

CRM: Cultural Resources Management

ECO: Environmental Control Officer

ESA: Early Stone Age

GPS: global positioning system

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Aurecon South Africa (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction of a 132kV overhead power line, two switching stations (each ±100m X 100m) and associated infrastructure (including access/service tracks along the powerline route) in an area to the north of Loeriesfontein, Calvinia Magisterial District, Northern Cape (Figures 1 & 2). The power lines are intended to link the proposed Kokerboom 1, 2 and 3 Wind Energy Facilities (WEFs) to the grid via the Eskom Helios Substation.

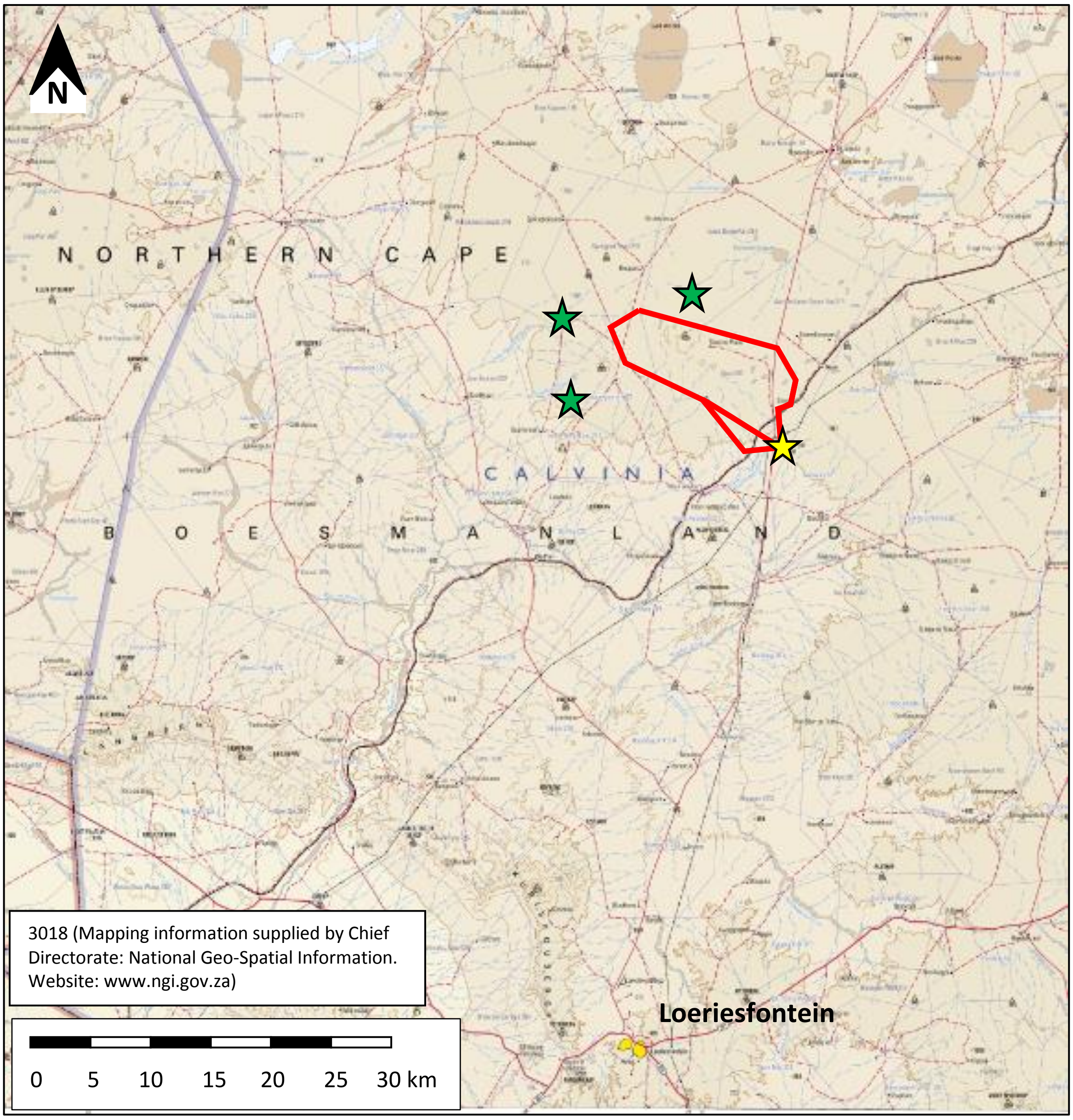

Figure 1: *Map showing the location of the various proposed transmission line routes (red lines), relative to the town of Loeriesfontein in the south. The Eskom Helios Substation is indicated by the yellow star, while the three proposed WEFs are shown by the green stars. The bold wavy line passing from southwest to northeast is the Sishen-Saldanha Railway.*

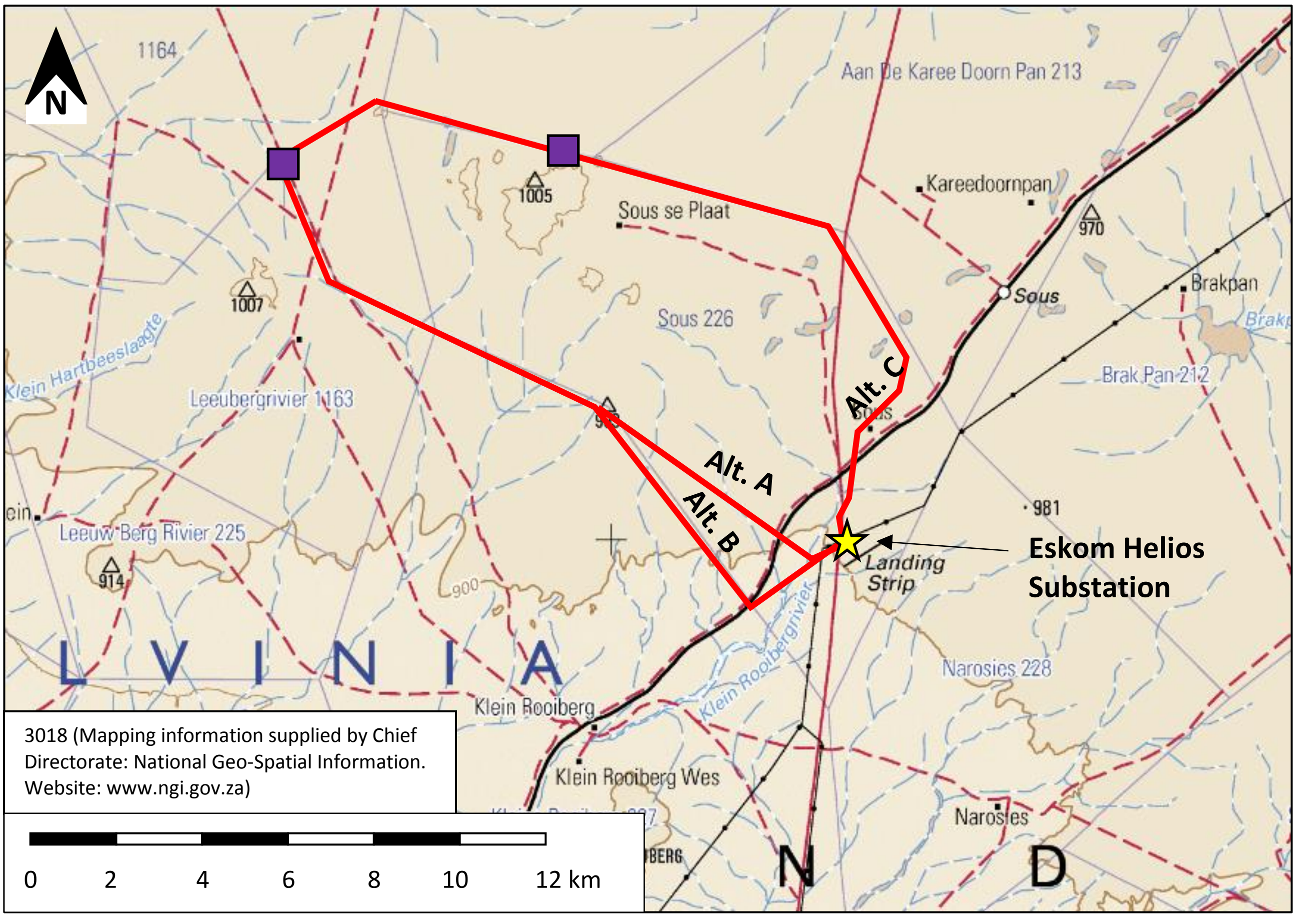

Figure 2: *Map showing the location of the various transmission line route alternatives proposed (red lines) relative to the Eskom Helios Substation (yellow star) and two on-site switching stations (purple squares; not to scale). The bold wavy line passing from southwest to northeast is the Sishen-Saldanha Railway.*

1.1. Project description

It is proposed to construct a 132 kV overhead transmission line (single or double circuit) and two switching stations to link the proposed Kokerboom WEFs to the existing Eskom Helios Substation located to the east of the WEF sites. The proposed transmission lines would be between 23 km and 27 km long depending on the route chosen for implementation. Three Alternatives – A, B and C – have been proposed with Alternative B currently favoured by the proponent. A 500m wide corridor was assessed for each proposed Alternative routing.

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for pylon foundations may impact on archaeological and/or palaeontological remains, while all above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA was asked by Aurecon to compile a heritage impact assessment (HIA) that would meet the requirements of the heritage authorities and deal with all aspects of heritage except palaeontology which has been considered by another specialist. In this regard, ASHA was asked to:

- Undertake a site investigation to determine the *status quo* and identify any sensitive features or no-go areas;
- Provide shapefiles of all sensitive features;
- Assess three proposed corridor alternatives;
- Make use of the Aurecon Impact Assessment Methodology (further detailed in the Kokerboom Transmission Line BAR) when assessing impacts for all alternatives as well as cumulative impacts;
- Provide a detailed description of appropriate mitigation measures that can be adopted to reduce or avoid negative impacts and improve positive impacts for each phase of the project, where required, and the significance of impacts pre- and post-mitigation;
- Provide a summary of succinct and practical recommendations based on mitigation measures identified to form the basis of Environmental Authorisation requirements, should the development be authorised; and
- Comply with the content requirements for specialist reports listed in Appendix 6 of the 2014 EIA Regulations (GN R982 of 2014, as amended).

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the National Department of Environmental Affairs (DEA) who will review the Basic Assessment (BAR) and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in the Western Cape and Northern Cape provinces of South Africa since 2004 (Please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: "any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith";
- Palaeontological material: "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace";
- Archaeological material: a) "material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures"; b) "rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation"; c) "wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";
- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38 (2a) states that if there is reason to believe that heritage resources will be affected then an impact assessment report must be submitted. This report fulfils that requirement.

Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to a BAR. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:250 000 map was sourced from the Chief Directorate: National Geo-Spatial Information. The aerial photograph in Figure 20 was sourced from http://ge-map-overlays.appspot.com/bing-maps/hybrid.

3.2. Field survey

The various alternatives were assessed over the course of several field surveys in conjunction with the Wind Farms they are intended to support (Figure 3; Orton 2017a, 2017b, 2017c). Alternatives A and B, where they fell outside of the Wind Energy Facility project boundaries, were examined on foot on 17 October 2016, while parts of Alternative C were examined on 29 and 30 January 2014 as part of another project (Orton 2014), as well as in February 2017. A 500m corridor (250m either side of the proposed line routing) was assessed for all alternative routes. The 2014 and 2017 surveys were in summer and the 2016 surveys in winter and in spring, but the season has no relevance on the heritage survey because, given the low and relatively sparse vegetation of the area, visibility does not change much with seasons. During the surveys the positions of finds were recorded on a hand-held GPS receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

3.3. Specialist studies

No specialist studies were commissioned for the present report, although palaeontological heritage resources have been assessed by another specialist (Dr John Almond) and reported on separately.

3.4. Impact assessment

For consistency, the impact assessment was conducted through application of a scale supplied by the Environmental Assessment Practitioner, Aurecon.

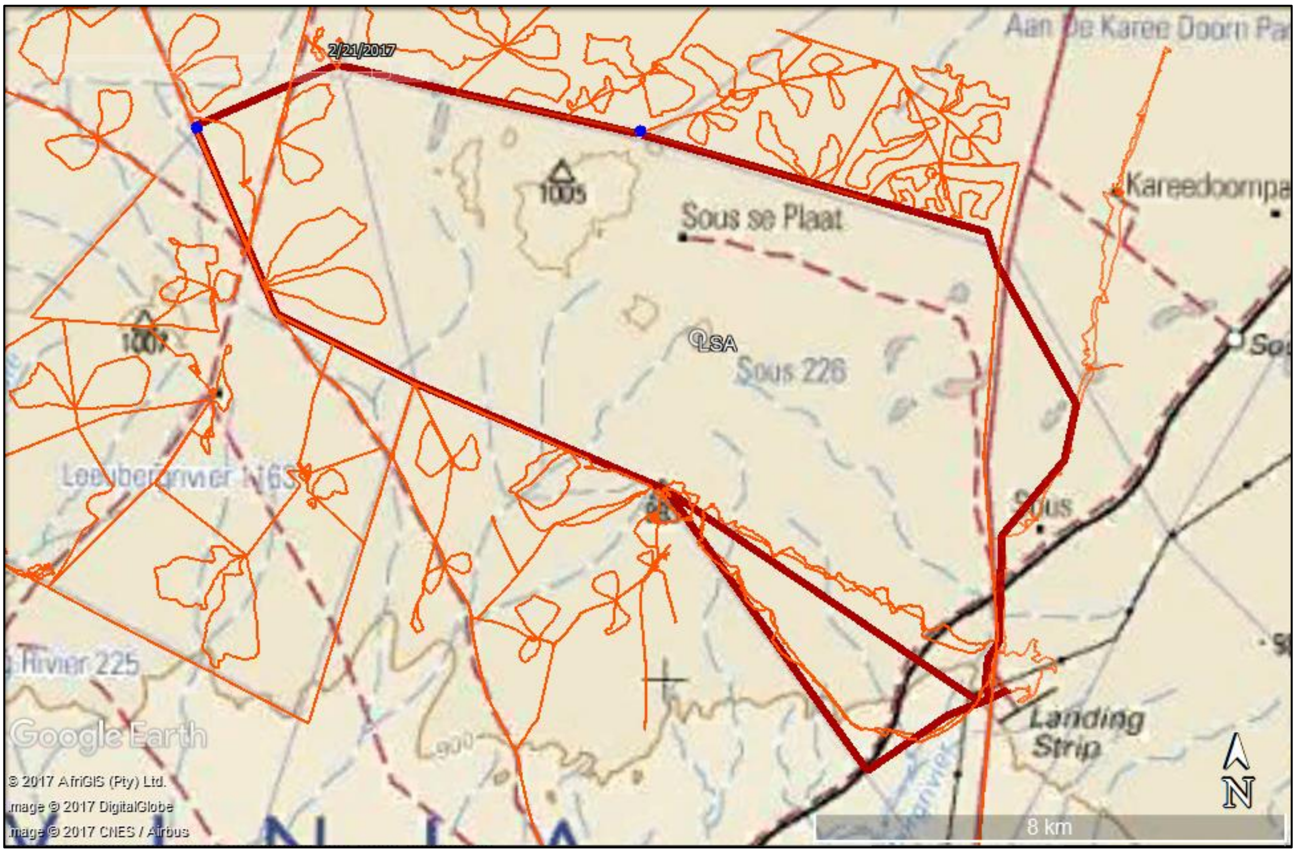

Figure 3: *Map of the study area (brown shaded corridors) showing the drive and walk paths created during the surveys, including those for the WEFs (orange lines).*

3.5. Grading

S.7(1) of the NHRA provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' and rated with an A (high/medium significance, requires mitigation), B (medium significance, requires recording) or C (low significance, requires no further action).

3.6. Consultation

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

3.7. Assumptions and limitations

The field study was carried out at the surface only and hence any completely buried archaeological sites would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Because of the very long alignments proposed, the width of the corridors (500 m) and the nature of the study area in which significant archaeological material is known to be confined largely to stream margins and hilltops, a decision was taken to examine the most sensitive-looking areas only (based on aerial photography). It is assumed that the spatial distribution of archaeological resources as just described would be largely consistent. A short section of Alternative A was realigned after the survey and was thus not covered on the ground, while a short section of Alternative C was not walked because of difficulty of access. Assessment of these sections was thus based on general knowledge of the landscape.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is in a very remote location on land that is used largely for livestock grazing. A precedent has already been set for electrical development with two wind energy facilities currently being under construction in the immediate vicinity. A further wind energy facility and a solar energy facility have also been authorised nearby. A large Eskom Substation (into which the proposed transmission lines would run) lies at the eastern end of the present study area, alongside the gravel road that leads northwards from Loeriesfontein. The Sishen-Saldanha Railway bisects the landscape between the substation and the study area.

4.2. Site description

The corridors for the transmission lines are topographically variable with a high point in the south-central area where Alternatives A and B split from one another (Figure 4). The hills tend to be rocky and coated in gravel, while the valleys are silty, especially close to the Helios Substation where the Klein Rooiberg River crosses a few of the corridors. Figures 4 to 7 show various views of the study area.

Figure 4: *View towards the northwest along Alternative A towards the point where they split on the high-lying ground in the right background.*

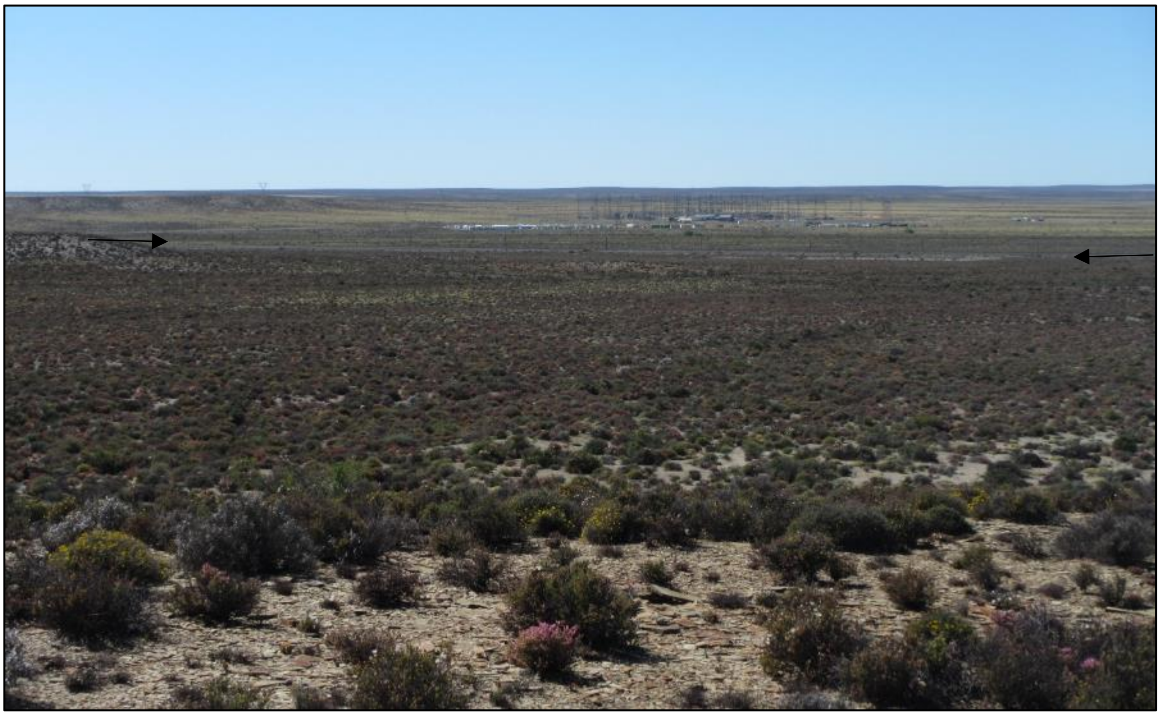

Figure 5: *View south-eastwards along the original Alternative A corridor towards the Helios Substation from the eastern-most hill. The Sishen-Saldanha Railway is arrowed and the Klein Rooiberg River lies between the railway and the substation.*

Figure 6: *View towards the southwest from the rocky hills surrounding the Helios Substation. Alternatives A,B & C approach the substation from behind the substation in this view.*

Figure 7: *View towards the north from an ephemeral pan along the Alternative C route. The tower faintly visible in the background is a wind measuring mast.*

5. HERITAGE CONTEXT

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What was found during the field survey may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources.

5.1. Archaeological aspects

Beaumont *et al.* (1995:240) have stated that "Thousands of square kilometres of Bushmanland are covered by a low density lithic scatter". Many impact assessments have found this to be true, although it can be stated that the scatter tends to be more noticeable in northern Bushmanland than in the south. The artefacts include material dating to the early (ESA), Middle (MSA) and Later (LSA) Stone Ages.

In the general vicinity of the present study area Van Schalkwyk (2011) found Stone Age sites to be associated with hills – they were either located on the crests or at the foot of the hills and were from both the MSA and the LSA. Orton (2013) found a few small LSA artefact scatters associated with both hill tops and the margins of streams. In addition to widespread but low density MSA artefacts forming part of the background scatter, Webley and Halkett (2012) also reported small LSA sites located on the crests of low hills just to the south of the present study area. These sites revealed primarily stone artefacts and ostrich eggshell, although one had pottery and a bead on it. They found another site, located close to a stream bed, which had a number of grooved grindstones on it.

Beaumont and Morris (1985 in Morris 2013) found dense LSA sites around pans to the west of Brandvlei (well to the east of the present study area). The finds included scatters of stone artefacts, pottery and ostrich eggshell, the latter perhaps having originated from water containers. A later survey by Morris (1996) near Calvinia yielded further similar sites on dunes associated with pans; he also recorded ostrich eggshell beads there.

Also to the east, Rudner and Rudner (1968) recorded engravings on dolerite outcrops as well as occupation sites dating to the LSA. These sites included stone artefacts, pottery, ostrich eggshell beads and stone features that may have been the remnants of hut circles and/or kraals.

Fourie (2011), who found nothing during his survey, reports the oral testimony of a Loeriesfontein farmer regarding the presence of rock art and engravings in the area and also that a cache of ostrich eggshell flasks had been found on his farm. Such caches have been reported from various parts of western South Africa (Henderson 2002; Jerardino *et al.* 2009; Morris 1994; Morris & Von Bezing 1996; Parkington 2006) and date to the LSA. Similar flasks are on display in the Fred Turner Museum in Loeriesfontein along with several bored stones and soapstone pipes from farms in the general region.

Other surveys have yielded low density scatters of stone artefacts of varying age (Kaplan 2008; Morris 2007, 2013), while some, quite surprisingly, found nothing at all (Fourie 2011; Van der Walt 2012, 2013).

The only historical archaeological material reported came from the farm Kleine Rooiberg, immediately to the south of the Farm Sous 226 (shown on Figure 3). It consisted of ceramic, glass and metal fragments thought to date to the early 20th century (Webley & Halkett 2012).

5.2. Historical aspects and the built environment

Van Schalkwyk (2011) reported an early 20th century farmstead constructed of stone and brick with corrugated iron roofs. It is unlikely that many earlier farmsteads would be present because this harsh landscape was only permanently settled in relatively recent times. This is borne out by the fact that the farms under study were only surveyed in 1880 and 1899. Prior to this, Van Schalkwyk (2011) notes that Dutch-speaking trek boers would have used the area on a seasonal basis. It was only after the 1870s introduction of wind pumps that water was more readily available and the area became more amenable to farming (Webley & Halkett 2012).

Van Schalkwyk (2011) found an unusual house that was built of clay and bricks and then cladded with corrugated iron sheeting. He thought it to date to approximately the 1920s. Another corrugated iron house nearby was visited by Orton (2013) who described a well-maintained stone livestock enclosure (‘*kraal*’), a recent but traditionally-styled cooking shelter (‘*kookskerm*’) and another outbuilding. Van Schalkwyk (2011: fig. 8) also illustrates (but does not describe) another farmhouse from the region – it is far grander than that noted above and looks to be from the early to mid-20th century.

Loeriesfontein, the nearest town to the site, was first established in 1894 by Frederik Turner who built a shop, the first building in Loeriesfontein (Figure 7). Once the shop was established the town slowly grew around it.

Figure 7: *The first building in Loeriesfontein as photographed in 1895 (Source: Fred Turner Museum, Loeriesfontein).*

Van Schalkwyk (2011) and Orton (2013) both described a small graveyard with two graves; one was dated to 1913. Van Schalkwyk (2011) also illustrated (but did not describe) an isolated grave.

6. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. It reports on material found during the present survey as well as during the 2014 survey (Orton 2014).

The findings of the field studies are presented in Table 1.

Table 1: *List of heritage resources recorded during the surveys. Under 'Significance' an indication is given of the amount of time required on each site to carry out archaeological mitigation where appropriate.*

Waypoint	GPS	Description	Field rating	Significance [mitigation]
173	S30 26 06.9 E19 25 31.2	Small scatter of historical ceramic fragments.	GP C	Low
393	S30 28 16.3 E19 29 56.3	Extensive scatter of white cryptocrystalline silica (CCS) and ostrich eggshell on top of a large hill with a trigonometric beacon on it. There was a small backed bladelet in CCS and one potsherd. It seems that there may be many more artefacts obscured by the gravel here.	GP A	Medium-High [**8 hours**]
398	S30 28 47.9 E19 30 21.2	Four fresh hornfels artefacts on top of a hill.	GP C	Very low
394	S30 28 12.4 E19 30 08.3	A light scatter of white CCS and ostrich eggshell on a hill. [Just outside power line corridor.]	GP C	Low
395	S30 28 13.5 E19 30 09.5	Scatter of white CCS artefacts and large amounts of ostrich eggshell on a hill. [Just outside power line corridor.]	GP B	Medium [**4 hours**]
396	S30 28 16.5 E19 30 08.8	Small scatter with a handful of white CCS artefacts on a hill.	GP C	Low
397	S30 29 39.0 E19 33 23.6	Small scatter of CCS artefacts immediately alongside existing construction camp.	GP C	Very low
001	S30 30 09.0 E19 33 49.6	Four small stone, brick and cement structures no doubt related to the airstrip.	---	-
002	S30 29 42.4 E19 33 51.8	LSA site on hilltop. CCS, quartz, hornfels, ostrich eggshell, cores, blades, 1 adze, 20 m diameter.	GP B	Medium [**4 hours**]
004	S30 29 45.2 E19 33 30.8	Ephemeral background scatter of heavily weathered stone artefacts, probably pertaining to the MSA.	GP C	Very low
005	S30 27 10.1 E19 34 26.9	Windmill, sheep dip. Nearby, in the seasonal pan, was one hand-painted refined earthenware ceramic fragment and one ostrich eggshell fragment.	GP C	Low
011	S30 27 00.2 E19 34 24.5	Ephemeral LSA scatter in CCS on edge of seasonal pan.	GP C	Low
012	S30 27 10.1 E19 34 25.5	A stone cairn made of round dolerite cobbles (there are no such cobbles naturally occurring in the immediate area). Location suggests it is unlikely to be a grave.	GP C	Low (possibly High)
013	S30 28 25.4 E19 33 42.3	Small LSA scatter of CCS within an area of about 2 m^2 and located on the crest of a hill.	GP B	Low-medium [**2 hours**]
014	S30 28 30.0 E19 33 50.4	Dump with shale pieces, red frog bricks, glass, ceramics, metal, animal bones and ashy patches. Most material is 20th century but a few items may date to the very late 19th century. GPS point marks the dump. A small vernacular house in stone and mud but with a more recent addition in brick on southern end lies to the east along with a recent (but traditional style) kookskerm and outdoor bread oven. The house also has a corrugated iron addition. The roof, which may once have been a brakdak (see Fagan 2008), is now of corrugated iron. House at S30 28 32.5 E19 33 52.3.	GP A	Medium-high [**Avoid or 16 hours**]

015	S30 28 57.6 E19 33 32.7	Isolated lower grindstone on bank of stream bed.	---	---
016	S30 29 04.8 E19 33 31.7	Ephemeral LSA scatter of CCS artefacts 100 m from the dry stream bed.	GP C	Very low
017	S30 29 05.6 E19 33 29.9	Ephemeral LSA scatter of CCS artefacts 65 m from the dry stream bed.	GP C	Very low
018	S30 29 05.3 E19 33 28.8	Ephemeral LSA scatter of CCS artefacts 35 m from the dry stream bed.	GP C	Very low
019	S30 29 02.5 E19 33 29.0	Ephemeral LSA scatter of CCS artefacts near dry stream bed but with some historical glass and ceramics also present.	GP C	Very low
020	S30 29 07.3 E19 33 26.0	LSA scatter of CCS, ostrich eggshell, 1 tooth enamel fragment on bank of dry stream bed. Probably truncated by disturbance from the gravel road.	GP B	Low-medium [4 hours]
021	S30 29 11.9 E19 33 27.4	Ephemeral scatter of historical ceramics with one bearing the text "...E IN BEL...", presumably "made in Belgium". Late 19th/early 20th century.	GP C	Very low
022	S30 29 11.3 E19 33 28.5	Very large LSA scatter of CCS, ostrich eggshell on the side of a dolerite outcrop just downslope of disturbed area. Scatter is about 15 m by 20 m. Also a boulder with "AL" scratched on it but this is recent.	GP A	Medium-high [16 hours]
023	S30 29 09.7 E19 33 32.0	Smaller LSA scatter of CCS and ostrich eggshell further east on same hill. Also some historical ceramic fragments.	GP B	Low-medium [4 hours]

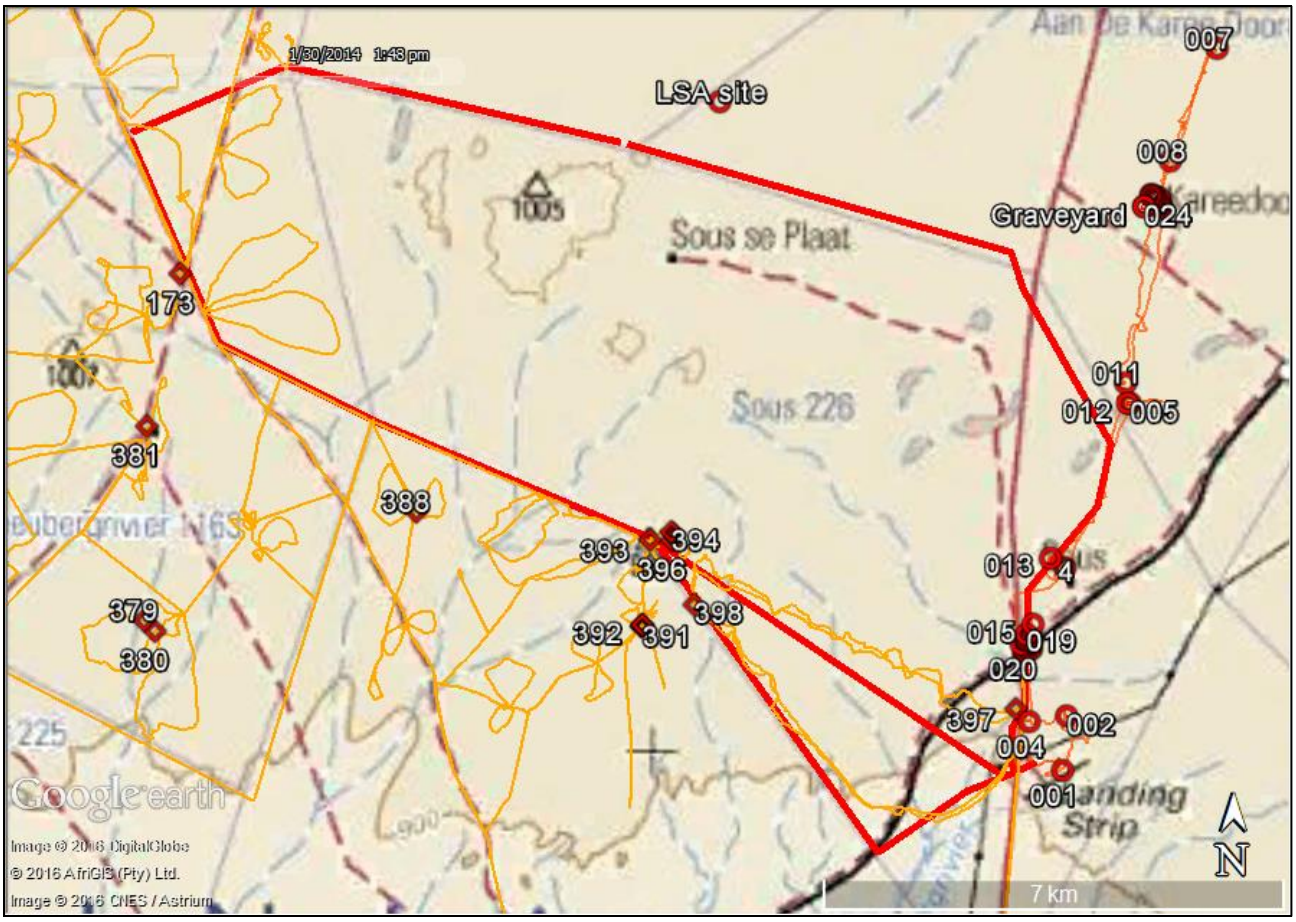

Figure 8: *Map of the study area showing the locations of the various finds. An area in the centre and three areas in the south are enlarged below.*

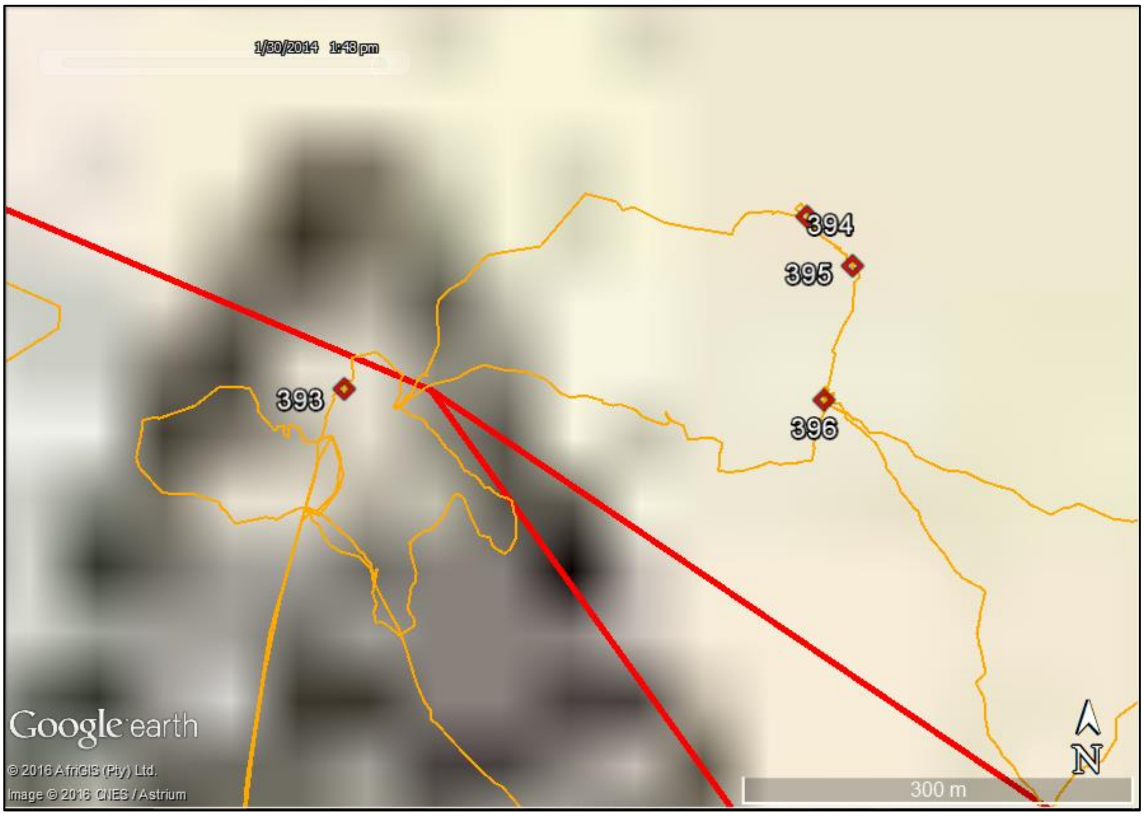

Figure 9: *Map of a small part of the Alternative A and B study areas showing the locations of finds.*

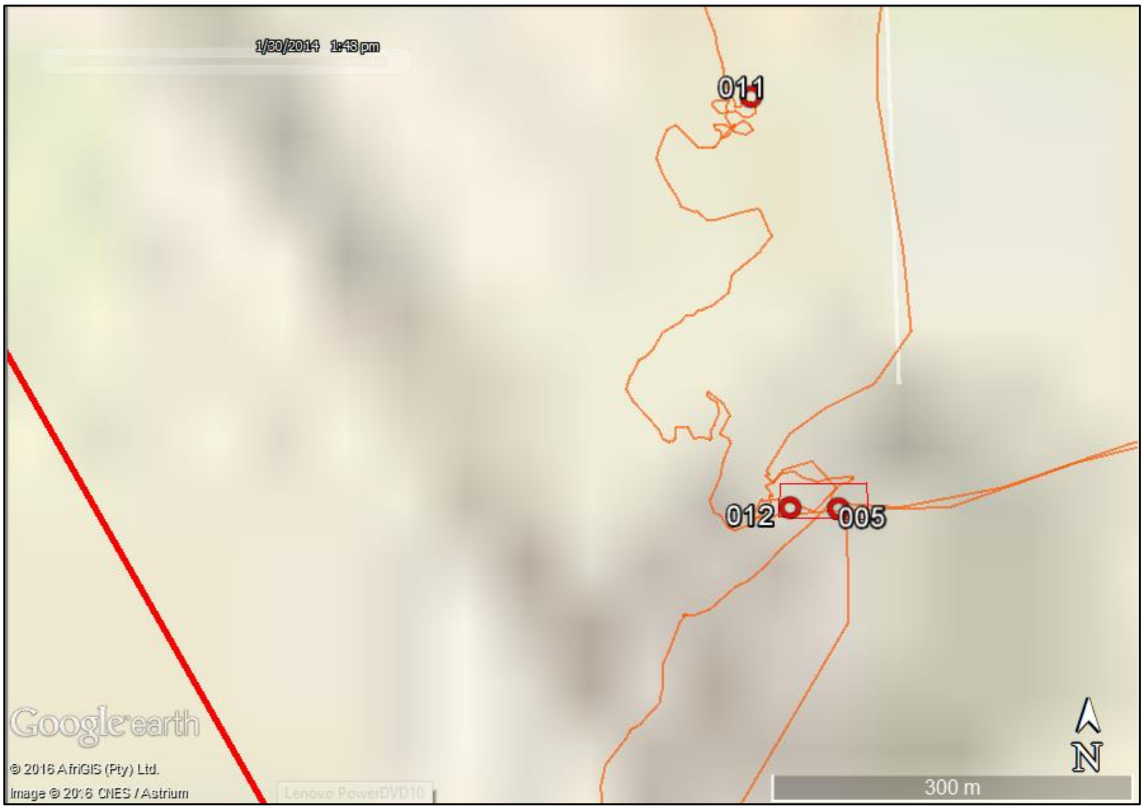

Figure 10: *Map of a small part of the Alternative C study area showing the locations of finds.*

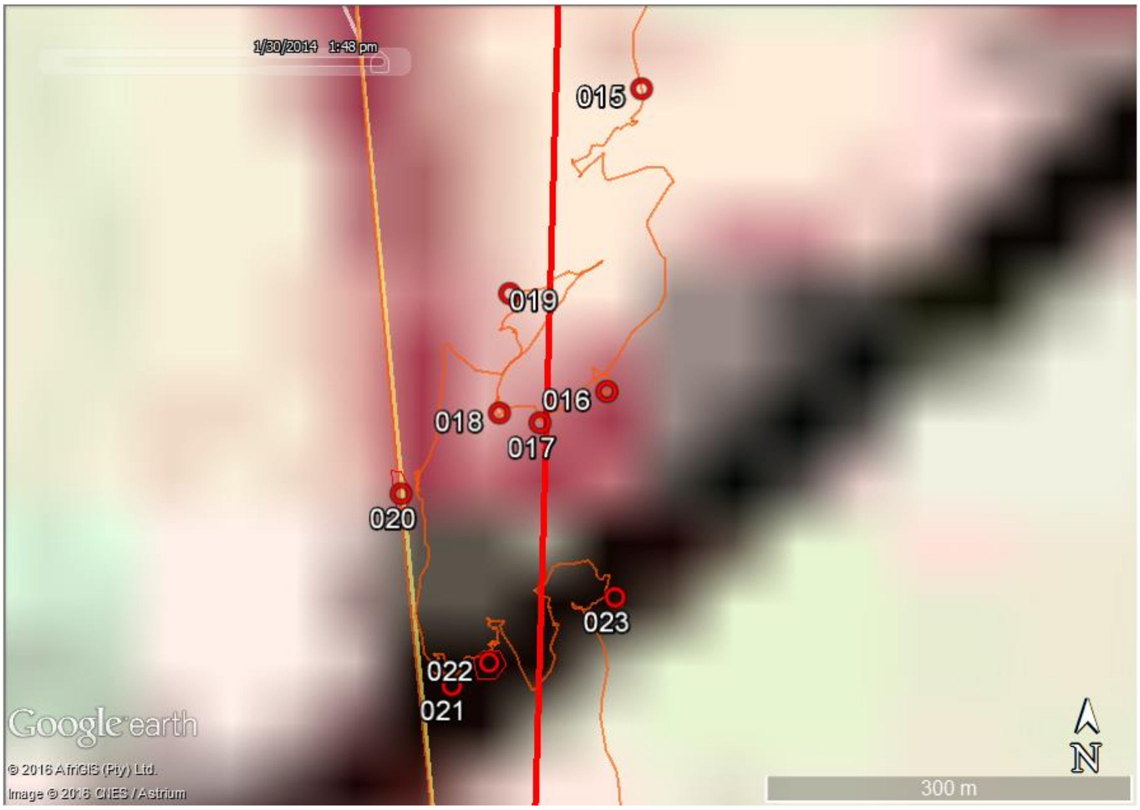

Figure 11: *Map of a small part of the Alternative C study area showing the locations of finds.*

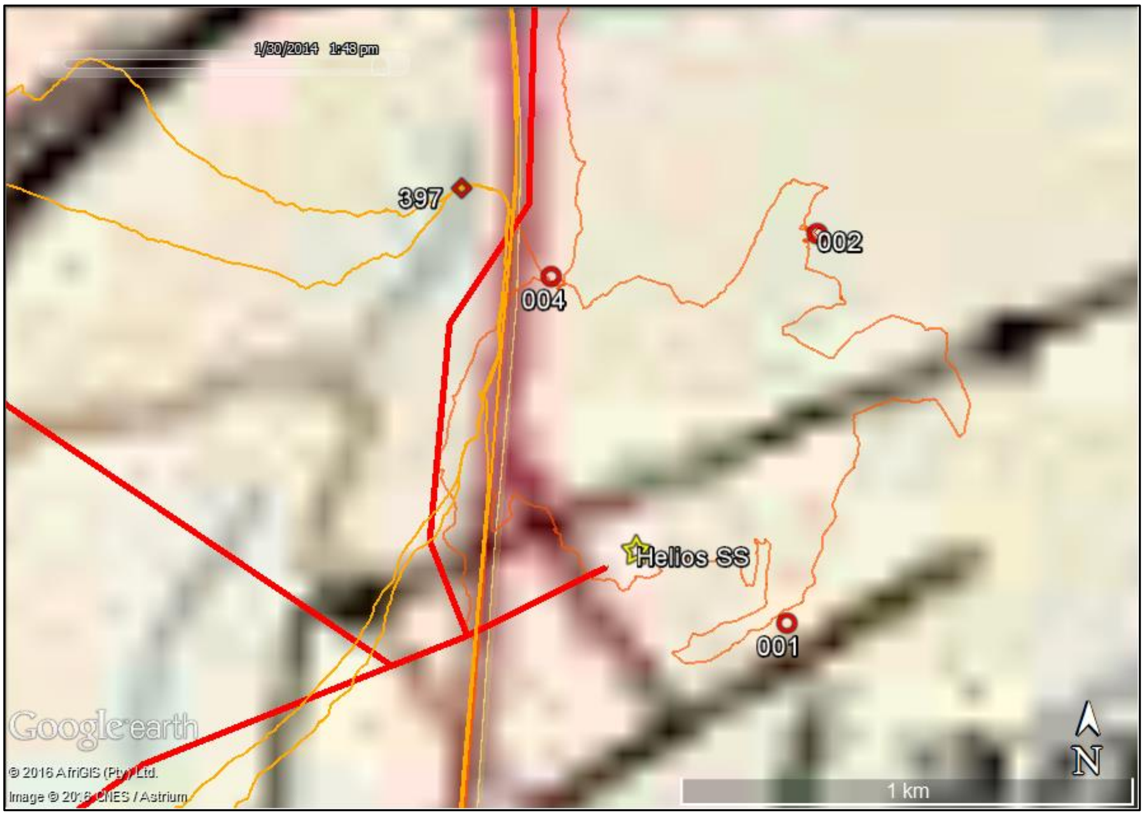

Figure 12: *Map of a small part of the study area around the Helios Substation (yellow star) showing the locations of finds.*

6.1. Archaeology

6.1.1. Stone Age archaeology

In general stone artefacts were found to be rare in the landscape with very few artefacts attributable to background scatter being seen. The sites recorded were largely in two clusters, one on the high ground near the split of Alternatives A and B and the other in the Alternative C corridor close to the intersection of a number of streams and right at the point where the railway line crosses the main stream bed. An important Stone Age site was at Waypoint 393. It was on a hill top and had stone artefacts (mostly in white CCS and including a CCS backed bladelet), ostrich eggshell fragments and a single pot sherd (the only one seen in the entire study area for the power line and wind energy facility projects; Figure 13). The pottery indicates an age of less than 2000 years. This site was one of several in this area. Another hilltop had just four artefacts on it. Although of no value because of this small number, the scatter was notable for being of a different type of stone – all four artefacts were made on hornfels. The very fresh nature of the artefacts – hornfels weathers quickly – suggests that the scatter is very recent (Figure 14).

Figure 13: *Scatter of stone artefacts and ostrich eggshell with a single pot sherd (waypoint 393). Scale in cm.*

Figure 14: *The four stone artefacts from Waypoint 398. Scale in cm.*

Close to the Klein Rooiberg River but isolated from the other sites, one dense scatter, at Waypoint 013, occurred within an area of no more than 2 m^2 on the crest of a hill (Figures 15 & 16), while another at Waypoint 022 was spread over a far larger area of some 15 m by 20 m and occurred within the large cluster of LSA scatters (Figure 11). Such *in situ* or at least partially *in situ* sites have research value and can be accorded medium to high archaeological significance.

Figure 15: *Unweathered CCS artefacts from an LSA site at waypoint 013. Scale in cm.*

Figure 16: *Artefacts and ostrich eggshell on the ground at Waypoint 013.*

6.1.2. Historical archaeology

Historical archaeological material tended to be rarer in the landscape than Stone Age material. Three locations with historical artefacts were recorded. Two were small, ephemeral scatters of ceramic fragments. At waypoint 173 a small scatter of white refined earthenware plate fragments was found on a hill top (Figure 17) in the Alternative A and B corridor, while another ephemeral scatter was located at waypoint 21, at the point where the Sishen-Saldanha railway line crosses the Klein Rooiberg River. The only historical archaeological site found was a domestic dump (waypoint 014) that was found some 85 m from an historical structure. Although the vast majority of material seemed to be early 20th century in age, there is a good chance that older material is preserved lower down in the dump because it was clearly quite deep (Figure 18).

Figure 17: *A scatter of 19th century plate fragments at Waypoint 173. They are white refined earthenware and mostly with transfer-printed decoration.*

Figure 18: *The mounded dump at waypoint 014. The dump has many shale fragments but includes bricks, glass, ceramics, bone, metal and ash.*

6.2. Built environment

One historical building occurs within the transmission line study area. This building was constructed in four phases with the earliest likely to have been during the late 19th century (Figures 19 & 20). The structure could well have begun life as a *brakdak* (see Fagan 2008). Curiously, the original house faces south. It also has a small *kookskerm* outside the house to its east. Nearby, some 140 m west of the house, there was a place in a stream bed where stone had been quarried, no doubt for the construction of the house.

Figure 19: *View of the front of the house at waypoint 014. The original south-facing structure is in the centre and has rustication around the windows and front door. It is likely late 19th century. The*

section to the right represents the third phase of construction, probably from the 1940s. The kookskerm *is visible in the background to the right.*

Figure 20: *Aerial view of the house at waypoint 014 with the four phases of construction labelled. The small kookskerm is visible as a circle to the east of the house. Source: Google Earth using Bing Maps overlay available at: http://ge-map-overlays.appspot.com/bing-maps/hybrid.*

6.3. Graves

No graves were seen in the study area and, due to the generally rocky substrate, the chance of impacting on graves is very limited.

6.4. Cultural landscape.

The site has a very weakly developed cultural landscape since the majority of anthropogenic interventions relate to farm tracks and fences. The landscape is largely a natural one, but has now been compromised by neighbouring wind farm developments, the Helios Substation and associated power lines which create a new 'cultural' layer on the landscape.

6.5. Statement of significance

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

The archaeological resources on the whole are deemed to have medium cultural significance for their scientific value.

The single built environment site is considered to have medium-high cultural significance for its architectural value.

The cultural landscape has low cultural significance for its aesthetic and social value.

6.6. Summary of heritage indicators and provisional grading

The primary type of heritage resource of concern here is archaeology. Several artefact scatters and a historical dump have been located that, if they were to be impacted, would require mitigation work as described in Section 7. They are LSA scatters and are allocated provisional grades of “Generally Protected A” to “Generally Protected C” (Table 1). The only other heritage resource is the broader cultural landscape, but this is of little concern as the landscape is largely natural with little cultural input. It is also currently being altered through the construction of two wind energy facilities on neighbouring farms. The SAHRA grading system was not designed for landscapes.

7. ASSESSMENT OF IMPACTS

Note that all three alternative alignments are considered to have the same impacts and are assessed as one.

7.1. Impacts to archaeological resources

Impacts to archaeological resources would occur during the construction phase only, so long as all operation and decommissioning activities take place within the authorised footprint, especially including continued reuse of any service road that is made along the power lines. They would be <u>negative</u> impacts because the sites may be damaged or destroyed and scientific data would be lost. Because the archaeological sites only have local cultural significance, the extent of the impacts would be <u>local</u>. The magnitude of impacts is likely to be <u>medium</u> because several sites of up to medium or medium-high cultural significance are on record and at least one of medium-high significance lies very close to the alignment of all three Alternatives. Because damage to archaeological sites is completely irreversible, the impacts are considered to be <u>long term</u> impacts. It is <u>unlikely</u> that impacts will occur because the footprint of the transmission line and its service road are relatively small. The overall significance rating of these potential impacts calculates to **<u>medium</u>**.

Mitigation would involve three steps:

1. Avoiding known sites where possible;
2. Commissioning a walk down of sections that are deemed sensitive (primarily river margins and hilltop areas); and finally
3. Controlled excavation and collection of archaeological material from any important sites that will still be impacted (waypoints 393 [<20 m from the Alt. A and Alt. B centre line] and possibly 20 [<30 m from the Alt. C centre line] are likely to require mitigation at this point because of their proximity to the proposed alignments).

With mitigation, the magnitude of the impact would reduce to <u>very low</u> and the overall significance to **<u>very low</u>** for all three alternatives. There are no fatal flaws because all archaeological sites could be satisfactorily mitigated should the need arise and, although preservation of one (at waypoint 014) is preferable, none of them are important enough to require *in situ* conservation.

Although some archaeological sites are likely to be lost during the construction of other power generation facilities and associated transmission lines (two wind energy facilities are under construction, while a third and a solar energy facility have been authorised nearby), cumulative impacts are deemed to be of low significance in this case because the broader landscape is extensive and is likely to hold many similar archaeological sites. Also, the individual significance of each site is such that it does not extend beyond the local area.

Although graves have been listed in Section 6 above, they are not specifically assessed here because the chances of impacts to graves are exceedingly small. They are also very difficult to predict.

7.2. Impacts to buildings

Impacts to buildings would occur during all three phases (construction, operation & decommissioning) and would relate to the presence of the transmission lines in a landscape that is otherwise gently undulating and distinctly rural and/or natural in character. They would be negative impacts because the rural context of the structures would be compromised. Although physical impacts are possible, these are very unlikely because avoidance of buildings is easy to successfully accomplish and is generally planned into the development from the start. Physical impacts are not considered further. Because the buildings are of low cultural significance, the extent of the impacts would be local. The magnitude of impacts is likely to be very low because contextual impacts are not of great concern in this instance, especially in the light of the wind energy facilities currently under construction in the area. Contextual impacts are reversible with rehabilitation but the impacts are considered to be long term impacts because the transmission lines are likely to be in operation for many years. If they are constructed, then the probability is definite because the existence of the transmission lines will be inescapable. The overall significance rating of these potential impacts calculates to **very low**.

No mitigation is possible. Transmission lines cannot be screened or placed in such a way as to be less visible from heritage structures. The ratings with mitigation thus do not change and the overall impact remains **very low**.

Although the construction of power generation facilities and associated transmission lines (two wind energy facilities are under construction, while a third wind farm and a solar energy facility have been authorised nearby) will also affect the cultural landscape, it is deemed preferable to cluster electrical developments such that the impacts are kept to one area. Further away buildings would no longer be affected. Cumulative impacts are deemed to be of very low significance in this case because of the very low density of significant heritage structures.

7.3. Impacts to the cultural landscape

Impacts to the cultural landscape would occur during all three phases and would relate to the presence of the transmission lines in a landscape that is otherwise gently undulating and distinctly rural and/or natural in character. They would be negative impacts because of the general incompatibility between transmission lines and the natural landscape. Because the cultural landscape is relatively weakly developed, it has been accorded low cultural significance and hence the extent of the impacts would be local. The magnitude of impacts is likely to be very low because the area is so remote. Damage to the landscape is reversible with rehabilitation but the impacts are considered to be long term impacts because the facility is likely to operate for many years. If the facility is constructed, then the probability is definite because the existence of the transmission lines will be inescapable. The overall significance rating of these potential impacts calculates to **very low**.

No mitigation is possible. Transmission lines cannot be screened or placed in such a way as to be less visible from surrounding roads and structures. The ratings with mitigation thus do not change and the overall impact remains **very low**.

Although the construction of other power generation facilities and associated transmission lines (two wind energy facilities are under construction, while a third wind farm and a solar energy facility have been authorised) will also affect the cultural landscape, it is deemed preferable to cluster electrical developments such that the impacts are kept to one area. Further away the cultural and natural landscape would no longer be affected. Cumulative impacts are deemed to be of very low significance in this case because the landscape is not highly sensitive and is rather more natural than cultural.

8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The final layout of the powerline within its chosen corridor should be considered by an archaeologist prior to construction. Given the surveys undertaken to date, the vast majority of the proposed corridors is considered to not be sensitive. However, any parts of the final chosen alignment that pass over prominent hills or follow the Klein Rooiberg River may need to be examined for archaeological sites prior to construction. Aside from ensuring that any archaeological mitigation that is necessary gets implemented, the only other management measure that should be incorporated into the Environmental Management Programme is the need to ensure that activities remain inside the authorised footprint and that archaeological sites located outside of the footprint do not get inadvertently damaged or destroyed. This would be the role of the Environmental Control Officer (ECO). Although any impacts would occur very quickly (just one vehicle driving in the wrong place can irreparably damage a sensitive archaeological site), it is obviously not feasible to be watching every aspect of construction throughout the construction period. Education of the staff is thus important to make sure that everyone knows the importance of remaining within the authorised footprints for all roads, turbine placements and other aspects of the development.

9. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development. The development will support three wind energy projects that will provide electricity for use in South Africa. This is deemed an important function because of the historical problems associated with South Africa's electricity supply. The construction phase of the facility will also provide an increase in jobs for the local population. None of the heritage impacts is considered to be more important than these social and economic benefits.

Table 2: Assessment of heritage impacts for all three Alternatives.

Impact			Without Mitigation								With Mitigation							
Category	Impact Title	Impact description	Type	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance	Type	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Heritage	Impacts to archaeological resources	Damage to or destruction of archaeological sites and artefacts due to construction of turbines, access roads and related infrastructure	Negative	Local	Medium	Long term	Probable	Sure	Irreversible	Medium (-)	Negative	Site specific	Very low	Long term	Probable	Sure	Irreversible	Very low (-)
Heritage	Impacts to buildings	Damage to buildings during construction and degradation of their context	Negative	Local	Very low	Long term	Unlikely	Certain	Reversible	Very low (-)	Negative	Local	Very low	Long term	Unlikely	Certain	Reversible	Very low (-)
Heritage	Alteration of cultural landscape	Addition of industrial-type structures to a rural landscape with minimal development in the broader area but with another wind energy facility currently under construction on a neighbouring property	Negative	Local	Very low	Long term	Definite	Certain	Reversible	Very low (-)	Negative	Local	Very low	Long term	Definite	Certain	Reversible	Very low (-)

10. CONCLUSIONS

This study has found that significant heritage resources tend to be quite rare in the landscape. Besides the landscape itself, which is of relatively low significance and has already been compromised by the other power lines, the Helios substation and two wind energy facilities that are currently under construction, the only other heritage resources of concern are a number of archaeological sites that occur on hill tops or along the margins of the Klein Rooiberg River, some of which are significant and located close to the proposed alignment options. Although it is likely that some isolated artefacts attributable to background scatter may be disturbed, these are not considered significant.

Although mitigation is likely to be required at one point along each of the routes, Alternatives A and B are equally favoured, while Alternative C is seen as less ideal because it passes close to and has the potential to impact upon more archaeological sites (both known and unknown). However, with the implementation of the recommended mitigation, all Alternatives are considered acceptable from a heritage resources perspective.

11. RECOMMENDATIONS

It is recommended that the development be allowed to proceed but subject to the following conditions which should be incorporated into the environmental authorisation should one be issued:

- The final alignment of the powerline within the chosen corridor should be considered by an archaeologist to ensure that known sites are safe from harm and to check whether a follow-up survey may be required in certain areas. Such survey should be carried out and any further resulting requirements (e.g. archaeological mitigation, including of the sites at waypoints 393 and/or 20 as appropriate) should be met prior to the start of construction; and
- If any archaeological material or human burials are uncovered during the course of development then the find should be protected from further disturbance and work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

12. REFERENCES

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 6A Scarborough Road, Muizenberg, 7945
Telephone: (021) 788 8425
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Memberships and affiliations:

South African Archaeological Society Council member	2004 –
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
ASAPA Cultural Resources Management Section member	2007 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

Fieldwork and project experience:

Extensive fieldwork as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

SOCIAL IMPACT ASSESSMENT
TRANSMISSION LINE ALTERNATIVES
FOR
THE KOKERBOOM WIND ENERGY FACILITIES,
NORTHERN CAPE PROVINCE

SEPTEMBER 2017

Prepared for

AURECON

By

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EXECUTIVE SUMMARY

INTRODUCTION AND LOCATION

Aurecon South Africa (Pty) Ltd (Aurecon) was appointed by Business Venture Investments No. 1788 (Pty) Ltd (BVI) as the lead consultant to manage the Environmental Impact Assessment (EIA) process for the three proposed Kokerboom Wind Energy Facilities (WEFs) located ~ 50 km north of the town of Loeriesfontein in the Hantam Local Municipality (HLM) in the Northern Cape Province (Figure 1.1). Each WEF will have a capacity of up to 240-256MW MW. The energy generated from the proposed WEFs will be excavated from the site to the Eskom Helios substation via an overhead 132 kV transmission line. Aurecon are managing the Basic Assessment (BA) process for the proposed transmission line and associated grid connection infrastructure.

Tony Barbour Environmental Consulting and Research was appointed by Aurecon to undertake a specialist Social Impact Assessment (SIA) as part of the Basic Assessment (BA) process undertaken for the transmission line. This report contains the findings of the SIA undertaken as part of the EIA process.

PROJECT DESCRIPTION

The proposed grid connection infrastructure consists of two switching stations (each approximately 100m X 100m), an overhead 132kV line (single or double circuit) and associated ancillaries including narrow access/service tracks. Three alternative transmission line routes have been identified, namely Alternative A, B and C. Alternative A is approximately 25.3 km in length. Alternative B is approximately 27km in length, and the longest of the three Alternatives. Alternative C is approximately 23 km in length, and the shortest of the three Alternatives. Each alternative links the three proposed Kokerboom WEFs to the Eskom Helios substation.

SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning;
- Construction phase impacts;
- Operational phase impacts;
- Cumulative Impacts;
- No-development option.

POLICY AND PLANNING FIT

The findings of the review indicated that renewable energy is strongly supported at a national and local level. At a national level, the White Paper on Energy Policy (1998) notes:

- Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future; and,
- The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind

and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

The development of and investment in renewable energy is also supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a provincial level the development of renewable energy is supported by the Northern Cape Provincial Growth and Development Strategy and Northern Cape Provincial Spatial Development Framework. The NDM and HLM IDP also highlight the importance of renewable energy for the area. It is therefore reasonable to assume that infrastructure associated with the establishment of renewable energy facilities, including power lines, is also supported.

However, the provincial and local policy and planning documents also make reference to the importance of tourism and the region’s natural resources. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed facility, and the associated power lines does not impact on the region’s natural resources and the tourism potential of the Province.

CONSTRUCTION PHASE SOCIAL IMPACTS

The findings of the SIA indicate that the potential social impacts associated with the construction phase of the power lines will be the same for each of the three alignment options, namely Alternative A, B and C. Separate assessments have therefore not been undertaken for each alternative. The assessment ratings for the construction phase therefore apply to all three alternative alignments. The social impacts associated with the construction phase therefore have no material bearing on the identification of a preferred alignment.

Potential positive impacts

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training.

The construction phase for the proposed power line connecting the three Kokerboom WEFs to the Helios substation is expected to extend over a period of 6 months and create up to 75 temporary employment opportunities, with 25 of the employment opportunities being unskilled, 40 semi-skilled and 10 highly-skilled. The total wage bill for the construction phase is estimated to be in the region of R5 million (2017 Rand values). The majority of the low and semi-skilled employment opportunities will be available to local residents in the area, specifically residents from Loeriesfontein and Niewoudtville. The majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community. In order to maximise the potential benefits the developer should commit to employing local community members to fill the low and medium skilled jobs.

Potential negative impacts

- Impacts associated with the presence of construction workers on site and in the area;
- Influx of job seekers to the area;
- Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site;
- Increased risk of grass fires;

- Impact of construction related activities, including damage to roads, safety and dust;
- Potential loss of productive grazing associated with construction-related activities.

The findings of the SIA indicate that the significance of the potential negative impacts with mitigation were Low Negative. All of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

Table 1 summarises the significance of the impacts associated with the construction phase.

Table 1: Summary of social impacts during construction phase (Alternative A, B and C)

Impact (Direct)	**Significance No Mitigation**	**Significance With Mitigation/Enhancement**
Creation of employment and business opportunities	Low (+)	Medium (+)
Presence of construction workers and potential impacts on family structures and social networks	Low (-)	Low (-)
Influx of job seekers	Low (-)	Low (-)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Low (-)	Low (-)
Increased risk of grass fires	Medium (-)	Low (-)
Impact of construction related activities	Low (-)	Low-Very Low (-)
Loss of grazing	Medium (-)	Low (-)

OPERATIONAL PHASE SOCIAL IMPACTS

The findings of the SIA indicate that the impacts associated with the operational phase, specifically the impact on affected landowners, will have the most significant bearing on the identification of the preferred power line alignment.

Potential positive impacts

- The establishment of infrastructure to support renewable energy.

The power line linking the Kokerboom WEFs to the Helios substation represent a key component of the project required to support the development of the renewable energy sector in South Africa.

Potential negative impacts

- The visual impacts and associated impact on sense of place;
- Impact on affected land owners.

Visual Impact on sense of place

The power lines associated with the proposed Kokerboom WEFs will have a visual impact on the landscape and remote, undeveloped sense of the place of the area.

However, the visual integrity of the area has been impacted by the Helios substation and associated transmission lines in the area. In addition, two WEFs, namely the Loeriesfontein and Khobab WEF, are being constructed in the area. Each of these WEFs also includes the establishment of power lines linking up to the Helios substation. The area is sparsely populated, the majority of the farms are un-occupied and there are no sensitive receptors located within close proximity of any of the proposed power line alternative. In addition, none of the local land owners interviewed indicated that they were concerned about the potential visual impacts associated with the proposed power lines. The visual impact of the proposed power lines on the areas overall sense of place and character is therefore likely to be limited, specifically within the context of the development of the area as a renewable energy node.

Impact on land owners

The impacts on the land owners affected by the proposed power line alternatives are linked to the impact on grazing areas associated with establishment of power lines and associated access roads. The maintenance of power lines by contractors during the operational life can also impact on farming operations, including disturbance of livestock, damage to farm infrastructure, such as gates, loss of livestock due to gates being left open, damage of veld, stock theft and littering.

Based on the findings of the SIA, Alternative B is regarded as the most suitable power line Alternative. Alternative B would only traverse a 2.7km section of Sous Farm, as opposed to the 6.9km and 9km sections associated with Alternative A and C respectively. Alternative B therefore has the least impact on Sous Farm, which is already impacted by a number of existing and proposed power lines. In this regard the owner of Sous Farm, Mr van der Merwe, indicated that he would like to restrict the establishment of power lines across his property.

The owners of Karreedoornpan (Mr Gys Lombard) and Struiskom (Mr Theunis Kotze) also indicated that the development of the proposed grid connection infrastructure in their land would not be preferred, if the Kokerboom 3 WEF (which is located on Kareedoorpan and Struiskom) is not developed for any reason. It is noted that the Proponent (BVI) has confirmed that the grid connection infrastructure on Mr Lombard’s and Mr Kotze’s properties would only be developed when the Kokerboom 3 WEF is developed – unless an alternate arrangement is reached between the land owners and BVI.

Table 2 summarises the significance of the impacts associated with the operational phase.

Table 2: Summary of social impacts during operational phase (Alternative A, B and C)

Impact	Significance No Mitigation	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Low (+)	Low (+)
Promotion of renewable energy projects	Low (-)	Medium (+)[1]
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on affected property owners	Low (-)	Low (-)

CUMULATIVE IMPACTS

Cumulative impact on sense of place

There are in the region of seven renewable energy projects located in the area, namely, the Khobab and Loeriesfontein WEFs (currently under construction), Kokerboom 1, 2 and 3 (proposed), Dwarsbrug WEF (proposed) and Orlight SEF (proposed). The potential cumulative impact of the proposed 132 kV overhead power line linking the Kokerboom WEFs to the Helios substation should be viewed within the overall context of the development of the area as a potential renewable energy node. In this regard establishment of a 132 kV power line will not alter the overall cumulative impact of the proposed Kokerboom WEFs. The potential contribution to the overall cumulative impact compared to the current and proposed WEFs is therefore rated as **Low Negative**.

Cumulative impact on services

The establishment of the proposed transmission lines, together with the Kokerboom WEF (Kokerboom 1, 2 and 3), and other renewable energy facilities in the area will place pressure on local services in the towns of Loeriesfontein and other nearby towns, specifically medical, education and accommodation. This pressure will largely be associated with the influx of workers to the area during the construction phase and to a lesser extent the operational phase. The potential impact on local services can be mitigated by employing local community members. The presence of non-local workers during both the construction and operation phase will also place pressure on property prices and rentals. As a result, local residents, government officials, such as municipal workers, school teachers and the police, may no longer be able to buy or afford to rent accommodation in towns such as Loeriesfontein and other nearby towns. With effective mitigation, the impact is rated as **Low Negative.**

However, as indicated below, this impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of a renewable energy hub in the area. These benefits will create opportunities for investment in Loeriesfontein and other nearby towns, including the opportunity to up-grade and expand existing services and the construction of new houses. In this regard, the establishment of a renewable energy hub will create a unique opportunity for these towns to develop. In should also be noted that it is the function of national, provincial and local government to address the needs created by development and provide the required services. The additional demand for services

[1] Assumes that the proposed WEF will be established

and accommodation created by the establishment of development renewable energy projects in the area should therefore be addressed in the Integrated Development Planning process undertaken by the HLM and NDM.

Cumulative impact on local economies
In addition to the potential negative impacts, the establishment of the construction of renewable energy facilities and the associated power lines will have a positive cumulative socio-economic impact on the local economy. The positive cumulative impacts include creation of employment, skills development and training opportunities, creation of downstream business opportunities. This benefit is rated as **High Positive** with enhancement.

NO-DEVELOPMENT OPTION

The establishment of the power lines linking the proposed Kokerboom WEFs to the Helios substation is an integral component of the three proposed renewable energy projects. The No-Development option would therefore represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a negative social cost.

However, at a provincial and national level, it should be noted that the proposed renewable energy development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Northern Cape and other parts of South Africa. Foregoing the proposed establishment of the proposed grid connection infrastructure would therefore not necessarily compromise the development of renewable energy facilities in the Northern Cape Province and or South Africa. However, the socio-economic benefits for local communities in the HLM would be forfeited.

CONCLUSIONS AND RECOMMENDATIONS

The establishment of the 132kV overhead power line linking the proposed Kokerboom WEFs to the Helios substation is an integral component of the proposed renewable energy projects. Based on the findings of the SIA, Alternative B is regarded as the most suitable power line alternative, however any of the three proposed alternatives are suitable from a social impact perspective, and no fatal flaws were identified with any of the proposed alternatives.

The establishment of Alternative B is therefore supported by the findings of the SIA, subject to the implementation of the recommended mitigation measures and management actions contained in the report. The final location of pylons should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

IMPACT STATEMENT

All three of the proposed alternatives are considered acceptable from a social impact perspective, subject to the implementation of the recommended mitigation measures and management actions contained in the report. Based on the findings of the SIA, Alternative B is however regarded as the most preferred alternative. The final location of pylons should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

ACRONYMS

DEA	Department of Environmental Affairs (National)
DEA&DP	Department of Environmental Affairs and Development Planning (WCP)
DM	District Municipality
HD	Historically Disadvantaged
HLM	Hantam Local Municipality
EIA	Environmental Impact Assessment
IDP	Integrated Development Plan
IPP	Independent Power Producer
kV	Kilovolts
LED	Local Economic Development
LLM	Laingsburg Local Municipality
LM	Local Municipality
MW	Megawatt
NDM	Namakwa District Municipality
NDP	National Development Plan
NCP	Northern Cape Province
NCPCCRS	Northern Cape Province Climate Change Response Strategy
PGDS	Provincial Growth and Development Strategy
PSDF	Provincial Spatial Development Framework
SDF	Spatial Development Framework
SIA	Social Impact Assessment
WEF	Wind Energy Facility

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

1.1 INTRODUCTION

Aurecon South Africa (Pty) Ltd (Aurecon) was appointed by Business Venture Investments No. 1788 (Pty) Ltd (BVI) as the lead consultant to manage the Environmental Impact Assessment (EIA) process for the proposed Kokerboom 1, 2, and 3 Wind Energy Facilities (WEFs) located ~ 50 km north of the town of Loeriesfontein in the Hantam Local Municipality (HLM) in the Northern Cape Province (Figure 1.1). Each WEF will have a capacity of up to 240 - 256 MW. The energy generated from the proposed WEFs will be excavated from the site to the Eskom Helios substation via an overhead 132 kV transmission line. Aurecon are managing the Basic Assessment (BA) process for the proposed grid connection infrastructure which includes an overhead 132Kv transmission line (three alternative routes proposed), two switching stations and associated ancillary infrastructure (including service tracks where required). Tony Barbour Environmental Consulting and Research was appointed by Aurecon to undertake a specialist Social Impact Assessment (SIA) as part of the Basic Assessment (BA) process undertaken for the transmission line. This report contains the findings of the SIA undertaken as part of the EIA process.

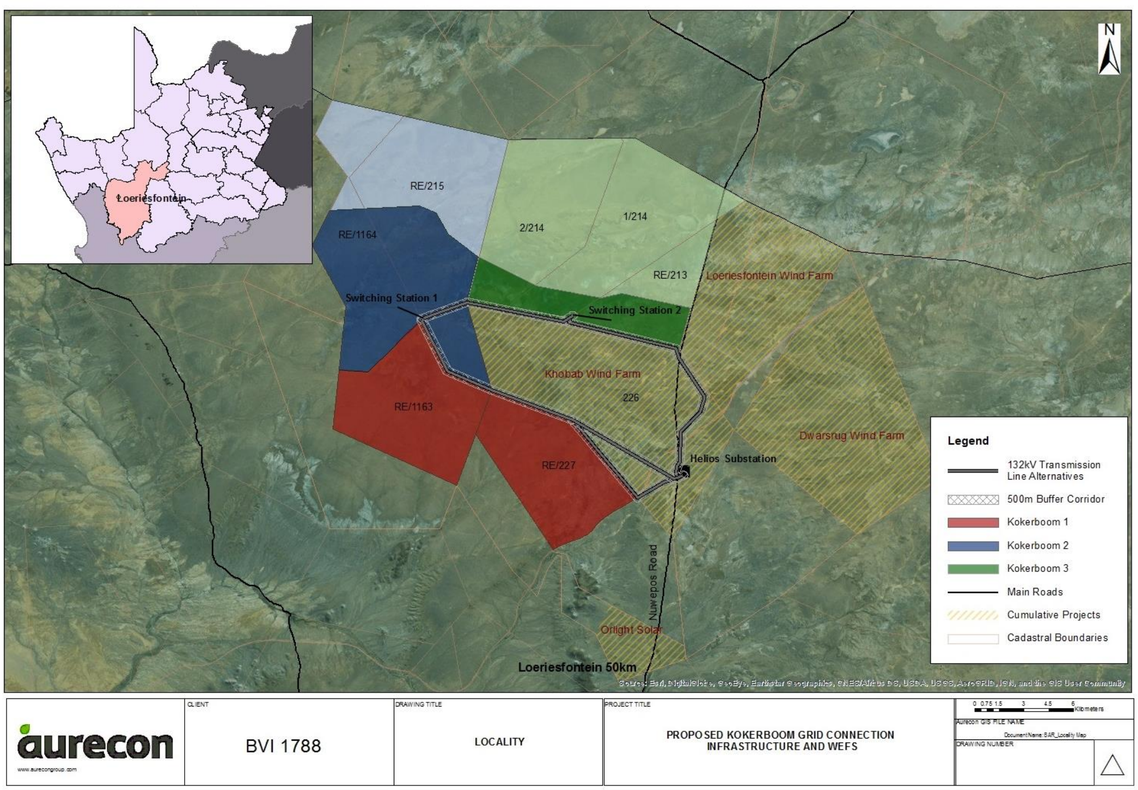

Figure 1.1: Location of the proposed grid connection alternatives, in relation to the location of the 3 proposed Kokerboom WEFs.

1.2 TERMS OF REFERENCE

The terms of reference for the SIA require:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed road upgrade;
- A description and assessment of the potential social issues associated with the proposed development and the associated alternatives;
- Identification of enhancement and mitigation measures aimed at maximizing opportunities and avoiding and or reducing negative impacts.

One of the key challenges facing SIA, therefore, does not necessarily involve the physical disruption of human populations, but understanding the meanings, perceptions and/or social significance of these changes. The social construction of reality is a characteristic of all social groups, including the agencies that attempt to implement changes, as well as the communities that are affected (Guidelines and Principles for Social Impact Assessment, 1994). The tendency of development agencies and proponents to dismiss the concerns of others as being merely imagined and perceived is therefore a key issue that needs to be addressed by social impact assessments.

The challenges that SIA faces associated with "social construct of reality" are further compounded by the dominance of technocratic rationality as the established approach to natural resource decision-making and assessment (Burdge and Vanclay, 1995). In order to understand the role of social assessment in the EIA process one needs to define what social impacts are. This issue is complicated by the way in which different people from different cultural, ethic, religious, gender, and educational backgrounds etc., view the world. This is referred to as the "social construct of reality". The social construct of reality informs people's worldview and the way in which they react to changes. However, in many instances these constructs are frequently treated as perceptions or emotions, to be distinguished from "reality."

Technocratic rationality dominates the current approach to the way in which EIA's are undertaken and assessed. This approach focuses on "measuring, predicting and reporting" on the impacts of proposals in order to objectively investigate alternatives and select the course of action with "the greatest net benefits for society" (Formby, 1990). The approach is favoured by engineers and natural scientists who are often uncomfortable with, or about, the involvement of what they regard to be an ill-informed public (Dugdale and West, 1991). However, despite the emphasis on objectivity, technocratic rationality is ill-equipped to deal either with the competing interests, beliefs, values and aspirations that characterize complex social situations, or with the active participation of multiple stakeholders in working through these situations (Lockie, 2003). However, Rickson et al (1998), however, argue that this is not just about conflicting worldviews, but also about power. It is about whose definition of an impact, an aspiration, a value and a fact are considered legitimate and whose is dismissed as subjective, emotional and irrelevant (Lockie *et al*, 1999). The quantifiable, technocratic rationality approach empowers governments and developers by highlighting positive impacts, such as regional economic and employment opportunities, while ignoring issues that cannot be measured within affected communities and the subjective and cultural meanings for these communities (Burdge and Vanclay, 1995; Lockie *et al*, 1999). SIA therefore has a critical role to play in ensuring that the needs and concerns of affected and vulnerable individuals and communities are included in the decision-making process. SIA therefore plays an important role in empowering communities (Barbour, 2007).

SIA's should enable the authorities, project proponents, individuals, communities and organizations to understand and be in a position to identify and anticipate the potential social consequences of the implementation of a proposed policy, programme, plan or project. The SIA process should also alert communities and individuals to the proposed project and possible social impacts, while at the same time allowing them to assess the implications and identify potential alternatives. The assessment process should also alert proponents and planners to the likelihood and nature of social impacts and enable them to anticipate and predict these impacts in advance so that the findings and recommendations of the assessment are incorporated into and inform the planning and decision-making process (Barbour, 2007). Based on comments from DEA on the Draft Scoping Report the assessment also includes a detailed assessment of potential cumulative impacts, including a cumulative impact environmental statement on whether the proposed development must proceed.

1.3 PROJECT DESCRIPTION

Three alternative transmission line routes have been identified, namely Alternative A, B and C. They are described below.

Alternative A
Alternative A is approximately 25.3 km in length (Figure 1.2). The alignment would run counter-clockwise from the proposed Switching Station 2 (SS2), via the proposed SS1, to feed into Eskom's Helios substation from the south. The initial segment of Alternative A from SS2 to SS1 would affect three properties belonging to three landowners, namely:

- Karee Doorn Pan 1/214 (Kareedoornpan), owned by Mr. Gys Lombard (distance of ~3.2 km);
- Karee Doorn Pan 2/214 (Struiskom), owned by Mr Theunis Kotze (distance of ~2 km), and;
- Springbok Tand Re/ 215 (Springboktand), owned by the van der Westhuizen family (2.6 km).

The portions affecting Kareedoornpan and Struiskom would be aligned just inside the southern boundaries of these properties, while the portion affecting Springboktand would traverse the southern portion of the property.

From the proposed SS1, Alternative A runs south-east, just inside the eastern and northern boundaries of Leeubergrivier RE/1163 (AJ van Heerden Familie Trust) and the northern boundary of Kleine Rooiberg RE/ 227 (van der Westhuizen family). Leeubergrivier would be affected along a distance of ~6 km, and Kleine Rooiberg along ~4.6 km. The terminal portion of the alignment would run from the north-easternmost point of Kleine Rooiberg across Sous Farm RE/ 226 (Mr. Francois van der Merwe) for ~6.9 km. This portion of the alignment would traverse the Sishen-Saldanha line ~1.6 km west of the Helios substation, and the Nuwepos Road ~200 m south of the existing Eskom lines entering the substation.

Alternative B
Alternative B is approximately 27km in length, and the longest of the three Alternatives (Figure 1.3). Like Alternative A, Alternative B would run counter-clockwise from the proposed SS2, via SS1 to the Helios substation. The initial 18.4 km – from SS2 to the north-easternmost point of Kleine Rooiberg RE/ 227 – is identical to the alignment of Alternative A.

However, unlike Alternative A, Alternative B continues just inside the eastern boundary of Klein Rooiberg for ~5.9 km, up to the Sishen Saldanha railway line. At this point the alignment swings north-east, traversing the south-easternmost portion of Sous Farm over a distance of 2.7 km. The portion across Sous Farm is located to the east of the Sishen-Saldanha line and traverses the Nuwepos road west of Helios.

Alternative C
Alternative C is approximately 23 km in length, and the shortest of the three Alternatives. Unlike Alternative A and B, Alternative C runs clockwise from SS1, via SS2 to the Helios substation (Figure 1.4).

The initial portion from SS1 to SS2 is identical to the proposed Alternative A and B alignments. East of SS2, the alignment runs just inside the southern boundary of Aan de Karee Doorn Pan (Mr Gys Lombard) for ~6.2 km, up to more or less the south-eastern point of the property, near the Nuwepos Road.

The terminal 9 km would be aligned across the eastern portion of Sous Farm. Apart from the initial and terminal portions of this 9 km stretch, the alignment is located to the east of the Nuwepos Road. Approximately 6 km of the alignment is located ~200-500 m parallel to the west of existing Eskom lines. The alignment traverses the Sishen-Saldanha line ~1.5 km north of the Helios substation, just to the east of the railway bridge. The final ~3 km of the alignment is located ~200 m parallel to the Nuwepos Road, initially to the east of the road, and finally the west. The line traverses the Nuwepos Road ~200 m south of the existing Eskom lines entering the Helios substation.

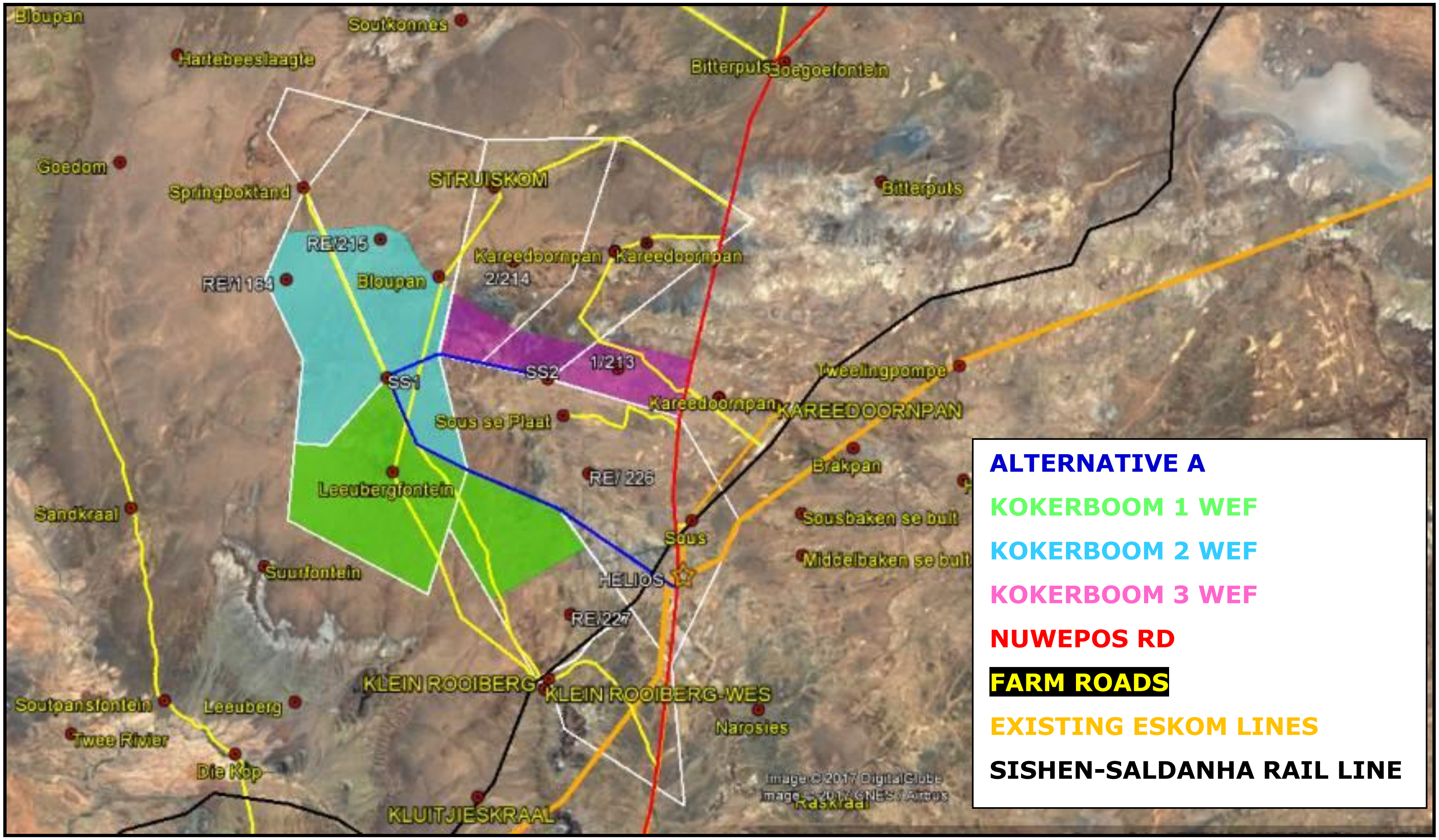

Figure 1.2: Proposed transmission line Alternative A in relation to affected properties[2]

[2] Permanently inhabited farms are indicated in capitals.

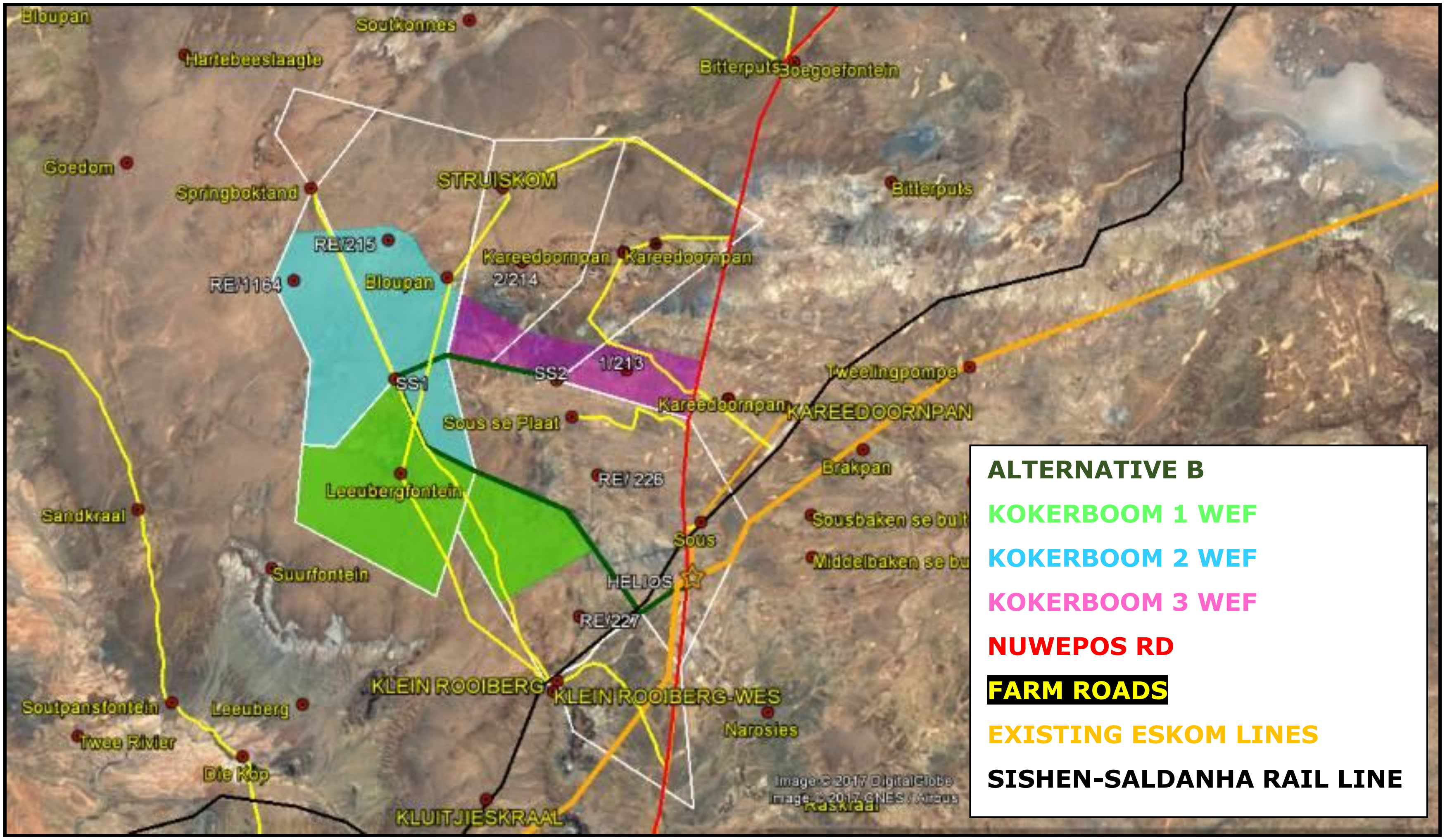

Figure 1.3: Proposed transmission line Alternative B in relation to affected properties[3]

[3] Permanently inhabited farms are indicated in capitals.

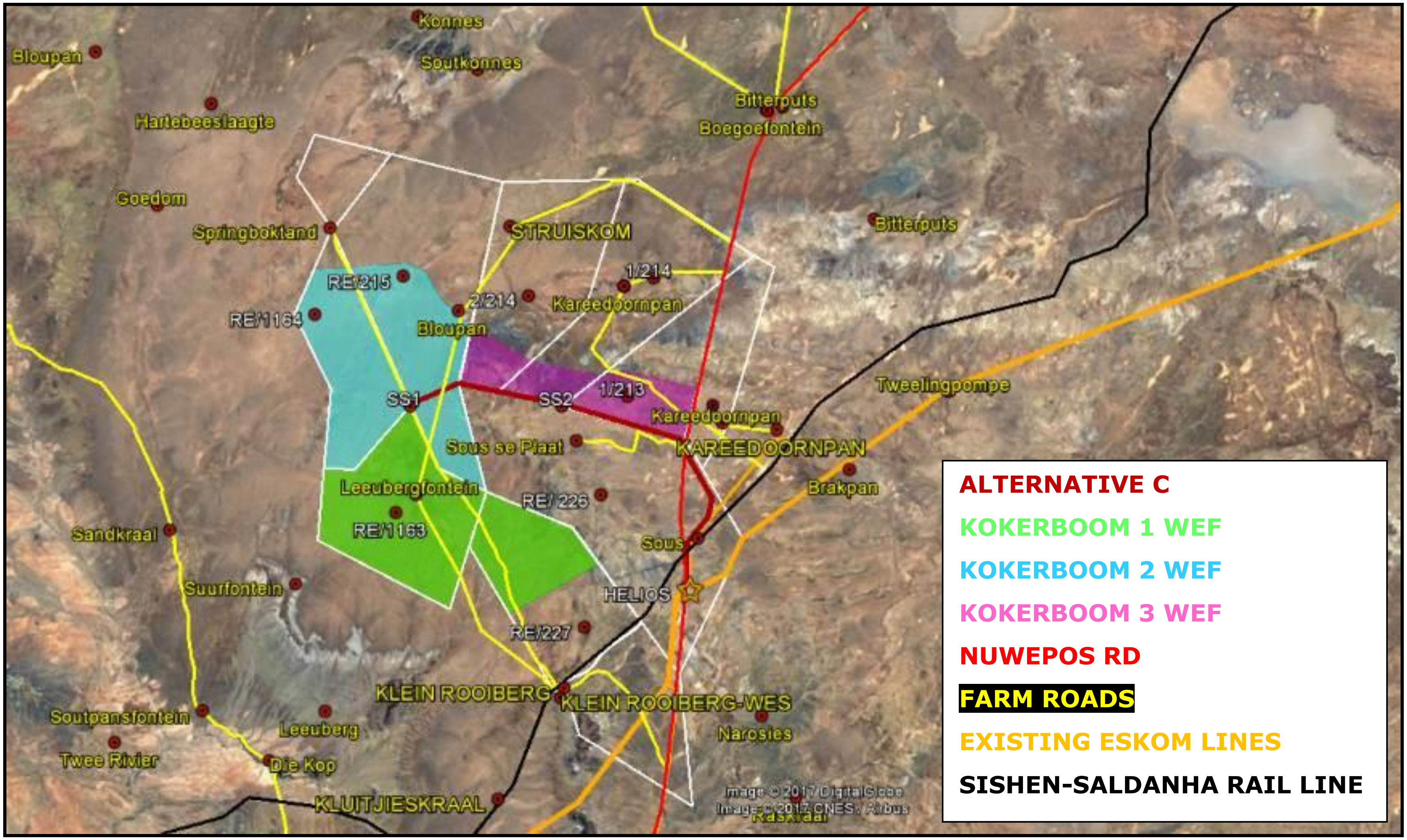

Figure 1.4: Proposed transmission line Alternative A in relation to affected properties[4]

[4] Permanently inhabited farms are indicated in capitals.

1.4 PROJECT LOCATION AND SURROUNDING LAND USES

The study area is located ~ 50-60 km north of the town of Loeriesfontein in the Hantam Local Municipal area in the Northern Cape Province (Photograph 1.1).The total population of Loeriesfontein was 2 744 in 2011. The town of Brandvlei (population 2 859) is located ~ 85 km north east of the site. The site is accessed via a gravel road that intersects with the R 357 ~ 1 km to the south west of the entrance to Loeriesfontein. The origin of Loeriesfontein is linked to a general store established in 1894 by a travelling bible salesman, Fredrick Turner. The store still exists and is owned by Mr Victor Haupt, the grandson of Fredrick Turner. The shop is currently called Turner & Haupt Spar and has been in the family for 113 years. The population density in the study area is very low.

The town of Loeriesfontein is accessible from the N7 (Cape Town-Namibia Route) via Vanrhynsdorp (R27) and Nieuwoudtville (R357). Access to the site and surrounding study area is via a gravel road linking Loeriesfontein in the south to Kakakmas in the Gariep River Valley to the north. The southern portion of the road (i.e. from Loeriesfontein) is known as the Nuwepos Road (Photograph 1.2). Granaatboskolk, located 58 km to the north-west of the site, is a farmstead at the junction of the Nuwepos Road and the public gravel road to Brandvlei. A public gravel road, located near Konnes se Pan off the Nuwepos Road, provides a link to the R355 to the west of the study area. The R355, a gravel road, links Loeriesfontein in the south with Pofadder and the N14 (Springbok-Upington) to the north.

Photograph 1.1: Loeriesfontein main road

Photograph 1.2: The Nuwepos Road, looking south from the Sishen-Saldanha railway bridge with Helios substation and Rooiberg in the background. The Kokerboom 1 site is located to right of the road

Eskom's Helios substation is located adjacent to the east of the Nuwepos Road, approximately 4.6 km east of the Kokerboom 1 site (Photograph 1.3). Two existing Eskom transmission lines currently link into Helios. Both lines traverse the Nuwepos Road near Helios. Portions of the relevant corridors are located within 500 m or less of the road over a distance of almost 7 km (Photograph 1.4).

Three WEFs, namely Kokerboom 1-3 have been proposed by Business Venture Investments 1788 (Pty) Ltd (BVI) on adjacent sites in the area to the north of the Nuwepos Road. The Kokerboom 2 site is located to the north of the Kokerboom 1 site. Separate substations and other on-site infrastructure are proposed. However, the three facilities will share two switching stations (each ±100m X 100m) and a 132kV overhead line to Eskom's Helios substation.

A farm road network provides access to farmsteads and stock posts off the Nuwepos Road (Photograph 1.5). Farm gates associated with property boundaries or internal camps are located at regular intervals along all the relevant roads. At the time of the site visit none of the gates were locked.

Photograph 1.3 Eskom's Helios substation adjacent to the Nuwepos Road

Photograph 1.4: Eskom lines located to the west of the Nuwepos Road south of Helios with Rooiberg in the background

Photograph 1.5: Farm road linking Klein Rooiberg (Kokerboom 1) to Springboktand (Kokerboom 2)

Additional power lines associated with Mainstream's Khobab and Loeriesfontein WEFs, which are currently under construction (see below), are likely to link into Helios over the next year or so. Both lines would link into Helios from the north. It is also understood that an additional Eskom servitude has been approved from Helios to Aggenys, located ~ 155 km north-west of Helios. This line would be located across some of the properties currently proposed for the Kokerboom WEF power line to Helios (Lombard, van der Merwe; pers. comm).

The Sishen-Saldanha railway line is located ~3.8 km to the south-east of the Kokerboom 1 WEF site (Photograph 1.6). The line is electrified and traverses the Nuwepos Road via an overpass ~1.8 km north-west of the Helios substation. A railway servitude road runs along the Sishen-Saldanha line. The road is well-maintained and appears to be used by the local farmers on an informal basis.

The areas remote, undeveloped sense of place has therefore been impacted by a number of infrastructure elements, including the Helios substation and associated transmission lines, the electrified Sishen-Saldanha railway line and the Khobab and Loeriesfontein WEFs.

Photograph 1.6: Sishen-Saldanha railway line and servitude road, viewed from the bridge across the Nuwepos Road, looking north-west

The study area terrain is essentially a broad, flat plain located ~40 km north-west of the escarpment portion between Loeriesfontein and Kliprand. Despite the general flatness of the study area terrain, low rises and ridges occur intermittently. The proposed turbine placements are largely associated with these slightly elevated areas. In addition, a few solitary and widely-spaced ridges, hills or small mountains occur in the study area, such as the Harderant Ridge on the Kokerboom 1 site, and the prominent Klein Rooiberg (Photograph 1.7) located approximately 6 km south-east of the Kokerboom 1 site.

Photograph 1.7: Klein Rooiberg viewed from the southern portion of the Kokerboom 1 site

The town of Loeriesfontein is traditionally seen as the southern gateway to Bushmanland, and the study area is therefore considered part of Bushmanland. Bushmanland is a vast, arid, hot, treeless and essentially flat expanse, characterized by broad, endorheic (blind) watercourses, and large, shallow depressions such as pans and salt pans. Three large salt pans, Konnes se Pan, Dwaggas Salt Pan and Commissioner's Salt Pan, are located 20-40 km to the north and north-east of the Kokerboom 1 site. Rainfall is low (~100 mm/a), evaporation rates very high, and episodic droughts frequent. Apart from a few isolated quiver trees the vegetation consists of low bushes and shrubs.

Agriculture and small-scale salt mining are traditionally the key economic activities in the study area. Essentially the only agricultural resource in the study area is grazing, almost exclusively for sheep. Much of the veld is palatable, but biomass production is very low (7-8 hectares per sheep). Consequently, economically viable units are very large, typically around 10 000 ha. As in many arid areas, biomass production is tied to "boom and bust" cycles associated with exceptional rainfall years and droughts. The study area soils are too poor and water too scarce to enable cropping agriculture, including fodder cropping for own use.

As pointed out by the historian Nigel Penn, the term "Bushmanland" has less to do with the fact that the region was originally favoured by the Bushmen (San), than that this extremely marginal area was a last refuge from colonial expansion when the term was coined. As Penn shows, until well into the 19th century the region was generally considered too marginal for European settlement, and was used for seasonal grazing during exceptional rainfall years only (Penn, 2005). More continuous and widespread farming only became possible thanks to windmills and boreholes during the first decades of the 20th century. The marginality of the region is still reflected in its very sparse settlement pattern and it’s almost total reliance on stock production.

For more than a century the study area portion of Bushmanland has been considered as the traditional summer-grazing grounds of farmers based in the Hantam region. The Hantam, roughly the triangular area between Loeriesfontein and the larger towns of Calvinia and Nieuwoudtville to its south, is an important sheep-farming area. The Hantam Region benefits from winter-rainfall and has more water, is generally cooler, and has a higher veld-carrying capacity than Bushmanland.

The veld in Bushmanland is traditionally considered too meagre to allow for year-round stocking. As a result many farmers in the past would spend the summer with their stock in Bushmanland. Nowadays it is more common for a solitary labourer to be left with the stock for the relevant period (van der Merwe; pers. comm). While grazing servitudes (trekgange) still exist in the study area these are no longer used as trucks are used to move stock to different grazing areas.

In terms of rainfall and veld type, the study area is located in the transition-zone between the winter-rainfall scrub (bossiesveld) associated with the Hantam and the summer-rainfall grassveld of Bushmanland (Danie van der Westhuizen, Kotze; pers. comm) (Photographs 1.8 and 1.9). The transitional nature of the veld on some of the study area properties, e.g. Klein Rooiberg and Struiskom, has enabled year-round occupation of these properties.

Photograph 1.8: Bossiesveld (scrub) on Bloupan stock post to the north of the site

Photograph 1.9: Grassveld on the Kokerboom 1 site portion of Klein Rooiberg Farm

Farms in the study area are all reliant on borehole water, supplemented by harvested rainwater for domestic use. Groundwater is typically pumped by pipeline over considerable distances to various stock watering-points on the large properties. Groundwater quality is generally poor, with the water too brackish for potable use or gardening on many properties (Kotze, Danie van der Westhuizen; pers. comm).

Due to low carrying capacities and unvaried terrain, the area is not very suitable for commercial hunting. Springbok and small game occur on a number of local farms, but hunting (Springbok) is mainly by the owners for biltong during hunting season (Danie van der Westhuizen, pers. comm).

The spectacular West Coast wildflower displays are mainly associated with the winter-rainfall zone further to the west (Namaqualand). Therefore, due to its remoteness, the relatively monotonous landscape, lack of anchoring tourism assets and limited potable water supplies, no dedicated tourism facilities are located in the study area. Due to these factors, the development potential of the area is also limited.

1.4.1 Site properties affected by transmission line options

The 3 proposed transmission line Alternatives from the Kokerboom WEFs to the Helios substation affect a total of seven properties and five landowners (See Figure 1.2.).

All five landowners would be affected by Alternative A and B, while Alternative C would only affect four (Table 1.1). Only one of the relevant properties, Struiskom, is permanently inhabited. In addition, the parent farm of Springboktand and Kleine Rooiberg, Klein Rooiberg, is also permanently inhabited. All the relevant properties are primarily used for grazing, some only seasonally. In addition, one property, Sous Farm, accommodates the Mainstream Khobab WEF, currently under construction. Apart from Kobab WEF there are no permanent workers who are employed on the affected properties. An overview of the different properties is provided below.

Table 1.1: Ownership and land use on site properties

Receptor	Owner	Alts	Use	Owner resident
Kareedoornpan: Karee Doorn Pan 1/214 Aan de Karee Doorn Pan RE/ 213	Mr Gys Lombard	A, B, C	Seasonal grazing	No
Struiskom: Karee Doorn Pan 2/214	Mr Theunis Kotze	A, B, C	Year-round grazing	Yes
Springboktand/ Bloupan: Springboktand RE/ 215	Mr Danie vd Westhuizen	A, B, C	Year-round grazing	No (adjacent)
Leeubergrivier/ Harderant: Leeubergrivier RE/1163	Mr van Heerden	A, B	Seasonal grazing	No
Klein Rooiberg Farm: Kleine Rooiberg RE/ 227	Mr Danie vd Westhuizen	A, B, C	Year-round grazing	No (adjacent)
Sous: Sous Farm RE/ 226	Mr Francois vd Merwe	A, B, C	Seasonal grazing; Khobab WEF	No

Kareedoornpan

Kareedoornpan and Aan de Kareedoornpan (here collectively referred to as Kareedoornpan) are owned by Mr Gys Lombard. Kareedoornpan forms part of Mr Lombard's Bushmanland summer farms, which also includes Konnes Farm located to the north-west of Kareedoornpan. The properties are located to the west of the Nuwepos Road.

Kareedoornpan is not inhabited. Mr Lombard's summer operations are based on Konnes (north of Kareedoornpan), while his winter operations take place on Rheeboksfontein in the Hantam area south of Loeriesfontein. Mr Lombard is one of the few remaining Hantam farmers that spends the summer living with his flock. Two permanent labourers are associated with his opertions. They migrate along with Mr Lombard between Konnes and Rheeboksfontein (Lombard, pers. comm).

No dwellings are located on Kareedoornpan, only a shed. Other infrastructure includes internal and boundary fences, gates, stock watering points and pipelines. Primary access to the farms is via a semi-circular road off the Granaatbboskolk Road. No powerlines or other services infrastructure currently traverse the properties. The owner has however indicated that Eskom has recently registered a servitude for the planned Helios-Aggenys line across both properties. The line would traverse Alternative C just to the east of the proposed Switching Station 2 (SS2) (Lombard, pers. comm).

Kareedoornpan would be affected by all three Alternatives. All three Alternatives would affect a common ~3.2 km stretch locted inside the southern boundary of Aan de Kareedoornpan (1/214), while Alternative C would also affect Kareedoornpan (RE/213) inside its southern boundary (additional ~6.2 km) (Photograph 1.10). The proposed SS2, also integral to the Kokerboom WEFs proposal, would be located on the boundary between Aan de Kareedoornpan and Kareedoornpan. The Kokerboom 2 WEF access road essentialy follow the proposed powerline alignment(s).

Photograph 1.10: Portion of Kareedoornpan (right of fence) which would be affected by Alternative C, seen from Nuwepos Road. Sous Farm is located to the left of the fence; the road is part of the Khobab WEF

Struiskom

Struiskom consists of one cadastral unit, Karee Doorn Pan 2/214. The property is owned by Mr Theunis Kotze, who is permanently based on Struiskom. Despite Struiskom's relatively small size (5 049 ha), the availability of summer and winter veld allows for year-round stocking. Due to low carrying capacities, stocking levels are kept low. Mr Kotze and his son do all the work on the property. No labourers or labourers houses are associated with Struiskom (Kotze; pers. comm).

Primary access to Struiskom is via a dedicated farm road off the Nuwepos Road, the extension of which provides access to Bloupan and Klein Rooiberg. The proposed new road would be located ~ 8 km to the south of the Struiskom farmstead (Photograph 1.15). No powerlines or other service industrial infrastructure are currently located across Struiskom, but the Eskom Helios-Aggenys servitude is aligned across the mid-portion of the property. In addition, the owner has indicated that he has been approached by Mainstream with regard for a possible line from the farm Graskoppies (to the north) across the westernmost portion of his property, and then inside the southern boundary east as currently proposed for the Kokerboom WEFs (Kotze, pers. Comm).

Struiskom would be affected by the same ~2 km stretch inside its southern boundary for all three Alternatives (Photograph 1.11). The proposed alignment is located ~8.1 km from the farm house on Struiskom. Struiskom forms part of Kokerboom 3 WEF.

Photograph 1.11: Portion of Struiskom (left of fence) which would be affected by Alternatives A-C, viewed from south-westernmost point on Struiskom. Sous Farm (Khobab WEF) is located to the right of the fence

Klein Rooiberg Farm

Kleine Rooiberg RE/277 and the adjacent Springboktand RE/215 (Bloupan) to the north, form part of the proposed Kokerboom 1 and Kokerboom 2 WEFs respectively. Both properties are farmed as part of the larger Klein Rooiberg Farm (total of 7 000 ha). The properties are owned by the van der Westhuizen family and farmed/ managed by Mr Danie van der Westhuizen and operations are based at the original Klein Rooiberg farmstead, located at the foot of the Klein Rooiberg (mountain), adjacent to the Sishen-Saldanha line (Photograph 1.12). Towards the east, Klein Rooiberg Farm extends up to the Nuwepos Road.

Photograph 1.12: Houses on Klein Rooiberg and Klein Rooiberg-Wes, viewed from across the Sishen-Saldanha railway line

A widely-interspaced cluster of five houses is located on Klein Rooiberg-Wes and the adjacent Klein Rooiberg farmsteads (collectively simply referred to as Klein Rooiberg). Only two of the houses are currently permanently inhabited. Another house is used from time to time by Mr Bobby van der Westhuizen (based in Loeriesfontein town), Mr Danie van der Westhuizen's uncle.

Klein Rooiberg farmstead is accessed from the Nuwepos Road. This road, which traverses the farmstead, also serves as primary access road to properties located to the north of Klein Rooiberg, such as Springboktand (Bloupan), Springbokpan, and Harderant farms – all properties forming part of the proposed Kokerboom 1 and 2 WEFs.

Klein Rooiberg is exclusively a sheep-farming operation (Photograph 1.13). The owner leases adjacent land from his uncle. The additional land and the fact that Klein Rooiberg has both winter and summer grazing enables him to occupy and utilise Klein Rooiberg year-round – one of only a few farms in the study area. The operation historically provided permanent employment to one resident worker. However, no one is currently employed on the farm. The only additional employment opportunities provided are limited to a visiting team of sheep-shearers once a year (Danie van der Westhuizen; pers. comm).

Photograph 1.13: Sheep at Bloupan outpost on Springboktand, part of Klein Rooiberg farm

No dwellings are located on the two properties which would be affected by the power line Alternatives. Infrastructure is limited to a shed and sheep-working station on Bloupan stock post (on Springboktand), fencing, gates, water pipelines and stock watering-points.

The two existing Eskom line corridors traverse the eastern portion of Klein Rooiberg, including Kleine Rooiberg RE/277 (Photograph 1.14). The lines are located approximately 5 km to the east of the farmstead. The lines traverse the access road to the farmstead near the entrance off the Nuwepos Road.

Springboktand would be affected by all three Alternatives – a common section of ~2.6 km across the property extending from the proposed ACED SS1 (to be located at the boundary of Springboktand, Springbokpan and Leeubergrivier farms) to the south-western boundary point of Struiskom. Kleine Rooiberg RE/277 would be affected by the terminal stretches of Alternatives A (4.6 km) and B (10.5 km). Both alignments would be just within the property's northern boundary with Sous Farm (Khobab WEF). None of the sections associated with the relevant Alternatives would be located within significant proximity to residential structures on Klein Rooiberg (~5 km +).

Photograph 1.14: Eskom line and stock watering point on Klein Rooiberg to the north of the access road off the Nuwepos Rd

Leeubergrivier/Harderant

Leeubergrivier RE/1163 - known variously as Leeubergrivier or Harderant – forms part of the proposed Kokerboom 1 WEF. The property belongs to Mr Herman van Heerden and his wife (neé van der Westhuizen). The owners are based in Cape Town. The property is used for seasonal grazing only.

Apart from a small shed, no structures are located on Harderant (Photograph 1.15). Infrastructure is limited to fencing, gates, roads, stock pens, -shelters, -watering points, windmills, small cement dams and plastic pipelines (Photograph 1.16). Most of the infrastructure is clustered just to the east of the Harderant, a prominent large ridge/ low hill. The property is only seasonally stocked. The grazing resource is of reletaively uniform quality. No dedicated employment opportunities are associated with the property (van Heerden; pers. comm).

No power lines or other service-industrial infrastructure are currently located on Leeubergrivier. Leeubergrivier would be affected over a distance of 6km just inside its northern boundary by both Alternatives A and B (common stretch). Approximately 3.3 km of the proposed alignments would run parallel to the existing farm road between Klein Rooiberg and Springboktand (uninhabited farmstead, partially on another portion of Springboktand owned by Mr Kokkie van der Westhuizen, and Springbokpan, part of Kokerboom 1).

Photograph 1.15: Shed, cement dam and windmill on Harderant

Photograph 1.16. Stock watering post on portion of Harderant near the site proposed for the Kokerboom 1 project substation

Sous Farm

Sous Farm does not from part of the proposed Kokerboom WEFs but will be affected by the proposed transmission lines. The property is owned by Mr Francois van der Merwe. Sous (~9 000 ha) has been used as summer veld for main operations based in the Hantam (Tierhoek Farm near Calvinia) for generations. A small house is located on Sous. It is only used for occasional visits when stock is being kept on the property. However, since the commencement of construction activities associated with the Khobab WEF on Sous ~ 18 months ago, all farming activities have been suspended (van der Merwe, pers. Comm).

The Khobab WEF was approved in the third REIPPP Bid-round and is currently being constructed by Mainstream Renewable Power. Construction started in early 2016, and the WEF is scheduled for completion towards the end of 2017[5]. The project construction camp is located along the west of the Nuwepos Road, opposite the Helios substation (Photograph 1.17).

Photograph 1.17: Khobab and Loeriesfontein WEFs construction camp along the Nuwepos Road. Note dust suppressant which has been applied to the road

Infrastructure associated with the Khobab WEF is located west of the Nuwepos Road, on the northern portion of Sous Farm (i.e. across the boundary from Struiskom and Kareedoornpan (Lombard)). The Khobab WEF will feed into Helios via a line which will run parallel to Alternative C from the Khobab substation to Helios. The Khobab substation is located next to the Nuwepos Road in the extreme north-eastern corner of the property (Photograph 1.18).

The Nuwepos Road and the Sishen-Saldanha railway line are located across the eastern portion of Sous Farm. Eskom's Helios substation along the Granaatbosklok road is located on land which originally formed part of Sous Farm. Two existing line

[5] http://khobabwind.co.za/.

corridors feed into and again out of Helios. The lines are located to the west of the Nuwepos Road and south of the Helios substation (Photograph 1.19).

Photograph 1.18: Khobab WEF project substation adjacent to Nuwepos road, currently under construction

Photograph 1.19: Powerlines entering Helios from both sides of the Nuwepos Road, viewed form the Sishen-Saldanha railway bridge

The alignments south of the Helios substation are parallel to one another ~500 m west of the Nuwepos Road, and traverse the road just to the south of Helios. North of the Helios substation one of the the corridors is aligned parallel (~300 m) to the east of the Nuwepos Road over a distance of ~2.3 km, before veering north-east, roughly parallel to the west of the Sishen-Saldanha line. The second corridor is aligned north-east from Helios, and its terminal portion follows the cadastral boundary to the easternmost point of Sous Farm. In addition, the registered Eskom servitude from Helios to Aggenys would traverse Sous Farm.

Sous Farm would be affected by all three Alternatives to varying degrees. All three Alternatives would cut across the property (as opposed to closely following cadastral boundaries) (Photographs 1.20 and 1.21).

Photograph 1.20: Portion of Sous Farm which would be affected by Alternatives A and B just before traversing the Nuwepos Road

Photograph 1.21: Portion of Sous Farm east of the Nuwepos road which would be affected by Alternative C. Eskom line in distance

Alternative A and B would both cut across the south-eastern portion of Sous Farm, with the distance affected by A (6.3 km) longer than that of B (2.4 km). Both Atternatives would traverse the Nuwepos Road in the vicinity of the area where the existing Eskom lines traverse the road, and enter Helios from the south. Alternative C would be aligned ~400 m inside the boundary between Sous and Kareedoornpan Farm (portion belonging to Mr Braam Lintvelt), and then essentially follow the alignment of the existing Eskom line to the west of the Sishen-Saldanha line, traversing the Nuwepos Road more or less opposite Helios, and entering Helios from the west.

1.4.2 Adjacent properties

Only two adjacent properties are located within any meaningful distance of the proposed Kokerboom power line Alternatives, namely Springbokpan (RE/1164) and Kareedoornpan (portions 1 & 2 of Farm 213, owned by Mr Lintvelt).

Springbokpan (RE/1164)
Springbokpan forms part of the proposed Kokerboom 2 WEF. The property is exclusively used for seasonal grazing. An uninhabited dwelling is located on Springbokpan, namely on a portion of the original Springboktand farm yard (now split between two owners). The owners are based in Stellenbosch, and the property is rented out to a farmer based in the Hantam near Calvinia. No dedicated employment is associated with the property (van Heerden; pers. Comm). Infrastructure consists of roads, fencing, pens, stock watering points and associated infrastructure. Springbokpan is accessed via a farm road from Klein Rooiberg farmstead, aligned just on the inside of the property's eastern boundary (Photograph 1.22).

Photograph 1.22: Farm road on Springbokpan linking Klein Rooiberg to Springboktand

No service related infrastructure is currently located on the property. The proposed SS1 would be partially located on the easternmost corner of Springbokpan, also straddling Springboktand (van der Westhuizen family) and Harderant (van Heerden). Alternatives A, B and C (common section) would feed in from the east into SS1, and Alternatives A and B (common section) would feed in from the south. No other portion of Springbokpan would be affected. The Springboktand farmyard is located ~9.6 km to the north of the SS1.

Portions 1 & 2 of Kareedoornpan 213 (Lintvelt)

The portion of the original Kareedoornpan Farm belonging to the Lintvelt family is located adjacent to the north of Khobab WEF, in the area east of the Nuwepos Road and west of the Sishen-Saldanha railway line. The relevant property (2 cadastral units) constitutes Mainstream's Loeriesfontein WEF which is currently under construction. Mr Braam Lintvelt resides permanently on Kareedoornpan. The farmstead is located west of the Sishen-Saldanha railway line, and is accessed off the Nuwepos Road. The property is primarily used for grazing.

The Loeriesfontein WEF is located on the southern half of the property. Approximately 8 of the Loeriesfontein WEF turbines are being constructed within 1 km of the Nuwepos Rd, with the nearest ~230 m of the road (Photograph 1.23).

Photograph 1.23: Turbines under construction on Loeriesfontein WEF on Kareedoornpan (Lintvelt) east of the Nuwepos road

The Sishen-Saldanha line and one existing Eskom line corridor currently traverse the south-eastern portion of Kareedoornpan. The Eskom and Sishen-Saldanha lines are located more or less parallel, with the Eskom line passing ~500 m and the railway line ~900 m to the east of the farmhouse respectively.

The nearest Loeriesfontein WEF turbine is located ~ 840 m from the farmhouse. Alternative C is located ~300-400 m from Kareedoornpan's south-western boundary with Sous Farm (Khobab). The proposed line would be located ~4.7 km south-east of the farmstead, and ~2.6 km of the nearest Loeriesfontein WEF turbine.

Other Renewable Energy Facilities
In addition to the proposed Kokerboom WEFs there are a number of Renewable Energy Facilities (REFs) currently proposed or under construction in the study area (Figure 1.3). These include the Khobab and Loeriesfontein WEFs, which were approved in the Third REIPPP Bid-round. Both facilities are owned by Mainstream Renewable Power and are currently under construction (Photograph 1.24). Construction started in early 2016. The construction camp for both facilities is located along the Nuwepos Road adjacent to the Helios substation. Both facilities are scheduled for completion towards the end of 2017[6].

The other proposed REFs include the Dwarsrug WEF and Orlight PV solar energy facility.Both projects have submitted final EIA applications and it is understood that environmental approval had been obtained for Orlight PV facility (2013) as well as the Dwarsrug WEF. The current status of the two projects is unclear. One interview also indicated that Mainstream is currently investigating Graskoppies Farm, located ~15 km to the north-west of the Kokerboom 1 site, as a potential WEF site (Kotze;

[6] http://khobabwind.co.za/; http://loeriesfonteinwind.co.za/

pers. comm). With current, proposed and potential REFs in the study area, the area around Helios substation may potentially become congested with feed-in lines. However, given the relative absence of receptors, this would not be a significant impact.

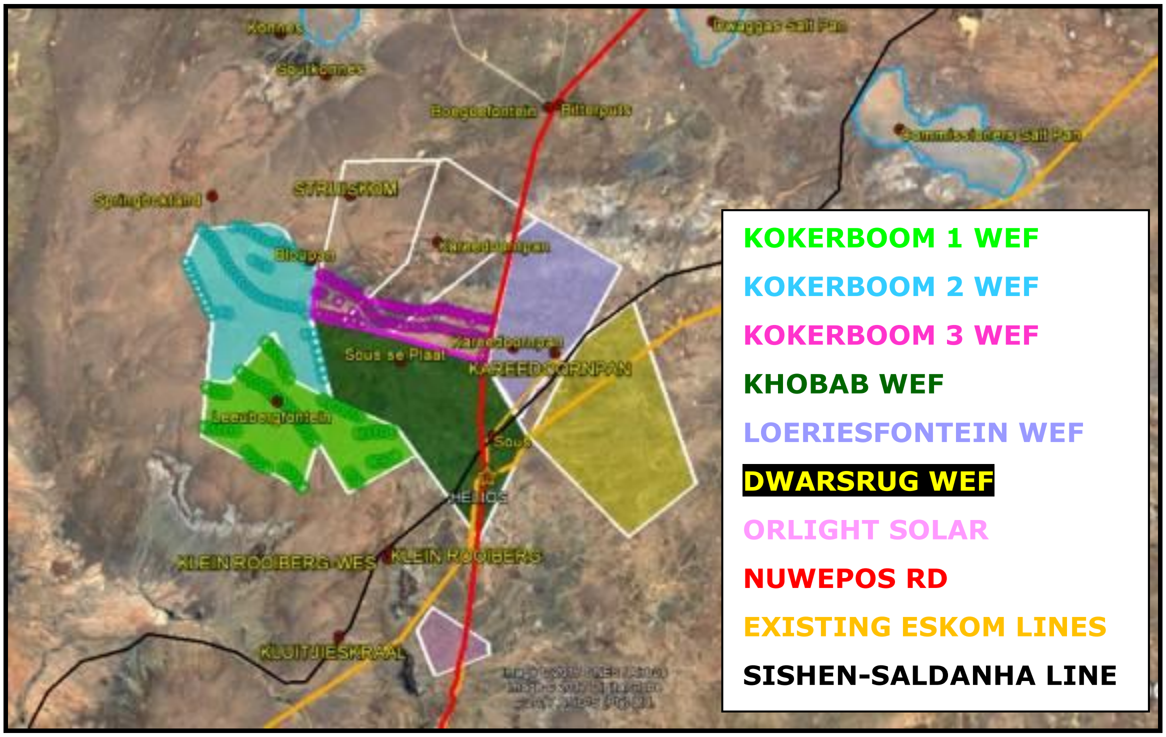

Figure 1.3: Location of renewable energy projects in the study area

Photograph 1.24: Khobab WEF project substation under construction

1.4.3 Distances with regard to receptors

A summary of the linear distances along which the relevant properties and property owners would be affected by the proposed grid connection infrastructure is provided in Table 1.3.

Table 1.3: Approximate linear distances along which affected properties and land owners would be affected by Alternatives A-C

Receptor	Owner	Alt A	Alt B	Alt C
Karee Doorn Pan 1/214 Aan de Karee Doorn Pan RE/ 213	Mr Gys Lombard	3.2 km	3.2 km	9.4 km
Karee Doorn Pan 2/214 "Struiskom"	Mr Theunis Kotze	2 km	2 km	2 km
Springbok Tand RE/ 215[7]	Mr Danie vd Westhuizen	2.6 km	2.6 km	2.6 km
Leeubergrivier RE/1163 'Harderant'	Mr van Heerden	6 km	6 km	
Kleine Rooiberg RE/ 227	Mr Danie vd Westhuizen	4.6 km	10.5 km	
Sous Farm RE/ 226	Mr Francois vd Merwe	6.9 km	2.7 km	9 km
		25.3 km	27 km	23 km

As is evident, while Alternatives A and B would affect all five owners, Alternative C would only affect four (not Leeubergrivier or Kleine Rooiberg). Alternative C would however affect Kareedoornpan and Sous Farm along longer distances. All three Alternatives would be located in close proximity to existing Eskom lines. However, additional power lines will be established in the area, including lines to two Mainstream WEFs under construction, the Eskom Helios-Aggenys line, and lines associated with other REFs proposed in the area. These lines are likely to affect the area on Sous Farm to the north of the Helios substation, which is where Alternative C is located. It is however noted that Alternative C has been designed to align with the Mainstream line form the Khobab WEF substation Helios.

While Alternative B has the longest alignment, at ~27 km in length it is approximately 4 km longer than the shortest alignment, namely Alternative C, it benefits from having the shortest section that is not located along existing cadastral lines. This is of specific relevance for Sous Farm, where Alternative B would only traverse 2.7 km of the property, as opposed to the 6.9 km and 9 km associated with Alternatives B and C respectively. Given the number of existing, proposed and potential lines on Sous Farm, the owner is keen to limit the extent of additional lines across the property (van der Merwe, pers. comm).

Table 1.4 provides an overview of approximate distances from proposed infrastructure associated with the three power line alternatives, namely Alternative A, B and C.

[7] Properties indicated in fill form part of existing or proposed WEFs.

Table 1.4: Approximate nearest distances from proposed Powerline Alternatives to key adjacent receptors

Receptor	Alt A	Alt B	Alt C
Nuwepos gravel Road	Traverses	Traverses	Traverses
Existing Eskom lines	Traverses	Traverses	Traverses
Kareedoornpan farmstead (Lintvelt)	9.6 km	9.6 km	4.7 km
Klein Rooiberg farmstead	6.7 km	5.1 km	7.4 km
Klein Rooiberg Wes farmstead	7.2 km	5.4 km	7.5 km
Kluitjieskraal farmstead	13.1 km	11.2 km	13.4 km
Struiskom farmstead	8.1 km	8.1 km	8.1 km
Bloupan stock post	3.5 km	3.5 km	3.5 km
Harderant stock post	1.6 km	1.6 km	4.5 km
Kareedoornpan (Lombard) stock post	6.6 km	6.6 km	6.5 km
Sous se Plaat stock post	4 km	4 km	1.4 km
Springboktand stock post	9.6 km	9.6 km	9.6 km

Based on the findings of the site visit, no inhabited farmsteads would be located within 5 km of Alternatives A and B, and only one within 5km of Alternative C, namely Kareedoornpan (Lindvelt), at 4.7 km. The relevant property forms part of the Loeriesfontein WEF.

In conclusion, the proposed lines would be located in a very sparsely populated area which only supports sheep farming and with grazing on many properties only utilized seasonally.

1.5 ASSUMPTIONS AND LIMITATIONS

1.5.1 Assumptions

Technical suitability
It is assumed that the development site represents a technically suitable site for the establishment of a wind energy facility and the associated infrastructure, including power lines.

Strategic importance of the project
The strategic importance of promoting wind energy is supported by the national and provincial energy policies. However, this does not mean that site related issues can be ignored or overlooked.

Fit with planning and policy requirements
Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported. However, the study recognises the strategic importance of wind energy and the technical, spatial and land use

constraints required for wind energy facilities and the associated infrastructure, including power lines.

1.5.2 Limitations

Demographic data

The information contained in some key policy and land use planning documents, such as Integrated Development Plans etc., may not contain data from the 2011 Census. However, where required this data has been up-dated with the relevant 2011 Census data.

1.6 APPROACH TO STUDY

The approach to the SIA study is based on the Western Cape Department of Environmental Affairs and Development Planning Guidelines for Social Impact Assessment (DEADP, 2007). These guidelines are based on international best practice. The key activities in the SIA process embodied in the guidelines include:

- Describing and obtaining an understanding of the proposed intervention (type, scale, and location), the settlements, and communities likely to be affected by the proposed project;
- Collecting baseline data on the current social and economic environment;
- Identifying the key potential social issues associated with the proposed project. This requires a site visit to the area and consultation with affected individuals and communities;
- Assessing and documenting the significance of social impacts associated with the proposed intervention;
- Identifying alternatives and mitigation measures.

The identification of potential social issues associated with the proposed infrastructure is based on observations during the project site visit, review of relevant documentation, experience with similar projects and the general area. Annexure A contains a list of the secondary information reviewed and interviews conducted. Annexure B outlines the assessment methodology used to assign significance ratings during the assessment phase.

1.6.1 Definition of social impacts

Social impacts can be defined as "The consequences to human populations of any public or private actions (these include policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society. These impacts are felt at various levels, including individual level, family or household level, community, organisation or society level. Some social impacts are felt by the body as a physical reality, while other social impacts are perceptual or emotional" (Vanclay, 2002).

When considering social impacts, it is important to recognise that social change is a natural and on-going process (Burdge, 1995). However, it is also important to recognise and understand that policies, plans, programmes, and/or projects implemented by government departments and/or private institutions have the potential to influence and alter both the ***rate*** and ***direction*** of social change. Many social impacts are not in themselves "impacts" but change process that may lead to social impacts (Vanclay, 2002). For example, the influx of temporary construction workers is in itself not a social impact. However, their presence can result in range of social impacts, such as increase in antisocial behaviour. The approach adopted by Vanclay stresses the importance of understanding the processes that can result in social impacts. It is therefore critical for social assessment specialists to think through the complex causal mechanisms that produce social impacts. By following impact pathways, or causal chains, and specifically, by thinking about interactions that are likely to be caused, the full range of impacts can be identified (Vanclay, 2002).

An SIA should therefore enable the authorities, project proponents, individuals, communities, and organisations to understand and be in a position to identify and anticipate the potential social consequences of the implementation of a proposed policy, programme, plan, or project. The SIA process should alert communities and individuals to the proposed project and possible social impacts, while at the same time allowing them to assess the implications and identify potential alternatives. The assessment process should also alert proponents and planners to the likelihood and nature of social impacts and enable them to anticipate and predict these impacts in advance so that the findings and recommendations of the assessment are incorporated into and inform the planning and decision-making process.

However, the issue of social impacts is complicated by the way in which different people from different cultural, ethic, religious, gender, and educational backgrounds etc. view the world. This is referred to as the "social construct of reality." The social construct of reality informs people's worldview and the way in which they react to changes.

1.6.2 Timing of social impacts

Social impacts vary in both time and space. In terms of timing, all projects and policies go through a series of phases, usually starting with initial planning (pre-feasibility and development), followed by implementation (construction), operation, and finally closure (decommissioning). The activities, and hence the type and duration of the social impacts associated with each of these phases are likely to differ.

1.7 SPECIALIST DETAILS

Tony Barbour, the lead author of this report is an independent specialist with 25 years' experience in the field of environmental management. In terms of SIA experience Tony Barbour has undertaken in the region of 200 SIAs and is the author of the Guidelines for Social Impact Assessments for EIA's adopted by the Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape in 2007. Annexure C contains a copy of Tony Barbour's CV.

Schalk van der Merwe, the co-author of this report, has an MPhil in Environmental Management from the University of Cape Town and has worked closely with Tony Barbour on a number of SIAs over the last twelve years.

1.8 DECLARATION OF INDEPENDENCE

This confirms that Tony Barbour and Schalk van der Merwe, the specialist consultants responsible for undertaking the study and preparing the SIA Report, are independent and do not have any vested or financial interests in the proposed WEF being either approved or rejected.

1.9 REPORT STUCTURE

The report is divided into five sections, namely:

- Section 1: Introduction;
- Section 2: Policy and planning context;
- Section 3: Overview of study area;
- Section 4: Identification and assessment of key issues; and
- Section 5: Key Findings and recommendations.

SECTION 2: POLICY AND PLANNING ENVIRONMENT

2.1 INTRODUCTION

Legislation and policy embody and reflect key societal norms, values and developmental goals. The legislative and policy context therefore plays an important role in identifying, assessing and evaluating the significance of potential social impacts associated with any given proposed development. An assessment of the "policy and planning fit[8]" of the proposed development therefore constitutes a key aspect of the Social Impact Assessment (SIA). In this regard, assessment of "planning fit" conforms to international best practice for conducting SIAs. Furthermore, it also constitutes a key reporting requirement in terms of the applicable Western Cape Department of Environmental Affairs and Development Planning's *Guidelines for Social Impact Assessment* (2007).

For the purposes of the meeting the objectives of the SIA the following national, provincial and local level policy and planning documents were reviewed, namely:

National
- National Energy Act (2008);
- White Paper on the Energy Policy of the Republic of South Africa (December 1998);
- White Paper on Renewable Energy (November 2003);
- Integrated Resource Plan (IRP) for South Africa (2010-2030);
- The National Development Plan (2011);
- New Growth Path Framework (2010);
- National Infrastructure Plan (2012).
- Strategic Environmental Assessment (SEA) for wind and solar PV energy in South Africa (CSIR, 2015).

Provincial
- Northern Cape Provincial Growth and Development Strategy (2004-2014);
- Northern Cape Climate Change Response Strategy;
- Northern Cape Spatial Development Framework.

District and local
- Namakwa District Municipality Integrated Development Plan (Review 2014/15);
- Hantam Local Municipality Integrated Development Plan (Review 2014/15).

[8] Planning fit" can simply be described as the extent to which any relevant development satisfies the core criteria of appropriateness, need, and desirability, as defined or circumscribed by the relevant applicable legislation and policy documents at a given time.

2.2 NATIONAL POLICY ENVIRONMENT

2.1.1 National Energy Act (Act No 34 of 2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including wind:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (…); to provide for (…) increased generation and consumption of renewable energies…" (Preamble).

2.1.2 White Paper on the Energy Policy of the Republic of South Africa

Investment in renewable energy initiatives, such as the proposed WEF, is supported by the White Paper on Energy Policy for South Africa (December 1998). In this regard the document notes:

"Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential".

"Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future".

The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and ***wind*** and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented;
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and,
- Addressing constraints on the development of the renewable industry.

The White Paper also acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive and many appropriate applications exist.

The White Paper also notes that renewable energy applications have specific characteristics that need to be considered. Advantages include:

- Minimal environmental impacts in operation in comparison with traditional supply technologies; and
- Generally lower running costs, and high labour intensities.

Disadvantages include:

- Higher capital costs in some cases;
- Lower energy densities; and
- Lower levels of availability, depending on specific conditions, especially with sun and wind based systems.

2.1.3 White Paper on Renewable Energy

The White Paper on Renewable Energy (November, 2003) (further referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognizes that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

The White Paper notes that while South Africa is well endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. As signatory to the Kyoto Protocol[9], Government is determined to make good the country's commitment to reducing greenhouse gas emissions. To this purpose, Government has committed itself to the development of a framework in which a national renewable energy framework can be established and operate.

South Africa is also a signatory of the Copenhagen Accord, a document that delegates at the 15th session of the Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change agreed to "take note of" at the final plenary on 18 December 2009. The accord endorses the continuation of the Kyoto Protocol and confirms that climate change is one of the greatest challenges facing the world. In terms of the accord South Africa committed itself to a reduction target of 34% compared to business as usual. In this regard the IRP 2010 aims to allocate 43% of new energy generation facilities in South Africa to renewables.

Apart from the reduction of greenhouse gas emissions, the promotion of renewable energy sources is aimed at ensuring energy security through the diversification of supply (in this regard, also refer to the objectives of the National Energy Act).

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels. :

[9] The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of November 2009, 187 states have signed and ratified the protocol (Wikipedia)

2.1.4 National Integrated Resource Plan for Electricity (2010-2030)

The current iteration of the Integrated Resource Plan (IRP) for South Africa, initiated by the Department of Energy (DoE) after a first round of public participation in June 2010, led to the Revised Balanced Scenario (RBS) that was published in October 2010 and later up-dated in November 2013. The document outlines the proposed generation new build fleet for South Africa for the period 2010 to 2030. This scenario was derived based on the cost-optimal solution for new build options (considering the direct costs of new build power plants), which was then "balanced" in accordance with qualitative measures such as local job creation. In addition to all existing and committed power plants, the RBS included a nuclear fleet of 9,6 GW; 6,3 GW of coal; 11,4 GW of renewables; and 11,0 GW of other generation sources.

A second round of public participation was conducted in November/December 2010, which led to several changes to the IRP model assumptions. The main changes were the disaggregation of renewable energy technologies to explicitly display solar photovoltaic (PV), concentrated solar power (CSP) and wind options; the inclusion of learning rates, which mainly affected renewables; and the adjustment of investment costs for nuclear units, which until then represented the costs of a traditional technology reactor and were too low for a newer technology reactor (a possible increase of 40%).

Additional cost-optimal scenarios were generated based on the changes. The outcomes of these scenarios, in conjunction with the following policy considerations, led to the Policy-Adjusted IRP:

- The installation of renewables (solar PV, CSP and wind) were brought forward in order to accelerate a local industry;
- To account for the uncertainties associated with the costs of renewables and fuels, a nuclear fleet of 9,6 GW was included in the IRP;
- The emission constraint of the RBS (2140 million tons of carbon dioxide per year after 2024) was maintained; and
- Energy efficiency demand-side management (EEDSM) measures were maintained at the level of the RBS.

Figure 2.1 indicates the new capacities of the Policy commitment. The dates shown in Table 2.1 indicate the capacity is required in order to avoid security of supply concerns. The document notes that projects could be concluded earlier than indicated. In terms of allocation, wind was allocated between 600 and 800MW per year and solar between 500 and 700MW. With Round 4 announcement in April 2015 the allocation for wind and solar was doubled in the so called Round 4b and even an expedited Round 4c with an additional 1 800MW was introduced for bidding in October 2015. Furthermore, the department announced that the current REIPPPP will be extended with an additional 63 00MW for the upcoming years. To date, there have been four (4) volumes or bidding windows under the REIPPPP. In April 2015, the DoE announced additional preferred bidders for the REIPPPP Bid Window 4 contributing 1 121MW to the national grid contributing to a total of 5 243MW procured since the implementation of the programme to date (DoE, 2015).

The key conclusions that are relevant to the renewable energy sector is that an accelerated roll-out of renewable energy options should be allowed in order to derive the benefits of these technologies.

	New build options								Committed					Non IRP
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas – CCGT	Peak – OCGT[1]	Wind	CSP	Solar PV	Coal	Other	DoE Peaker	Wind[2]	Other Renew.	Co-generation
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
2010	0	0	0	0	0	0	0	0	380	260	0	0	0	0
2011	0	0	0	0	0	0	0	0	679	130	0	0	0	0
2012	0	0	0	0	0	0	0	300	303	0	0	400	100	0
2013	0	0	0	0	0	0	0	300	823	333	1020	400	25	0
2014	500	0	0	0	0	400	0	300	722	999	0	0	100	0
2015	500	0	0	0	0	400	0	300	1444	0	0	0	100	200
2016	0	0	0	0	0	400	100	300	722	0	0	0	0	200
2017	0	0	0	0	0	400	100	300	2168	0	0	0	0	200
2018	0	0	0	0	0	400	100	300	723	0	0	0	0	200
2019	250	0	0	237	0	400	100	300	1446	0	0	0	0	0
2020	250	0	0	237	0	400	100	300	723	0	0	0	0	0
2021	250	0	0	237	0	400	100	300	0	0	0	0	0	0
2022	250	0	1 143	0	805	400	100	300	0	0	0	0	0	0
2023	250	1 600	1 183	0	805	400	100	300	0	0	0	0	0	0
2024	250	1 600	283	0	0	800	100	300	0	0	0	0	0	0
2025	250	1 600	0	0	805	1 600	100	1 000	0	0	0	0	0	0
2026	1 000	1 600	0	0	0	400	0	500	0	0	0	0	0	0
2027	250	0	0	0	0	1 600	0	500	0	0	0	0	0	0
2028	1 000	1 600	0	474	690	0	0	500	0	0	0	0	0	0
2029	250	1 600	0	237	805	0	0	1 000	0	0	0	0	0	0
2030	1 000	0	0	948	0	0	0	1 000	0	0	0	0	0	0
Total	6 250	9 600	2 609	2 370	3 910	8 400	1 000	8 400	10133	1722	1020	800	325	800

2011 Determinations   2012 Determinations   Eskom commitments (pre IRP)

Notes: 1. OCGT is seen as natural gas in the determination
2. Includes Sere (100MW)

Source: IRP 2010-2030 Update Report November 2013

Figure 2.1: IRP2010 Policy Adjusted Plan with Ministerial Determinations

The IRP is currently being updated in order to reflect recent developments in the energy sector, country and region. A Draft IRP for public comment and stakeholder engagement was published in November 2016. The comment period closes in February 2017[10].

2.1.5 National Development Plan

The National Development Plan (NDP) contains a plan aimed at eliminating poverty and reducing inequality by 2030. The NDP identifies 9 key challenges and associated remedial plans. Managing the transition towards a low carbon national economy is identified as one of the 9 key national challenges. Expansion and acceleration of commercial renewable energy is identified as a key intervention strategy.

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[10] Media Briefing by Minister Tina Joemat-Petterson, 22 November 2016. (http://www.gov.za/speeches/minister-tina-joemat-pettersson-media-briefing-integrated-energy-plan-and-integrated)

2.1.6 The New Growth Path Framework

Government released the New Economic Growth Path Framework on 23 November 2010. The aim of the framework is to enhance growth, employment creation and equity. The policy's principal target is to create five million jobs over the next 10 years and reflects government's commitment to prioritising employment creation in all economic policies. The framework identifies strategies that will enable South Africa to grow in a more equitable and inclusive manner while attaining South Africa's developmental agenda. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard the framework identifies investments in five key areas namely: ***energy***, transport, communication, water and housing.

The New Growth Path also identifies five other priority areas as part of the programme to create jobs, through a series of partnerships between the State and the private sector. The Green Economy is one of the five priority areas, including expansions in construction and the production of technologies for solar, wind and biofuels. In this regard clean manufacturing and environmental services are projected to create 300 000 jobs over the next decade.

2.1.7 National Infrastructure Plan

The South African Government adopted a National Infrastructure Plan in 2012. The aim of the plan is to transform the economic landscape while simultaneously creating significant numbers of new jobs and strengthen the delivery of basic services. The plan also supports the integration of African economies. In terms of the plan Government will invest R827 billion over the next three years to build new and upgrade existing infrastructure. The aim of the investments is to improve access by South Africans to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools and dams will contribute to improved economic growth.

As part of the National Infrastructure Plan, Cabinet established the Presidential Infrastructure Coordinating Committee (PICC). The Committee identified and developed 18 strategic integrated projects (SIPs). The SIPs cover social and economic infrastructure across all nine provinces (with an emphasis on lagging regions) and consist of:

- Five geographically-focussed SIPs;
- Three spatial SIPs;
- Three energy SIPs;
- Three social infrastructure SIPs;
- Two knowledge SIPs;
- One regional integration SIP;
- One water and sanitation SIP.

The three energy SIPs are SIP 8, 9 and 10.

SIP 8: Green energy in support of the South African economy

- Support sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the <u>Integrated Resource Plan</u> (IRP 2010);

- Support bio-fuel production facilities.

SIP 9: Electricity generation to support socio-economic development

- Accelerate the construction of new electricity generation capacity in accordance with the IRP 2010 to meet the needs of the economy and address historical imbalances;
- Monitor implementation of major projects such as new power stations: Medupi, Kusile and Ingula.

SIP 10: Electricity transmission and distribution for all

- Expand the transmission and distribution network to address historical imbalances, provide access to electricity for all and support economic development.
- Align the 10-year transmission plan, the services backlog, the national broadband roll-out and the freight rail line development to leverage off regulatory approvals, supply chain and project development capacity.

2.1.8 Strategic Environmental Assessment (SEA) for Wind and Solar PV energy in South Africa

The Strategic Environmental Assessment (SEA) for wind and solar PV energy in South Africa (CSIR, 2015) identified eight (8) ***Renewable Development Zones*** (REDZs). The REDZs identified areas where large scale wind energy facilities can be developed in in a manner that limits significant negative impacts on the environment while yielding the highest possible socio-economic benefits to the country. The proposed WEF is not located within any of the wind zones identified in the SEA (Figure 2.2). The closest wind zone is the Komsberg Wind Zone, which is located ~ 150 km south east of the study area.

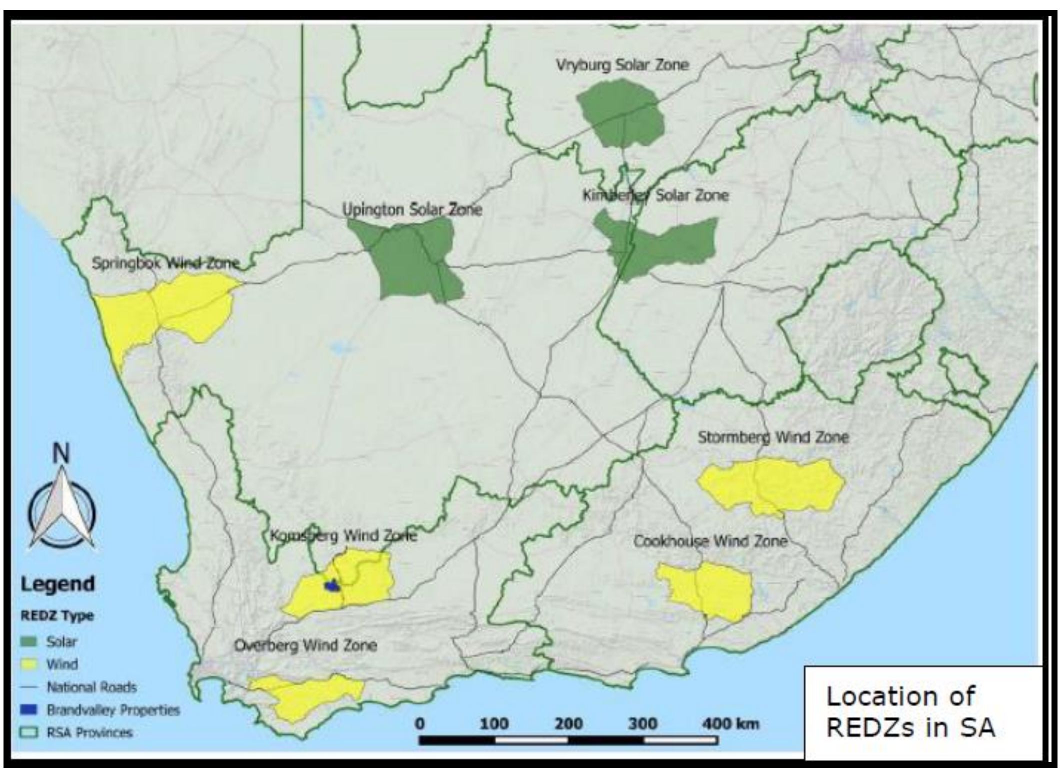

Figure 2.2: Location of Renewable Development Zones in South Africa *(Source CSIR)*

2.3 PROVINCIAL POLICY AND PLANNING ENVIRONMENT

2.3.1 Northern Cape Province Provincial Growth and Development Strategy

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) identifies poverty reduction as the most significant challenge facing the government and its partners. All other societal challenges that the province faces emanate predominantly from the effects of poverty. The NCPGDS notes that the only effective way to reduce poverty is through long-term sustainable economic growth and development. The sectors where economic growth and development can be promoted include:

- Agriculture and Agro-processing;
- Fishing and Mariculture;
- Mining and mineral processing;
- Transport;
- Manufacturing;
- Tourism.

However, the NCPGDS also notes that economic development in these sectors also requires:

- Creating opportunities for lifelong learning
- Improving the skills of the labour force to increase productivity
- Increasing accessibility to knowledge and information

The achievement of these primary development objectives depends on the achievement of a number of related objectives that, at a macro-level, describe necessary conditions for growth and development. These are:

- Developing requisite levels of human and social capital
- Improving the efficiency and effectiveness of governance and other development institutions
- Enhancing infrastructure for economic growth and social development

Of specific relevance to the SIA the NCPGDS make reference to the need to ensure the availability of inexpensive energy. The section notes that in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured. At the same time, the development of new sources of energy through the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments must be encouraged. In this regard the NCPGDS notes "the development of energy sources such as wind and solar energy, the natural gas fields, bio-fuels, etc., could be some of the means by which new economic opportunity and activity is generated in the Northern Cape". The NCPGDS also highlights the importance of close co-operation between the public and private sectors in order for the economic development potential of the Northern Cape to be realised.

The NCPGDS also highlights the importance of enterprise development, and notes that the current levels of private sector development and investment in the Northern Cape are low. In addition, the province also lags in the key policy priority areas of SMME Development and Black Economic Empowerment. The proposed wind energy facility therefore has the potential to create opportunities to promote private sector investment and the development of SMMEs in the Northern Cape Province.

In this regard care will need to be taken to ensure that the proposed WPP and other renewable energy facilities do not negatively impact on the regions natural environment. In this regard the NCPGDS notes that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation. The document also indicates that due to the provinces exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed wind energy facility, do not affect the tourism potential of the province.

2.3.2 Northern Cape Provincial Spatial Development Framework

Northern Cape Provincial Spatial Development Framework (NCSDF) (2012) lists a number of sectoral strategies and plans are to be read and treated as key components of the PSDF. Of these there are a number that are relevant to the proposed WPP. These include:

- Sectoral Strategy 1: Provincial Growth and Development Strategy of the Provincial Government.
- Sectoral Strategy 2: Comprehensive Growth and Development Programme of the Department of Agriculture, Land Reform and Rural Development.
- Sectoral Strategy 5: Local Economic Development (LED) Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 11: Small Micro Medium Enterprises (SMME) Development Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 12: Tourism Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 19: Provincial renewable energy strategy (to be facilitated by the Department of Economic Development and Tourism).

Under Section B 14.4, Energy Sector, the NCSDF (2012), notes the total area of high radiation in South Africa amounts to approximately 194 000 km^2 of which the majority falls within the Northern Cape. It is estimated that, if the electricity production per km^2 of mirror surface in a solar thermal power station were 30.2 MW and only 1% of the area of high radiation were available for solar power generation, then generation potential would equate to approximately 64 GW. A mere 1.25% of the area of high radiation could thus meet projected South African electricity demand in 2025 (80 GW) (NCPSDF, 2012). However, the SDF does indicate that this would require large investments in transmission lines from the areas of high radiation to the main electricity consumer centres. The SDF also notes that the implementation of large concentrating solar power (CSP) plants has been proposed as one of the main contributors to greenhouse gas emission reductions in South Africa. In this regard, various solar parks and CSP plants have been proposed in the province with Upington being the hub of such developments (NCPSDF, 2012).

Section C8.2.3, Energy Objectives, sets out the energy objectives for the Northern Cape Province. The section makes specific reference to renewable energy. The objectives are listed below:

- Promote the development of renewable energy supply schemes. Large-scale renewable energy supply schemes are strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimizing detrimental environmental impacts.
- Enhance the efficiency of Eskom's power station at the Vanderkloof power station.
- In order to reinforce the existing transmission network and to ensure a reliable electricity supply in the Northern Cape, construct a 400kV transmission power line from Ferrum Substation (near Kathu/Sishen) to Garona Substation (near Groblershoop). There is a national electricity supply shortage and the country is now in a position where it needs to commission additional plants urgently. Consequently, renewable energy projects are a high priority.
- Develop and institute innovative new energy technologies to improve access to reliable, sustainable and affordable energy services with the objective to realize sustainable economic growth and development. The goals of securing supply, providing energy services, tackling climate change, avoiding air pollution and reaching sustainable development in the province offer both opportunities and synergies which require joint planning between local and provincial government as well as the private sector.
- Develop and institute energy supply schemes with the aim to contribute to the achievement of the targets set by the White Paper on Renewable Energy (2003). This target relates to the delivery of 10 000 GWh of energy from renewable energy sources (mainly biomass, wind, solar, and small-scale hydro) by 2013.

Section C8.3.3, Energy Policy, sets out the policy guidelines for the development of the energy sector, with specific reference to the renewable energy sector.

- The construction of telecommunication infrastructure must be strictly regulated in terms of the spatial plans and guidelines put forward in the PSDF. They must be carefully placed to avoid visual impacts on landscapes of significant symbolic, aesthetic, cultural or historic value and should blend in with the surrounding environment to the extent possible.
- EIAs undertaken for such construction must assess the impacts of such activities against the directives listed in (a) above.
- Renewable energy sources such as wind, solar thermal, biomass and domestic hydroelectricity are to constitute 25% of the province's energy generation capacity by 2020.
- The following key policy principles for renewable energy apply:
  - Full cost accounting: Pricing policies will be based on an assessment of the full economic, social and environmental costs and benefits of energy production and utilisation.
  - Equity: There should be equitable access to basic services to meet human needs and ensure human well-being. Each generation has a duty to avoid impairing the ability of future generations to ensure their own well-being.
  - Global and international cooperation and responsibilities: Government recognises its shared responsibility for global and regional issues and act with due regard to the principles contained in relevant policies and applicable regional and international agreements.
  - Allocation of functions: Government will allocate functions within the framework of the Constitution to competent institutions and spheres of government that can most effectively achieve the objectives of the energy policy.
  - The implementation of sustainable renewable energy is to be promoted through appropriate financial and fiscal instruments.

- An effective legislative system to promote the implementation of renewable energy is to be developed, implemented, and continuously improved.
- Public awareness of the benefits and opportunities of renewable energy must be promoted.
- The development of renewable energy systems is to be harnessed as a mechanism for economic development throughout the province in accordance with the Sustainable Development Initiative (SDI) approach (refer to Toolkit D10) or any comparable approach.
- Renewable energy must, first, and foremost, be used to address the needs of the province before being exported.

2.3.3 Northern Cape Climate Change Response Strategy

The key aspects of the PCCRS Report are summarised in the MEC's (NCPG: Environment and Nature Conservation) 2011 budget speech: "The Provincial Climate Change Response Strategy will be underpinned by specific critical sector climate change adaptation and mitigation strategies that include the Water, Agriculture and Human Health sectors as the 3 key Adaptation Sectors, the Industry and Transport alongside the Energy sector as the 3 key Mitigation Sectors with the Disaster Management, Natural Resources and Human Society, livelihoods and Services sectors as 3 remaining key Sectors to ensure proactive long term responses to the frequency and intensity of extreme weather events such as flooding and wild fire, with heightened requirements for effective disaster management".

Key points from MEC Lucas' address include the NCPG's commitment to develop and implement policy in accord with the National Green Paper for the National Climate Change Response Strategy (2010), and an acknowledgement of the NCP's extreme vulnerability to climate-change driven desertification. The development and promotion of a provincial green economy, including green jobs, and environmental learnership is indented as an important provincial intervention in addressing climate change. The renewable energy sector, including solar and wind energy (but also biofuels and energy from waste), is explicitly indicated as an important element of the Provincial Climate Change Response Strategy. The MEC also indicated that the NCP was involved in the processing a number of WPP and SEF EIA applications.

2.3.4 Northern Cape Province Provincial Growth and Development Strategy

The Provincial Growth and Development Strategy (PGDS) notes that the most significant challenge that the government and its' partners in growth and development are confronted with is the reduction of poverty. All other societal challenges that the province faces emanate predominantly from the effects of poverty. The PGDS notes that the only effective way to reduce poverty is through long-term sustainable economic growth and development. The sectors where economic growth and development can be promoted include:

- Agriculture and Agro-processing;
- Fishing and Mariculture;
- Mining and mineral processing;
- Transport;
- Manufacturing;
- Tourism.

However, the PGDS also notes that economic development in these sectors also requires:

- Creating opportunities for lifelong learning;
- Improving the skills of the labour force to increase productivity;
- Increasing accessibility to knowledge and information.

The achievement of these primary development objectives depends on the achievement of a number of related objectives that, at a macro-level, describe necessary conditions for growth and development. These are:

- Developing requisite levels of human and social capital;
- Improving the efficiency and effectiveness of governance and other development institutions;
- Enhancing infrastructure for economic growth and social development.

Of specific relevance to the SIA the NCPGDS make reference to the need to ensure the availability of inexpensive energy. The section notes that in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured. At the same time, the development of new sources of energy through the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments must be encouraged. In this regard, the NCPGDS notes "the development of energy sources such as **wind** and solar energy, the natural gas fields, bio-fuels, etc., could be some of the means by which new economic opportunity and activity is generated in the Northern Cape". The NCPGDS also highlights the importance of close co-operation between the public and private sectors in order for the economic development potential of the Northern Cape to be realised.

The NCPGDS also highlights the importance of enterprise development, and notes that the current levels of private sector development and investment in the Northern Cape are low. In addition, the province also lags in the key policy priority areas of SMME Development and Black Economic Empowerment. The proposed WEF therefore has the potential to create opportunities to promote private sector investment and the development of SMMEs in the NCP.

In this regard care will need to be taken to ensure that the proposed WPP and other renewable energy facilities do not negatively impact on the regions natural environment. In this regard, the NCPGDS notes that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation. The document also indicates that due to the provinces exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed WEF, do not materially affect the tourism potential of the province. The potential impact on heritage sites may also have social implications. This issue will be assessed during the Assessment Phase.

2.4 DISTRICT AND LOCAL POLICY AND PLANNING ENVIRONMENT

2.4.1 Namakwa District Municipality Integrated Development Plan

The vision for the NDM as set out in the Namakwa District Municipality Integrated Development Plan (Draft 2012-2016) is to develop the NDM as "a centre of excellence". The associated Mission Statement notes:

- A government institution legislatively mandated to stimulate economic and social transformation within the jurisdiction of the Namakwa District Municipality;
- By fostering partnership with relevant institutions to ensure sustainable development;
- Proactively supporting and capacitating B-municipalities;
- Be a transparent and accountable centre of excellence.

Of relevance to the proposed development, the IDP identifies climate change as one of the key challenges facing the NDM. The key challenges and possible effects faced by the Northern Cape government and population include:

- The Northern Cape specifically will be affected very adversely by climate change;
- Climate change threatens food security, poverty alleviation and sustainable socio-economic growth;
- Fire will be a constant risk due to hot winds and dead or dry vegetation – fire risk projections for the western parts of South Africa indicate an increase in risk approximately 300%;
- Climate Change will impact persons and groups that are already vulnerable to food insecurity. Higher prices for agricultural inputs, water and food imports must be expected;
- The productivity of livestock, rooibos tea farming and fisheries will be affected, as well as potential income from tourism.
- Subsistence farmers will suffer the most – they are one of the social spectrum: poor, barely literate and quite likely to lose their livelihood to the encroaching desert.

The IDP identifies as five year implementation plan that identifies a number of key outcomes. The following outcomes are relevant to the proposed development:

- Outcome 4: Decent employment through inclusive economic growth. The associated projects to achieve this outcome include the creation of employment in the B-Municipalities;
- Outcome 6: An efficient, competitive and responsive economic infrastructure network. The associated projects to achieve this outcome include; support for SMME's, manufacturing, infrastructure development, tourism and renewable energy development. The IDP specifically notes that the objective of the renewable development project is to "position NDM strategically in order to attract renewable energy investment";
- Outcome 10: Environmental assets and natural resources that is well protected and continually enhanced. The associated projects to achieve this

The 2007-2012 Namakwa IDP also identifies a number of key performance areas (KPAs). Of relevance to the proposed project is KPA 3: Local Economic Development. A number of projects are listed under the Local Economic Development KPA of these the following are of specific relevance to the project;

- Project No. LE02 : Renewable Energy Cluster: The Development of a synergy between the energy resources within Namakwa Region;
- Project No. LE05: SMME Development Cluster: The development of a Management support system for SMME'S.

The objective of Project No: LEO2 is to ensure the participation of the NDM in the development of a synergy between **wind** energy, natural gas, solar, bio-fuel and wave energy so that the energy sector can enhance competitive and comparative advantage of the Namakwa region. The key outputs of the project listed in the IDP include:

- Establishment of Renewable energy resources like natural gas, **wind**, bio-fuel, waves, solar, hydro and waste recycling in the key municipalities and the NDM as whole.

2.4.2 Namakwa District Local Economic Development Strategy

The major developmental challenges facing the Namakwa District Municipality identified in the Local Economic Development (LED) strategy are:

- High unemployment levels, coupled to the need to create sustainable income-generating opportunities;
- High level of indigent households;
- Low skills and education levels;
- High dependency rate;
- The spread of HIV/AIDS; and
- The declining contribution of mining to employment in the District.

2.4.3 Hantam Local Municipality Integrated Development Plan

The vision for the HLM as set out in the IDP is *"We create homes for all in partnership with the community".* The associated Mission Statement is "To create a tourism and investment friendly environment in which growth and cost effective services can realise and where people can fulfil their full potential".

The IDP lists a number of Strategic Objectives, of which the following are relevant to the proposed development:

- Strategic Objective 2: Sustainable infrastructure development and basic service delivery. Under Key Projects the IDP identifies the need to raise public awareness on green energy and energy saving. In terms of Loeriesfontein the IDP lists need to develop play parks and tennis courts and establish sports grounds. These types of projects could benefit from the Community Trust established as part of the proposed development.
- Strategic Objective 3: Local economic development. Under Key Projects the IDP identifies renewable energy and climate change as key issues and opportunities.

SECTION 3: OVERVIEW OF STUDY AREA

3.1 INTRODUCTION

Section 3 provides an overview of the study area with regard to:

- The administrative context;
- The demographic and socio-economic context.

3.2 ADMINISTRATIVE CONTEXT

The site is located in the Northern Cape Province, within the Hantam Local Municipality (HLM), which forms part of the Namakwa District Municipality (NDM) (Figure 3.1). The NDM is bordered by the Siyanda and Pixley ka Seme Districts of the Northern Cape Province to the North-East and East, respectively, and by the Western Cape Province to the South (the West Coast, Boland and Central Karoo District Municipalities). The Atlantic Ocean is forms the Western boundary, while the Orange River forms the Northern border with Namibia.

Figure 3.1: Location of the Hantam LM within the Namaqua DM

The HLM is one of six local municipalities that make up the Namakwa District Municipality (NDM)). Hantam is a Khoi name that means "mountains where the bulbs grow". The municipality is named after the Hantam Mountains found in the area. The town of Calvina is the administrative seat of the HLM.

3.3 PROVINCIAL CONTEXT[11]

The proposed WEF is located in the Northern Cape Province, which is the largest province in South Africa and covers an area of 361,830 km^{2}, and constitutes approximately 30% of South Africa. The province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Siyanda, and Kgalagadi DM, twenty-six Category B municipalities and five district management areas.

Population
Despite having the largest surface area, the Northern Cape has the smallest population of 1 145 861 (Census 2011) or 2.28% of the population of South Africa. The population has increased from 991 919 in 2001. Of the five districts, Frances Baard has the largest population of 382 086. The other districts and their respective populations are Siyanda (236 783), John Taola Gaetsewe (224 799), Pixley ka Seme (186 351) and Namakwa (115 1402). In terms of age, 30.1% are younger than 15 years of age and 64.2% fall within the economically active age group of 15-64 years of age (Census 2011). The female proportion makes up approximately 52.7% of the total with males making up the remaining 47.3% (Census 2011).

Education
Based on the information contained in the NCPSDF the average adult education attainment levels in the Northern Cape are lower than the adult education attainment levels of South Africa as a whole. Approximately 19.7% of the Northern Cape adults have no schooling in comparison to South Africa's 18.1%. The Northern Cape has the second lowest percentage of adult individuals (5.5%) that obtained a tertiary education in South Africa. The LED Strategy for the Northern Cape indicates that Pixley ka Seme has the lowest adult education attainment levels in the Northern Cape with 27.3% of the adult population having no form of schooling, whilst John Taolo Gaetsewe is second with 25.4% having no schooling. The highest number of the adult population with tertiary education (6.4%) is located in Frances Baard.

The Northern Cape also has the smallest portion (11.1%) of highly skilled formal employees in South Africa and Gauteng has the highest (14.3%). Linked to this the Northern Cape has the second largest portion of semi and unskilled formal employees in the country. A lack of skilled people often results in both the public and the private sector being unable to implement planned growth strategies and achieve the desired productivity, service delivery and service quality (NCSDF, 2012).

Economic development
Over the past 8 years there has been little to no variance in the Human Development Index (HDI) figures for the Northern Cape, indicating no increase or decrease in the overall standard of living[12]. This trend is unlikely to change in the foreseeable future,

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[11] The information in this section is based on the Northern Cape Provincial Growth and Development Strategy 2004-2014. This document does not include 2011 Census Data. Where possible data from the 2011 Census and the NCSDF 2012 has been used to update the information.

[12] The Human Development Index (HDI) was developed by the United Nations Development Programme (UNDP) based on the philosophy that the goal of development was to ensure that individuals live long, informed and comfortable lives. The HDI consists of three components:

mainly due to the marginal economic base of the poorer areas, and the consolidation of the economic base in the relatively better-off areas. It is important to note that the HDI for the Northern Cape (0.55) is substantially below the South African figure of 0.72. The HDI of 0.55 displays a pattern of semi-development, and there is a definite inequality between the different population groups, with the Whites having a higher development lifestyle than the African or Coloured groups.

The percentage of Northern Cape people living below the poverty line has decreased from 40% in 1995 to 27% in 2011, while the poverty gap has decreased from 11% in 1995 to 8% in 2011 (Figure 3.2). The goal set by the province is to decrease the percentage of people living below the poverty line to 20% by 2015 NCSDF, 2012). The alleviation of poverty is one of the key challenges for economic development. Higher levels of economic growth are a key challenge for poverty eradication. Investment in people is pivotal to the eradication of poverty and inequality. Investment in people is also, to a large extent, about delivering social and economic infrastructure for education, welfare, health, housing, as well as transport and bulk infrastructure.

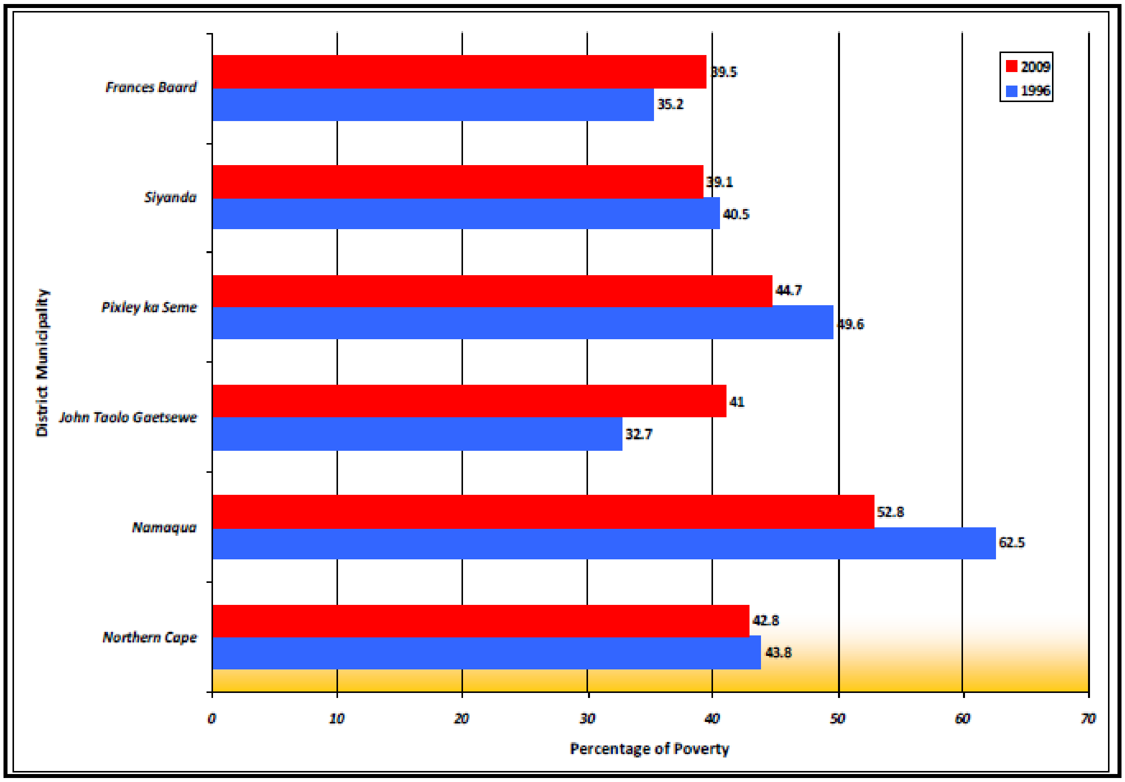
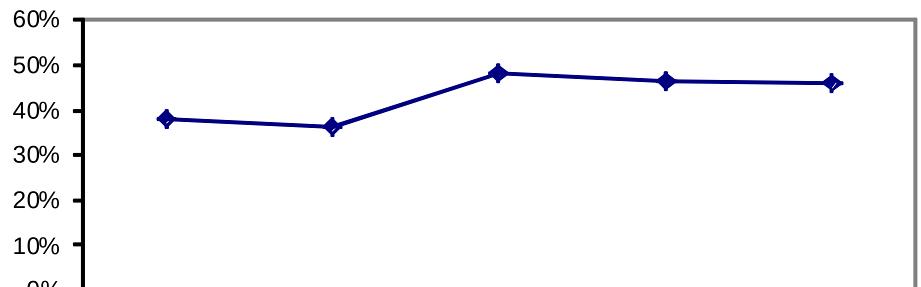


Figure 3.2: Percentage of people living in poverty in the Northern Cape (Source: Global Insight, 2009 as cited in the PGDS, July 2011).

Longevity, which is measured by life expectancy at birth; Educational attainment, which is measured by two education variables, namely adult literacy and combined gross primary, secondary and tertiary enrolment ratio, and; Income, which is measured by gross domestic product (GDP) per capita. Performance in each dimension is expressed as a value between 0 and 1, and the HDI index gives an internationally accepted measure of the wellness (quality of life) of the population of the area under consideration. The closer the HDI is to 1.0, the higher the level of "living condition". For example, Sweden has an index of 0.91 defined as high, South Africa at 0.72 is defined as middle and Lesotho at 0.47 is defined as low.

In terms of per capita income, the Northern Cape Province has the third highest per capita income of all nine provinces. However, income distribution is extremely skewed, with a high percentage of the population living in extreme poverty. The measure used in the PGDS document to measure poverty is the percentage of people living below the poverty line or breadline is used[13]. The poverty line indicates a lack of economic resources to meet basic food needs. Figure 3.3 indicates the percentage of household income below the poverty breadline of R800 in the Northern Cape Province, the highest being Karoo at 48% and the lowest being Namakwa at 36%.



	Kgalagadi	Namaqua	Pixley Ka Seme	Siyanda	Frances Baard
% Below breadline	38%	36%	48%	46%	46%

Figure 3.3: Percentage of household income below the poverty breadline by district (*Source: Northern Cape PGDS)*

Economic sectors

The Northern Cape economy has shown significant recovery since 2000/2001 when it had a negative economic growth rate of -2.5% (LED Strategy). The provincial economy reached a peak of 3.7% in 2003/2004 and remained the lowest of all provinces. The Northern Cape is the smallest contributing province to South Africa's economy (only 2% to South Africa GDP per region in 2007).

The mining sector is the largest contributor to the provincial GDP, contributing 28.9% to the GDP in 2002 and 27.6% in 2008. The mining sector is also important at a national level. In this regard the Northern Cape produces approximately 37% of South Africa's diamond output, 44% of its zinc, 70% of its silver, 140% of its iron-ore, 93% of its lead and 99% if its manganese.

Agriculture and agri-processing sector is also a key economic sector. Approximately 2% of the province is used for crop farming, mainly under irrigation in the Orange River Valley and Vaalharts Irrigation Scheme. Approximately 96% of the land is used

[13] In terms of the poverty line, a person is considered poor if his or her consumption or income level falls below some minimum level necessary to meet basic needs. The minimum level is usually called the poverty line. In South Africa the poverty income level is set at R800/month.

for stock farming, including beef cattle and sheep or goats, as well as game farming. The agricultural sector contributed 5.8% to the Northern Cape GDP per region in 2007 which was approximately R1.3 billion, and it employs approximately 19.5% of the total formally employed individuals (NCSDF, 2012). The sector is experiencing significant growth in value-added activities, including game-farming. Food production and processing for the local and export market is also growing significantly.

The main agricultural produce of the Northern Cape include:

- High-value horticultural products such as table grapes, sultanas and wine grapes, dates, nuts, cotton, fodder, and cereal crops are grown along the Orange River.
- Wheat, fruit, groudnuts, maize and cotton in the Vaalharts irrigation scheme in the vicinity of Hartswater and Jan Kempdorp.
- Vegetables and cereal crops at the confluence of the Vaal River and the Orange Rivers in the vicinity of Douglas.
- Wool, mohair, karakul, Karoo lamb, ostrich meat and leather, and venison throughout most of the province.

Economic development in the Northern Cape is hampered by the vastness of the area and the remoteness of its communities in rural areas. Development is also hampered by the low education and skills levels in the province. As a result unemployment in the Northern Cape presents a major challenge.

Employment

According to Statistics South Africa Labour (2012) the community and social services sector is the largest employer in the province at 29%, followed by the agricultural sector (16%), wholesale and retail trade (14%), finance (8%) manufacturing (6%) and mining (6%), etc. (Figure 3.4).

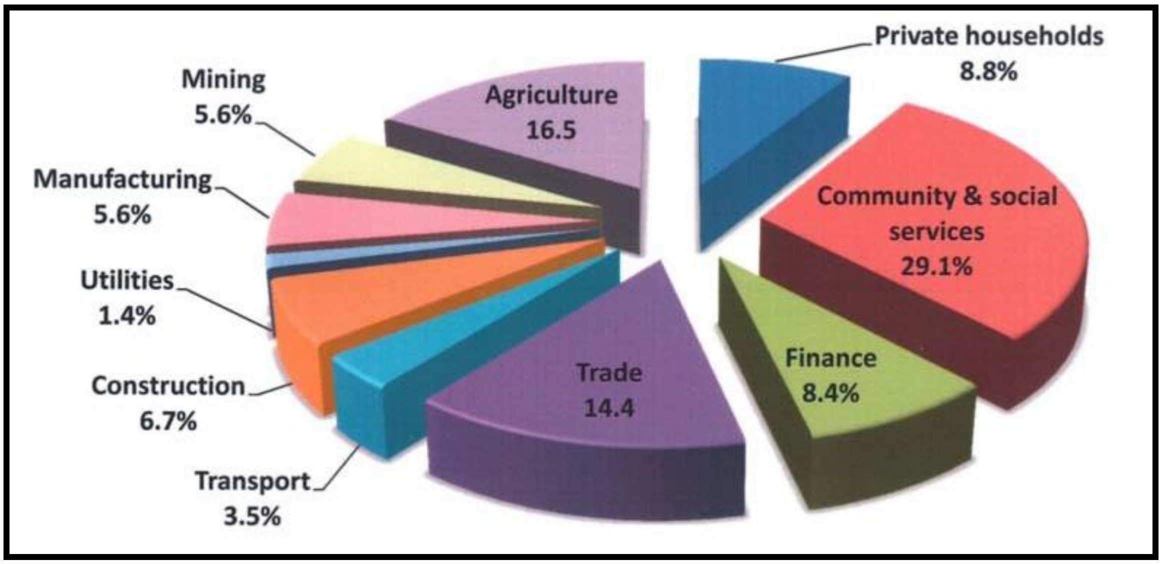


Figure 3.4: Employment by Economic Sector and Industry (Source: Statistics South Africa 2012).

3.2 MUNICIPAL LEVEL OVERVIEW

Population

As indicated in Table 3.1., the population of the NDM increased by from 108 111 in 2001 to 115 1402 in 2011, which represents an increase of ~ 7%. The population of the HLM increased from 20 351 in 2001 to 21 578 in 2011 (~ 6%) over the same period. This represents an average annual increase of ~ 0.69% and 0.59% for the NDM and HLM respectively. The increase in the population in the both the NDM and HLM was largely linked to an increase in the 15-64 age group. There was a decrease in the less than 15 age group in both the NDM and HLM. This is likely to reflect a situation where the majority of job seekers in the 15-64 age group are single males who have not settled down and started a family in the area. As expected, the number of households in both the NDM and HLM increased between 2001 and 2011. The size of the household sizes in both areas has decreased marginally, namely from 3.5 to 3.2 (NDM) and 3.4 to 3.2 (HLM).

The majority of the population is in the HLM was Coloured (82.2 %), followed by Whites (12.1 %) and Black Africans (4.4%)(Census, 2011). The dominant language within the Municipality is Afrikaans (93.1 3%) with the main other languages being English (1%) and isiXhosa (0.6%)(Census 2011).

The dependency ratio in both the NDM and HLM decreased from 56.4 to 51.2 and a high 65.5 to 55.6 respectively. The decrease represents a positive socio-economic improvement by indicating that there are a decreasing number of people dependent the economically active 15-64 age group. The age dependency ratio is the ratio of dependents, people younger than 15 or older than 64, to the working, age population, those ages 15-64. It is also worth noting that the dependency ratio for the HLM is essentially the same as the ratio for the Northern Cape as whole, 55.7 in 2011. The dependency ratio for the HLM is however higher than the national average of 52.7.

In terms of percentage of formal dwellings, the number of formal dwellings in the NDM increased from 89.4% in 2001 to 93.8% in 2011. In the HLM the number of formal dwellings increased from an already high level of 95.2 % to 96.6 % for the same period. The increase in the number of formal dwellings in both the NDM and HLM is also reflected in the improvements in service delivery (see Table 3.2). The figures for the NDM and HLM are also higher than the provincial figure of 82.4%.

Employment

The official unemployment rate in the NDM and HLM decreased for the ten year period between 2001 and 2011. In the NDM the rate fell from 28.5% to 20.1%, a decrease of 8.4%. For the HLM the rate dropped from 19.7 % to 11.8 %, a drop of 7.9 %. Youth unemployment in the NDM and HLM also decreased over the same period. The unemployment and youth unemployment levels in the NDM and HLM are lower than the provincial and national averages.

Household income

Based on the data from the 2011 Census, 6.8 % of the population of the HLM have no formal income, 2.5 % earn between 1 and R 4 800, 4.8 % earn between R 4 801 and R 9 600 per annum, 21.1 % between R 9 601 and 19 600 per annum and 24.8% between R 19 600 and R 38 200 per annum (Census 2011).

The poverty gap indicator produced by the World Bank Development Research Group measures poverty using information from household per capita income/consumption. This indicator illustrates the average shortfall of the total population from the poverty line. This measurement is used to reflect the intensity of poverty, which is based on living on less than R3 200 per month for an average sized household. Based on this measure, 60 % of the households in the HLM live close to or below the poverty line. The low-income levels reflect the limited formal employment opportunities in the HLM and the dependence on the agricultural sector. The low income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low income levels also result in reduced spending in the local economy and less tax and rates revenue for the district and local municipality.

Education

The education levels in both the NDM and HLM improved for the period 2001 t0 2011, with the percentage of the population over 20 years of age with no schooling in the NDM decreasing from 11.7% to 6.6%. For the HLM the decrease was from a high 26.8 % to 15.3 %. While there has been a significant improvement the figure for the HTM remains higher than the provincial average of 11.3 %. The percentage of the population over the age of 20 with matric also increased in both the NDM and HLM, from 15.7% to 18.8% in the NDM and 14.9% to 18.8% in the HLM. Despite these increases the figures are significantly lower than the provincial (27.7%) and national (28.4%) averages. Low education levels, specifically higher education, therefore remains a challenge in both the NDM and HLM.

Table 3.1: Overview of key demographic indicators for the NDM and HLM

	NDM		HLM	
ASPECT	**2001**	**2011**	**2001**	**2011**
Population	108 111	115 1402	20 351	21 578
% Population <15 years	29.3	25.8	31.1	27.5
% Population 15-64	64.0	66.1	60.4	64.3
% Population 65+	5.4	5.7	8.5	8.3
Households	27 776	33 856	5 619	6 340
Household size (average)	3.5	3.2	3.4	3.2
Formal Dwellings %	89.4 %	93.8 %	95.2 %	96.9 %
Dependency ratio per 100 (15-64)	56.4	51.2	65.5	55.6
Unemployment rate (official) - % of economically active population	28.5 %	20.1 %	19.7 %	11.8 %
Youth unemployment rate (official) - % of economically active population 15-34	37.7 %	25.4 %	26.7 %	15.3 %
No schooling - % of population 20+	11.7 %	6.6 %	26.8 %	14.4 %
Higher Education - % of population 20+	5.9 %	7.4 %	6.2 %	6.1 %
Matric - % of population 20+	15.7 %	18.8 %	14.9 %	18.8 %

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

3.2.1 Municipal services levels

As indicated in Table 3.2, access municipal services as measured in terms of flush toilets, refuse removal, piped water and electricity, increased in both the NDM and

HLM for the period 2001 to 2011. This represents a positive social benefit for the local communities in the area. The services level indicators for both the NDM and HLM are also on the whole higher than the provincial and national averages for 2011.

Table 3.2: Overview of access to basic services in the NDM and HLM

	NDM		HLM	
	2001	**2011**	**2001**	**2011**
% households with access to flush toilet	53.3	57.9	41.9	53.7
% households with weekly municipal refuse removal	73.3	80.1	60.2	72.5
% households with piped water inside dwelling	50.0	68.3	41.6	59.8
% households which uses electricity for lighting	77.5	86.5	72.0	76.9

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

SECTION 4: IDENTIFICATION OF KEY SOCIAL ISSUES

4.1 INTRODUCTION

Section 4 provides an assessment of the key social issues identified during the study. The identification of key issues was based on:

- Review of project related information;
- Interviews with key interested and affected parties;
- Experience/ familiarity of the authors with the area and local conditions;
- Experience with similar projects.

The assessment section is divided into the following sections:

- Assessment of compatibility with relevant policy and planning context ("planning fit";
- Assessment of social issues associated with the construction phase;
- Assessment of social issues associated with the operational phase;
- Assessment of the "no development" alternative.

4.2 ASSESSMENT OF POLICY AND PLANNING FIT

The findings of the review indicated that renewable energy is strongly supported at a national and local level. At a national level the White Paper on Energy Policy (1998) notes:

- Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future; and,
- The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

The development of and investment in renewable energy is also supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a provincial level the development of renewable energy is supported by the Northern Cape Provincial Growth and Development Strategy and Northern Cape Provincial Spatial Development Framework. The NDM and HLM IDP also highlight the importance of renewable energy for the area. It is therefore reasonable to assume that infrastructure associated with the establishment of renewable energy facilities, including power lines, is also supported.

However, the provincial and local policy and planning documents also make reference to the importance of tourism and the region's natural resources. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed facility, and the associated power lines does not impact on the region's natural resources and the tourism potential of the Province.

4.3 CONSTRUCTION PHASE SOCIAL IMPACTS

The findings of the SIA indicate that the potential social impacts associated with the construction phase of the power lines will be the same for each of the three alignment options, namely Alternative A, B and C. Separate assessments have therefore not been undertaken for each alternative. The assessment ratings for the construction phase therefore apply to all three alternative alignments. The social impacts associated with the construction phase therefore have no material bearing on the identification of a preferred alignment.

The key social issues associated with the construction phase of the power lines are the following:

Potential positive impacts
- Creation of employment and business opportunities, and opportunity for skills development and on-site training.

Potential negative impacts
- Impacts associated with the presence of construction workers on local communities;
- Impacts related to the potential influx of job-seekers;
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site;
- Increased risk of grass fires associated with construction related activities;
- Noise, dust, waste and safety impacts of construction related activities and vehicles;
- Impact on productive farmland.

4.3.1 Creation of local employment, training, and business opportunities

It is estimated that construction phase associated with the establishment of a 27-23 km 132 kV power line will extend over a period of ~6 months and create up to 75 temporary employment opportunities, with 25 of the employment opportunities being unskilled, 40 semi-skilled and 10 highly-skilled. Members from the local community in the area are likely to be in a position to qualify for the majority of the low skilled and semi-skilled employment opportunities. In this regard the establishment of the Loeriesfontein and Khobab WEFs is likely to create a pool of local labour with the required experience and skills for the low and semi-skilled positions. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local HLM community. As indicated above, the opportunities for employment are limited in the area. As a result the unemployment levels in the HLM are high. The creation of potential employment opportunities, even temporary employment, will represent a significant, if localised, social benefit. The majority of the skilled employment opportunities are likely to be associated with the contactors appointed to construct the WEF and associated infrastructure.

The total wage bill for the 6 month construction phase will be in the region of R5 million (2017 Rand value). This is based on a monthly wage of R 5 000 for low-skilled workers, R 10 000 for semi-skilled workers and R 30 000 for skilled workers over a period of 6 months. A percentage of the wage bill will be spent in the local economy and will create opportunities for local businesses in Loeriesfontein and Niewoudville. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. This is confirmed by the experience with the other renewable projects in small, rural towns in South Africa, such as the Abengoa solar energy project near Pofadder in the Northern Cape Province. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc. associated with the construction workers on the site. These benefits to the local economy will be confined to the construction period (6 months). The hospitality industry in the area is also likely to benefit from the provision of accommodation and meals for professionals (engineers, quantity surveyors, project managers, product representatives etc.) and other (non-construction) personnel involved on the project. However, based on the findings of the SIA there are limited accommodation opportunities in Loeriesfontein. This is an issue that will need to be addressed by the proponent. Lessons learnt from the Loeriesfontein and Khobab WEF construction phase should implemented by the proponent.

The implementation of the proposed enhancement measures listed below would also enable the establishment of the proposed power-line to support co-operation between the public and private sectors which would support local economic development in the HLM.

Table 4.1: Impact assessment of employment and business creation opportunities during the construction phase (Alternative A, B and C)

Nature: Creation of employment and business opportunities during the construction phase (+)		
	Without Enhancement	**With Enhancement**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Construction Period	Construction Period
Significance	**Low**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	N/A	N/A

Assessment of No Go option

There is no impact, as the current status quo will be maintained. The potential employment and economic benefits associated with the construction of the proposed grid connection infrastructure would be foregone. Moreover, the significant employment and socio-economic benefits associated with the 3 Kokerboom WEFs would also be forgone, since the grid connection is an essential component of the WEF development and without the grid connection infrastructure the development of the WEF would not proceed. The potential opportunity costs in terms of local capital expenditure, employment, skills development and opportunities for local business are therefore regarded as a negative. Potential opportunity costs would be greatest with regards to local employment provision and opportunities for the local service sector.

Recommended enhancement measures
In order to enhance local employment and business opportunities associated with the construction phase the following measures should be implemented.

Employment
- Where reasonable and practical the proponent should appoint local contractors, and implement a 'locals first' policy, especially for semi and low-skilled job categories. Due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area;
- Where feasible, efforts should be made to employ suitably qualified and experienced local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria;
- Before the construction phase commences the proponent should meet with representatives from the HLM to establish the existence of a skills database for the area. If such as database exists it should be made available to the contractors appointed for the construction phase.
- The local authorities and relevant community representatives should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.
- The need to implement a training and skills development programme for local workers should be investigated prior to the initiation of the construction phase. The aim of the programme would be to maximise local employment opportunities;
- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Business
- The proponent should liaise with the HLM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors. These companies should be notified of the tender process and invited to bid for project-related work;
- The HLM, in conjunction with the local business sector and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.

4.3.2 Impact of construction workers on local communities

The presence of construction workers poses a potential risk to family structures and social networks in the town of Loeriesfontein and Niewoudtville. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

- An increase in alcohol and drug use;
- An increase in crime levels;
- The loss of girlfriends and/or wives to construction workers;
- An increase in teenage and unwanted pregnancies;
- An increase in prostitution; and
- An increase in sexually transmitted diseases (STDs), including HIV.

As indicated above, the majority of the low skilled and semi-skilled work opportunities associated with the construction of the power line are likely to benefit members from the local community. If these opportunities are taken up by local residents the potential impact on the local community will be low as these workers will form part of the local family and social networks. Employing members from the local community to fill the low-skilled job categories will therefore reduce the risk and mitigate the potential impact on the local communities. The use of local residents to fill the low skilled job categories will also reduce the need to provide accommodation for construction workers in Loeriesfontein and Niewoudtville. The skilled workers and workers from outside the study area are likely to be accommodated in local guest houses in Loeriesfontein and on local farms surrounds. However, given the shortage of accommodation in the area there may be a need to establish accommodation facilities on or near the site as in the case of the Loeriefontein and Khobab WEFs.

While the risks associated with construction workers at a community level are likely to be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease (STD) or an unplanned pregnancy. Experience with other renewable energy projects located in rural areas indicates that the presence of construction workers can result in an increase in the spread of STDs, un-planned pregnancies, drugs, alcohol abuse and anti-social behavior, especially in small, isolated towns such as Loeriesfontein. Given the nature of construction projects it is not possible to totally avoid these potential impacts at an individual or family level.

In terms of the potential threat to the families of local farm workers in the vicinity of the site, the risk is likely to be low. This is due to the very low number of permanent workers residing on local farms in the area. The potential risk will therefore be negligible. The risk can also be effectively mitigated by ensuring that the movement of construction workers on and off the site is carefully controlled and managed.

Table 4.2: Assessment of impact of the presence of construction workers in the area on local communities (Alternative A, B and C)

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Construction Period	Construction Period
Significance	**Low**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible for individuals who are affected by STDs, specifically HIV and or AIDS, and unplanned / unwanted pregnancies etc.	Irreversible for individuals who are affected by STDs, specifically HIV and or AIDS, and unplanned / unwanted pregnancies etc.
Irreplaceability	N/A	N/A

Assessment of No Go option

There is no impact as the current status quo would be maintained. The potential positive impacts on the local economy associated with the additional spending by construction workers in the local economy will also be lost.

Recommended mitigation measures

The potential risks associated with construction workers can be effectively mitigated. The detailed mitigation measures should be outlined in the Environmental Management Plan (EMP) for the Construction Phase. Aspects that should be covered include.

- Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories;
- The proponent should consider the need for establishing a Monitoring Forum (MF) in order to monitor the construction phase and the implementation of the recommended mitigation measures. If required, the MF should be linked to the MF associated with the construction of the WEF. The MF should be established before the construction phase commences, and should include key stakeholders, including representatives from the HLM, farmers and the contractor(s). The MF should also be briefed on the potential risks to the local community and farm workers associated with construction workers;
- The proponent and the contractor(s) should, in consultation with representatives from the MF, develop a code of conduct for the construction phase. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be dismissed or appropriately disciplined. All dismissals must comply with the South African labour legislation;
- The proponent and contractor (s) should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;
- No workers should be permitted to trespass onto adjacent properties. Failure to adhere to this should be made a dismissible offence;

- In the event of workers being accommodated in Loeriesfontein or other location removed from the site, the contractor should provide transport to and from the site on a daily basis for workers. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site;
- Where necessary and possible, the contractors should make the necessary arrangements to enable workers from outside the area to return home over weekends and/ or on a regular basis. This would reduce the risk posed to local family structures and social networks;
- The need and feasibility of establishing accommodation on site should be assessed by the proponent;
- If accommodation on site is not required and/ or feasible it is recommended that no construction workers, with the exception of security personnel, be permitted to stay over-night on the site. However, some staff may be accommodated in houses located on local farms in the area.

4.3.3 Influx of job seekers

Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the manner in which they conduct themselves can impact on the local community.

Experience from large projects has also shown that the families of job seekers may also accompany individual job seekers or follow them at a later date. The influx of job seekers to the area and their families can also place pressure on the existing services in the area, specifically low income housing. In addition to the pressure on local services, the influx of construction workers and job seekers can also result in competition for scarce employment opportunities. Further secondary impacts include increase in crime levels, especially property crime, as a result of the increased number of unemployed people. These impacts can result in increased tensions and conflicts between local residents and job seekers from outside the area. These issues are similar to the concerns associated with the presence of construction workers and are discussed in Section 4.4.2. However, in some instances the potential impact on the community may potentially be greater given that job seekers may not be able to find accommodation and may decide to stay on in the area after the construction phase has ended.

However, give the relatively small scale of project, namely the construction of power lines, the potential for the influx of job seekers is likely to be low. The findings of the SIA therefore indicate that potential for economically motivated in-migration and subsequent labour stranding in Loeriesfontein and Niewoudtville is likely to be low. This is due to the relatively small scale of the project combined with the remote location of these small towns and limited employment opportunities in the area. The risk of job seekers moving to the area in search of employment on the project is therefore likely to be low. The risks associated with the influx of job seekers are therefore likely to be of low significance.

Table 4.3: Assessment of impact of job seekers on local communities associated with the construction phase (Alternative A, B and C)

Nature: Potential impacts on family structures, social networks and community services associated with the influx of job seekers (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Construction Period	Construction Period
Significance	**Low**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible for individuals who are affected by serious crimes, STDs, specifically HIV and or AIDS, and unplanned / unwanted pregnancies etc.	Irreversible for individuals who are affected by serious crimes, STDs, specifically HIV and or AIDS, and unplanned / unwanted pregnancies etc.
Irreplaceability	N/A	N/A

Assessment of No Go option
There is no impact as the current status quo would be maintained. The potential positive impacts on the local economy associated with the additional spending by construction workers in the local economy will also be lost.

Recommended mitigation measures
It is not possible to prevent job seekers from coming to the area in search of a job. However, as indicated above, the potential influx of job seekers to the area as a result of the proposed grid connection infrastructure is likely to be low. In addition:

- The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities;
- The proponent should implement a policy that no employment will be available at the gate.

4.3.4 Risk to safety, livestock and farm infrastructure

The presence of and movement of construction workers on and off the site may pose a potential safety threat to local famer's and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged or stock theft linked either directly or indirectly to the presence of farm workers on the site. The findings of the SIA indicated that stock theft is not currently an issue. This is largely associated with the distance from towns, and the fact that site properties are essentially only accessible via one road (Klein Rooiberg to Struiskom), accessed off the Nuwepos Road. The road essentially carries no through traffic. While none of the property owners indicated that stock theft was an issue, they did indicate that the presence of construction workers on the site increased the exposure of their farming operations and livestock to the outside world, which, in turn, could increase the potential risk of stock theft and crime.

The local farmers did, however, indicate that the potential risks (safety, livestock and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction on the site workers during the construction phase.

Table 4.4: Assessment of risk to safety, livestock and damage to farm infrastructure (Alternative A, B and C)

Nature: Potential risk to safety of farmers and farm workers, livestock and damage to farm infrastructure associated with the movement of construction workers on and off the site (-)		
	Without Mitigation	**With Mitigation**
Extent	Local	Local
Magnitude	Low	Low
Duration	Construction Period	Construction Period
Significance	**Low**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible for individuals who are affected by serious crimes	Irreversible for individuals who are affected by serious crimes
Irreplaceability	N/A	N/A
Can impact be mitigated?	Yes	Yes

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
Key mitigation measures include:

- The proponent should enter into an agreement with the land owners whereby damages to farm property etc. during the construction phase proven to be associated with the construction activities for the grid connection infrastructure will be compensated for, if evidence can be provided. The contractor may be liable for such compensation costs, as per the contract between the proponent and the contractor. The necessary agreement/s should be signed before the construction phase commences;
- No workers should be permitted to trespass onto adjacent properties. Failure to adhere to this should be made a dismissible offence. In this regard contractors appointed by the proponent must ensure that construction workers who are found guilty of trespassing, stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation;
- Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. This would reduce the potential risk of trespassing on the remainder of the farm and adjacent properties;
- The proponent should consider the option of establishing a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. If required, the MF should be linked to the MF associated with the construction of

the WEF. This committee should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site;

- The proponent should hold contractors liable for compensating farmers in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and relevant landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below);
- The Environmental Management Programme (EMP) should outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested;
- Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms;
- It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site. However, it is recognised that there may need to establish accommodation on site. If this is the case then the movement of workers should be contained to the construction camp area.

4.3.5 Increased risk of grass fires

The presence of construction workers and construction-related activities on the site poses an increased risk of grass fires that could in turn pose a threat to grazing and livestock in the area. Due to low biomass, the veld is not very fire prone. However, should a fire occur, it would deprive the affected owners of their primary grazing resource. Given the low carrying capacity of the veld any loss of valuable grazing land would impact on farming livelihoods. Farm infrastructure, such as fences and water pipes, may also be damaged or destroyed. The risk of grass fires is higher during windy conditions in the area, specifically during the dry, summer months from December to March. The potential risk of grass fires can be effectively addressed by implementing the mitigation measures listed below.

Table 4.5: Assessment of impact of increased risk of grass fires (Alternative A, B and C)

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires (-)		
	Without Mitigation	**With Mitigation**
Extent	Local	Local
Magnitude	Medium	Low
Duration	Construction Period	Construction Period
Significance	**Medium**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	Medium	Medium

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The mitigation measures include:

- The proponent should enter into an agreement with the land owners whereby damages to farm property etc. during the construction phase proven to be associated with the construction activities for the grid connection infrastructure will be compensated for, if evidence can be provided. The contractor may be liable for such compensation costs, as per the contract between the proponent and the contractor. The necessary agreement/s should be signed before the construction phase commences;
- The landowners should be encouraged to join the local Fire Protection Association;
- Contractor should ensure that no open fires are allowed on the site;
- Contractor to ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced;
- Measures to reduce the risk of fires include avoiding undertaking activities that have potential to cause fires (i.e. "hot works") in high wind conditions when the risk of fires is greater. In this regard, special care should be taken during the high risk dry, windy summer months;
- Contractor should provide adequate fire fighting equipment on-site;
- Contractor should provide fire-fighting training to selected construction staff;
- As per the conditions of the Code of Conduct, in the event of a fire proven to be caused by construction workers and or construction activities, the appointed contractors should compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.

4.3.6 Impacts associated with construction related activities

The movement of heavy construction vehicles during the construction phase has the potential to damage local farm roads and create dust and safety impacts for other road users in the area. The project components for the power lines are likely to be transported to the site via the N7. The N7 provides the key link between the Western Cape and Namibia and is an important commercial and tourist route. The transport of components of the WEF to the site therefore has the potential to impact on other road users travelling along the N7. Measures will need to be taken to ensure that the potential impact on motorist using the N7 is minimised. The other roads that may be impacted include the R 27 and the R 357. The recommended mitigation measures are listed below.

At a local level access to the site will be via the Nuwepos gravel road. Based on the findings of the SIA the volume of traffic along this road is low. The potential impact on other road users is therefore likely to be limited. The movement of heavy construction vehicles along the Nuwepos gravel road and local farm roads will also damage the surface of these roads, which will impact on other road users. The Nuwepos Road is primarily used as a road by farmers in the region to move stock and visit their properties. In this regard, there are ~ 5-6 permanently inhabited farmsteads located off the road in the study area. The lessons learnt from Khobab and Loeriesfontein WEF include restructuring the road at the outset (before deep structural damage is done) and applying an effective dust-suppressant (as is currently done on the Mainstream projects) from the start (Kotze; Danie van der Westhuizen; pers. Comm).

The lessons learnt from the Loeriesfontein and Khobab WEF also indicate that sheep farming may need to be suspended on the affected portions of the properties during construction. Mr van der Merwe indicated that sheep were affected by traffic and other construction activities and the farm gates between camps were often left open. The proponent should liaise with the affected farmers so they can make alternative arrangements for their sheep.

Experience from other projects also indicates that the transportation of construction workers to and from the site can result in the generation of waste along the route (packaging and bottles etc. thrown out of windows etc.). This impact is likely to be confined to the Nuwepos Road and local internal farm roads.

Table 4.6: **Assessment of the impacts associated with construction related activities (Alternative A, B and C)**

Nature: Potential dust and safety impacts and damage to road surfaces associated with movement of construction related traffic to and from the site (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Construction Period	Construction Period
Significance	**Low**	**Low-Very Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	Medium	Medium

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The potential impacts associated with heavy vehicles can be effectively mitigated. The mitigation measures include:

- As far as possible, the transport of components to the site along the N7 should be planned to avoid weekends, holiday periods and the Spring Flower season if possible;
- Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers;
- The contractor must ensure that damage caused by construction related traffic to the Nuwepos Road and local farm roads is repaired on a regular basis throughout the construction phase. The costs associated with the repair must be borne by the contractor;
- All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits;

- The Contractor should liaise with the affected farmers regarding timing and location of construction activities so they can make alternative arrangements for their sheep;
- The Contractor should ensure that workers are informed that no waste can be thrown out of the windows while being transported to and from the site. Workers who throw waste out windows should be fined;
- The Contractor should be required to collect waste along the road reserve of the access road on a weekly basis, if necessary;
- Waste generated during the construction phase should be transported to the local landfill site or appropriate recycling facility.

4.3.7 Impacts associated with loss of grazing resources

The activities associated with the construction phase have the potential to result in the loss of land available for grazing and other agricultural activities. The key construction phase related issues are linked to the movement of heavy construction vehicles on the site and the establishment of laydown areas and access roads. All of these activities have the potential to impact on grazing resources, which, in turn, could impact on sheep farming activities.

The owner of Sous Farm also indicated that the construction of Khobab WEF has resulted in some unnecessary damage to the veld in places due to careless activities, including off-road driving (van der Merwe; pers. Comm). This concern would also apply to the establishment of power lines. Given the low rainfall, damaged veld can take many years to recover.

The final disturbance footprint can be reduced by careful site design and placement of power lines. The impact on grazing associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase.

Table 4.7: Assessment of impact on grazing areas due to construction related activities (Alternative A, B and C)

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the power lines will result in a loss of grazing (-)		
	Without Mitigation	**With Mitigation**
Extent	Site specific	Site specific
Magnitude	Medium	Low
Duration	Construction Period	Construction Period
Significance	**Medium**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	Medium	Medium

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The potential impacts associated with damage to and loss of farmland can be effectively mitigated. The aspects that should be covered include:

- The final location of pylons/ towers, access roads, laydown areas etc. should be discussed with and confirmed with the locally affected landowners before being finalised;
- The footprint areas for the establishment of pylons and other infrastructure should be clearly demarcated prior to commencement of construction activities. All construction related activities should be confined to the demarcated area and minimised where possible;
- An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase;
- All areas disturbed by construction related activities, such as construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. The rehabilitation plan should be informed by input from an appropriately qualified professional, with experience in arid regions;
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed;
- The implementation of the Rehabilitation Programme should be monitored by the ECO.

4.4 OPERATIONAL PHASE SOCIAL IMPACTS

The findings of the SIA indicate that the impacts associated with the operational phase, specifically the impact on affected landowners, will have the most significant bearing on the identification of the preferred power line alignment.

The following key social issues are of relevance to the operational phase:

Potential positive impacts
- The establishment of infrastructure to support renewable energy.

Potential negative impacts
- The visual impacts and associated impact on sense of place;
- Impact on affected land owners.

4.4.1 Development of infrastructure to support renewable energy

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is the nineteenth largest per capita producer of carbon emissions in the world, and Eskom, as an energy utility, has been identified as the world's second largest producer of carbon emissions.

The overall contribution to South Africa's total energy requirements of the proposed WEF is relatively small. However, the development of the three Kokerboom WEFs (with Kokerboom 2 & 3 having a capacity of up to 240MW each, and Kokerboom 1 with a capacity of up to 256MW) will assist to offset the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as an important contribution. The power line linking the Kokerboom WEFs to the Helios substation represents a key component of the project required to support the development of the renewable energy sector in South Africa.

Without the proposed grid connection infrastructure, the Kokerboom WEFs would not be able to feed into the national grid, and the development of the WEFs would not proceed.

Table 4.8: Development of infrastructure to support renewable energy (Alternative A, B and C)

Nature: Support for development of renewable energy sector (+)		
	Without Enhancement[14]	**With Enhancement**
Extent	Regional	Regional
Magnitude	Low	Medium
Duration	Long Term	Long Term
Significance	**Low (-)**	**Medium (+)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	N/A	N/A
Irreplaceability	N/A	N/A

Assessment of No-Go option

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. This would represent a negative opportunity cost.

Recommended mitigation measures

The establishment of the proposed facility is a mitigation measure in itself. In order to maximise the benefits of the proposed project, the proponent should:

- Use the project to promote and increase awareness of the contribution of renewable energy to the national energy supply.

4.4.2 Impact on sense of place and character of the landscape

The power lines associated with the proposed Kokerboom WEFs will have a visual impact on the landscape and remote, undeveloped sense of the place of the area. However, the visual integrity of the area has been impacted by the Helios substation and the associated transmission lines in the area. The areas remote, undeveloped sense of place has also been impacted by the electrified Sishen-Saldanha railway line. In addition, two WEFs, namely the Loeriesfontein and Khobab WEF, are being constructed in the area. Each of these WEFs also includes the establishment of power lines linking up to the Helios substation. The findings of the SIA also indicate that the area is sparsely populated, the majority of the farms are un-occupied and there are no sensitive receptors located within close proximity of any of the proposed power line alternative. In addition, none of the local land owners interviewed indicated that they were concerned about the potential visual impacts associated with the proposed power lines.

[14] Assumes that the proposed WEF will not be established

The visual impact of the proposed power lines on the areas overall sense of place and character is therefore likely to be limited, specifically within the context of the development of the area as a renewable energy node.

Table 4.9: Visual impact and impact on sense of place (Alternative A, B and C)

Nature: Visual impact associated with the proposed power lines and the potential impact on the areas remote, undeveloped sense of place (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Long Term	Long Term
Significance	**Low**	**Low**
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
Irreplaceability	Low	Low

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The recommendations contained in the VIA should also be implemented.

4.4.3 Impact on land owners affected by power line alternatives

The impacts on the land owners affected by the proposed power line alternatives are linked to the impact on grazing areas associated with establishment of power lines and associated access roads and the potential visual impacts. Experience from other power line projects has also shown that maintenance of power lines by contractors during the operational life impacts on farming operations. These impacts include disturbance of livestock, damage to farm infrastructure, such as gates, loss of livestock due to gates being left open, damage of veld, stock theft and littering. Farmers do not therefore generally support the establishment of power lines over their properties.

In terms of potential impact on grazing areas, Alternative A and B would affect five owners, while Alternative C would affect four (not Leeubergrivier). However, Alternative C affects Kareedoornpan and Sous Farm over a longer distance. While all three Alternatives are located in close proximity to existing Eskom lines a number of additional lines are likely to affect the area on Sous Farm to the north of the Helios substation. These lines are linked to the power lines for the two Mainstream WEFs currently under construction, the Eskom Helios-Aggenys power line servitude and lines associated with other potential REFs proposed in the area. Sous Farm and the area to the north of the Helios substation would also be affected by Alternative C. However, as indicated, the portion of Alternative C from the Khobab WEF subtstation to Helios is aligned to the overhead line from Kobab to Helios.

Therefore, while Alternative B is the longest alternative (at ~27 km it is approximately 4 km longer than the shortest, Alternative C), it is also the alternative with that has the shortest route section that is not aligned along cadastral lines. This is of specific relevance with regard to Sous Farm, where Alternative B would only traverse 2.7 km of the property, as opposed to the 6.9 km and 9 km associated with Alternatives A and C respectively. Alternative B therefore has the least impact on Sous Farm, which, as indicated above, is already impacted by a number of existing and proposed lines. In this regard the owner of Sous Farm, Mr van der Merwe, indicated that he would like to limit the extent of additional lines across the property (van der Merwe, pers. comm). Mr van der Merwe indicated that he would like to restrict the establishment of power lines across his property as opposed to following cadastral boundaries. Mr van der Merwe therefore indicated that Alternative C (9 km) and Alternative A (6.9 km) are therefore the least preferred options. Alternative B, which extends for a distance of 2.7 km across Sous Farm and is located near existing infrastructure, such as the Sishen-Saldanha railway line, was identified as acceptable by Mr van der Merwe (pers. comm).

In terms of potential visual impacts, the findings of the SIA indicate that the three proposed Alternatives (Alternative A, B and C) are not located within close proximity to any sensitive receptors. In this regard none of the affected land owners identified visual impacts as a concern. In terms of current land uses, all of the affected farms are primarily used for grazing, and only one has an inhabited dwelling (Struiskom, located ~8km north of Alternative C), while 2 other dwellings are located on adjacent properties (Klein Rooiberg and Kareedoornpan (Lintvelt)). Only the farmstead on Kareedoornpan is located within 5km of any of the proposed Kokerboom line Alternatives (namely 4.7 km from Alternative C)..

The findings of the SIA found that all three of the proposed alignments are acceptable to the Kokerboom WEF site property owners.

However, the owners of Kareedoornpan (Mr. Gys Lombard) and Struiskom (Mr. Theunis Kotze) indicated that the development of the proposed grid connection infrastructure on their land would not be preferred, if the Kokerboom 3 WEF (which is located on Kareedoornpan and Struiskom) is not developed for any reason. Mr Lombard indicated that in the absence of Kokerboom 3 WEF there would be no benefits associated with the establishment of the a power line and it would also would only introduce an additional risk to the current farming operations (open gates, outside people travelling across the properties etc.). The proposed SS2 would also be located on Kareedoornpan and, as a result, each of the three Kokerboom power line Alternatives would be located along the corridor proposed for the new access road to Kokerboom 2. However, in both cases it should be noted that the proposed alignments and associated infrastructure are located in the extreme southern portions of the relevant properties and along cadastral boundaries to ensure minimal impact to the turbine locations of Kokerboom 3 WEF. It is also noted that the Proponent (BVI) has confirmed that the grid connection infrastructure on Mr Lombard's and Mr Kotze's land would only be developed when the Kokerboom 3 WEF is developed – unless an alternate arrangement is reached between the land owners and BVI beforehand.

Although the significance ratings for Alternative A, B and C for both impact on grazing and visual are rated to be the same, namely Low Negative with and without mitigation based on the findings of the SIA, Alternative B is regarded as the most suitable power lines Alternative. This is due to the impact on Sous Farm. However, the proponent should meet with the owners of Kareedoornpan (Mr. Gys Lombard) and Struiskom (Mr. Theunis Kotze) to discuss the concerns that they have raised.

Table 4.10: Impact on grazing and impacts associated with future maintenance for land owners affected by power line alternatives (Alternative A, B and C)

Nature: Impact on land owners affected by the proposed power line alternatives. These impacts are linked to impact on grazing areas, and impacts associated with maintenance activities by contractors (-)		
	Without Mitigation	**With Mitigation**
Extent	Site specific	Site specific
Magnitude	Low	Low
Duration	Long Term	Long Term
Significance	**Low**	**Low**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	Low	Low

Table 4.9: Impact of power lines on sense of place (Alternative A, B and C)

Nature: Visual impact associated with the proposed WEF and the potential impact on the areas remote, undeveloped sense of place (-)		
	Without Mitigation	**With Mitigation**
Extent	Site specific	Site specific
Magnitude	Low	Low
Duration	Long Term	Long Term
Significance	**Low**	**Low**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	Low	Low

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The recommendations contained in the VIA should also be implemented. The proponent should also meet with the owners of Kareedoornpan (Mr. Gys Lombard) and Struiskom (Mr. Theunis Kotze) to discuss the concerns that they have raised.

4.5 CUMULATIVE IMPACTS

4.5.1 Impact on sense of place

The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. The key concerns in terms of cumulative impacts are linked to visual impacts and the impact on rural, undeveloped landscapes.

The Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These concerns are also likely to apply the power lines associated with wind farms. The relevant issues raised by the Scottish Natural Heritage Report include:

- Combined visibility (whether two or more wind farms will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
- The visual compatibility of different wind farms in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

The concerns outlined in the Australian Wind Farm Development Guidelines and Scottish Natural Heritage Report also apply to the power lines associated with wind farms.

As indicated above, the visual integrity of the area has been impacted by the Helios substation, the associated transmission lines and the electrified Sishen-Saldanha railway line. In addition, two WEFs, namely the Loeriesfontein and Khobab WEF, are currently being constructed in the area. The findings of the VIA (VRM Africa, 2017), rates the potential for negative cumulative effects associated with the proposed Kokerboom WEFs as Medium Negative. In this regard, the findings note that "the existing two wind farms in the area, and the large Eskom Substation, are likely to increase the potential for the area to be established as a renewable energy node. Further authorisation of the wind farm could reinforce this effect to some degree. The potential is moderated by the remoteness of the locality, where existing dry-land sheep farming can continue to take place amongst the turbines, and also due to there being no landscape based eco-tourism in the vicinity".

The potential cumulative impact of the proposed 132 kV overhead power line linking the Kokerboom WEFs to the Helios substation should be viewed within the overall context of the development of the area as a potential renewable energy node. In this regard establishment of a 132kV power line will not alter the overall cumulative impact of the proposed Kokerboom WEFs. The potential contribution to the overall cumulative impact compared to the current and proposed WEFs is therefore rated as Low Negative.

Table 4.10: Cumulative impacts on sense of place and the landscape (Alternative A, B and C)

Nature: Visual impacts associated with the establishment of a 132 kV power line on the areas rural sense of place and character of the landscape (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Long Term	Long Term
Significance	**Low**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	N/A	N/A

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The recommendations of the SIA and VIA should be implemented.

4.5.2 Local services and accommodation

The establishment of the proposed power line alternatives (Alternative A, B and C) on their own is unlikely to place significant pressure on local services and accommodation in the HLM. However, when considered with the overall context of the establishment of three proposed Kokerboom WEF (Kokerboom 1, 2 and 3) and other renewable energy facilities in the study area, the construction of the proposed power line will place pressure on local services, specifically medical, education and accommodation in the HLM. This pressure will be largely associated with the influx of workers to the area during the construction and to a lesser extent during the operational phases of renewable energy projects proposed in the area. The potential impact on local services can be mitigated by employing local community members. However, due to the low education and skills levels in the area there is likely to be a need to implement a training and skills development programme to ensure that local employment opportunities are maximised.

The presence of non-local workers during both the construction and operation phase also has the potential to place pressure on property prices and rentals. As a result, local residents, such as government officials, municipal workers, school teachers, and the police, may no longer be able to buy or afford to rent accommodation in towns such as Loeriesfontein and Niewoudtville. However, as indicated below, this impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of a renewable energy hub in the area. These benefits will create opportunities for investment in Loeriesfontein and Niewoudtville, including the opportunity to up-grade and expand existing services and the construction of new houses. In this regard, the establishment of a renewable energy hub will create a unique opportunity for these towns to develop.

The Community Trusts associated with each project will generate revenue that can be used by the HLM, in consultation with the Northern Cape Provincial Government, to invest in up-grading local services where required (see below). In should also be noted that it is the function of national, provincial and local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of development renewable energy projects in the area should therefore be addressed in the Integrated Development Planning process undertaken by the HLM and NDM.

Table 4.11: Cumulative impacts on local services

Nature: The establishment of a number of renewable energy facilities in the HLM and NDM will place pressure on local services, specifically medical, education and accommodation (-)		
	Without Mitigation	**With Mitigation**
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Long Term	Short Term
Significance	**Medium**	**Low**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	N/A	N/A

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The Northern Cape Provincial Governments, in consultation with the HLM, NDM and the proponents involved in the development renewable energy projects in the HLM, should consider establishing a Development Forum to co-ordinate and manage the development and operation of renewable energy projects in the HLM, with the specific aim of mitigating potential negative impacts and enhancing opportunities. This would include identifying key needs, including capacity of existing services, accommodation and housing and the implementation of an accredited training and skills development programmes aimed at maximising the opportunities for local workers to be employed during the construction and operational phases of the various proposed projects. These issues should be addressed in the Integrated Development Planning process undertaken by the HLM and NDM.

4.5.3 Local economy

In addition to the potential negative impacts, the establishment of the power lines associated with the proposed Kokerboom WEFs (Kokerboom 1, 2 and 3) and other renewable energy facilities in the HLM also has the potential to result in significant positive cumulative socio-economic opportunities for the region, which, in turn, will result in a positive social benefit. The positive cumulative impacts include creation of employment, skills development and training opportunities, and downstream business opportunities during the construction and operational phases of the projects.

Table 4.12: Cumulative impacts on local economy

Nature: The establishment of a number of renewable energy facilities in the HLM and NDM will create employment, skills development and training opportunities, creation of downstream business opportunities (+)		
	Without Enhancement	**With Enhancement**
Extent	Regional	Regional
Magnitude	Low	High
Duration	Long Term	Long Term
Significance	**Medium**	**High**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	N/A	N/A

Assessment of No-Go option
There is no impact as it maintains the current status quo. This would represent a lost socio-economic opportunity for the HLM.

Recommended mitigation measures
The proposed establishment of suitably sited renewable energy facilities within the HLM should be supported, and use of local labour, services and materials should be promoted where possible.

4.6 ASSESSMENT OF NO-DEVELOPMENT OPTION

As indicated above, South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result, South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions.

The establishment of the power lines linking the proposed Kokerboom WEFs to the Helios substation is an integral component of the three proposed renewable energy projects. The No-Development option would therefore represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a negative social cost. However, at a provincial and national level, it should be noted that the proposed renewable energy development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Northern Cape and other parts of South Africa. Foregoing the proposed establishment of the proposed WEF would therefore not necessarily compromise the development of renewable energy facilities in the Western Cape Province and or South Africa. However, the socio-economic benefits for local communities in the HLM would be forfeited, since the development of the Kokerboom WEFs could not proceed without the proposed grid connection infrastructure (i.e. if the development does not proceed, the significant socio-economic benefits associated with the grid connection itself as well as the associated Kokerboom WEFs would be foregone).

Table 4.13: Assessment of no-development option (Alternative A, B and C)

Nature: The no-development option would result in the lost opportunity for the local economy. The no-development option would also forego the benefits associated with the development of clean, renewable energy		
	Without Mitigation	**With Mitigation**[15]
Extent	Regional	Regional
Magnitude	Medium	Medium
Duration	Long Term	Long Term
Significance	**Medium (-)**	**Medium (+)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
Irreplaceability	N/A	N/A

Recommended enhancement measures

The mitigation and enhancement measures identified in the SIA and other specialist studies should be implemented, should the construction of the transmission lines, in association with the wind energy facilities, proceed. However, the impact of large renewable energy facilities and the associated power lines on sense of place and landscape character are issues that need to be addressed in the location, design and layout of the proposed facilities and power lines.

[15] Mitigation assumes that the proposed renewable energy facility will be developed

SECTION 5: KEY FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

Section 5 lists the key findings of the study and recommendations. These findings are based on:

- A review of the issues identified during the Scoping Process;
- A review of key planning and policy documents pertaining to the area;
- Semi-structured interviews with interested and affected parties;
- A review of social and economic issues associated with similar developments;
- A review of selected specialist studies undertaken as part of the EIA;
- A review of relevant literature on social and economic impacts; and
- The experience of the authors with other wind energy projects in South Africa

5.2 SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning;
- Construction phase impacts;
- Operational phase impacts;
- Cumulative Impacts;
- No-development option.

5.2.1 Policy and planning issues

The findings of the review indicated that renewable energy is strongly supported at a national and local level. At a national level the White Paper on Energy Policy (1998) notes:

- Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future; and,
- The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

The development of and investment in renewable energy is also supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a provincial level the development of renewable energy is supported by the Northern Cape Provincial Growth and Development Strategy and Northern Cape Provincial Spatial Development Framework. The NDM and HLM IDP also highlight the importance of renewable energy for the area. It is therefore reasonable to assume that infrastructure associated with the establishment of renewable energy facilities, including power lines, is also supported.

However, the provincial and local policy and planning documents also make reference to the importance of tourism and the region's natural resources. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed facility, and the associated power lines does not impact on the region's natural resources and the tourism potential of the Province.

5.1.1 Construction phase impacts

The findings of the SIA indicate that the potential social impacts associated with the construction phase of the power lines will be the same for each of the three alignment options, namely Alternative A, B and C. Separate assessments have therefore not been undertaken for each alternative. The assessment ratings for the construction phase therefore apply to all three alternative alignments. The social impacts associated with the construction phase are of low significance and therefore have no material bearing on the identification of a preferred alignment.

Potential positive impacts

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training.

The construction phase for the proposed power line connecting the three Kokerboom WEFs to the Helios substation is expected to extend over a period of 6 months and create up to 75 temporary employment opportunities, with 25 of the employment opportunities being unskilled, 40 semi-skilled and 10 highly-skilled. The total wage bill for the construction phase is estimated to be in the region of R5 million (2017 Rand values). The majority of the low and semi-skilled employment opportunities will be available to local residents in the area, specifically residents from Loeriesfontein and Niewoudtville. The majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community. In order to maximise the potential benefits the developer should commit to employing local community members to fill the low and medium skilled jobs.

Potential negative impacts

- Impacts associated with the presence of construction workers on site and in the area;
- Influx of job seekers to the area;
- Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site;
- Increased risk of grass fires;
- Impact of construction related activities, including damage to roads, safety and dust;
- Potential loss of productive grazing associated with construction-related activities.

The findings of the SIA indicate that the significance of the potential negative impacts with mitigation were Low Negative. All of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

Table 5.1 summarises the significance of the impacts associated with the construction phase.

Table 5.1: Summary of social impacts during construction phase (Alternative A, B and C)

Impact	Significance No Mitigation	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Low (+)	Medium (+)
Presence of construction workers and potential impacts on family structures and social networks	Low (-)	Low (-)
Influx of job seekers	Low (-)	Low (-)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Low (-)	Low (-)
Increased risk of grass fires	Medium (-)	Low (-)
Impact of construction related activities	Low (-)	Low-Very Low (-)
Loss of grazing	Medium (-)	Low (-)

5.2.2 Operational phase impacts

The findings of the SIA indicate that the impacts associated with the operational phase, specifically the impact on affected landowner, will have the most significant bearing on the identification of the preferred power line alignment.

Potential positive impacts
- The establishment of infrastructure to support renewable energy.

The power line linking the Kokerboom WEFs to the Helios substation represent a key component of the project required to support the development of the renewable energy sector in South Africa.

Potential negative impacts
- The visual impacts and associated impact on sense of place;
- Impact on affected land owners.

Visual Impact on sense of place
The power lines associated with the proposed Kokerboom WEFs will have a visual impact on the landscape and remote, undeveloped sense of the place of the area. However, the visual integrity of the area has been impacted by the Helios substation and associated transmission lines in the area. In addition, two WEFs, namely the Loeriesfontein and Khobab WEFs, are being constructed in the area. Each of these WEFs also includes the establishment of power lines linking up to the Helios substation. The area is sparsely populated, the majority of the farms are un-occupied and there are no sensitive receptors located within close proximity of any of the proposed power line alternative. In addition, none of the local land owners interviewed indicated that they were concerned about the potential visual impacts associated with the proposed power lines. The visual impact of the proposed power lines on the areas overall sense of place and character is therefore likely to be limited, specifically within the context of the development of the area as a renewable energy node.

Impact on land owners
The impacts on the land owners affected by the proposed power line alternatives are linked to the impact on grazing areas associated with establishment of power lines and associated access roads. The maintenance of power lines by contractors during the operational life can also impact on farming operations, including disturbance of livestock, damage to farm infrastructure, such as gates, loss of livestock due to gates being left open, damage of veld, stock theft and littering.

Based on the findings of the SIA, Alternative B is regarded as the most suitable power line Alternative. Alternative B would only traverse a 2.7km section of Sous Farm, as opposed to the 6.9km and 9km sections associated with Alternative A and C respectively. Alternative B therefore has the least impact on Sous Farm, which is already impacted by a number of existing and proposed power lines. In this regard the owner of Sous Farm, Mr van der Merwe, indicated that he would like to restrict the establishment of power lines across his property.

The owners of Karreedoornpan (Mr Gys Lombard) and Struiskom (Mr Theunis Kotze) also indicated that the development of the proposed grid connection infrastructure in their land would not be preferred, if the Kokerboom 3 WEF (which is located on Kareedoorpan and Struiskom) is not developed for any reason. It is noted that the Proponent (BVI) has confirmed that the grid connection infrastructure on Mr Lombard's and Mr Kotze's properties would only be developed when the Kokerboom 3 WEF is developed – unless an alternate arrangement is reached between the land owners and BVI. Table 5.2 summarises the significance of the impacts associated with the operational phase.

Table 5.2: Summary of social impacts during operational phase (Alternative A, B and C)

Impact	Significance No Mitigation	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Low (+)	Low (+)
Promotion of renewable energy projects	Low (-)	Medium (+)[16]
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on affected property owners	Low (-)	Low (-)

5.2.3 Assessment of cumulative impacts

Cumulative impact on sense of place
There are in the region of seven renewable energy projects located in the area, namely, the Khobab and Loeriesfontein WEFs (currently under construction), Kokerboom 1, 2 and 3 (proposed), Dwarsbrug WEF (proposed) and Orlight SEF (proposed). The potential cumulative impact of the proposed 132 kV overhead power line linking the Kokerboom WEFs to the Helios substation should be viewed within the overall context of the development of the area as a potential renewable energy node. In this regard establishment of a 132 kV power line will not alter the overall cumulative impact of the proposed Kokerboom WEFs. The potential contribution to the overall cumulative impact compared to the current and proposed WEFs is therefore rated as **Low Negative**.

[16] Assumes that the proposed WEF will be established

Cumulative impact on services

The establishment of the proposed transmission lines, together with the Kokerboom WEF (Kokerboom 1, 2 and 3), and other renewable energy facilities in the area will place pressure on local services in the towns of Loeriesfontein and other nearby towns, specifically medical, education and accommodation. This pressure will largely be associated with the influx of workers to the area during the construction phase and to a lesser extent the operational phase. The potential impact on local services can be mitigated by employing local community members. The presence of non-local workers during both the construction and operation phase will also place pressure on property prices and rentals. As a result, local residents, government officials, such as municipal workers, school teachers and the police, may no longer be able to buy or afford to rent accommodation in towns such as Loeriesfontein and other nearby towns. With effective mitigation, the impact is rated as **Low Negative.**

However, as indicated below, this impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of a renewable energy hub in the area. These benefits will create opportunities for investment in Loeriesfontein and other nearby towns, including the opportunity to up-grade and expand existing services and the construction of new houses. In this regard, the establishment of a renewable energy hub will create a unique opportunity for these towns to develop. In should also be noted that it is the function of national, provincial and local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of development renewable energy projects in the area should therefore be addressed in the Integrated Development Planning process undertaken by the HLM and NDM.

Cumulative impact on local economies

In addition to the potential negative impacts, the establishment of the construction of renewable energy facilities and the associated power lines will have a positive cumulative socio-economic impact on the local economy. The positive cumulative impacts include creation of employment, skills development and training opportunities, creation of downstream business opportunities. This benefit is rated as **High Positive** with enhancement.

5.2.4 Assessment of no-development option

The establishment of the power lines linking the proposed Kokerboom WEFs to the Helios substation is an integral component of the three proposed renewable energy projects. The No-Development option would therefore represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a negative social cost.

However, at a provincial and national level, it should be noted that the proposed renewable energy development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Northern Cape and other parts of South Africa. Foregoing the proposed establishment of the proposed WEF would therefore not necessarily compromise the development of renewable energy facilities in the Northern Cape Province and or South Africa. However, the socio-economic benefits for local communities in the HLM would be forfeited.

5.3 CONCLUSIONS AND RECOMMENDATIONS

The establishment of the 132kV overhead power line linking the three proposed Kokerboom WEFs to the Helios substation is an integral component of the three proposed renewable energy projects. Based on the findings of the SIA, all three alternatives are considered acceptable, subject to the implementation of the recommended mitigation measures and management actions contained in the report. No fatal flaws were identified. Alternative B is regarded as the most suitable power line alternative due to land owner preference (owner of Sous Farm).

The final location of pylons should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

5.4 IMPACT STATEMENT

All three alternatives are considered acceptable, subject to the implementation of the recommended mitigation measures and management actions contained in the report. The establishment of Alternative B emerged as the most preferred option in the SIA. The final location of pylons should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

ANNEXURE A

INTERVIEWS

- Kotze, Mr Theunis (13-12-16). Struiskom Farm.
- Lintvelt, Mr Sakkie (e-mail: 8-12-16). Owner of Kareedoornpan Farm.
- Lombard, Mr Gys (14-12-16). Karee Doorn Pan 1/214; Aan de Karee Doorn Pan RE/ 213.
- Van der Merwe, Mr Francois (12-12-16). Sous Farm RE/ 226
- Van der Westhuizen, Mr. Danie (13-12-16). Kleine Rooiberg Farm.
- Van der Westhuizen, Mr. Deon (telephonic: 08-12-16). Kleine Rooiberg RE/ 227; Springbok Pan RE/ 1164
- Van Heerden, Mr Herman (telephonic: 08-12-16). Leeubergrivier RE/1163

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ANNEXURE B: AURECON IMPACT METHODOLOGY

The section outlines the proposed method for assessing the significance of the potential environmental impacts. For each impact, the EXTENT (spatial scale), MAGNITUDE (severity of impact) and DURATION (time scale) are described.

These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.

The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Table 1: Aurecon Impact Criteria Table

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10km radius of the candidate site.
	Local	Within a 10km radius of the candidate site.
	Site specific	On site or within 100m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	18-24 months
	Short Term	Up to 3 years after construction
	Medium Term	3-10 years after construction
	Long Term	More than 10 years after construction

Table 2: Aurecon Definition of Significance Rating Table

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

The **SIGNIFICANCE** of an impact is derived by taking into account the temporal and spatial scales and magnitude. Once the significance of an impact has been determined, the **PROBABILITY** of this impact occurring as well as the **CONFIDENCE** in the assessment of the impact would be determined using the rating systems outlined in Table 3 and Table 4 respectively. It is important to note that the significance of an impact should always be considered in conjunction with the probability of that impact occurring. Lastly, the **REVERSIBILITY** and **IRREPLACEABILITY** of the impact is estimated using the rating system outlined in Table 5 and Table 6.

Table 3: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 4: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 5: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

Table 6: Definition of irreplaceability ratings

REVERSIBILITY RATINGS	CRITERIA
Low	The affected resource is not unique and or does not serve an critical function or is degraded
Medium	The affected resource is moderately important in terms of uniqueness and function or in pristine condition
High	The affected resource is important in terms of uniqueness and function and or in pristine condition and warrants conservation / protection

ANNEXURE C: CV

Tony Barbour
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Tony Barbour's experience as an environmental consultant includes working for ten years as a consultant in the private sector followed by four years at the University of Cape Town's Environmental Evaluation Unit. He has worked as an independent consultant since 2004, with a key focus on Social Impact Assessment. His other areas of interest include Strategic Environmental Assessment and review work.

EDUCATION

- BSc (Geology and Economics) Rhodes (1984);
- B Economics (Honours) Rhodes (1985);
- MSc (Environmental Science), University of Cape Town (1992)

EMPLOYMENT RECORD

- Independent Consultant: November 2004 – current;
- University of Cape Town: August 1996-October 2004**:** Environmental Evaluation Unit (EEU), University of Cape Town. Senior Environmental Consultant and Researcher;
- Private sector: 1991-August 2000: 1991-1996**:** Ninham Shand Consulting (Now Aurecon, Cape Town). Senior Environmental Scientist; 1996-August 2000: Steffen, Robertson and Kirsten (SRK Consulting) – Associate Director, Manager Environmental Section, SRK Cape Town.

LECTURING

- University of Cape Town: Resource Economics; SEA and EIA (1991-2004);
- University of Cape Town: Social Impact Assessment (2004-current);
- Cape Technikon: Resource Economics and Waste Management (1994-1998);
- Peninsula Technikon: Resource Economics and Waste Management (1996-1998).

RELEVANT EXPERIENCE AND EXPERTISE

Tony Barbour has undertaken in the region of 200 SIA's, including SIA's for infrastructure projects, dams, pipelines, and roads. All of the SIAs include interacting with and liaising with affected communities. In addition he is the author of the Guidelines for undertaking SIA's as part of the EIA process commissioned by the Western Cape Provincial Environmental Authorities in 2007. These guidelines have been used throughout South Africa.

Tony was also the project manager for a study commissioned in 2005 by the then South African Department of Water Affairs and Forestry for the development of a Social Assessment and Development Framework. The aim of the framework was to enable the Department of Water Affairs and Forestry to identify, assess and manage social impacts associated with large infrastructure projects, such as dams. The study also included the development of guidelines for Social Impact Assessment, Conflict Management, Relocation and Resettlement and Monitoring and Evaluation.

Countries with work experience include South Africa, Namibia, Angola, Botswana, Zambia, Lesotho, Swaziland, Ghana, Mozambique, Mauritius, Kenya, Ethiopia, Oman, South Sudan and Sudan.

PALAEONTOLOGICAL HERITAGE ASSESSMENT: COMBINED DESKTOP & FIELD-BASED SCOPING STUDY

Proposed 132 kV Transmission Line Corridor and associated grid connection infrastructure from Proposed Kokerboom WEF to existing Helios Substation near Loeriesfontein, Namaqua District Municipality, Northern Cape

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July 2016

EXECUTIVE SUMMARY

Business Venture Investments No. 1788 (Pty) Ltd is proposing to construct two switching stations and a 132 kV overhead transmission line (OHL) and associated infrastructure to connect three proposed Kokerboom Wind Energy Facilities (WEFs) to the existing Eskom Helios Main Transmission Substation (MTS). The proposed transmission line corridors are located some 60 km to the north of Loeriesfontien in the Namaqua District Municipality, Northern Cape. The present palaeontological heritage assessment is based on a desktop study combined with a short, field-based assessment of the study area.

The study area is underlain by several formations of potentially fossiliferous Late Palaeozoic sediments of the Ecca Group (Karoo Supergroup) that are extensively intruded by unfossiliferous igneous rocks of the Early Jurassic Karoo Dolerite Suite. The Ecca Group rocks (Prince Albert, Whitehill and Tierberg Formations) are very poorly-exposed and deeply-weathered near-surface. They have also been locally baked (thermally metamorphosed) by nearby dolerite intrusions and occasionally secondarily mineralised. The only fossils recorded within these rocks comprise low-diversity trace fossil assemblages that occur widely within the Loeriesfontein region and are therefore not of unique scientific interest. No fossil vertebrate or plant remains were recorded during the field assessment.

The Karoo dolerites that crop out over the majority of the study area, especially in the west, are also poorly-exposed, deeply-weathered for the most part and, in addition, do not contain

fossils. Several unmapped, small-scale occurrences of post-Karoo breccia pipes and igneous intrusions were encountered during fieldwork. Some of the associated sandy sediments contain simple invertebrate trace fossils of uncertain age and stratigraphic position. Similar traces have previously been recorded from similar settings elsewhere within the Loeriesfontein region; they are not considered to be of great scientific significance.

None of the wide range of Late Caenozoic superficial deposits examined during fieldwork (*e.g.* alluvium, colluvium, surface gravels, calcretes, stream and pan sediments, sandy soils) appear to be highly fossiliferous. Important mammalian remains are known from pan and river sediments elsewhere in Bushmanland, but they are rare and their occurrence is unpredictable.

Highly sensitive no-go areas within the area have not been identified in this study. It is concluded that the bedrocks and superficial sediments underlying the entire study area are of *low* palaeontological sensitivity.

Potential impacts to fossil heritage resources within the study area involve the disturbance, damage or destruction of fossil material within the development footprint during the construction phase of the transmission line and switching stations. Due to the rarity of well-preserved, unique fossils of potential scientific importance within the study area, potential impacts on palaeontological heritage during the construction phase are assessed as of *very low (negative) significance* (before and after mitigation). The No-go alternative (*i.e.* no development) will have a neutral impact on palaeontological heritage. There is no preference on palaeontological heritage grounds for a specific transmission line route option, based on the three alternatives assessed. Cumulative impacts posed by the three separate wind farms and transmission lines are inferred to be low. This also applies to cumulative impacts from known similar developments in the region.

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, horn cores, petrified wood) during the construction phase of the transmission line and switching stations, no further specialist palaeontological studies or mitigation are recommended for this project. The Environmental Control Officer (ECO) responsible for the development should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads or pylon foundations) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis. Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the finds should be safeguarded, preferably *in situ* and the South African Heritage Resources Agency, SAHRA, should be alerted as soon as possible (Contact details: Dr Ragna Redelstorff. Heritage Officer Archaeology, Palaeontology & Meteorites Unit, SAHRA. 111 Harrington Street, Cape Town, 8001. Tel: +27 (0)21 202 8651. Fax: +27 (0)21 202 4509 E-mail:rredelstorff@sahra.org.za). This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the developer's expense.

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).These monitoring and mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for this project. The operational and decommissioning phases of the development is unlikely to have further significant impacts on palaeontological heritage and no recommendations are made in this regard.

1. INTRODUCTION

The proposed Kokerboom study area (which includes the proposed areas for the grid connection infrastructure and associated Wind Energy Facilities (WEFs)) near Loeriesfontein, Northern Cape, overlies potentially fossiliferous bedrocks and superficial sediments of Permian to Recent age. Fossil remains preserved within these underlying rocks or exposed at surface are protected by law (National Heritage Resources Act, 1999) and may be disturbed, damaged or destroyed by the proposed development. The present combined desktop and field-based palaeontological heritage assessment has therefore been commissioned by Aurecon South Africa (Pty) Ltd as part of a comprehensive Heritage Impact Assessment for this alternative energy development, including all four wind farms of the WEF as well as the associated 132 kV transmission line connection to Helios Substation. This report refers only to the proposed grid connection infrastructure. The three Kokerboom WEFs will be assessed via separate EIA processes.

2. PROJECT OUTLINE & BRIEF

2.1. Project outline

The company Business Venture Investments No. 1788 (Pty) Ltd is proposing to construct three wind farms (known as the Kokerboom 1, 2 & 3 Wind Farms) and associated grid connection infrastructure, near Loeriesfontein in the Northern Cape. This report relates specifically to the proposed grid connection infrastructure required to connect the three proposed Kokerboom Wind Farms to the national grid at the existing Eskom Helios substation. The three wind farms will be assessed via separate EIA processes.

The proposed grid connection infrastructure will consist of the following:

- Two switching stations;
- A 132 kV overhead powerline (3 Alternative routes are proposed);
- Service/ access tracks;
- Temporary site camps, laydown areas etc.

The site is located in the semi-arid region of southern Bushmanland, some 60 km to the north of Loeriesfontien in the Northern Cape. The site is located within the Namakwa District Municipality and Hantam Local Municipality. The following land parcels are involved in the proposed transmission line connections to the existing Eskom Helios Substation, which is located just to the southeast of the Kokerboom WEF development area (refer to Figure 1):

- Leeuwbergriver Remainder of Farm 1163
- Springbok Pan Remainder of Farm 1164
- Springbok Tand and Remainder of Farm 215
- Kleine Rooiberg Remainder of Farm 227
- Aan De Karree Doorn Pan Remainder of Farm 213
- Karree Doorn Pan Portion 1 of Farm 214
- Karree Doorn Pan Portion 2 of Farm 214
- Sous Portion 2 of Farm 226.

Aurecon South Africa (Pty) Ltd (Aurecon) has been commissioned by the developer to carry out three Environmental Impact Assessment (EIA) processes for the three proposed Kokerboom Wind Energy Facilities (WEFs) as well as one Basic Assessment (BA) process for the associated grid connection infrastructure (Aurecon contact details: Ms Mieke Barry. Senior Environmental Consultant, Aurecon South Africa (Pty) Ltd. Address: Aurecon Centre, 1 Century City Drive, Waterford Precinct, Century City, South Africa. Tel: +27 21 5266025. Fax: +27 86 5359856. E-mail: Mieke.Barry@aurecongroup.com).

2.2. Terms of Reference

The following Terms of Reference for the present palaeontological study has been defined by Aurecon South Africa (Pty) Ltd:

> Palaeontological heritage impact assessment for three Environmental Impact Assessments and one Basic Environmental Assessment, to be undertaken by the Consultant. These are for three proposed wind farms generating up to 240-256MW each and one associated Transmission Line, near Loeriesfontein in the Northern Cape Province, South Africa. The terms of reference included for the following:
>
> - Undertake a desktop study and information review.
> - Conduct a field assessment study to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development.
> - Based on the desktop review and field assessment, prepare a specialist report identifying the likely impacts of the proposed development on local fossil heritage and provide recommendation concerning any specialist mitigation measures, if required.

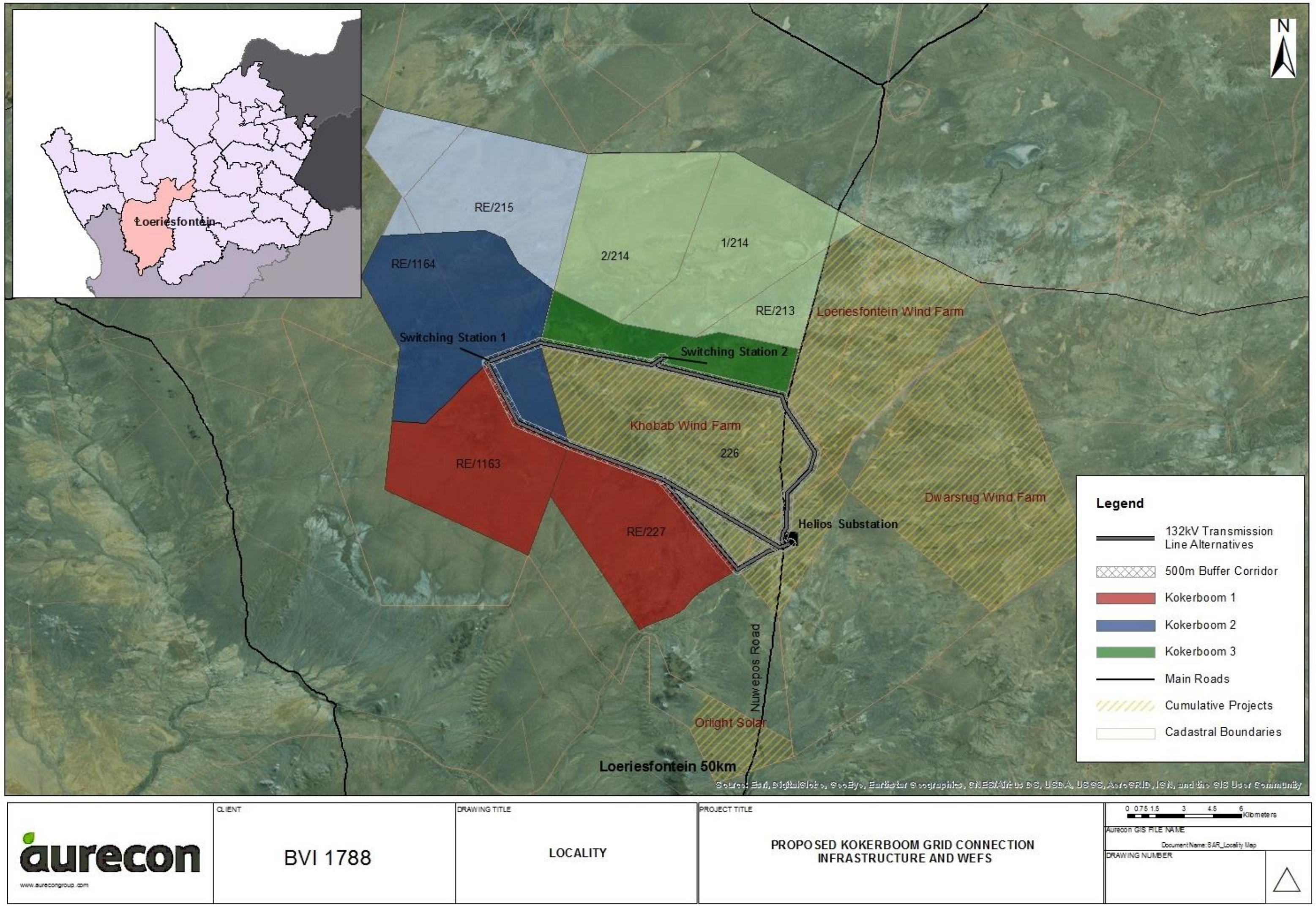

Figure 1: Map showing the location of the land parcels concerned in the proposed Kokerboom 132kV grid connection infrastructure some 60 km to the north of Loeriesfontein, Northern Cape. The study area comprises the three Kokerboom wind farms (red, blue and green areas), which will be serviced by the grid connection infrastructure. (Image provided by Aurecon South Africa (Pty) Ltd).

3. APPROACH TO STUDY

This PIA report provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations for specialist palaeontological mitigation where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, including previous palaeontological impact assessments in the area (*e.g.* Almond 2008c, 2011a, 2011b, 2014b, 2014c), (2) published geological maps and accompanying sheet explanations, (3) a three-day field study in the study area north of Loeriesfontein (23-25 June 2016) as well as (4) the author's extensive field experience with the formations concerned and their palaeontological heritage (*e.g.* Almond *in* Macey *et al.* 2011).

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here). This data is then used to assess the palaeontological sensitivity of each rock unit to development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond & Pether 2008) and are shown on the palaeosensitivity map on the SAHRIS (South African Heritage Resources Information System) website. The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most notably the extent of fresh bedrock excavation and ground clearance envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field assessment study by a professional palaeontologist is usually warranted.

The focus of palaeontological field assessment is *not* simply to survey the development footprint or even the development area as a whole (*e.g.* farms or other parcels of land concerned in the development). Rather, the palaeontologist seeks to assess or predict the diversity, density and distribution of fossils within and beneath the study area, as well as their heritage or scientific interest. This is primarily achieved through a careful field examination of one or more representative exposures of all the sedimentary rock units present (*N.B.* Metamorphic and igneous rocks rarely contain fossils). The best rock exposures are generally those that are easily accessible, extensive, fresh (*i.e.* unweathered) and include a large fraction of the stratigraphic unit concerned (*e.g.* formation). These exposures may be natural or artificial and include, for example, rocky outcrops in stream or river banks, cliffs, quarries, dams, dongas, open building excavations or road and railway cuttings. Uncemented superficial deposits, such as alluvium, scree or wind-blown sands, may occasionally contain fossils and should also be included in the field study where they are well-represented in the study area. It is normal practice for impact palaeontologists to collect representative, well-localised (*e.g.* GPS and stratigraphic data) samples of fossil material during field assessment studies. In order to do so, a fossil collection permit from SAHRA is required and all fossil material collected must be properly curated within an approved repository (usually a museum or university collection).

Note that while fossil localities recorded during field work within the study area itself are obviously highly relevant, most fossil heritage here is embedded within rocks beneath the land surface or obscured by surface deposits (soil, alluvium *etc*) and by vegetation cover. In many cases where levels of fresh (*i.e.* unweathered) bedrock exposure are low, the hidden fossil resources have to be *inferred* from palaeontological observations made from better exposures of the same formations elsewhere in the region but outside the immediate study area. Therefore a palaeontologist might reasonably spend far *more* time examining road cuts and borrow pits close to, but outside, the study area than within the study area itself. Field data from localities even further afield (*e.g.* an adjacent province) may also be adduced to build up a realistic picture of the likely fossil heritage within the study area.

On the basis of the desktop and field studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological and taphonomic data) – is usually most effective during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority, SAHRA (Contact details: Ms Ragna Redelstorff, Heritage Officer Archaeology, Palaeontology & Meteorites Unit South African Heritage Resources Agency. P.O. Box 4637, Cape Town 8000. Tel: 021 462 8651. Fax: 021 462 4509. Email: rredelstorff@sahra.org.za). It should be emphasised that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

4. ASSUMPTIONS AND LIMITATIONS

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerised database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist, as in the case of the present study.

In the case of the Kokerboom study area near Loeriesfontein in the Northern Cape, preservation of potentially fossiliferous bedrocks is favoured by the semi-arid climate and sparse vegetation. However, bedrock exposure is highly constrained by extensive superficial deposits, especially in areas of low relief, as well as pervasive karooid *bossieveld* vegetation (Bushmanland Basin Shrubland). The study area is very extensive and for the most part fairly flat, with some gentle hillslopes and few access roads. However, sufficient bedrock exposures were examined during the course of the three-day field study to assess the palaeontological heritage sensitivity of the main rock units represented within the study area (See Appendix for locality data). Comparatively few academic palaeontological studies have been carried out hitherto in the region, so any new data from impact studies here are of scientific interest. Palaeontological and geological data from the recent field study is usefully supplemented by those from several other field-based fossil heritage impact studies carried out in the Loeriesfontein region by the author in recent years (See reference list). Confidence levels for this impact assessment are consequently rated as moderate, despite the unavoidable constraints of limited exposure, time and access.

5. LEGISLATIVE CONTEXT

The present combined desktop and field-based palaeontological heritage report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.

(2) All archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have recently been published by SAHRA (2013).

6. GEOLOGICAL CONTEXT

The broader study area for the Kokerboom WEF and associated transmission line connections to Helios Substation (yellow polygon in Fig. 5), situated *c*. 60 km north of Loeriesfontein, lies within semi-arid, gently undulating terrain at elevations between *c*. 900 and 1000 m amsl on the southern borders of the Bushmanland region. The prominent, dolerite-capped hills of Groot Rooiberg, Klein Rooiberg and Leeuberg just to the south reach elevations of *c*. 880-1000 m amsl. (Fig. 4). The Sishen-Saldanha railway runs to the southeast and the Loeriesfontein – Granaatboskolk - Pofadder dust road traverses the eastern margins of the area. Several large pans are located some 10-20 km to the north and northeast. The southern portion of the Kokerboom study area is drained by several southwesterly-flowing streams that eventually join the ancient Kromrivier drainage system flowing down into the Knersvlakte through a gap in the Great Escarpment. The northern portion of the area is drained by comparatively few ephemeral streams that flow into pans within or outside its margins (*e.g.* Kareedoringpan, Konnes se Pan) (Fig. 30).

The Kokerboom WEF study area is characterised by gently-undulating terrain with low hills, few rocky *kranzes* (ridges or scarps), shallow, usually dry water courses and extensive gravelly *vlaktes* (plains) (Figs. 2 & 3. The landscape is mantled in low karroid *bossieveld* with few, small trees along water courses and in rocky areas. In general levels of bedrock exposure are very low indeed due to the pervasive cover by superficial sediments (alluvium, colluvium, surface gravels, pedocretes *etc*); it is mainly limited to sporadic small dolerite *koppies*, stream beds, low scarps, erosion gullies as well as the margins of pans and dams. Several borrow pits, mainly situated along the Loeriesfontein – Pofadder dust road, provide important additional windows into the subsurface geology.

Figure 2: Typical low-relief terrain in the Kokerboom WEF study area, here on Karee Doorn Pan 214. Note surface gravels of reworked calcrete.

Figure 3: Sandy soils overlying nodular subsurface calcrete in the south-eastern portion of the study area (Kleine Rooiberg 227).

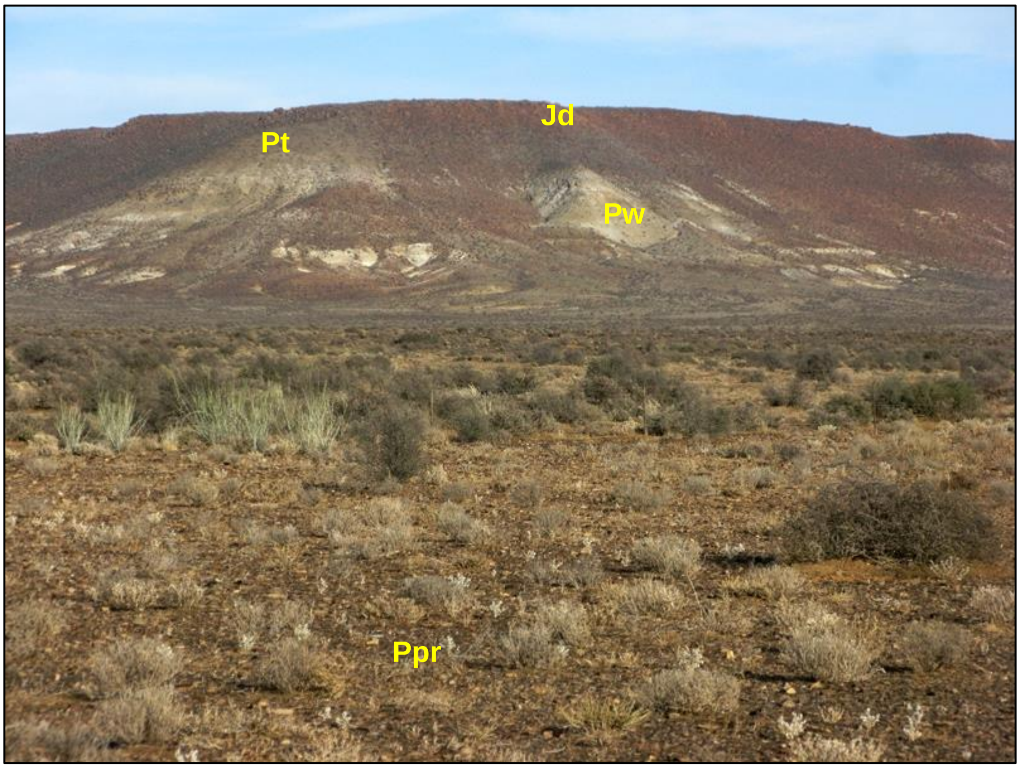

Figure 4: The main stratigraphic units represented in the Kokerboom study area, as seen on the northern flanks of the Klein Rooiberg, just south of the area itself. Ppr = Prince Albert Fm; Pw = Whitehill Fm; Pt = Tierberg Fm; Jd = Karoo Dolerite Suite.

The Loeriesfontein region lies towards the north-western edge of the Main Karoo Basin of South Africa (Johnson *et al.* 2006). The geology of the Kokerboom study area is shown on 1: 250 000 geology sheet 3018 Loeriesfontein (Macey *et al.* 2011) (Fig. 5). The sedimentary bedrock successions involved are predominantly basinal mudrocks assigned to the Early to Middle Permian **Ecca Group** (**Karoo Supergroup**) (See stratigraphic column in Fig. 9). They become broadly younger towards the east, although this pattern is largely obscured by much later, extensive dolerite intrusions. The three Ecca Group subunits represented in the study area include (1) dark mudrocks and fine-grained sandstones of the **Prince Albert Formation** (Ppr); (2) white-weathering carbonaceous mudrocks of the **Whitehill Formation** (Pw) followed by grey-green mudrocks and wackes (impure sandstones) of the **Tierberg Formation** (Pt). Early Jurassic sills of the **Karoo Dolerite Suite** (Jd) intrude the Ecca Group country rocks over large areas, especially in the west. In addition, several **breccia pipes** associated with Karoo dolerite intrusion occur in the area, but are unmapped. Swarms of such intrusive pipes are well known from the Karoo region north of Loeriesfontein where they are especially abundant in the Prince Albert Formation outcrop area but also pierce through the overlying Whitehill rocks (*cf.* Macey *et al.* 2011, Almond 2014c). Several small-scale intrusive bodies (possibly dykes) of pale greyish igneous rock encountered within the study area are tentatively assigned to the Late Cretaceous / early Tertiary **Gamoep Suite** (*cf* Macey *et al.* 2011, Chapter

6). A range of Late Caenozoic superficial sediments - mostly unconsolidated and probably of Quaternary to Recent age – represented within the study area include alluvial and pan deposits, pedocretes (*e.g.* calcrete), surface gravels (including doleritic rubble) and various sandy to gravelly soils.

In the remainder of this section of the report these various rock units are briefly described and illustrated with reference to the Kokerboom study area (black polygon and red dashed lines in Fig. 5) as well as the broader study area comprising land parcels concerned in the development (yellow polygon in Fig. 5) . GPS data for all numbered localities mentioned in the text are given in the Appendix.

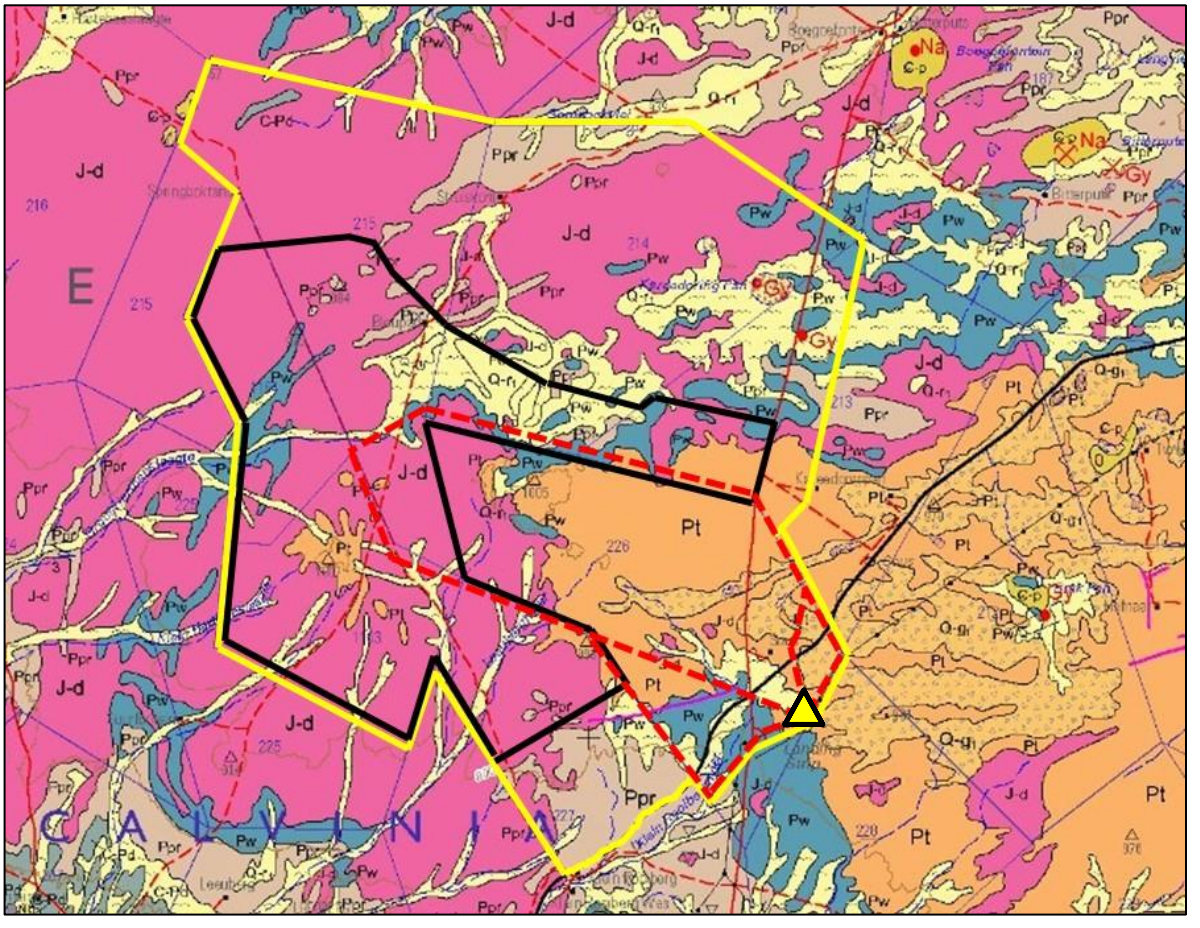

Figure 5: Extract from 1: 250 000 geology sheet 3018 Loeriesfontein showing the land parcels concerned with the Kokerboom WEFs and associated grid connection (yellow polygon) situated *c.* 60 km north of Loeriesfontein, Northern Cape (Council for Geoscience, Pretoria). The black polygon shows the WEF study area while the red dashed line indicates transmission line corridors to the existing Eskom Helios Substation on farm Sous 226 (yellow triangle).

The main rock units represented within the study area are:

1. KAROO SUPERGROUP

- **ECCA GROUP**

Prince Albert Formation (Ppr, buff)
Whitehill Formation (Pw, blue)
Tierberg Formation (Pt, orange)

2. KAROO DOLERITE SUITE

Dolerite sills and dykes (J-d, pink)

3. LATE CAENOZOIC SUPERFICIAL SEDIMENTS

Stream and river alluvium (pale yellow with flying bird symbol), sandy soils (Q-r1, pale yellow), dolerite rubble (Q-g1, pale orange with triangle symbols), unmapped scree deposits, various surface gravels, pan sediments (red dotted areas; Gy = gypsum deposits).

6.1. Ecca Group

Useful recent geological accounts of the Early to Middle Permian Ecca Group in the Loeriesfontein area are given by De Beer *et al.* (2002), Johnson *et al.* (2006), Johnson (2009) and Macey *et al.* (2011). Most of the Ecca Group bedrocks in the study area are mantled with shaly or doleritic surface gravels, or other superficial sediments, or obscured by shrubby vegetation (See, for example, Figs. 11 & 17). However, a few good exposures are seen in river beds and borrow pits. Better examples in the Loeriesfontein region have already been described and illustrated in previous palaeontological assessment reports by the author (*e.g.* Almond 2014b, 2014c).

- **Prince Albert Formation (Ppr)**

As shown on the new 1: 250 000 geological map (Fig. 5), basinal mudrocks of the **Prince Albert Formation** (Ppr) are poorly represented within the broader study area except in the extreme south and north. These areas, which will not be directly impacted by the proposed WEF development, often appear dark on satellite images because the outcrop is mantled in gravels rich in ferromanganese minerals (Gravel clasts often have a shiny-black patina of "desert varnish"). Key geological accounts of the Prince Albert Formation are given by Visser (1992) and Cole (2005), while Macey *et al.* (2011) and Almond (2014c) describe occurrences in the Loeriesfontein area. The succession is Early Permian (Asselian / Artinskian) in age and was previously known as "Upper Dwyka Shales". The Prince Albert succession consists mainly of tabular., thin--bedded mudrocks of blue-grey, olive-grey to reddish-brown colour with occasional thin (dm) buff sandstones and even thinner (few cm), soft-weathering layers of yellowish water-lain tuff (*i.e.* volcanic ash layers). Deposition was largely by suspension settling of fine muds in a fairly deep, cool, post-glacial sea. Extensive diagenetic modification of these sediments has led to the formation of thin cherty beds, pearly- blue phosphatic nodules, rusty iron carbonate nodules, as well as beds and elongate ellipitical concretions impregnated with iron and manganese minerals. These last occur within prominent-weathering, metallic-looking beds, some of which display well-developed snuffbox weathering and concentric *Liesegang* rings. Partial cementation of fine-grained siliciclastics by secondary minerals may result in the formation of distinctive "spherulitic" horizons that are spotted with small spherical nodules of silica and / or iron minerals.

Extensive bedding plane exposures of tabular-bedded, flaggy, greenish-grey laminated mudrocks of the Prince Albert Formation are exposed in the bed of the Klein-Rooibergrivier to the east of Klein Rooiberg Wes (Figs. 6 & 7). Elsewhere the outcrop area of this formation is largely mantled in angular, platy surface gravels of mudrock and dark grey hornfels, with common desert-vanished ferruginised mudrock clasts (Fig. 8).

Figure 6: Flaggy, grey-green mudrocks of the Prince Albert Formation exposed in the bed of the Klein-Rooibergrivier to the east of Klein Rooiberg Wes (Loc. 249).

Figure 7: Close-up of laminated mudrocks of the Prince Albert Formation (Loc. 249) (Hammer = 30 cm).

Figure 8: Dark grey baked hornfels of the Prince Albert Formation on hillslopes north of Bloupan farmstead (Loc. 254) (Hammer = 30 cm).

- **Whitehill Formation (Pw)**

A broad band of country across the Kokerboom study area is underlain by finely-laminated sediments of the Whitehill Formation (Pw) but this recessive-weathering unit is extensively intruded and baked by Karoo dolerite. It comprises a thin (*c*. 80 m) succession of well-laminated, carbon-rich mudrocks of Early / Mid Permian (Artinskian) age. These distinctive clay-rich and subordinate silty sediments were laid down about 278 Ma (million years ago) in an extensive shallow, brackish to freshwater basin – the Ecca Sea – that stretched across southwestern Gondwana, from southern Africa into South America. Thin volcanic tuffs and large, irregular to oblate dolomitic diagenetic nodules occur within the laminated mudrocks. Key fossiliferous exposures of the Whitehill Formation are present on the outskirts of Loeriesfontein and elsewhere on 1:250 000 geology sheet 3018 (McLachlan & Anderson 1973, Oelofsen 1981, 1987, Visser 1992, 1994, Cole & Basson 1991, Johnson *et al*. 2006, Almond 1996, Macey *et al.* 2011, Evans & Bender 1999, Evans 2005, Johnson *et al*. 2006). Near-surface weathering of these highly-carbonaceous sediments to release gypsum produces pale grey to cream colours that are readily seen in satellite images and hillslopes where the bedrock is exposed (Fig. 2). Good sections through the Whitehill Formation are seen on the northern and western flanks of the Klein Rooiberg, just south of the present study area (Figs. 6 & 7).

Most of the Whitehill Formation outcrop within the Kokerboom study area is topographically subdued and mantled with pale grey platy mudrock clasts as well as fragments of downwasted dolomite concretions and gypsum (Fig. 11). Locally, upward-coarsening packages of dark, paper-laminated to thin-bedded mudrocks are exposed along low scarps, capped by thin-bedded greyish siltstones (Fig. 12) that are recorded in the middle and top of the Whitehill Formation succession in the Loeriesfontein area (See stratigraphic log, Fig. 9). Both laminated and silty facies are well-exposed in several roadside borrow pits as well as erosion gullies along pan margins in the eastern part of the study area (Karee Doorn Pan 214). The bedrocks here are deeply-weathered and covered with a thick mantle of saprolite (*in situ* weathered material) and silty soils (Figs. 13, 31). Lenses and thin horizons of transluscent gypsum are common. Whitehill beds exposed in an old gypsum borrow pit at Loc. 263 show small-scale folding that is probably a consequence of extensive secondary ferro-manganese mineralisation as well as surface gossans and irregular gypsum lenses (Figs. 14 & 15).

Thin tabular beds and lenses of a hard, creamy-whitish mineral, variously showing a vuggy (*i.e.* containing open cavities), fibrous or pustular texture, are locally associated with the Whitehill Formation outcrop on Karee Doorn Pan 214 (*e.g.* Loc. 237). The identity and origin of these mineral bodies are unclear; they may represent secondary modification (*e.g.*

silicification) of gypsum or calcrete, perhaps associated with Mesozoic or younger hydrothermal activity, though this is highly speculative.

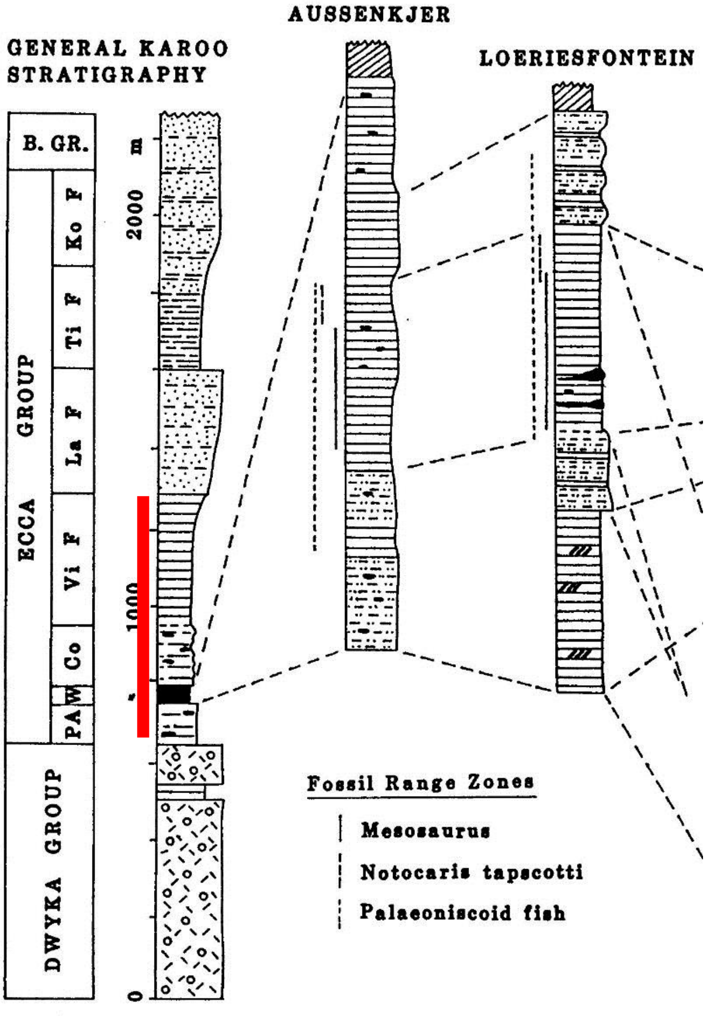

Figure 9: Stratigraphy of the Ecca Group in the Main Karoo Basin (Modified from Visser 1992). The position of the Prince Albert (PA) and Whitehill (W) Formations as well as the overlying basal mudrocks of the Tierberg Formation (equivalent to Co and Vi F on this figure) represented in the present study area is emphasized here by the red bar. On the right hand side is presented a detailed section through the Whitehill Formation at Loeriesfontein, showing the range zones of major fossil groups.

Figure 10: Good hillslope exposures of the pale-weathering Whitehill Formation on the northern side of Klein Rooiberg, just south of the study area. Prominent-weathering silty beds are seen in the middle and towards the top of the Whitehill succession (*cf* Fig. 9).

Figure 11: Typical low-relief outcrop of the Whitehill Formation within the study area, the bedrocks mantled by pale grey, platy mudrock clasts (Loc. 244).

Figure 12: Low *kranz* of dark- to pale grey-weathering, papery carbonaceous Whitehill mudrocks overlain by thin-bedded grey siltstones (Loc. 244) (Hammer = 30 cm).

Figure 13: Borrow pit cut face section through gently-dipping, tabular-bedded mudrocks of the Whitehill Formation overlain by saprolite and thick, silty, gypsiferous soils (Loc. 261) (Hammer = 30 cm).

Figure 14: Thick lenticular body of layered, greyish, transluscent gypsum exposed in an old gypsum quarry excavated into the Whitehill Formation (Loc. 263) (Hammer = 30 cm).

Figure 15: Folding and contortion of thin beds in the Whitehill Formation associated with extensive secondary ferro-manganese mineralisation (Loc. 263) (Hammer = 30 cm).

- **Tierberg Formation (Pt)**

The Tierberg Formation is a thick, recessive-weathering, mudrock-dominated succession consisting predominantly of dark, often brown to grey, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones or wackes (Prinsloo 1989, Le Roux 1993, Viljoen 2005, Johnson *et al*., 2006). The Tierberg shales are Early to Middle Permian in age and were deposited in a range of offshore, quiet water environments below wave base. These include basin plain, distal turbidite fan and distal prodelta in ascending order (Viljoen 2005, Almond *in* Macey *et al.* 2011). Thin coarsening-upwards cycles occur towards the top of the formation with local evidence of soft-sediment deformation, ripples and common calcareous concretions. Thin water-lain tuffs (volcanic ash layers) are also known. A restricted, brackish water environment is reconstructed for the Ecca Basin at this time. Close to the contact with Karoo dolerite intrusions the Tierberg mudrocks are often baked to a dark grey hornfels with a reddish-brown crust (Prinsloo 1989).

The Tierberg Formation outcrop area is mainly confined to the easternmost portion of the Kokerboom study. On satellite images the Tierberg Formation outcrop area has a distinctive, finely-banded appearance reflecting cyclical deposition patterns (*e.g.* thin upward-coarsening cycles) (*cf* Almond 2015c). Good bedrock exposure in this rolling hilly terrain is very limited indeed, with small bedding plane exposures along stream gullies and thin, prominent-weathering tabular beds observed on some steeper hillslopes (Fig. 16). As mapped, much of the outcrop area is mantled by blocky surface rubble of doleritic or quartzitic / hornfels composition (Fig. 27), while the bedrocks have frequently been baked by adjacent dolerite intrusions. Elsewhere the outcrop is usually mantled by platy, orange-brown patinated surface gravels of baked mudrock, wacke and quartzite, or by alluvial soils in low-lying areas. Occasional thin, tabular, greyish, rusty-brown weathering cherty beds (Fig. 17) may represent northern correlatives of the volcanic tuff-related Matjiesfontein Member (Collingham Formation) that is recognised further to the south within the Main Karoo Basin.

Figure 16: Very limited surface exposure of baked, thin-bedded, flaggy wackes of the Tierberg Formation on Harderant (Loc. 252) (Hammer = 30 cm).

Figure 17: Tabular, pale greyish cherty bed within the lowermost Tierberg Formation, with pale grey outcrop of the underlying Whitehill Formation in the background (Loc. 248) (Hammer = 30 cm).

6.2. Karoo Dolerite Suite and younger igneous rocks

The Karoo Dolerite Suite is an extensive network of basic igneous bodies (dykes, sills) that were intruded into sediments of the Main Karoo Basin in the Early Jurassic Period, about 183 million years ago (Duncan & Marsh 2006, Cole *et al.* 2004). These dolerites form part of the Karoo Igneous Province of Southern Africa that developed in response to crustal doming and stretching preceding the break-up of Gondwana. Hard cappings of blocky, reddish-brown to rusty-weathering dolerite are a very typical feature of the flat-topped koppies in the Great Karoo region (*e.g.* Klein Rooiberg Fig. 10). In the Loeriesfontein area the dolerite sills variously intrude the Prince Albert, Whitehill Formation and Tierberg Formations of the Ecca Group as well as the underlying Dwyka Group. As seen on the geological map (Fig. 5), dolerite intrusions are mapped as underlying a very large portion of the Kokerboom study area, especially in the west. Close to the margins of these intrusions the country mudrocks have been thermally metamorphosed or baked to form tough, splintery hornfels.

The Karoo dolerites are unfossiliferous igneous rocks and so will only be briefly treated here. Despite the large mapped area of dolerite within the study area, fresh exposures are in fact very rare since the outcrop area is largely mantled in superficial deposits. Highly-weathered, crumbly dolerite ("*sabunga*") showing extensive veining by Late Caenoziic calcrete as well as well-developed overlying nodular calcretes is well seen in erosion gullies incised through the superficial sediment cover (Fig. 19). Small bouldery *koppies* of moderately- to well-rounded dolerite corestones, often showing desert varnish, are seen in the northern part of the broader study area (Fig. 18); they have formed by *in situ* weathering of major intrusive bodies. Doleritic surface rubble that is mapped in the eastern portion of the study area (*e.g.* in the vicinity of Helios Substation) reflects downwasting of buried dolerite intrusions. Highly weathered dolerite *sabunga*, locally with a platy fracture or enclosing onionskin-weathered corestones, is well seen in several large borrow pits in this region (*e.g.* Loc. 258).

Numerous breccia pipes related to dolerite intrusion in the Early Jurassic punctuate the Prince Albert and Whitehill outcrop areas to the north of Loeriesfontein, including several unmapped examples within the study area itself (*cf* Macey *et al.* 2011, Almond 2014c). They are of palaeontological interest as possible conduits for the degassing of potent greenhouse gases (*e.g.* methane) that may have played an important role in climate-driven extinction events in the Early Jurassic (Toarcian) (Svensen *et al.* 2007). Several low rounded hills of brownish-weathering, ferruginous, igneous or hybrid igneous-sedimentary rocks were encountered within the broader Kokerboom WEF study area (e.g. Loc. 247 on the border of Karee Doorn Pan 214 and Sous 226); these are interpreted as probable breccia pipes.

Several intrusive bodies of brownish-weathering, pale grey, massive, medium-grained, quartz-poor igneous rock with whitish phenocrysts are locally seen cross-cutting the Ecca Group country rocks (Figs. 20 & 21). They show blocky or onionskin weathering as well as enclosed sedimentary clasts and might represent younger (Cretaceous – Early Tertiary) intrusive dykes or pipes related to the post-Karoo Gamoep Suite (*cf* Macey *et al.* 2011, Chapter 6). The thin-bedded, steeply–dipping beds of greyish arenite and associated greyish igneous rocks that are seen at Loc. 255 (northern edge of Karee Doorn Pan 214) may be related to a sediment-infilled diatreme of the Gamoep Suite (Fig. 22).

Figure 18: Typical bouldery dolerite *koppie* on the margins of a small pan, Karee Doorn Pan 214 (Loc. 256).

Figure 19: Highly-weathered, olive-grey dolerite bedrock (*sabunga*) exposed in an erosion gulley on Springbok Tand 215. Note the well-developed nodular calcrete horizon within the overlying sandy soils.

Figure 20: Trackway exposure of pale grey, blocky weathering igneous sheet or dyke intruding Ecca country rocks, Karee Doorn Pan 214 (Loc. 246) (Hammer = 30 cm).

Figure 21: Dark-hued, baked Ecca country rocks (LHS) cross-cut by pale grey intrusive igneous body (RHS), Karee Doorn Pan 214 (Loc. 255) (Hammer = 30 cm).

Figure 22: Steeply-dipping, thin beds of greyish arenite associated with the igneous intrusive rocks illustrated above, both probably related to a sediment-infilled diatreme or pipe (possible Gamoep Suite).

6.3. Late Caenozoic superficial sediments

Various types of superficial deposits of Late Caenozoic (Miocene / Pliocene to Recent) age occur widely throughout the Karoo study region (*e.g.* Holmes & Marker 1995, Cole *et al.* 2004, Partridge *et al.* 2006). They include pedocretes (*e.g*. calcretes), colluvial slope deposits, down-wasted surface gravels, river alluvium, wind-blown sands as well as spring and pan sediments. This mantle of superficial deposits obscures the Palaeozoic and Mesozoic bedrock geology in many parts of the Kokerboom study area. Furthermore, deep chemical weathering in the Late Cretaceous to Tertiary interval has probably converted some of the near-surface Ecca rocks to *in situ* weathered saprolite (*cf* Bok 2011).

Useful geological overviews of talus deposits, alluvium and calcrete occurrences in a semi-arid Karoo region are given by Cole *et al.* (2004). Short accounts of the superficial deposits in the Loeriesfontein sheet area are given in the geological sheet explanation by Macey *et al.* (2011) and the recent palaeontological heritage report by Almond (2014c). The Karoo Supergroup hillslopes around Loeriesfontein are typically mantled with a thin to thick layer of colluvium or slope deposits (*e.g.* sandstone and dolerite scree or talus deposits, sheetwash). Thicker accumulations of sandy, gravelly and bouldery alluvium of Late Caenozoic age (< 5 Ma) are found in stream and river beds. Alluvial gravels in the study area are composed largely of angular, platy clasts of Ecca mudrocks and hornfels as well as reworked, rounded dolerite corestones (Figs. 23 & 24). These colluvial and alluvial deposits may be extensively calcretised (*i.e*. cemented with soil limestone or calcrete), especially in the neighbourhood of dolerite intrusions where groundwaters are enriched in dissolved carbonate. Rusty-brown areas seen on satellite images often represent dolerite-rich colluvial or down-wasted surface gravels.

A wide range of eluvial surface gravels are developed over the various Ecca Group formations within the Kokerboom WEF study area, variously dominated by platy siltstone or sandstone, grey dolomite, shiny dark brown (desert-varnished) ferruginous mudrock, brown ferruginous carbonate, hornfels, quartzite, wacke, reworked calcrete or dolerite *etc* (*e.g.* Figs. 26 & 27). Tough-weathering, often ferruginous gravel clasts are common over Prince Albert mudrocks and dolerite gravels over Whitehill mudrocks. The Tierberg outcrop area has fewer resistant gravels and more platy shale / hornfels / wacke clasts, although ferruginous carbonate concretion fragments and sandstones may be locally very abundant. Closely-spaced platy clasts at surface may form a coherent *reg* or desert pavement. Extensive areas of doleritic rubble are separately mapped in the easternmost portion of the study area (Q-g1 in Fig. 5). The rounded to angular fragments of dolerite rock, including downwasted and reworked corestones, locally overlie orange-brown, ferruginous lateritic soils.

Angular to subrounded float clasts of semi-transluscent chert with an orange-brown cortex and superficial shrinkage cracks are widely dispersed within surface gravels across the study area (Concentrations were observed at Locs. 237, 243 on Karee Doorn Pan 214, for example) (Fig 28). They frequently show anthropogenic flaking. The fresh cherts are often greenish-yellow, but flaked examples show a wide spectrum of hues, including an opaque porcellanous cream colour (Almond 2014c). Their provenance is unclear, but may involve older carbonate deposits around the margins of local pans, as is the case with Plio-Pleistocene cherts at Etosha Pan, Namibia (Pickford *et al.* 2009). Comparable, so-called Magadi-type cherts have been widely recorded from Pleistocene and older alkaline lake deposits in East Africa and elsewhere. The original source of the opaline silica may have been hydrothermal (hotsprings or vents), volcanogenic (*e.g.* tuff material) or biogenic (diatoms / bacteria). Rubbery precursor nodules of hydrated sodium silicate (the mineral magadiite) with a mammilated surface were converted to chert bodies with distinctive shrinkage cracks and surface reticulation patterns (Schubel & Simonson 1990, Behr 2012). The chert-forming lakes concerned near Loeriesfontein might be Quaternary or older pans in southern Bushmanland, or perhaps related to the much older, Late Cretaceous – Tertiary volcanic pipes of the Gamoep Suite that occur abundantly in the region.

Subsurface calcretes are locally well developed in the study area, especially in the vicinity of extensive subsurface dolerite intrusions where they cement older alluvial gravels, siltstones and soils and form veins penetrating into the underlying bedrocks. Beautiful examples of large, pebble-sized, well-rounded subsurface calcrete nodules are exhumed along the sides of farm tracks (Figs. 19 and 25). They show a marked concentric lamination internally. Extensive calcretisation of thick (> 2 m) silty soils overlying the Whitehill Formation outcrop area is seen in roadside borrow pits and erosion gullies along the margins of pans (Fig. 31). The overlying gravels comprise mudrock flakes, dolomite, calcrete and some ferruginous chert or ironstone.

Stream gravels are poorly represented in the study region where they reflect local resistant-weathering lithologies (*e.g.* platy clasts of Ecca mudrocks or fine-grained sandstones, wackes, hornfels, dolerite rubble, reworked calcrete or ferruginous carbonate nodules, minor chert) (Figs. 23 & 24). The alluvium is often calcretised subsurface, as well seen in streambank exposures. Finer-grained alluvial deposits may reach thicknesses of several metres and coarse, gravelly basal or internal horizons are often well- to semi-consolidated by carbonate cement. The underlying bedrocks are often permeated by calcrete veins. The basal, poorly-sorted, gravel-rich alluvium is overlain by finer-grained younger silty alluvium and downwasted surface gravels. Polymict older stream gravels (dolerite, hornfels, sandstone *etc*) may occur up to a couple of metres above the present stream beds.

Thick, orange-brown sandy soils are frequently developed overlying subsurface dolerite and calcrete (Fig. 29). Deflated areas show concentrations of fine, resistant-weathering gravels (*e.g.* dark ferruginous mudrock, hornfels, quartzite). Pan areas (*e.g.* northern portion of Karee Doorn Pan 214) feature thick, silty to sandy deposits that are usually calcretised at depth and show efflorescence of various evaporite minerals at the surface (Figs. 30 & 31).

Figure 23: Basal gravelly and overlying sandy alluvial deposits overlying Ecca Group bedrocks along the banks of the Klein-Rooibergrivier (Loc. 249) (Hammer = 30 cm).

Figure 24: Stringer of resistant-weathering stream gravels - including dark, desert-varnished ferruginous mudrock or ironstone and white reworked calcrete - exposed along a shallow drainage line on Karee Doorn Pan 214 (Loc. 245).

Figure 25: Well-developed nodular calcrete horizon overlain by silty alluvial soils, farm track on Kleine Rooiberg 227 (Hammer = 30 cm).

Figure 26: Carpet of angular gravel clasts of ferruginised mudrock overlying the Tierberg Formation (Loc. 239) (Hammer = 30 cm).

Figure 27: Angular surface gravels of baked hornfels and wacke of the Tierberg Formation overlying subsurface dolerite, Sous 226 (Loc. 257) (Hammer = 30 cm). These deposits are sometimes mapped as doleritic rubble.

Figure 28: Gravel clasts of greenish chert with a pale cream-coloured cortex showing local shrinkage cracks – possibly Magadi-type cherts downwasted from ancient alkalkine lake deposits (Loc. 237) (Scale in cm and mm).

Figure 29: Sandy soils on the northern edge of Karee Doorn Pan, seen in the distance (Loc. 240).

Figure 30: Typical sandy to silty pan deposits with pale salty efflorescence, small pan on the northern margin of Karee Doorn Pan 214 (Loc. 256).

Figure 31: Pale grey, laminated Whitehill Formation bedrocks overlain by poorly-consolidated saprolite and then several meters of calcretised pan sediments, northern margins of Karee Doorn Pan (Loc. 243).

7. PALAEONTOLOGICAL HERITAGE

In this section of the report fossil assemblages that have been previously recorded from the main sedimentary rock units represented within the Kokerboom study area are outlined, while fossil material recorded during the present field assessment is listed and illustrated. Much of the background data has been abstracted from the unpublished report on the fossil heritage of the Loeriesfontein 1: 250 000 sheet area by Almond *in* Macey *et al.* (2011) as well as several palaeontological heritage assessments in the Loeriesfontein area by the author (especially Almond 2014c). GPS locality details and brief descriptions for numbered palaeontological sites are provided in the Appendix.

7.1. Fossils in the Prince Albert Formation

The fossil biota of the postglacial mudrocks of the Prince Albert Formation is summarised by Cole (2005), Almond (2008b) and Almond *in* Macey *et al.* (2011). Epichnial (bedding plane) trace fossil assemblages of the non-marine *Mermia* Ichnofacies, dominated by the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails), are commonly found in basinal mudrock facies of the Prince Albert Formation throughout the Ecca Basin. These assemblages have been described by Anderson (1974, 1975, 1976, 1981) and briefly reviewed by Almond (2008a, b; Almond *in* Macey 2011). The only fossils recorded from the Prince Albert Formation in the Loeriesfontein sheet area are various types of trace fossils, some of which have apparently been misinterpreted as plant remains by earlier authors (Almond 2008a). Almond (1996) describes seaweed-like “fucoids” on the farm Bloukranz 1173, along the R355 just to the south of the present study area, that take the form of distinctively bifurcating, flat, smooth burrow systems up to several centimetres across. Similar bifurcating burrow systems characterise the khaki sandstone facies within the Prince Albert Formation to the north of Loeriesfontein (Almond 2014c).

Diagenetic nodules containing the remains of palaeoniscoids (primitive bony fish), sharks, spiral bromalites (coprolites, spiral gut infills *etc* attributable to sharks or temnospondyl amphibians) and petrified wood have been found in the Ceres Karoo (Almond 2008b and refs. therein). Rare shark remains (*Dwykaselachus*) are recorded near Prince Albert on the southern margin of the Great Karoo (Oelofsen 1986). Microfossil remains in this formation include sponge spicules, foraminiferal and radiolarian protozoans, acritarchs and miospores. The most diverse, as well as biostratigraphically, palaeobiogeographically and palaeoecologically interesting, fossil biota from the Prince Albert Formation is that described from calcareous concretions exposed along the Vaal River in the Douglas area of the Northern Cape (McLachlan and Anderson 1973, Visser *et al.,* 1977-78). The important Douglas biota contains petrified wood (including large tree trunks), palynomorphs (miospores), orthocone nautiloids, nuculid bivalves, articulate brachiopods, spiral and other “coprolites” (probably of fish, possibly including sharks) and fairly abundant, well-articulated remains of palaeoniscoid fish. Most of the fish have been assigned to the palaeoniscoid genus *Namaichthys* but additional taxa, including a possible acrolepid, may also be present here (Evans 2005). The invertebrates are mainly preserved as moulds.

Trace fossil material recorded from dark mudrocks of the Prince Albert Formation during the present field assessment includes straight to curved, highly-flattened, unbranched horizontal burrows (*c*. 1 cm width) from shaly mudrocks and fine-grained sandstones (Fig. 32). The burrows have a distinctive shiny sheen and may contain a subordinate meandering substructure within them (possibly a siphon or snorkel trace). Dark- to pearly-hued, broad, strap-shaped, smooth burrow systems showing dichotomous or right-angle branching patterns (“fucoids”) are well exposed on flaggy siltstones in the bed of the Klein-Rooibergrivier (Figs. 33 & 34). They have been described previously from the Prince Albert beds in the Loeriesfontein area (*e.g.* Almond 1996, 2014c).

Figure 32: Horizontal intrastratal burrows with a narrow central strand from the Prince Albert Formation, bed of the Klein-Rooibergrivier (Loc. 249) (Scale in cm and mm).

Figure 33: Dichotomously branching, flattened "fucoid" burrows within bioturbated siltstones of the Prince Albert Formation (Loc. 249) (Scale in cm).

Figure 34: Dichotomous to right-angled branching, flattened "fucoid" burrows within bioturbated siltstones of the Prince Albert Formation (Loc. 249) (Scale in cm).

7.2. Fossil heritage within the Whitehill Formation

In palaeontological terms the Whitehill Formation is one of the richest and most interesting stratigraphic units within the Ecca Group. The overall palaeontological sensitivity of this formation has accordingly been rated as very high (Almond & Pether 2008). The rich fossil record of the Whitehill formation in the Loeriesfontein sheet area has been reviewed by Almond *in* Macey *et al.* (2011). The biostratigraphic distribution of the most prominent fossil groups – mesosaurid reptiles, palaeoniscoid fishes and notocarid crustaceans – within the Whitehill Formation has been documented by several authors, including Oelofsen (1987), Visser (1992) and Evans (2005), and is shown here in Figure 9. A non-technical illustrated account of the fossil biota of the Ecca Sea is given by MacRae (1999). Note that in the earlier geological literature the Whitehill Formation or "Witband" was included within the Upper Dwyka Shales.

In brief, the main groups of Early Permian fossils found within the Whitehill Formation include:

- aquatic **mesosaurid reptiles** (the earliest known sea-going reptiles)
- rare **cephalochordates** (ancient relatives of the living lancets)
- a variety of **palaeoniscoid fish** (primitive bony fish)
- highly abundant small **eocarid crustaceans** (bottom-living shrimp-like forms)
- **insects** (mainly preserved as isolated wings, but some intact specimens also found)
- a low diversity of **trace fossils** (*e.g.* king crab trackways, possible shark coprolites / faeces)
- **palynomorphs** (organic-walled spores and pollens)
- **petrified wood** (mainly of primitive gymnosperms, silicified or calcified)
- other sparse **vascular plant remains** (*Glossopteris* leaves, lycopods *etc*).

Important material of the fossil groups listed above has mainly been collected in the Western Cape Province during the twentieth century by a series of palaeontologists (See, for example, McLachlan & Anderson 1973, Oelofsen 1981, 1987, Almond 1996, 2008a, 2008b, Almond & Pether 2008, Evans & Bender 1999, Evans 2005, and refs. therein). Where the Whitehill Formation has been thermally metamorphosed or baked by nearby dolerite intrusions, as is often the case in the Loeriesfontein study area, the preservation of moulds of mesosaurid reptiles and fish may be locally enhanced.

No new body fossil localities within Whitehill Formation were recorded during the present field study, including from the well-developed dolomitic lenses that occasionally contain well-preserved crustaceans in the southern Karoo. The recessive-weathering Whitehill sediments within the study area are usually highly weathered, thermally-metamorphosed by nearby dolerite intrusions, and mantled with thick shaly surface gravels and soil.

7.3. Fossil heritage within the Tierberg Formation

The fossil record of the Tierberg Formation in the Loeriesfontein sheet area and elsewhere within the Main Karoo Basin has been reviewed in detail by Almond *in* Macey *et al.* (2011). Rare body fossil records include disarticulated microvertebrates (*e.g.* fish teeth and scales) from calcareous concretions in the Koffiefontein sheet area (Zawada 1992) and allochthonous plant remains (leaves, petrified wood). The latter become more abundant in the upper, more proximal (prodeltaic) facies of the Tierberg succession (*e.g.* Wickens 1984). Prinsloo (1989) records numerous plant impressions and unspecified "fragmentary vertebrate fossils" within fine-grained sandstones in the Britstown sheet area. Dark carbonaceous Ecca mudrocks are likely to contain palynomorphs (*e.g.* pollens, spores, acritarchs).

The commonest fossils by far in the Tierberg Formation are sparse to locally concentrated assemblages of trace fossils that are often found in association with thin event beds (*e.g.*distal turbidites, prodeltaic sandstones) within more heterolithic successions. A modest range of ten or so different ichnogenera have been recorded from the Tierberg Formation (*e.g.* Abel 1935, Anderson 1974, 1976, Wickens 1980, 1984, 1994, 1996, Prinsloo 1989, De Beer *et al*., 2002, Viljoen 2005, Almond *in* Macey *et al.* (2011)). These are mainly bedding parallel, epichnial and hypichnial traces, some preserved as undertracks.

Low-diversity trace fossil assemblages are recorded from Tierberg finely, rhythmically-laminated wackes at several localities in the Loeriesfontein area. Dense monospecific bedding plane-parallel populations of simple, hollow, flattened horizontal intrastratal burrows with a pale yellowish or brownish coloration are well seen, for example, at Loeriesfontein reservoir (Almond 2014b). Dense, moderately diverse ichnoassemblages are well seen on a bedding plane of baked Tierberg Formation laminated mudrocks in the Loeriesfontein townlands (*ibid.*). The epichnial trace assemblages are dominated by two or more types of arthropod trackway – a large (4 cm wide) form of *Umfolozia* (possibly crustacean) as well as a trackway with a median drag mark and strongly oblique rows of tracks within each set (possibly chelicerate, *cf Palaeohelcura, Palmichnium, Kouphichnium*) – but there are also sinuous fish swimming trails (*Undichna*) and wiggly, "segmented" horizontal burrows, bilobed epichnial ridges ("*Gyrochorte*"), and vaguely-preserved horizontal furrows (perhaps "*Scolicia*" of Anderson 1974). Flattened, band-shaped endichnial horizontal burrows up to 6 cm wide with a smooth or possibly pelleted surface and reflective sheen, as widely recorded from the Prince Albert

Formation in the Loeriesfontein-Calvinia area (*e.g.* Almond 1996), are also seen in the younger Tierberg Formation near Loeriesfontein. Strap-shaped burrows (possible "*Plagiogmus*"), hollow "segmented" horizontal burrows, *Umfolozia* arthropod trackways, microbial mat textures and small-scale under mat burrows (3 mm wide positive epichnia) are seen on baked bedding planes of Tierberg mudrocks on the Loeriesfontein townlands (Almond 2014b).

The only fossils recorded from the very poorly-exposed Tierberg Formation within the Kokerboom study area were a small range of epichnial and endichnial horizontal burrows seen within siltstone or wacke float blocks (Fig. 35).

Figure 35: Simple horizontal burrows preserved within grey-green siltstone float blocks of the Tierberg Formation (Loc. 238) (Scale in cm and mm).

7.4. Fossil heritage within the Karoo Dolerite suite and Gamoep Suite

The extensive dolerite intrusions in the Loeriesfontein study area are in themselves of no palaeontological significance. These are high temperature igneous rocks emplaced at depth within the Earth's crust so they do not contain fossils. However, as a consequence of their proximity to large dolerite intrusions, some of the Ecca Group sediments will have been thermally metamorphosed or "baked" (*i.e*. recrystallised, impregnated with secondary minerals). Embedded fossil material of phosphatic composition, such as bones and teeth, is frequently altered by baking – bones may become blackened, for example - and can be very difficult to extract from the hard matrix by mechanical preparation. In some cases – such as fossil moulds of mesosaurid reptiles and palaeoniscoid fish - baking may enhance the quality of preservation of Ecca fossils while other fossil groups (*e.g*. carbonaceous remains of plants, organic-walled palynomorphs) are more likely to be compromised.

Steeply-dipping, pale grey, flaggy sandstones associated with greyish volcanic rocks on Karee Dorn Pan 214 (Fig. 22) contain simple intrastratal burrows preserved in positive and negative relief (Fig. 36). These sediments have been tentatively correlated with diatreme infills of the Late Cretaceous – Early Tertiary Gamoep Suite, which elsewhere is associated with a range of fossil vertebrates, plants and microfossils (See Almond *in* Macey *et al.* 2011). However, the trace-bearing beds might alternatively represent deformed country rocks of the Ecca Group, so their age and relations are currently highly ambiguous (*cf* also Almond 2014c for other occurrences of trace fossils associated with breccia pipe margins close to the Kokerboom study area).

Figure 36: Flaggy grey sandstones with simple horizontal burrows preserved on parting surfaces (Loc. 255) (Scale in cm and mm). The age of these fossiliferous beds, which are associated with a probable breccia pipe, is not established.

7.5. Fossil heritage within the Late Caenozoic superficial deposits

The central Karoo "drift deposits" have been comparatively neglected in palaeontological terms. However, they may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises. Good examples are the Pleistocene mammal faunas at Florisbad, Cornelia and Erfkroon in the Free State and elsewhere (Wells & Cooke 1942, Cooke 1974, Skead 1980, Klein 1984, Brink, J.S. 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al*. 1995, MacRae 1999, Meadows & Watkeys 1999, Churchill *et al*. 2000 Partridge & Scott 2000). Other late Caenozoic fossil biotas from these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites), and plant remains such as peats or palynomorphs (pollens, spores) in organic-rich alluvial horizons (Scott 2000) and siliceous diatoms in pan sediments. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest (*e.g.* Smith 1999 and refs. therein). Stone artefacts of Pleistocene and younger age may additionally prove useful in constraining the age of superficial deposits such as gravelly alluvium within which they are occasionally embedded.

No fossil remains were recorded from the Late Caenozoic superficial deposits within the Kokerboom study area.

8. ASSESSMENT OF IMPACTS ON PALAEONTOLOGICAL RESOURCES

The Kokerboom study area is underlain by several formations of potentially fossiliferous sediments of the Ecca Group (Karoo Supergroup) that are extensively intruded by unfossiliferous igneous rocks of the Karoo Dolerite Suite (Fig. 4). Combined desktop and field studies dealing with the study area show that:

- The Ecca Group rocks (Prince Albert, Whitehill and Tierberg Formations) are very poorly-exposed and deeply-weathered near-surface. They have also been locally baked (thermally metamorphosed) by nearby dolerite intrusions and occasionally secondarily mineralised. The only fossils recorded here within these rocks comprise low-diversity trace fossil assemblages that occur widely within the Loeriesfontein region and therefore not of unique scientific importance. No scientifically important vertebrate or plant remains were recorded during the field assessment.
- The Karoo dolerites that crop out over the majority of the study area are also poorly-exposed, deeply-weathered for the most part and, in addition, do not contain fossils.
- Several unmapped, small-scale occurrences of post-Karoo breccia pipes and igneous intrusions were encountered during fieldwork. Some of the associated sandy sediments contain simple invertebrate trace fossils of uncertain age and stratigraphic position. Similar traces have previously been recorded from similar settings elsewhere within the Loeriesfontein region; they are not considered to be of great scientific significance.

- None of the wide range of Late Caenozoic superficial deposits examined during fieldwork (*e.g.* alluvium, colluvium, surface gravels, calcretes, stream and pan sediments, sandy soils) appears to be highly fossiliferous. Important mammalian remains are known from pan and river sediments elsewhere in Bushmanland, but they are rare and their occurrence is unpredictable.

It is concluded that the bedrocks and superficial sediments underlying the entire Kokerboom study area generally are of *low* palaeontological sensitivity. This conclusion applies to the study areas for all three phases of the proposed WEF development as well as the alternative corridors for the associated 132 kV transmission line connections to Helios Substation.

The potential impact on local fossil heritage resources of the transmission line alternatives was evaluated and assessed according to the impact assessment methodology provided by Aurecon.The assessment applies to all the key infrastructural components outlined in Section 5.1.

The destruction, damage or disturbance out of context of legally-protected fossils preserved at the ground surface or below ground that may occur during construction of the grid connection infrastructure entail direct *negative* impacts to palaeontological heritage resources that are confined to the development footprint (*site specific*). These impacts can often be mitigated but they are permanent and cannot be fully rectified (*i.e.* they are *long term* and *irreversible*). All of the sedimentary formations represented within the study area contain fossils of some sort (*e.g*. microfossils) but scientifically important, well-preserved, unique or rare fossil material is likely to be very rare. Impacts of some sort on fossil heritage are definite but, given the general low palaeontological sensitivity of the study area, they are likely to be of *very low magnitude* (Local impacts on highly-significant fossil remains – such as rare vertebrate fossils – cannot be completely excluded). Most (but *not* all) of the fossils concerned are likely to be of widespread occurrence within the outcrop areas of the formations concerned; the probability of loss of *unique or rare* fossil heritage is therefore low (*unlikely*). Given the very low levels of sedimentary bedrock exposure within the study area, confidence levels for this assessment - based on desktop as well as fieldwork data for the Kokerboom study area as well as for several nearby regions in southern Bushmanland - are rated as moderate (*sure*).

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, (2) the high levels of bedrock weathering and thermal metamorphism in the study area, as well as (3) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the Kokerboom study area, the overall impact significance of the construction phase of the proposed wind energy project is assessed as *VERY LOW* (negative). This assessment applies equally to both switching station locations and all three alternative route options for the 132 kV transmission line connection to Helios Substation, as indicated in Fig. 1. There are therefore no preferences on palaeontological heritage grounds for any particular layout among the various options under consideration. A palaeontological heritage assessment has only been conducted here for the *construction phase* of the development since further impacts on fossil heritage during the design, operational and decommissioning phases of the grid connection infrastructure are not anticipated.

Given the low palaeontological sensitivity of the entire Kokerboom study area, and the very low impact significance determined for the development, the cumulative impact significance of the grid connection infrastructure itself is rated as *low*. Taking into account several alternative energy developments proposed or authorised in the vicinity, these have likewise been assessed to be of low palaeontological impact significance (*e.g.* Almond 2011b, 2014c, Pether 2012). The cumulative impact of all these developments and their associated grid connection infrastructure is inferred to be *low*.

The No-go Alternative (*i.e.* no development) will have a neutral impact on palaeontological heritage. Without development natural weathering processes and erosion will continue to steadily destroy fossils preserved near or at the ground surface, but at the same time new fossils will be continually exposed. There are no fatal flaws in the development proposal as far as fossil heritage is concerned. Providing that the proposed recommendations outlined below for palaeontological monitoring and mitigation are followed through, there are no objections on palaeontological heritage grounds to authorisation of the Kokerboom grid connection infrastructure.

9. RECOMMENDED MONITORING AND MITIGATION (FOR INCLUSION IN ENVIRONMENTAL MANAGEMENT PROGRAMMES)

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, horn cores, petrified wood) during the construction phase of the development, no further specialist palaeontological studies or mitigation are recommended for this project.

The Environmental Control Officer (ECO) responsible for the development should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for pylon and switching station foundations, access/service roads etc.) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis. Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the finds should be safe guarded, preferably *in situ* and the South African Heritage Resources Agency, SAHRA, should be notified as soon as possible (Contact details: Dr Ragna Redelstorff. Heritage Officer Archaeology, Palaeontology & Meteorites Unit, SAHRA. 111 Harrington Street, Cape Town, 8001. Tel: +27 (0)21 202 8651. Fax: +27 (0)21 202 4509 E-mail:rredelstorff@sahra.org.za). This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the developer's expense.

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

These monitoring and mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed development. The operational and decommissioning phases of the development is unlikely to have further significant impacts on palaeontological heritage and no recommendations are made in this regard.

It should be noted that, should fossils be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would remain very low (negative). However, residual negative impacts from inevitable loss of fossil heritage would be partially offset by an improved palaeontological database as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region of Bushmanland would constitute a useful addition to our scientific understanding of the fossil heritage here.

10. CONCLUSIONS

The present palaeontological heritage assessment is based on a desktop study combined with a short, field-based scoping study of the Kokerboom study area (which encompassed the footprint of the 3 Kokerboom Wind farms and three potential transmission line corridors). While levels of bedrock exposure within the study area are very low indeed due to pervasive superficial sediment cover (*e.g.* alluvium, surface gravels, calcrete), relevant supplementary geological and palaeontological data is available from several recent field studies carried out in the vicinity of Loeriesfontein.

The Kokerboom study area is underlain by several formations of potentially fossiliferous sediments of the Ecca Group (Karoo Supergroup) that are extensively intruded by unfossiliferous igneous rocks of the Karoo Dolerite Suite. The Ecca Group rocks (Prince Albert, Whitehill and Tierberg Formations) are very poorly-exposed and deeply-weathered near-surface. They have also been locally baked (thermally metamorphosed) by nearby dolerite intrusions and occasionally secondarily mineralised. The only fossils recorded here within these rocks comprise low-diversity trace fossil assemblages that occur widely within the Loeriesfontein region and are therefore not of unique scientific interest. No vertebrate or plant remains were recorded during the field assessment.

The Karoo dolerites that crop out over the majority of the study area are also poorly-exposed, deeply-weathered for the most part and, in addition, do not contain fossils. Several unmapped, small-scale occurrences of post-Karoo breccia pipes and igneous intrusions were encountered during fieldwork. Some of the associated sandy sediments contain simple invertebrate trace fossils of uncertain age and stratigraphic position. Similar traces have previously been recorded from similar settings elsewhere within the Loeriesfontein region; they are not considered to be of great scientific significance.

None of the wide range of Late Caenozoic superficial deposits examined during fieldwork (*e.g.* alluvium, colluvium, surface gravels, calcretes, stream and pan sediments, sandy soils) appear to be highly fossiliferous. Important mammalian remains are known from pan and river sediments elsewhere in Bushmanland, but they are rare and their occurrence is unpredictable..

Highly ssensitive no-go areas within the area have not been identified in this study. It is concluded that the bedrocks and superficial sediments underlying the entire Kokerboom study area are of *low* palaeontological sensitivity. This conclusion applies to the both switching station locations and all three alternative powerline corridors.

Potential impacts to fossil heritage resources within the study area involve the disturbance, damage or destruction of fossil material within the development footprint during the construction phase of the development. Due to the rarity of well-preserved, unique fossils of potential scientific importance within the study area, potential impacts on palaeontological heritage during the construction phase are assessed as of *very low (negative) significance* (before and after mitigation). The No-go alternative (*i.e.* no development) will have a neutral impact on palaeontological heritage. There is not preference on palaeontological heritage grounds for a specific transmission line route option. Cumulative impacts posed by the four separate wind farms and transmission lines are inferred to be low. This also applies to cumulative impacts from known alternative energy developments (and their associated grid connections) in the region.

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, horn cores, petrified wood) during the construction phase of the development, no further specialist palaeontological studies or mitigation are recommended for this project.

The Environmental Control Officer (ECO) responsible for the developments should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, turbine placements) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis. Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the finds should be safeguarded, preferably *in situ*. and the South African Heritage Resources Agency, SAHRA should be alerted as soon as possible (Contact details: Dr Ragna Redelstorff. Heritage Officer Archaeology, Palaeontology & Meteorites Unit, SAHRA. 111 Harrington Street, Cape Town, 8001. Tel: +27 (0)21 202 8651. Fax: +27 (0)21 202 4509. E-mail:rredelstorff@sahra.org.za). This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the developer's expense.

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

These monitoring and mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for this project. The operational and decommissioning phases of the development are unlikely to have further significant impacts on palaeontological heritage and no recommendations are made in this regard.

11. ACKNOWLEDGEMENTS

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13. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Gauteng and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and

HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond

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APPENDIX: GPS LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84. *N.B.* Fossil locality data is not for general release to the public for conservation reasons.

Locality number	GPS data	Comments
235	30 25 00.1 S 19 32 03.0 E	Karee Doorn Pan 214. *Vlaktes* with surface gravels (calcrete, Tierberg shale, silicified mudrock)
237	30 24 41.1 S 19 30 30.8 E	Karee Doorn Pan 214. Whitehill Fm outcrop area with weathered pale grey mudrocks, intrusive dark brown veins of igneous rock, lenses of creamy, vuggy, fibrous mineral (silicified or calcified gypsum / calcrete?), common float black of semi-translucent chert in surface gravels (often flaked).
238	30 24 43.7 S 19 30 35.6 E	Karee Doorn Pan 214. Locally abundant small float blocks of orange- to cream-patinated chert (often flaked) overlying weathered Tierberg Fm. Mudrocks. Occasional Tierberg siltstone float blocks with simple horizontal burrows.
239	30 24 31.6 S 19 31 26.1 E	Karee Doorn Pan 214. Low exposure of prominent-weathering, thin, reddish-brown weathering wacke within Tierberg Fm. Platy, orange-brown patinated surface gravels. Occasional flakes of pale grey, speckled Matjiesfontein Chert. Locally abundant desert-varnished surface gravels, some well-rounded.
240	30 21 29.1 S 19 33 18.4 E	Karee Doorn Pan 214, N of main pan. Pale brown sandy soils with patches of surface gravels (hornfels, dolerite, calcrete)
241	30 21 28.6 S 19 34 01.6 E	Karee Doorn Pan 214, N of main pan. Surface gravels dominated by downwasted hornfels, quarztite. Occasonal small blocks of semi-transluscent chert.
242	30 21 29.3 S 19 34 17.1 E	Karee Doorn Pan 214, N of main pan. Surface gravels dominated by downwasted dolerite rubble, corestones. Occasonal small blocks of semi-transluscent chert.
243	30 21 33.9 S 19 34 33.7 E	Karee Doorn Pan 214, margins of Kareedoorn Pan itself. Pale grey, highly-weathered Whitehill Fm shales with veins and lenses of gypsum overlain by thick (sev. m.) of pale brownish silty pan sediments, heavily calcretised, including remobilised slurry of Whitehill saprolite overlying bedrock. Ground surface around pan with gravels of downwasted calcrete, desert-varnished pebbles, occasional pale greenish-yellow cherty clasts.
244	30 23 50.0 S 19 30 11.9 E	Karee Doorn Pan 214, low kranz and hillslope exposure of weathered pale grey to blackish Whitehill Fm laminated mudrocks (paper-shale dark claystones coarsening-up to paler, laminated to thin-bedded, flaggy siltstones), veins of gypsum. Common float clasts of greenish-yellow chert in float around koppie margins, sometimes flaked.
245	30 24 10.1 S 19 30 10.0 E	Karee Doorn Pan 214, exposure of resistant stream gravels (subrounded desert-varnished, quartzite, hornfels, ferruginised mudrock and sandstone, calcrete, minor chert) along shallow drainage line.
246	30 24 20.2 S 19 30 01.0 E	Karee Doorn Pan 214, track exposure of pale greyish, blocky-weathering, medium-grained igneous rock with creamy phenocrysts – probably Late Cretaceous / Early Tertiary alkaline igneous intrusion (Gamoep Suite).
247	30 24 45.9 S 19 28 10.4 E	Border of Karee Doorn Pan 214 and Sous 226. Low koppie with brownish-weathering sandy ferruginous rock, massive, pale grey medium-grained igneous rock showing onionskin weathering - probably pipe-like Late Cretaceous / Early Tertiary alkaline igneous intrusion (Gamoep Suite).

248	30 23 12.9 S 19 29 44.4 E	Karee Doorn Pan 214. Thin capping of rusty-brown weathering, grey cherty beds overlying Whitehill Fm – possibly northern equivalent of Matjiesfontein Member chert bed within lowermost Tierberg Fm.
249	30 32 10.2 S 19 31 01.2 E	Klein Rooiberg 227. Extensive riverbed exposure of well-jointed greenish laminated mudrocks of the Prince Albert Fm in the Klein-Rooibergrivier to the east of Klein Rooiberg Wes. Bedding plane exposures of branching “fucoid” and simple horizontal burrow trace fossils. Good vertical sections through overlying Late Caenozoic sandy and gravelly alluvium.
250	30 29 14.9 S 19 27 48.3 E	Leeubergrivier 1163. Several meters of orange-brown sandy soils overlying calcrete hardpan and weathered dolerite at depth. Upper sandy soils pale above with small calcrete glaebules. Gravels of calcrete, Ecca shale and minor dolerite along shallow drainage lines. Exposures of large sphaeroidal calcrete nodules in shallow roadside cuttings.
251	30 26 07.5 S 19 25 33.3 E	Leeubergrivier 1163, Uitspankop. Platy surface gravels overlying baked Tierberg Fm outcrop area. Sparse flaked hornfels artefacts.
252	30 27 09.3 S 19 25 16.3 E	Leeubergrivier 1163, Harderant. Flaggy, baked Tierberg Fm mudrocks and fine wackes / quartzites.
253	30 20 58.2 S 19 22 53.8 E	Springbok Tand 215, gullies track exposure SE of Spirngboktand homestead showing deeply-weathered, calcrete-veined dolerite bedrocks overlain by well-developed nodular calcrete hardpan.
254	30 21 53.1 S 19 26 19.1 E	Springbok Tand 215, hillslopes N of Bloupan. Extensive angular surface gravels of dark grey hornfels overlying thin-bedded to laminated Prince Albert Fm mudrocks.
255	30 19 13.7 S 19 31 35.7 E	Karee Doorn Pan 214, northern edge. Cluster of boulder dolerite corestones. Thin-bedded, Ecca wackes nearby (probably Prince Albert Fm) baked, intruded by probable hybrid rock with small sediment inclusions within pale grey igneous matrix. Pale grey, thin-bedded, gently-dipping sandstones with horizontal burrows associated with breccia pipe.
256	30 19 37.5 S 19 31 13.5 E	Karee Doorn Pan 214, northern margin. Small pan surrounded by grassy terrain on deep, orange-brown sandy soils, boulder dolerite koppies.
257	30 27 24.6 S 19 34 20.7 E	Sous 226, north of Sous Farmstead. Surface gravels of angular, brown-weathering,baked Tierberg wackes, dolerite corestones near active quarry. Possibly mapped as doleritic rubble.
258	30 25 25.3 S 19 33 53.3 E	Aan Die Karee Doorn Pan 213, small quarry near Loeriesfontein dust road. Highly weathered dolerite with platy jointing, onionskin weathering.
260	30 27 02.5 S 19 35 41.6 E	Aan Die Karee Doorn Pan 213, large shallow quarry adjacent to railway line excavated into calcretised alluvial sediments overlying weathered dolerite, baked Tierberg Fm (latter exposed along northern pit margin).
261	30 23 12.2 S 19 34 03.7 E	Karee Doorn Pan 214, deep borrow pit just west of Loereisfontein road exposing deeply-weathered, gently-dipping Whitehill Fm overlain by calcretised saprolite and silty soils. Thin-bedded, tabular facies of Whitehill exposed in pit walls.
262	30 23 38.9 S 19 34 07.4 E	Karee Doorn Pan 214, deep borrow pit just west of Loereisfontein road exposing deeply-weathered, gently-dipping Whitehill Fm.
263	30 22 30.9 S 19 34 23.2 E	Karee Doorn Pan 214, extensive shallow gypsum quarry into heavily mineralised (iron / manganese), folded and tectonised Whitehill Formation.

BASIC ASSESSMENT FOR THE PROPOSED KOKERBOOM TRANSMISSION LINE & ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE, SOUTH AFRICA

BASIC ASSESSMENT SPECIALIST REPORT: VISUAL IMPACT

05th September 2017

Document prepared for Aurecon South Africa (Pty) Ltd;

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GLOSSARY

Best Practicable Environmental Option (BPEO)
This is the option that provides the most benefit, or causes the least damage, to the environment as a whole, at a cost acceptable to society, in the long, as well as the short, term.
Cumulative Impact
The impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person, undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.
Impact (visual)
A description of the effect of an aspect of a development on a specified component of the visual, aesthetic or scenic environment, within a defined time and space.
Issue (visual)
Issues are concerns related to the proposed development, generally phrased as questions, taking the form of “what will the impact of some activity be on some element of the visual, aesthetic or scenic environment?”
Key Observation Points (KOPs)
KOPs refer to receptors (people affected by the visual influence of a project) located in the most critical locations surrounding the landscape modification, who make consistent use of the views associated with the site where the landscape modifications are proposed. KOPs can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or a linear view along a roadway, trail or river corridor.
Management Actions
Actions that enhance the benefits of a proposed development, or avoid, mitigate, restore or compensate for, negative impacts.
Receptors
Individuals, groups or communities who would be subject to the visual influence of a particular project.
Sense of Place
The unique quality or character of a place, whether natural, rural or urban.
Scenic Corridor
A linear geographic area that contains scenic resources, usually, but not necessarily, defined by a route.
Scoping
The process of determining the key issues, and the space and time boundaries, to be addressed in an environmental assessment.
Viewshed
The outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed. This reflects the area in which, or the extent to which, the landscape modification is likely to be seen.
Zone of Visual Influence (ZVI)
The ZVI is defined as ‘the area within which a proposed development may have an influence or effect on visual amenity.’
Glare and Glint
Glare is defined in the Oxford dictionary (http://www.oxforddictionaries.com) as ‘shine with a strong or dazzling light’. Glint is defined as the circumstance relating to ‘reflect small flashes of light’

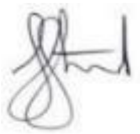
LIST OF ACRONYMS

APHP	Association of Professional Heritage Practitioners
BLM	Bureau of Land Management (United States)
BPEO	Best Practicable Environmental Option
CALP	Collaborative for Advanced Landscape Planning
DEA	Department of Environmental Affairs (National)
DEA&DP	Department of Environmental Affairs and Development Planning (Western Cape Province)
DEM	Digital Elevation Model
DoC	Degree of Contrast
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographic Information System
I&APs	Interested and Affected Parties
IEMA	Institute of Environmental Management and Assessment (United Kingdom)
IEMP	Integrated Environmental Management Plan
KOP	Key Observation Point
MAMSL	Metres above mean sea level
NELPAG	New England Light Pollution Advisory Group
PSDF	Provincial Spatial Development Framework
SAHRA	South African National Heritage Resources Agency
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
VRM	Visual Resource Management
ZVI	Zone of Visual Influence

This document was completed by Silver Solutions 887 cc trading as VRM Africa, a Visual Impact Study and Mapping organisation located in George, South Africa. VRM Africa cc was appointed as an independent professional visual impact practitioner to facilitate this VIA.

This document was undertaken by the following team:

Stephen Stead	Director/ Visual Impact	APHP accredited VIA Practitioner
Lisa Schultz	Editing and Contrast Rating	Bachelor of Arts, Fine Art



Stephen Stead
APHP accredited VIA Specialist

1 INTRODUCTION

Visual Resource Management Africa CC (VRMA) was appointed by Aurecon South Africa (Pty) Ltd to undertake a ***Basic Visual Impact Assessment*** for the proposed Kokerboom Wind Energy Facility (WEF) grid connection, which will consist of a 132 kV overhead ***Transmission Line*** (single or double circuit)***,*** two switching stations (each ±100m X 100m) and associated infrastructure (including service tracks) on behalf of Business Venture Investments No. 1788 (Pty) Ltd. A site visit was undertaken on the 8th of June 2016.

The proposed development site is located in the Northern Cape Province, Namakwa District Municipality and within the Hantam Local Municipality. The proponent is proposing to evacuate the power generated from three new wind farms (Kokerboom 1, 2 & 3 Wind Farms) to the national grid via the Eskom Helios Substation.

1.1 Terms of Reference

According to the Bureau of Land Management, U.S. Department of Interior, landscape significance is assessed by differentiating between those landscapes of recognised or potential significance or sensitivity to modification and landscapes that have low sensitivity and scenic value. "Different levels of scenic values require different degrees of management. For example, management of an area with high scenic value might be focused on preserving the existing character of the landscape, and management of an area with little scenic value might allow for major modifications to the landscape. Assessing scenic values and determining visual impacts can be a subjective process. Objectivity and consistency can be greatly increased by using standard assessment criteria to describe and evaluate landscapes, and to also describe proposed projects." (USDI., 2004)

The scope of this study is to cover the entire proposed project area. The terms of reference for the study are as follows:

- Collate and analyse all available secondary data relevant to the affected proposed project area. This includes a site visit of the full site extent, as well as of areas where potential impacts may occur beyond the site boundaries.
- Consider all cumulative effects in all impact reports.
- Specific attention is to be given to the following:
  - Evaluation and classification of the landscape in terms of sensitivity to a changing land use.
  - Determining viewsheds, view corridors and important viewpoints in order to assess the visual impacts of the proposed project.
  - Determining visual issues, including those identified in the public participation process.
  - Reviewing the legal framework that may have implications for visual/scenic resources.
  - Assessing the significance of potential visual impacts resulting from the proposed project for the construction, operation and decommissioning phases of the proposed project.
  - Assessing the potential cumulative impacts associated with the visual impact.
  - Identifying possible mitigation measures to reduce negative visual impacts for inclusion into the proposed project design, including input into the Environmental Management Programme (EMPr).

1.2 Assumptions and Limitations

- Although every effort to maintain accuracy was undertaken, as a result of the Digital Elevation Model (DEM) being generated from satellite imagery and not being a true representation of the earth's surface, the viewshed mapping is approximate and may not represent an exact visibility incidence.
- The use of open source satellite imagery was utilised for base maps in the report.
- The viewsheds were generated using ASTER elevation data. (NASA, 2009)
- Some of the mapping in this document was created using Bing Maps (previously *Live Search Maps*, *Windows Live Maps*, *Windows Live Local*, and *MSN Virtual Earth*) and powered by the Enterprise framework.
- Determining visual resources can be a subjective process where absolute terms are not achievable. Evaluating a landscape's visual quality is complex, as assessment of the visual landscape applies mainly qualitative standards. Therefore, subjectivity cannot be excluded in the assessment procedure (Lange, 1994). The project deliverables, including electronic copies of reports, maps, data, shape files and photographs are based on the author's professional knowledge, as well as available information.
- VRM Africa reserves the right to modify aspects of the project deliverables if and when new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

1.3 Visual Impact Methodology Summary

The process that VRM Africa follows when undertaking a VIA is based on the United States Bureau of Land Management's (BLM) Visual Resource Management method (USDI., 2004). This mapping and GIS-based method of assessing landscape modifications allows for increased objectivity and consistency by using standard assessment criteria.

The VRM process involves the systematic classification of the broad-brush landscape types within the receiving environment into one of four VRM Classes. Each VRM Class is associated with management objectives that serve to guide the degree of modification of the proposed site. The Classes are derived by means of a simple matrix with the three variables being the scenic quality, the expected receptor sensitivity to landscape change, and the distance of the proposed landscape modification from key receptor points. The Classes are not prescriptive and are utilised as a guideline to determine visual carrying capacity, where they represent the relative value of the visual resources of an area. Classes I and II are the most valued, Class III represents a moderate value; and Class IV is of least value.

To determine impacts, a degree of contrast exercise is required. This is an assessment of the expected change to the receiving environment in terms of the form, line, colour and texture, as seen from the surrounding Key Observation Points. This is to determine if the proposed project meets the visual objectives defined for each of the Classes. If the expected visual contrast is strong, mitigations and recommendations are made to assist in meeting the visual objectives. To assist in the understanding of the proposed landscape modifications, visual representation, such as photomontages or photos depicting the impacted areas, can be generated. There is an ethical obligation in the visualisation process, as visualisation can be misleading if not undertaken ethically.

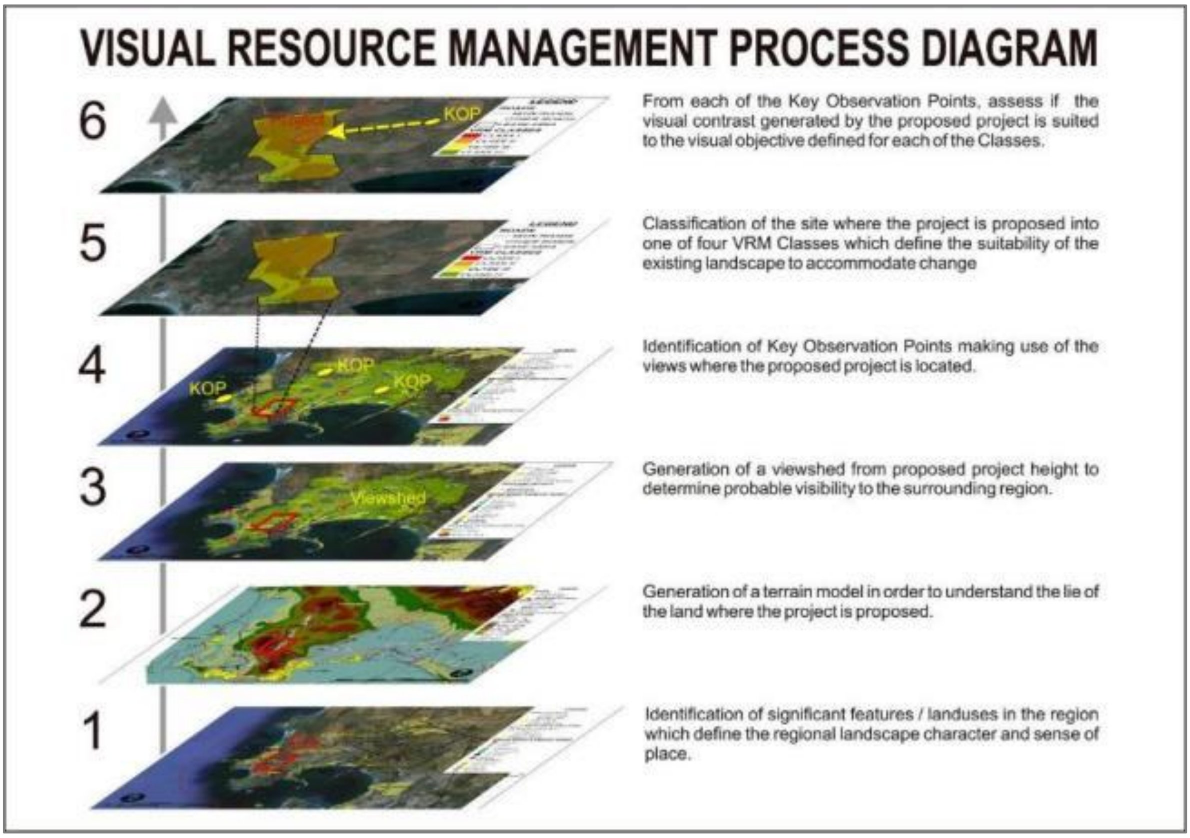


Figure 1: VRM process diagram

2 PROJECT DESCRIPTION

It is anticipated that the three Kokerboom wind farms will have an output capacity of up to 240-256 MW each (i.e. up to 736MW for the three wind farms combined), which will need to be evacuated from the proposed sites to the nearby Eskom Helios Substation. The proposed grid connection infrastructure will include:

- Access roads (narrow jeep tracks, approximately 4m wide)
- Two switching stations (each Approximately 100m X 100m);
- A 132kV overhead line (single circuit or double circuit) that will connect each WEF to the centrally located Eskom Helios Substation. (Aurecon (PTY) LTD, 2016). The pylon/ towers will be stayed or self-supporting monopoles.

A Basic Assessment will be undertaken for the proposed switching stations and the 132 kV overhead transmission lines (~23-27 km) between two switching stations (each ±100m X 100m) and the existing Eskom Helios substation. (Aurecon (PTY) LTD, 2016). Three alternative transmission line corridors have been proposed, with Alternative B being the client preferred option. The proposed power line routings are depicted in the map below.

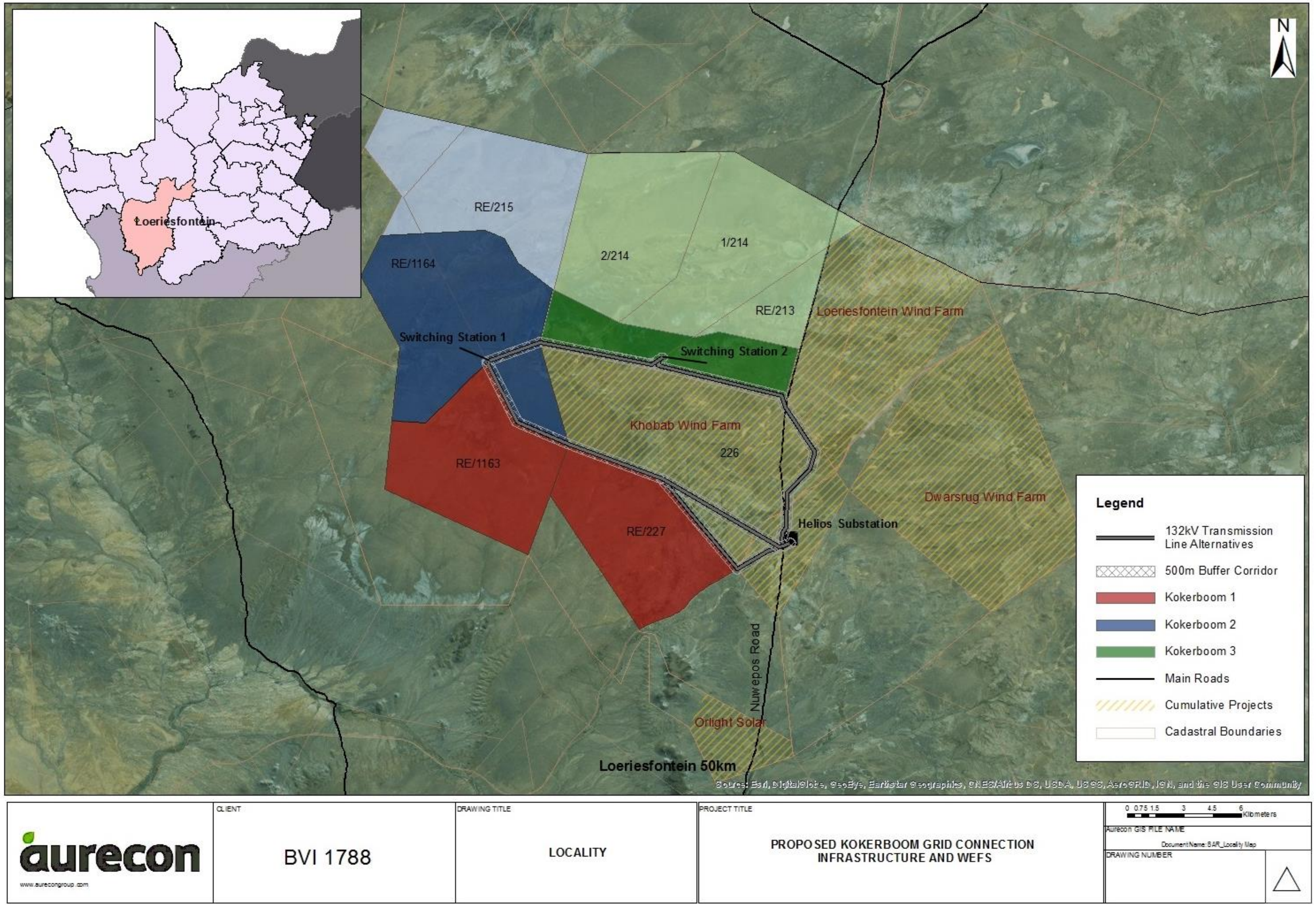


Figure 2: Proposed routing alignments map provided by Aurecon.

Figure 3: Example of a 132kV double circuit self-supporting monopole (left) and a 132kV double-circuit guyed monopole (right)

Figure 4: A photograph of a typical single-circuit monopole type structure. Bird diverters (alternating black and white) can be seen on the line

2.1 Legislative and Planning Context

In order to comply with the Visual Resource Management requirements, it is necessary to clarify which planning policies govern the proposed property area to ensure that the scale, density and nature of activities or developments are harmonious and in keeping with the sense of place and character of the area. The proposed landscape modifications must be viewed in the context of the planning policies from the following organisations guidelines:

2.1.1 *World Bank Group: Environmental, Health and Safety Guidelines for Wind Energy*

Depending on the location, a wind energy facility may have an impact on viewscapes, especially if visible from or located near residential areas or tourism sites. Visual impacts associated with wind energy projects typically concern the installed and operational turbines themselves (e.g., colour, height, and number of turbines). The guideline also indicates that impacts may also arise in relation to operational wind facilities' interaction with the character of the surrounding landscape and/or seascape and that Legally Protected and Internationally Recognised Areas of importance to biodiversity and cultural heritage features are also a consideration. Preparing zone of visual influence maps and preparing wire-frame images and photomontages from key viewpoints is recommended to inform both the assessment and the consultation processes.

It is Avoidance and minimisation measures to address landscape, seascape, and visual impacts are largely associated with the siting and layout of wind turbines.

Other factors can be considered in relation to minimising visual impacts:

- Minimise presence of ancillary structures on the site by minimising site infrastructure, including the number of roads, as well as by burying collector system power lines, avoiding stockpiling of excavated material or construction debris, and removing inoperative turbines.
- Erosion measures should be implemented and cleared land should be promptly re-vegetated with local seed stock of native species. (World Bank Group, 2015)

2.1.2 *International Finance Corporation (IFC)*

The IFC prescribes eight performance standards (PS) on environmental and social sustainability. The first is to identify and evaluate the environmental and social risks and impacts of a project, as well as to avoid, minimise or compensate for any such impacts. Under PS 6, ecosystem services are organised into four categories, with visual / aesthetic benefits falling into the category of cultural services, which are the non-material benefits people obtain from ecosystems. (IFC, 2012)

2.1.3 *DEA&DP Guideline for involving Visual and Aesthetic Specialists in EIA Processes*

As there is no national guideline related to visual and aesthetic best practice, use of the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) Guideline for involving visual and aesthetic specialists in EIA processes will be utilised. This states that the Best Practicable Environmental Option (BPEO) should address the following:

- Ensure that the scale, density and nature of activities or developments are harmonious and in keeping with the sense of place and character of the area. The BPEO must also ensure that development must be located to prevent structures from being a visual intrusion (i.e. to retain open views and vistas).
- Long term protection of important scenic resources and heritage sites.

- Minimisation of visual intrusion in scenic areas.
- Retention of wilderness or special areas intact as far as possible.
- Responsiveness to the area's uniqueness, or sense of place. (Oberholzer, 2005)

3 BASELINE

3.1 Broad Brush Landscape Context

3.1.1 *Locality*

The proposed development site in located in the Northern Cape Province, Namakwa District Municipality and within the Hantam Local Municipality. The nearest town is Loeriesfontein that is located approximately 50km to the south. The proposed site is accessed from Loeriesfontein along the Nuwepos Road.

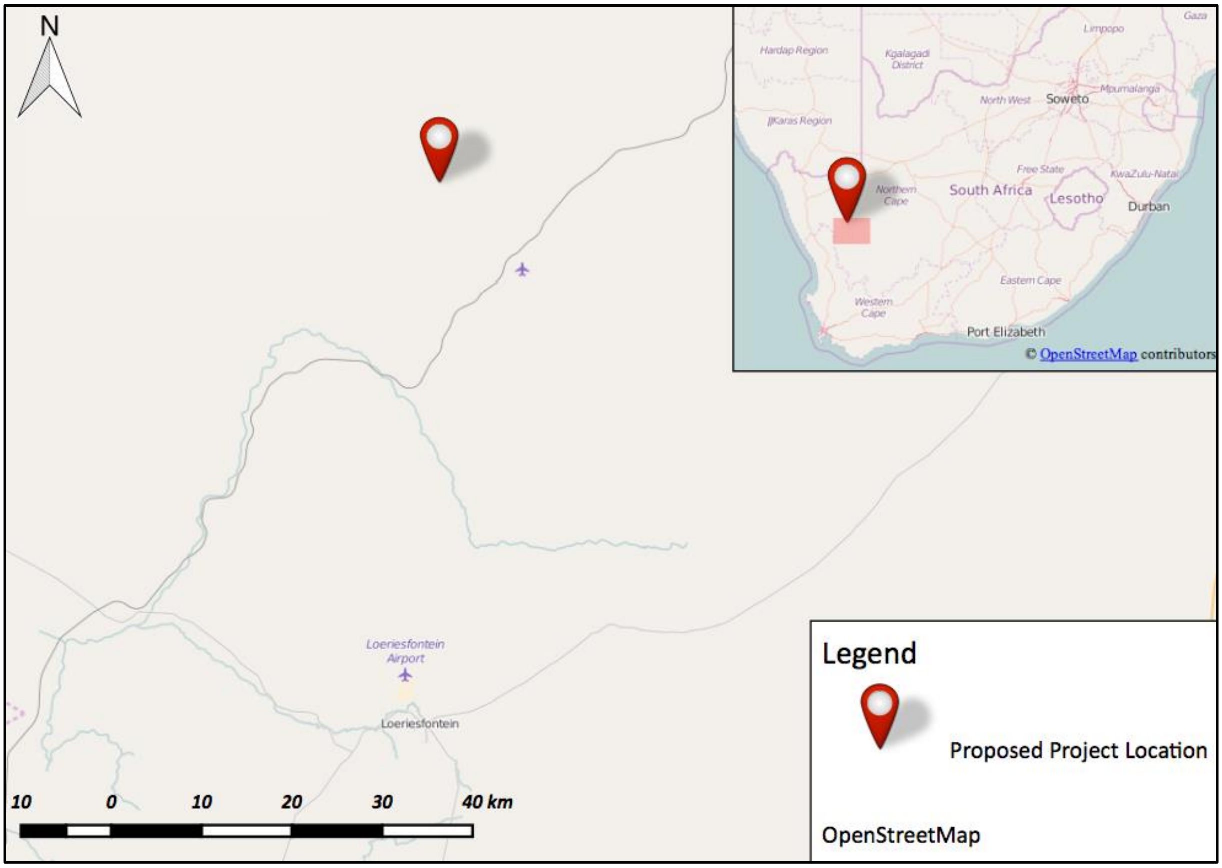


Figure 5: Regional locality map

3.1.2 *Regional Landscape Topography*

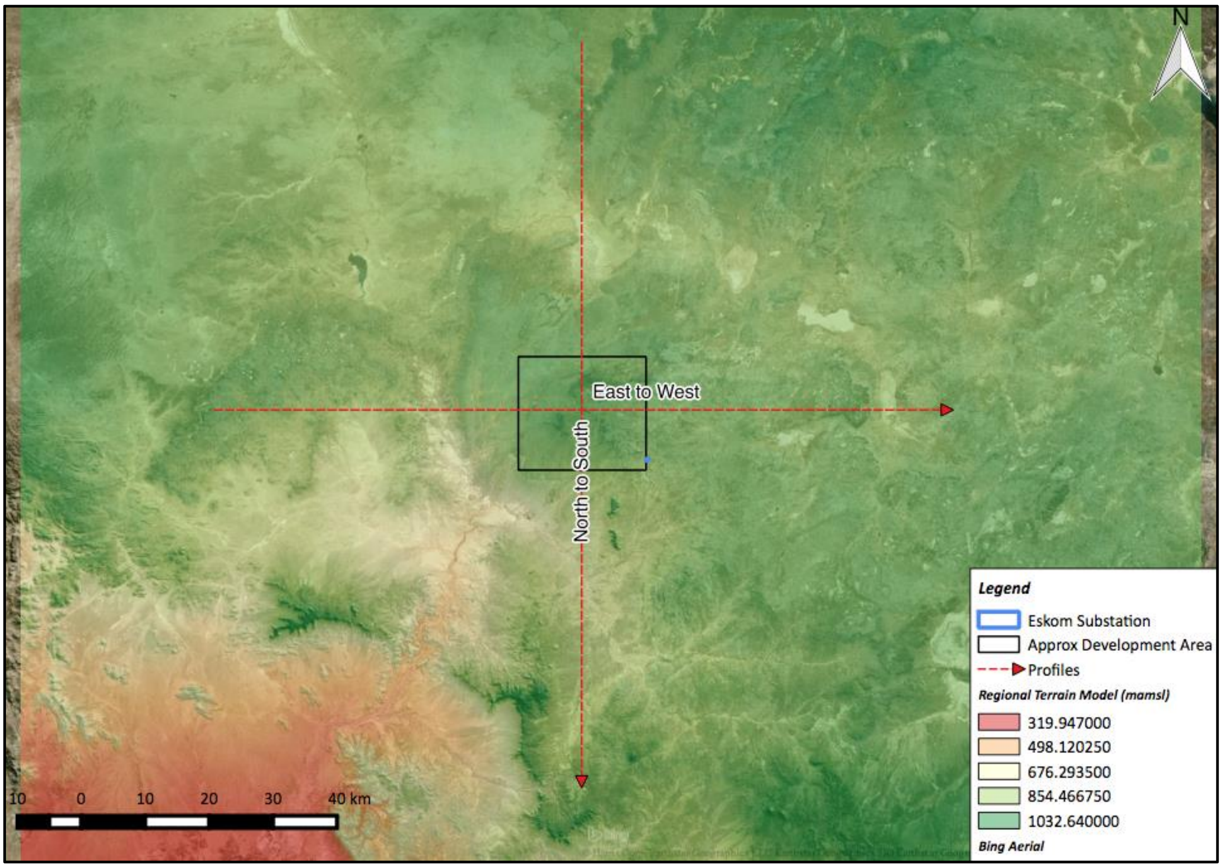


Figure 6: Regional Digital Elevation Model Map

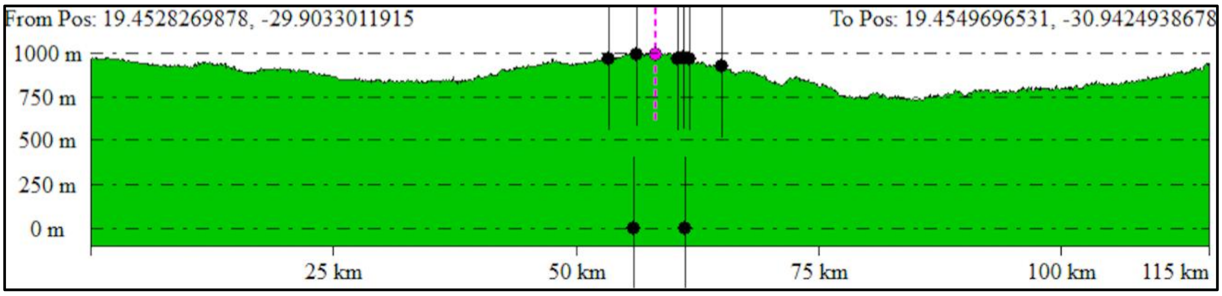


Figure 7: North to South Terrain Profile Graph

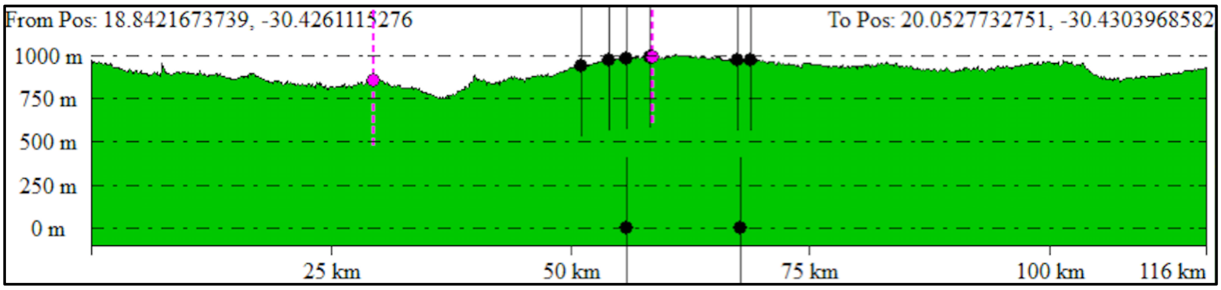


Figure 8: East to West Terrain Profile Graph

The two images above (Figure 5 and Figure 6) reflect the broad-brush profiles of the regional topography and extend over 50km on each side of the rectangle covering the approximate development area. As indicated in the North to South Profile (Figure 7) the proposed development area is slightly elevated at a regional level with an overall approximate variation in elevation of 250m over the 100km length. The East to West Profile (Figure 8) depicts a similar elevation variation across the regional extent. There is a more pronounced drop in elevation to the west of the proposed project area, with the eastern areas reflecting more uniformity of elevation variation. At a regional level, there is some topographic variation, but in essence, the surrounding terrain is described as predominantly flat without key topographic features in the landscape.

3.1.3 *Landuse*

The current landuse of the proposed properties is agricultural with low intensity sheep farming carried out in this arid environment. Due to the low stock carrying capacity of the Bushmanland vegetation, the farms are large in size. Man-made modifications associated with the sheep farming are isolated farmsteads, farm tracks, fences and water reservoirs. These features are small in scale in the landscape and do not detract from the sense of place.

Figure 9: Photograph taken approximately five kilometres north of the project area depicting the low intensity sheep farming characteristic of the rural agricultural area.

3.1.4 *Vegetation*

According to the South African National Biodiversity Institute 2012 Vegetation Map of South Africa, Lesotho and Swaziland, the vegetation biome where the WEF development is proposed is Nama-Karoo. The Bioregion is the Nama-Karoo and the vegetation type is Bushmanland Basin Shrubland. The vegetation and landscape features are described as "slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*". Remarks made with respect to this bioregion are "the Bushmanland Basin forms an environment for a number of endorheic pans and extensive systems of intermittent river channels (including that of the Sak River). In comparison to the bordering

Bushmanland Arid Grassland in the north, the vegetation of the Bushmanland Basin shows increased presence of shrubs (especially succulents) and plant indicators of high salt status of soil" (South African National Biodiversity Institute, 2012).

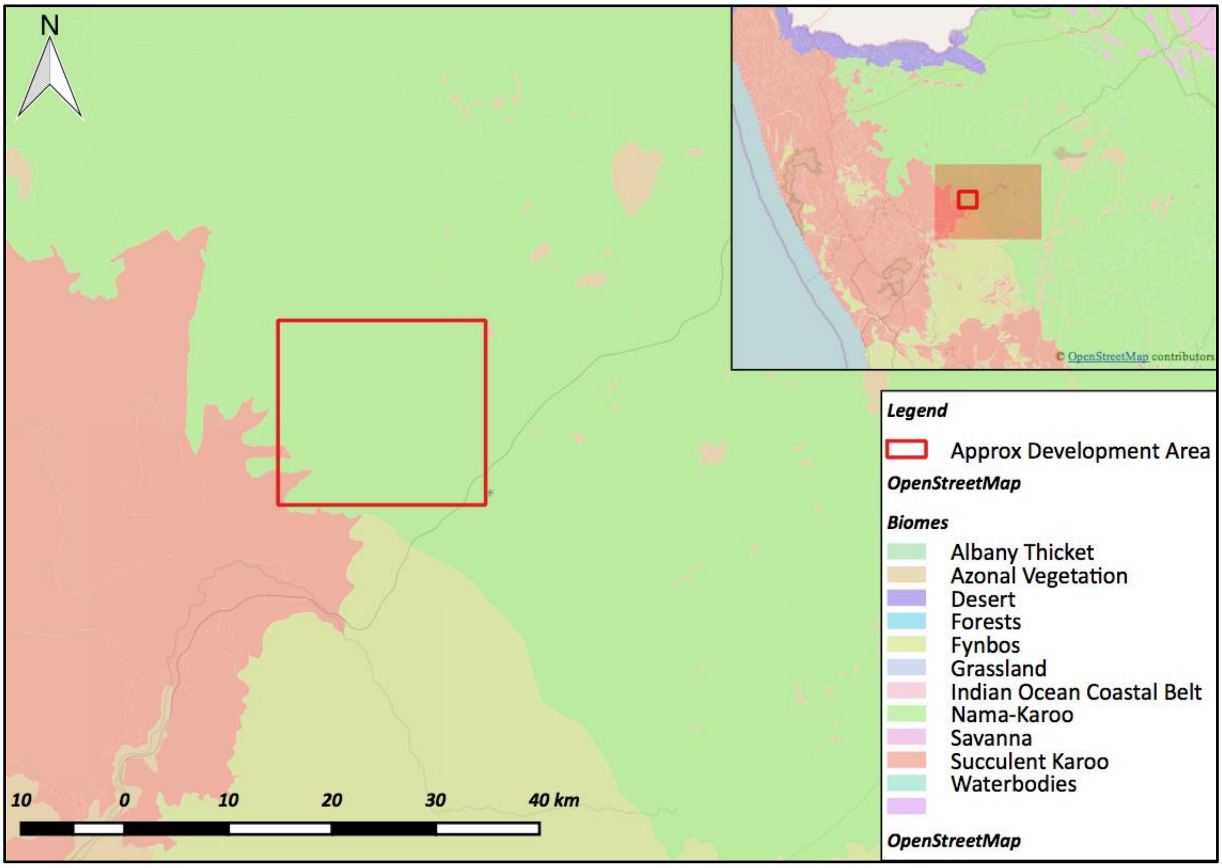


Figure 10: Vegetation Biome Map (South African National Biodiversity Institute, 2012)

It is important to note that the area is arid, with high summer temperature averages. The low rainfall of the region results in vegetation being low in profile, which in relation to the flat terrain creates a uniform broad-brush landscape that has a low visual absorption capacity.

3.1.5 *Project Visibility*

The visible extent, or viewshed, is "the outer boundary defining a view catchment area, usually along crests and ridgelines" (Oberholzer, 2005). In order to define the extent of the possible influence of the proposed project, a viewshed analysis was undertaken from the proposed site at a specified height above ground level as indicated in the table 1 below, table making use of open source NASA ASTER Digital Elevation Model data (NASA, 2009). The extent of the viewshed analysis was restricted to a defined distance that represents the approximate zone of visual influence (ZVI) of the proposed activities, which takes the scale, and size of the proposed projects into consideration in relation to the natural visual absorption capacity of the receiving environment. The maps are informative only as visibility tends to diminish exponentially with distance, which is well recognised in visual analysis literature (Hull & Bishop, 1988).

Table 1: Proposed Project Heights Table

Proposed Activity	Approx. Height (m)	Probable Zone of Visual Influence (ZVI) (km)
Power Line Structures	25	8

A viewshed analysis was undertaken for the site making use of ASTER 90m Digital Elevation Model data. The Offset value was set at 25m above ground to represent the approximate height of the proposed monopoles. Due to visibility reducing in relation to distance, the extent of the expected zone of visual influence was capped at eight kilometres from the proposed line routing. Although the monopoles have a small visual footprint and grey colour which helps dissipate the visual contrast, the surrounding area is flat and has low vegetation and few structures that would obscure the views of the proposed landscape modification which could extend the potential zone of visual influence.

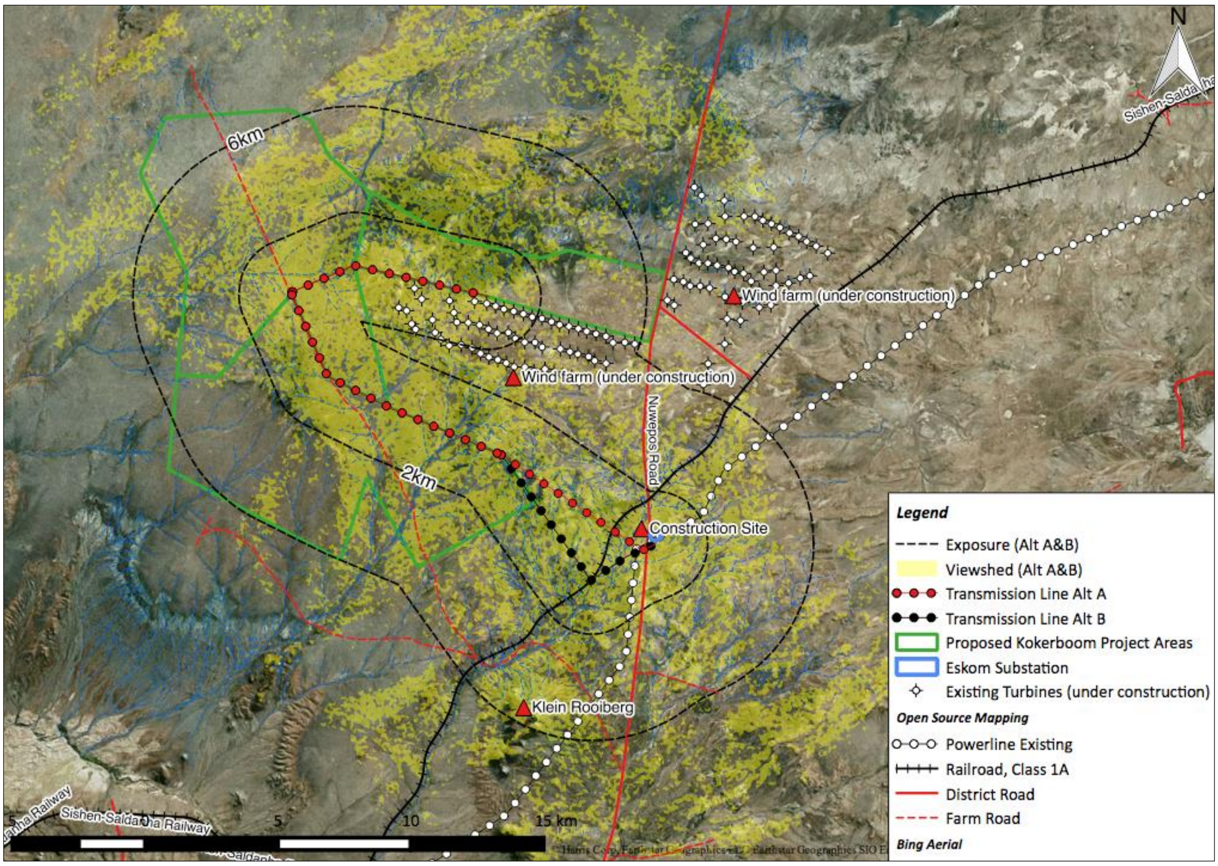


Figure 11: Alternative A & B approximate visibility map generated from a 25m Offset.

The above map (Figure 11) depicts the approximate extent of the proposed Transmission Line Alternatives A and B. A single viewshed map was generated for these alternatives as the routings are very similar, with the exception of the southern section where Alternative B follows a cadastral line and Alternative A is routed more directly to the Eskom Helios Substation.

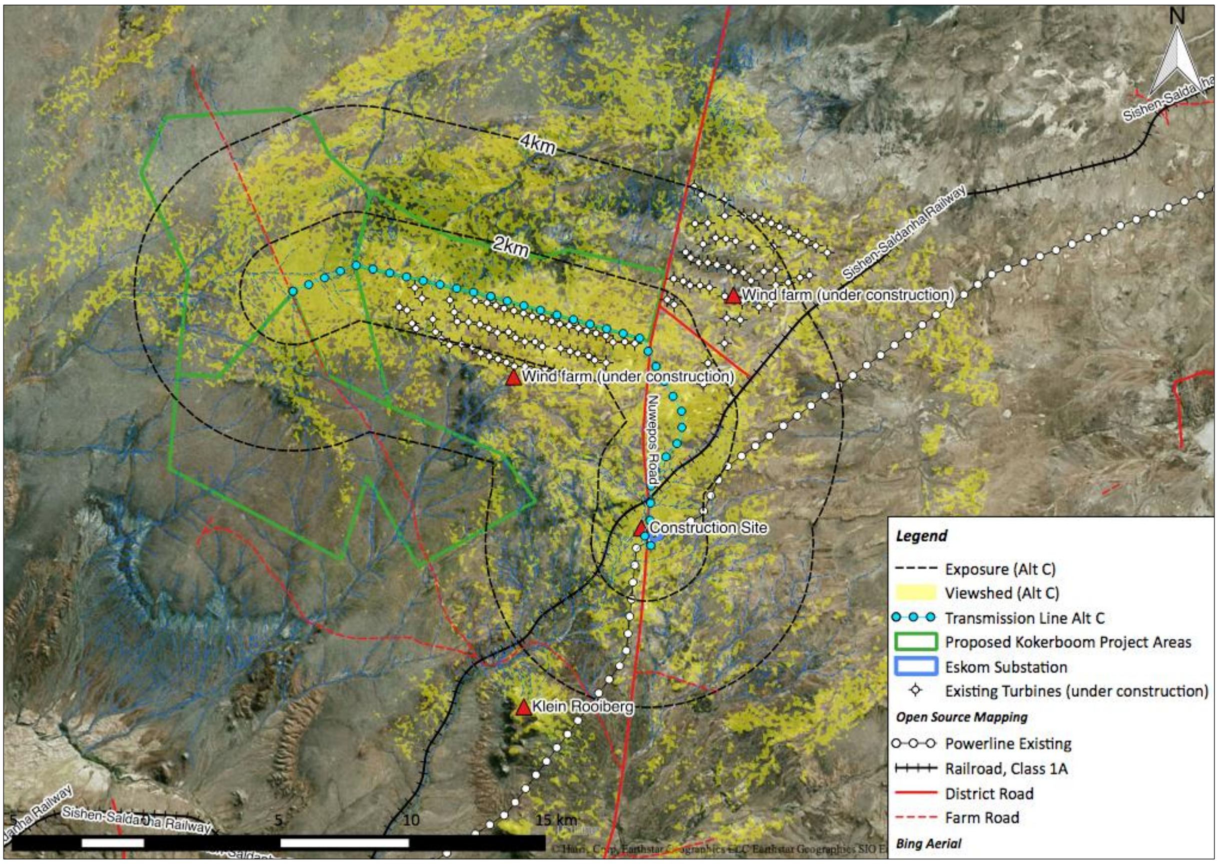


Figure 12: Alternative C approximate visibility map generated from a 25m Offset.

The above map (Figure 12) depicts the approximate extent of the proposed Transmission Line Alternative C. This routing differs from Alternative A and B in that the power line is routed to the east and then south, to connect with the Substation. Like the other alternatives, the viewshed extent is mainly uniformly distributed within two kilometre high exposure distance area, but becomes fragmented moving further away with views extending mainly to the north and the east. The coverage of all the routing alternatives viewsheds are rated Medium as due to the flat terrain and limited vegetation, the visibility could extend to the Foreground / Middle Ground distance, but due to the small visual footprint of the powerlines and monopoles, the zone of visual influence is contained. Receptors making use of the landscape are few and mainly associated with rural dryland agriculture, Eskom maintenance workers and a few railway line maintenance personnel. This routing differs from A & B in that the main views of the proposed routings would be from receptors using the gravel road who would cross the power line routing three times, increasing visual exposure. Due to the close proximity to the proposed power lines, the Visual Exposure of Alternative C is rated as High as approximately 6km of this routing would be in clear view of the gravel road users.

3.1.6 *Infrastructure and Road Access*

Located within the vicinity of the project are the following linear and structural infrastructure features, the Shishen – Saldanha Railway Line, the Eskom Helios Substation and 400kV distribution line, the Nuwepos gravel road and numerous farm access roads.

The Helios substation is located in close proximity to the railway line, and the combination of the substation and the overhead electrical cables of the railway line, strongly increase the vertical line element in the landscape. The numerous electrical power lines that include a 400kV and two other smaller lines, further reinforce this effect and increase the visual absorption capacity within the foreground / middle ground areas surrounding the Helios substation.

Two authorised wind farms (the Khobab Wind Farm and Loeriesfontein Wind Farm) are under development by Mainstream Renewable Power and would fall within the local viewshed of the proposed grid connection infrastructure, increasing the visual absorption capacity to some degree.

Figure 13: Photograph of the Eskom Helios substation and the Mainstream wind farm construction camp in the foreground.

Figure 14: Photograph of the overhead electrical structures and cabling associated with the Shishen – Saldanha railway line.

3.1.7 *Proposed Renewable Development*

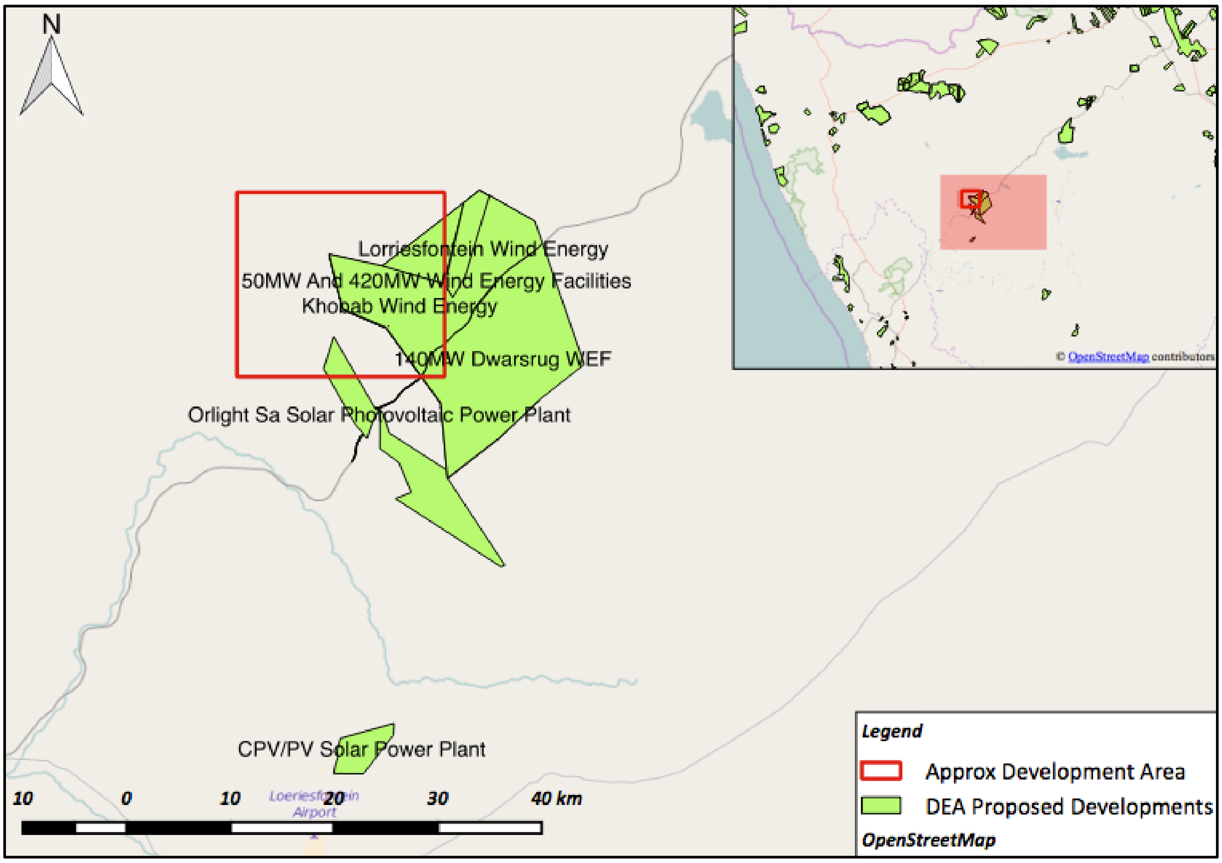


Figure 15: Map depicting the DEA Renewable Energy mapping in relation to the approximate development area of the Kokerboom Wind Farms.

As identified in the map above, numerous other renewable energy projects have been attracted to the site due to the better wind opportunities and close proximity to the Helios Eskom Substation. Listed on the DEA database within the immediate vicinity are the Orlight Solar PV Project, the Dwarsrug 140MW WEF, the Khohab WEF, a 50MW and 420MW WEF as well as the Loeriesfontein 140MW WEF. Each facility would be associated with its own grid connection infrastructure. Khobab and Loeriesfontein WEF projects are currently under construction. The Dwarsrug WEF & Orlight PV site have received environmental authorisation from DEA. The status of the other projects is currently unknown (refer to Figure 16, Aurecon surrounding proposed development map below). The construction camp for the Loeriesfontein & Khobab wind farms is located west of the Helios substation. A clear indication of the WEF construction underway is depicted in the photographs below. From a cumulative perspective, if all these proposed projects are constructed, a significant change to the regional landscape character could result. Aurecon provided the following cumulative map of the main renewable energy projects.

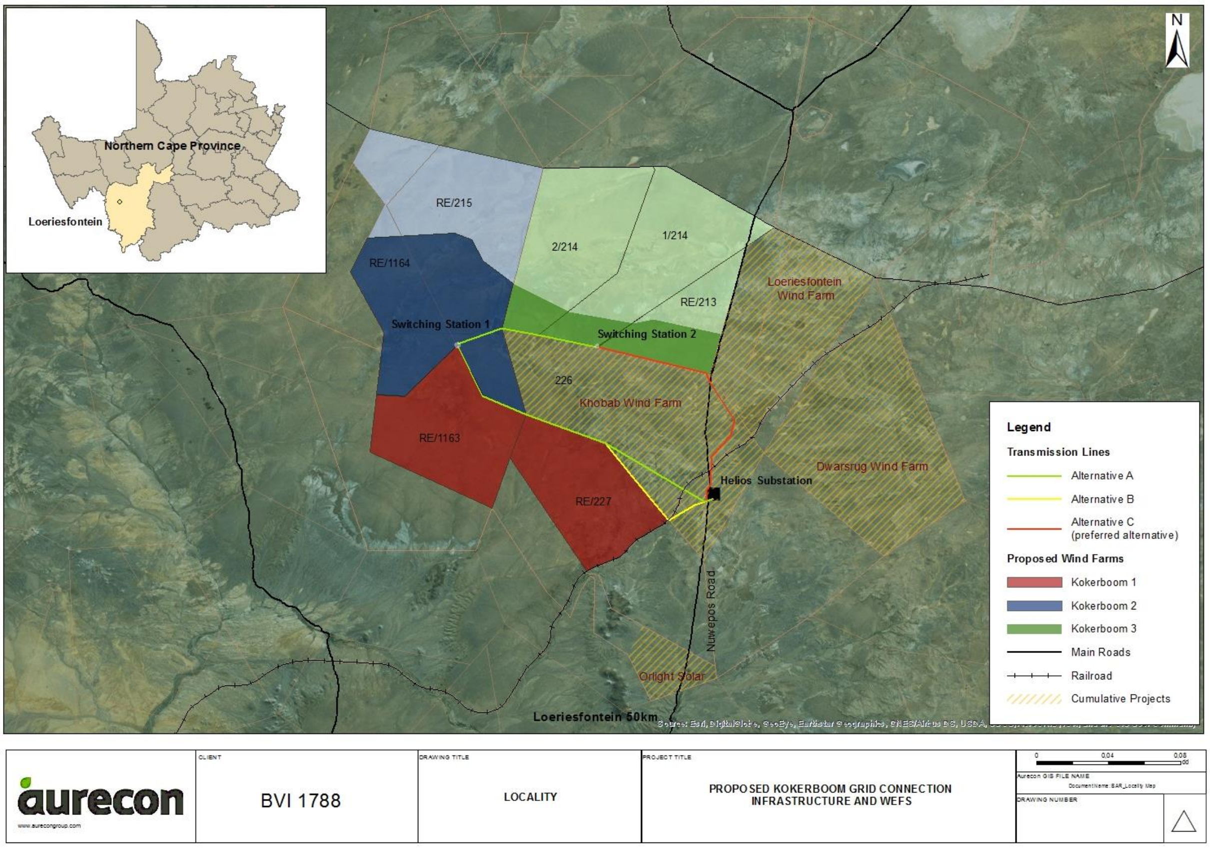


Figure 16: Map depicting cumulative development sites around the proposed project properties.

Figure 17: Earth moving vehicles currently on site for the construction of the Mainstream WEF.

Figure 18: Existing wind farm construction camp adjacent the gravel road.

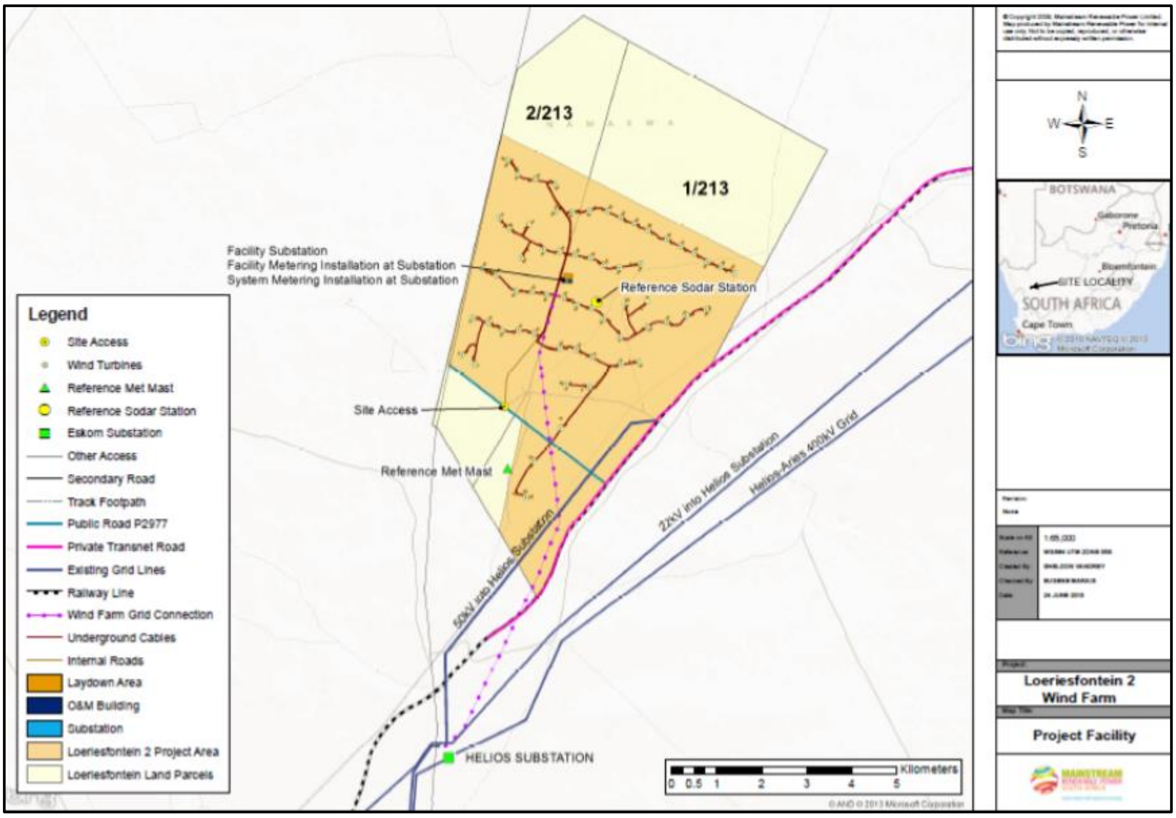


Figure 19: Mainstream Loeriesfontein 2 WEF layout plan which is one of the wind farms under construction adjacent to which Alternative C would be routed. (source: Mainstream, 2013)

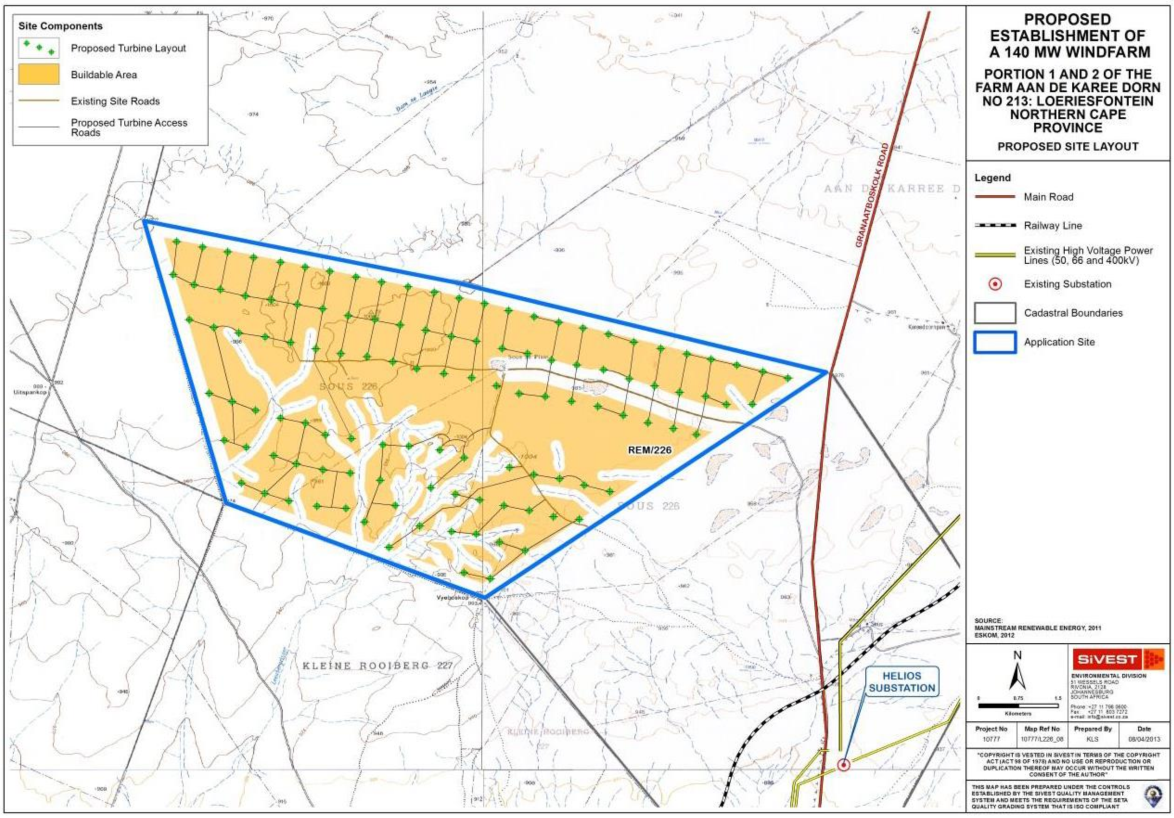


Figure 20: Mainstream Khobab WEF layout plan. The three alternative transmission line alternatives are located to the north and south of this farm boundary. (source: Mainstream, 2013)

3.1.8 *Mountain and Hill Features*


Figure 21: Photograph of the Klein Rooiberg hill feature.

Only a single hill feature was identified within the surrounding area, the Klein Rooiberg hill. Although the isolation of the hill does increase the visual importance of this landmark in the surrounding flat Nama-Karoo landscape, it is located approximately 7km to the southeast of the proposed site and its visual importance would not be significantly degraded by the proposed power line landscape modification.

3.2 Site Landscape Character

In terms of VRM methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and distance of the proposed landscape modification from key receptor points. As this is a basic assessment, the specific ratings for the landform and receptor sensitivity were not defined, and only a general description of the landscape was made using the VRM criteria. The map below indicates the photographic survey points and the direction of the photographs that were utilised in defining the following broad-brush landscapes, as well as the Scenic Quality and Receptor Sensitivity ratings.

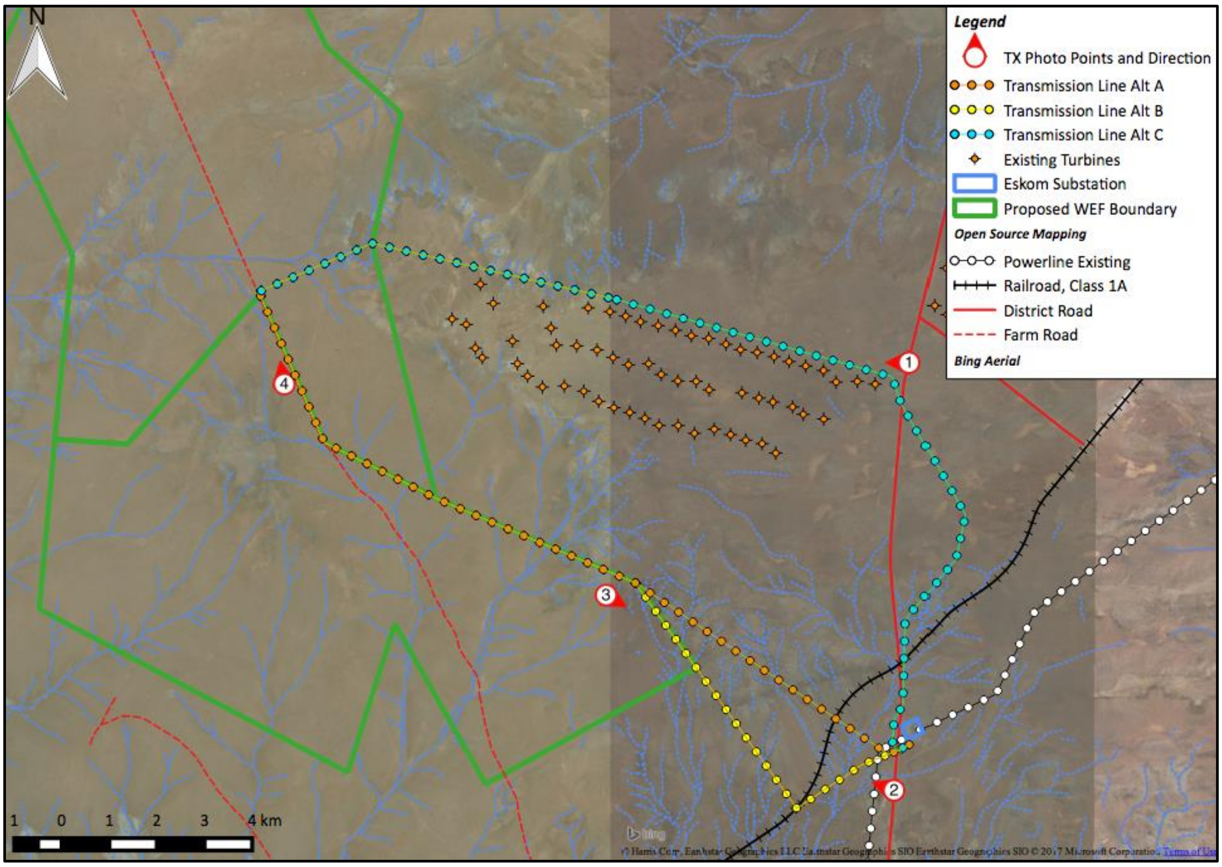


Figure 22: Site photograph locality and direction points overlay onto Bing satellite image map.

Figure 23: Photograph 1 from Nuwepos Road westbound view towards the proposed power line Alt C which would be routed along the farm road on the right.

Figure 24: Photograph 2 from Nuwepos Road westbound view towards the proposed Alt A & B power line routing with the Eskom power lines in the middle ground.

Figure 25: Photograph 3 of the slightly undulating terrain associated with numerous smaller drainage channels.

Figure 26: Photograph 4 of the existing farm roads and Bushmanland Basin Shrublands.

4 FINDINGS

4.1 Landscape Context

At a regional level, there is some topographic variation, but in essence, the surrounding terrain is described as predominantly flat without key topographic features. The current landuse of the proposed properties is agricultural, with low intensity sheep farming carried out in this arid environment. The Bioregion is Nama-Karoo with the main vegetation type being Bushmanland Basin Shrubland. Due to the low stock carrying capacity of the Bushmanland vegetation, the farms are large in size. Man-made modifications associated with the sheep farming are isolated farmsteads, farm tracks, fences and water reservoirs. These features are small in scale in the landscape and do not detract from the sense of place.

Located within the vicinity of the project are the following linear and structural infrastructure features: the Shishen–Saldanha Railway Line, the Eskom Helios Substation and 400kV distribution line, the Nuwepos gravel road and numerous farm access roads. Due to the wind resources of the area, two Wind Farms (Khobab and Loeriesfontein) are currently being constructed within the visual context of the proposed project, with their construction camp being located west of the Eskom Helios substation. Due to the substation, the numerous transmission lines and the railway line infrastructures, the landscape around this section of the road is degraded to some degree and the visual absorption capacity for vertical line element is increased.

4.2 Visibility

The proposed Transmission Line ***Alternatives A and B visibility*** is rated as ***Medium***. The routings are very similar, with the exception of the southern section where Alternative B follows a cadastral line and Alternative A is routed more directly to the Substation. The viewshed extent shows a uniform distribution spread within the two kilometre high exposure distance zone, but becomes fragmented further away, with views extending mainly to the north and the south. Coverage of the viewshed is rated Medium, as due to the flat terrain and limited vegetation, with visibility extending to the Foreground / Middle Ground distance. Receptors making use of the landscape are few and mainly associated with rural dry land agriculture, Eskom maintenance workers and a few railway line maintenance personnel. The main views of the proposed routings would be from receptors using the gravel road where views of Alternatives A and B would be mainly located on the west side of the road, only crossing the road in close proximity to the Helios Substation. Due to the close proximity to the proposed power lines, the ***Visual Exposure is rated as Medium to High***. Moderation of the rating is due to the remoteness of the locality where traffic is limited.

Transmission Line Alternative C differs from Alternative A and B in that the power line is routed to the east and then south, to then connect with the Helios Substation. Like the other alternatives, the viewshed extent shows uniform distribution within the two kilometre high exposure distance area, but becomes fragmented moving further away with views extending mainly to the north and the east. Coverage is also rated ***Medium*** as due to the flat terrain and limited vegetation, the visibility could extend to the Foreground / Middle Ground distance. Receptors making use of the landscape are few and mainly associated with rural dry land agriculture, Eskom maintenance workers and a few railway line maintenance personnel. This routing differs from A & B in that the main views of the proposed routings would be from receptors using the gravel road who would cross the power line routing three times, significantly increasing visual exposure. However, unlike Alternative A & B, the ***Visual Exposure is rated as High*** as approximately 6km of this routing would be in clear view of the gravel road users.

4.3 Scenic Quality

Due to minimal undulation of the site and the surrounding terrain, Landform is rated medium to low. Vegetation of this Bushmanland Basin Shrubland consists mainly of sparse shrubs and Bushmanland Grasslands, which are likely to contain important species, but as a whole are rated Medium to Low due to the uniformity of the vegetation. In this semi-arid environment, water or water sculpted features are not apparent, and colours are mainly related to the browns and greys of the vegetation. The key value driver for this landscape is the current lack of man-made development that creates a strong wilderness sense of place. This will, however, change to some degree with the construction of the wind farm on the neighbouring property and the landscape will become one dominated by large turbines. Existing cultural modifications are mostly rural agricultural in nature and do not detract from the property landscape character. For the above reasons, the Scenic Quality is rated ***Medium to Low.***

4.4 Receptor Sensitivity

Due to the semi-arid nature of the environment, the area is sparsely populated, with only a few dwellings located within the immediate viewshed. The nearest farmstead is located approximately 12 kilometres to the north. Other receptors in the area include Eskom maintenance persons and railway line workers. The access road to this area does not link through to any major tourist activity and as such tourist users are unlikely. Due to the remoteness of the rural setting, the Type of User is likely to be farmers, or Eskom maintenance workers and as such is rated Medium. Due to the remoteness of the locality, the Amount of Use was rated Low and Public Interest is also rated Low. No tourist activities making use of the scenic resources were apparent and the Adjacent Users' sensitivity to landscape change is thus rated Low. The area is not formally protected as a conservancy or nature reserve and hence is rated Low as a Special Area. The overall ***Receptor Sensitivity*** to landscape change is rated ***Low***.

5 IMPACT ASSESSMENT

5.1 Aurecon Impact Methodology

This section outlines the proposed method for assessing the significance of the potential environmental impacts. For each impact, the EXTENT (spatial scale), MAGNITUDE (severity of impact) and DURATION (time scale) are described.

These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.

The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Table 2: Aurecon Impact Criteria Table

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10km radius of the candidate site.
	Local	Within a 10km radius of the candidate site.
	Site specific	On site or within 100m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 1 year
	Short Term	Up to 3 years after construction
	Medium Term	3-10 years after construction
	Long Term	More than 10 years after construction

Table 3: Aurecon Definition of Significance Rating Table

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration

	• Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

The **SIGNIFICANCE** of an impact is derived by taking into account the temporal and spatial scales and magnitude. Once the significance of an impact has been determined, the **PROBABILITY** of this impact occurring as well as the **CONFIDENCE** in the assessment of the impact would be determined using the rating systems outlined in Table 9 and Table 10 respectively. It is important to note that the significance of an impact should always be considered in conjunction with the probability of that impact occurring. Lastly, the **REVERSIBILITY** and **IRREPLACEABILITY** of the impact is estimated using the rating system outlined in Table 11 and Table 12.

Table 4: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 5: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 6: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

Table 7: Definition of irreplaceability ratings

REVERSIBILITY RATINGS	CRITERIA
Low	The affected resource is not unique and or does not serve an critical function or is degraded

Medium	The affected resource is moderately important in terms of uniqueness and function or in pristine condition
High	The affected resource is important in terms of uniqueness and function and or in pristine condition and warrants conservation / protection

5.2 Key Observation Points

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

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

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

Based on the above information, the following visual issues were assessed in this basic visual assessment:

- Views as seen from the Nuwepos Road receptors.
- Cumulative visual effects of multiple power line congesting on the Helios Eskom Substation.

5.3 Visual Impact Description

Construction Phase impacts include the use of large vehicles and a crane to raise the power line monopoles. Small maintenance access routes would be created along the proposed power line route which could result in soil erosion if not adequately managed. Due to the small footprint of the monopole and small track, windblown dust is likely to be limited. ***Operation Phase*** impacts will include the occasional maintenance vehicle travelling down the access track to check on possible soil erosion and the power lines. ***Decommissioning Phase*** impacts include the movement of large vehicles and cranes for the removal of the monopoles as well as the rehabilitation of the access track.

Potential visual ***cumulative impacts*** are caused mainly by multiple power lines being routed adjacent to each other, or converging on a specific area, resulting in a massing effect and subsequent landscape degradation.

The impact considered below is therefore the visual obstruction of the landscape to sensitive receptors (-).

Due to the mitigation potential being limited to routing alignment, no post mitigation ratings are defined for this Basic Assessment. Best practice environmental mitigations are defined which are recommended. There is very little difference between construction and operation phases, as it is likely that cranes could also be used during operation for maintenance, but on a very infrequent basis. Due to the small footprint of the monopoles, the landscape modification can be effectively reversed should deconstruction be required.

Table 8: Visual Impacts relating to the proposed power line routings and the utilisation of large construction vehicles (including cranes)

Impact description	The visual impacts caused by transmissions lines include the location of repeatative vertical line, and texture changes to the receiving environment, the use and movement of large vehicles and a crane to raise the power line monopoles. Small maintenance access routes would be created along the proposed powerline route which could result in soil erosion if not adequately managed. Due to the small footprint of the monopole and small track, windblown dust is likely to be limited. The impacts are likely to be similar in each of the project phases, although the frequency of vehicles and use of crane is likely to be more significant in the construction phase. Very limited mitigation is available to screen a 25m high structure and therefore the only mitigation available refers to the management of erosion. The impact will not change with mitigation and the three alternative transmission line corridors will impact on the sensitive receptors differently as below.		
	Alternative A	**Alternative B**	**Alternative C**
	No mitigation	**No mitigation**	**No mitigation**
Type	Negative	Negative	Negative
Extent	Local	Local	Local
Magnitude	Low	Low	Medium
Duration	Long Term	Long Term	Long Term
Significance	**LOW (-)**	**LOW (-)**	**MEDIUM (-)**

Probability	Probable	Probable	Probable
Confidence	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible

Mitigation measures:

- Soil erosion measures need to be adequately implemented and routinely monitored by the ECO. This should occur monthly during construction, bi-annual during operation, and bi-annual for a year following decommissioning.
- Should the infrastructure be decommissioned, all structures should be removed and recycled where possible.
- The rubble should be managed according to the NEM:WA and deposited at a registered landfill if it cannot be recycled or reused.
- All compacted areas should be ripped and then rehabilitated according to a rehabilitation specialist. During decommissioning, all buildings, rubble and non-permanent infrastructure must be removed from site.

5.4 Type of Impact

The nature of the impact will be **Negative** for all Alternatives as most of the areas where the power lines are proposed have existing medium to high levels of scenic quality which add value to the greater landscape. The No-Go option will remain neutral.

5.5 Extent of the Impact

Due to the relatively contained visual footprint of the monopoles, the Extent of the project visibility is rated **Local** as the project zone of visual influence is unlikely to extend beyond a 6km radius of the candidate site.

5.6 Magnitude of the Impact

Magnitude for Alternatives A & B is rated **Low.** Their proposed routing is further away from the gravel road and will cross the road in the vicinity of the existing Helios Substation which has a high visual absorption capacity. This is created by the stronger visual presence of the existing substation, associated power lines as well as railway line infrastructure. Magnitude for Alternative C is rated **Medium**. Although there is some vertical contrast created by the adjacent wind farms, the power line crosses over the road three times. This proximity is likely to increase the intensity of the visual impact as seen from receptors using the gravel road.

5.7 Duration of the Impact

The power line alternatives are all rated **Long Term** as the visual impact will last more than 10 years after the construction and will most likely become a permanent feature in the landscape.

5.8 Probability of the Impact

Due to the low height of the scrub vegetation, it is **Probable** that the impact will occur in all areas where there are clear views of the proposed landscape modification from road receptors.

It is also probable that the existing landscape sense of place will be retained for the No-Go option.

5.9 Confidence of the Impact

Confidence in the impact was rated Sure as sufficient information was provided to adequately understand the proposed landscape modification in relation to the environmental factors of the site.

5.10 Reversibility of the Impact

Due to the relatively small footprint of the monopoles in relation to the large size of the project area, the removal of the power line could result in the resultant post-power line landscape returning to the previous rural agricultural landscape status, and visual impact would be neutral in the long term.

5.11 Resource Irreplaceability of the Impact

This section of the Nama-Karoo is relatively flat with shallow undulations and, other than the Klein Rooiberg hill, is devoid of landform focal points which would detract from the scenic quality. As such, the Resource Irreplaceability of the Impact for Alternatives A & B are rated **Low**. Due to the routing of Alternative C along the only road that accesses the area, the Resource Irreplaceability is rated **Medium**, as the surrounding wind farms could create an interesting landscape which could be enhanced by un-cluttered views of the turbines. The route crossing the road and running adjacent to the road in some areas could detract from the wind farm landscape effect.

5.12 Mitigability of the Impact

Due to the technical specifications of the power line, mitigation in terms of colour, form (type) of structure is limited for all alternatives and rated **Low**.

5.13 Visual Significance of the Impact

Due to the Low Magnitude and Local Extent, the Visual Significance for Alternatives A & B are rated **Low**, even though Duration would be Long Term. Due to Medium Magnitude, Local Extent but Long Term Duration, the Visual Significance for Alternative C was rated **Medium**.

5.14 Cumulative Impact Assessment

The main issue relating to cumulative effects is landscape cluttering when multiple power lines are viewed from a single location, or where a new power line is constructed which then sets a new routing precedent for future power line routings. For Alternatives A & B, the potential for negative Cumulative Effects was rated **Low**. This is due to the remoteness of the locality for most of the routing and the higher visual absorption capacity of the area where the power lines will be viewed from the road. The potential for negative Cumulative Effects from Alternative C is rated **Medium** as the close proximity to the road with its three crossings will increase the potential of the proposed routing cluttering the local landscape. For this reason, routing Alternatives A & B are visually preferred. Potential for Alternative C to degrade visual resources is moderated by the landscape around the Helios Substation being degraded to some degree, as well the other powerlines from the Mainstream Khohab and Louriesfontein Wind Farms which would also follow a similar routing alignment.

6 ENVIRONMENTAL MANAGEMENT PLAN

6.1 Construction Phase

- Soil erosion measures need to be adequately implemented and routinely monitored by the ECO (monthly).

6.2 Operation Phase

- Soil erosion needs to be adequately monitored by the wind farm operator on a Bi-Annual basis.

6.3 Closure Phase

- All structures should be removed and where possible, re-used or recycled.
- The rubble should be managed according to NEMWA and deposited at a registered landfill if it cannot be recycled or reused.
- All compacted areas should be ripped and then rehabilitated according to a rehabilitation specialist.
- Monitoring for soil erosion should be undertaken on a bi-annual basis for a year following the completion of closure phase.

7 OPPORTUNITIES AND CONSTRAINTS

7.1 Power Line Alternative A & B

7.1.1 *Opportunities*

- The remoteness of the locality would result in ***Medium*** levels of Visual Exposure to adjacent receptors.
- There is a higher VAC generated by the existing Eskom Helios Substation, the railway line as well as the WEFs under construction. Views from the main receptor locations towards the site would mainly be seen in conjunction with the strong vertical line element created by the existing substation Busbars and the wind turbines at Mainstream's Khobab & Loeriesfontein Wind Farms (currently under construction).
- Existing power line and substation infrastructure increase the VAC levels.

7.1.2 *Constraints*

- The relatively flatter terrain in conjunction with the 25m height of the structures, results in a wide spread viewshed which is ***Local*** in extent.

7.2 Power Line Alternative C

7.2.1 *Opportunities*

- The area is remote and receptors are likely to be limited to a small number of local farmers or contractors associated with the construction of the two existing wind farms, or Eskom substation maintenance workers.
- For the southern extent of the routing, there is a higher VAC generated by the existing Eskom Substation, the railway line as well as the powerlines from the two Mainsteam Wind Farms that follow a similar routing alignment.

7.2.2 *Constraints*

- The relatively flatter terrain in conjunction with the 25m height of the structures, results in a wide spread viewshed which is ***Local*** in extent.
- The routing crosses the gravel road three times which is likely to increase visual intrusion and possibly detract from views of the surrounding wind farms.

8 CONCLUSION

Visual Resource Management Africa CC (VRMA) was appointed by Aurecon (Pty) Ltd to undertake a ***Basic Visual Impact Assessment*** for the grid connection infrastructure for the three proposed Kokerboom Wind Energy Facilities (WEFs) on behalf of Business Venture Investments No. 1788 (Pty) Ltd. A site visit was undertaken on the 8th of June 2016. The proposed development site is located in the Northern Cape Province, Namakwa District Municipality and within the Hantam Local Municipality. The proponent is proposing to evacuate the power generated from three new wind farms (Kokerboom 1, 2 & 3 Wind Farms) to the Eskom Helios Substation.

The Magnitude rating for Alternatives A & B is Low. These routes are sited further away from the gravel road and will only cross the road in the vicinity of the existing Helios Substation. This immediate area has a high visual absorption capacity created by the substation, associated power lines and the railway line infrastructure. Magnitude for Alternative C is rated Medium. Although there is some vertical contrast created by the adjacent wind farms, the proposed power line will cross over the road three times. This proximity is likely to increase the intensity of the visual impact as seen from receptors using the gravel road.

As such the Visual Significance for Alternatives A & B was rated Low due to the Low Magnitude and Local Extent. Due to Medium Magnitude, Local Extent but Long Term Duration, the Visual Significance for Alternative C was rated Medium.

The main issue relating to cumulative effects is landscape cluttering when multiple power lines are viewed from a single location, or where a new power line is constructed which then sets a new routing precedent for future power line routings. For Alternatives A & B, the potential for negative Cumulative Effects was rated Low. This is due to the remoteness of the locality for most of the routing and the higher visual absorption capacity of the area where the power lines will be viewed from the road. The potential for negative Cumulative Effects from Alternative C is rated Medium to High as the close proximity to the road with its three crossings will increase the potential of the proposed routing cluttering the local landscape. However, potential for Alternative C to degrade visual resources is moderated by the landscape around the Helios Substation being degraded to some degree, as well as the remoteness of the locality. For this reason, routing Alternatives A & B are visually preferred, but all three alternatives are considered acceptable.

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10 Annexure 2: Specialist Information

10.1 Declaration of Interest

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Kokerboom 1 & 2 Wind Energy Facility

Specialist:	**Visual Impact**		
Contact person:	**Stephen Stead**		
Postal address:	**P.O Box 7233, Blanco, George**		
Postal code:	**6531**	Cell:	**0835609911**
Telephone:		Fax:	
E-mail	**steve@vrma.co.za**		
Professional affiliation(s) (if any)	**Association of Professional Heritage Professionals**		

Project Consultant:	**Aurecon South Africa (Pty) Ltd**		
Contact person:	**Ms Mieke Barry**		
Postal address:	**PO Box 494, Cape Town**		
Postal code:	**8000**	Cell:	**N/A**
Telephone:	**021 526 6025**	Fax:	**021 526 9500**
E-mail:	**Mieke.Barry@aurecongroup.com**		

4.2 The specialist appointed in terms of the Regulations_

I, Stephen Stead , declare that --

General declaration:

I act as the independent specialist in this application;

I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

I declare that there are no circumstances that may compromise my objectivity in performing such work;

I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

I will comply with the Act, Regulations and all other applicable legislation;

I have no, and will not engage in, conflicting interests in the undertaking of the activity;

I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

all the particulars furnished by me in this form are true and correct; and

I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Stephen Stead

Signature of the specialist:

VRM Africa

Name of company (if applicable):

20 Oct 2016

Date:

10.2 Curriculum Vitae

Curriculum Vitae (CV)

1. **Position**: Owner / Director
2. **Name of Firm**: Visual Resource Management Africa cc *(www.vrma.co.za)*
3. **Name of Staff**: Stephen Stead
4. **Date of Birth**: 9 June 1967
5. **Nationality:** South African
6. **Contact Details:** **Tel: +27 (0) 44 876 0020**
   Cell: +27 (0) 83 560 9911
   Email: steve@vrma.co.za

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7. **Educational qualifications**:
   - University of Natal (Pietermaritzburg):
   - Bachelor of Arts: Psychology and Geography
   - Bachelor of Arts (Hons): Human Geography and Geographic Information Management Systems
8. **Professional Accreditation**
   - Association of Professional Heritage Practitioners (APHP) Western Cape
     - Accredited VIA practitioner member of the Association (2011)
9. **Association involvement:** :
   - International Association of Impact Assessment (IAIA) South African Affiliate
     - Past President (2012 - 2013)
     - President (2012)
     - President-Elect (2011)
     - Conference Co-ordinator (2010)
     - National Executive Committee member (2009)
     - Southern Cape Chairperson (2008)
10. **Conferences Attended:**
    - IAIAsa 2012
    - IAIAsa 2011
    - IAIA International 2011 (Mexico)
    - IAIAsa 2010
    - IAIAsa 2009
    - IAIAsa 2007
11. **Continued Professional Development:**
    - Integrating Sustainability with Environment Assessment in South Africa (IAIAsa Conference, 1 day)
    - Achieving the full potential of SIA (Mexico, IAIA Conference, 2 days 2011)

- Researching and Assessing Heritage Resources Course (University of Cape Town, 5 days, 2009)

12. Countries of Work Experience:
- South Africa, Mozambique, Malawi, Lesotho, Kenya and Namibia

13. Relevant Experience:

Stephen gained six years of experience in the field of Geographic Information Systems mapping and spatial analysis working as a consultant for the KwaZulu-Natal Department of Health and then with an Environmental Impact Assessment company based in the Western Cape. In 2004 he set up the company Visual Resource Management Africa that specializes in visual resource management and visual impact assessments in Africa. The company makes use of the well documented Visual Resource Management methodology developed by the Bureau of Land Management (USA) for assessing the suitability of landscape modifications. In association with ILASA qualified landscape architect Liesel Stokes, he has assessed of over 100 major landscape modifications throughout southern and eastern Africa. The business has been operating for eight years and has successfully established and retained a large client base throughout Southern Africa which include amongst other, Rio Tinto (Pty) Ltd, Bannerman (Pty) Ltd, Anglo Coal (Pty) Ltd, Eskom (Pty) Ltd, NamPower and Vale (Pty) Ltd, Ariva (Pty) Ltd, Harmony Gold (Pty) Ltd, Mellium Challenge Account (USA), Pretoria Portland Cement (Pty) Ltd

14. Languages:
- English – First Language
- Afrikaans – fair in speaking, reading and writing

15. Projects:

A list of ***some*** of the large scale projects that VRMA has assessed has been attached below with the client list indicated per project (Refer to www.vrma.co.za for a full list of projects undertaken).

YEAR	NAME	DESCRIPTION	LOCATION
2016	Hotazel PV	Solar Energy	Northern Cape
2016	Eskom Sekgame Bulkop Power Line	Infrastructrue	Northern Cape
2016	Ngonye Hydroelectric	Hydroelectric	Zambia
2016	Levensdal Infill	Settlement	Western Cape
2016	Arandis CSP	Solar Energy	Namibia
2016	Bonnievale PV	Solar Energy	Western Cape
2015	Noblesfontein 2 & 3 WEF (Scoping)	Wind Energy	Eastern Cape
2015	Ephraim Sun SEF	Solar Energy	Nothern Cape
2015	Dyasonsklip and Sirius Grid TX	Solar Energy	Nothern Cape
2015	Dyasonsklip PV	Solar Energy	Nothern Cape
2015	Zeerust PV expansion and transmission line	Solar Energy	North West
2015	Bloemsmond SEF	Solar Energy	Nothern Cape
2015	Juwi Copperton PV	Solar Energy	Nothern Cape
2015	Humansrus Capital 14 PV	Solar Energy	Nothern Cape
2015	Humansrus Capital 13 PV	Solar Energy	Nothern Cape
2015	Spitzkop East WEF (Scoping)	Solar Energy	Western Cape
2015	Lofdal Rare Earth Mine and Infrastructure	Extraction	Namibia
2015	AEP Kathu PV	Solar Energy	Nothern Cape

2014	Joram Solar	Solar Energy	Northern Cape
2014	RERE PV Postmasberg	Solar Energy	Northern Cape
2014	RERE CPV Upington	Solar Energy	Northern Cape
2014	Rio Tinto RUL Desalinisation Plant	Industrial	Namibia
2014	NamPower PV	Solar Energy	Namibia
2014	Pemba Oil and Gas Port Expansion	Industrial	Mozambique
2014	Brightsource CSP Upington	Solar Energy	Northern Cape
2013	Cape Winelands DM Regional Landfill	Industrial	Western Cape
2013	Drennan PV Solar Park	PV Solar Energy	Eastern Cape
2013	Eastern Cape Mari-culture	Mari-culture	Eastern Cape
2013	Eskom Pantom Pass Substation	Substation /Tx lines	Knysna
2013	Frankfort Paper Mill	Plant	Free State
2013	Gibson Bay Wind Farm Transmission lines	Tranmission lines	Eastern Cape
2013	Houhoek Eskom Substation	Substation /Tx lines	Western Cape
2013	Mulilo PV Solar Energy Sites (x4)	PV Solar Energy	Northern Cape
2013	Namies Wind Farm	Wind Energy	Northern Cape
2013	Rössing Z20 Pit and WRD	Mining	Namibia
2013	SAPPI Boiler Upgrade	Plant	Mpumalanga
2013	Tumela WRD	Mine	North West
2013	Weskusfleur Substation (Koeburg)	Substation /Tx lines	Western Cape
2013	Yzermyn coal mine	Mine	Mpumalanga
2012	Afrisam	Mine	Saldana
2012	Bitterfontein	PV Energy	N Cape
2012	Bitterfontein slopes	Slopes Analysis	N Cape
2012	Kangnas PV	Energy	N Cape
2012	Kangnas Wind	Energy	N Cape
2012	Kathu CSP	Solar Power	Northern Cape
2012	Kobong Hydro	Hydro & Powerline	Lesotho
2012	Letseng Diamond Mine Upgrade	Mine	Lesotho
2012	Lunsklip Windfarm	Windfarm	Stilbaai
2012	Mozambique Gas Engine Power Plant	Plant	Mozambique
2012	Ncondezi Thermal Power Station	Substation /Tx lines	Mozambique
2012	Sasol CSP	Solar Power	Free State
2012	Sasol Upington CSP	Solar Power	Northern Cape
2011	Beaufort West PV Solar Power Station	Power Station	Beaufort West
2011	Beaufort West Wind Farm	Wind Energy	Beaufort West
2011	De Bakke Cell Phone Mast	Mast	Western Cape
2011	ERF 7288 PV	PV	Beaufort West
2011	Gecko Industrial park	Industrial	Namibia
2011	Green View Estates	Residential	Mossel Bay
2011	Hoodia Solar	PV expansion	Beaufort West

2011	Kalahari Solar Power Project	Solar Power	Northern Cape
2011	Khanyisa Power Station	Power Station	Western Cape
2011	Laingsburg Windfarm	Level 4	Mpumalanga
2011	Olvyn Kolk PV	Solar Power	Northern Cape
2011	Otjikoto Gold Mine	Mining	Namibia
2011	PPC Rheebieck West Upgrade	Industrial	
2011	Slopes analysis Erf 7288 Beaufort West	Slopes	Beaufort West
2011	Southern Arterial	Road	George
2010	Bannerman Etango Uranium Mine	Mining	Namibia
2010	Bantamsklip Transmission Revision	Transmission	Eastern Cape
2010	Beaufort West Urban Edge	Mapping	Beaufort West
2010	Bon Accord Nickel Mine	Mine	Barbeton
2010	Herolds Bay N2 Development Baseline	Residential	George
2010	MTN Lattice Hub Tower	Structure	George
2010	N2 Herolds Bay Residental	Residential	Herolds Bay
2010	Onifin(Pty) Ltd Hartenbos Quarry Extension	Mining	Mossel Bay
2010	Rössing South Board Meeting	Mining	Namibia
2010	Still Bay East	Mapping	SA, WC
2010	Vale Moatize Coal Mine and Railwayline	Mining_rail	Mozambique
2010	Vodacom Mast	Structure	Reichterbosch
2010	Wadrif Dam	Dam	Beaufort West
2009	Asazani Zinyoka UISP Housing	Residential Infill	Mossel Bay
2009	Bantamsklip GIS Mapping	Mappig	Western Cape
2009	Eden Telecommunication	Structure	George
2009	George Landscape Characterisation	George SDF	George
2009	George Western Bypass	Structure Road	George
2009	Rössing Uranium Mine Phase 2	Mining	Namibia
2009	Sun Ray Wind Farm	Wind Energy	Still Bay
2008	Bantamsklip Transmission Lines Scoping	Transmission	Western Cape
2008	Erf 251 Damage Assessment	Residential VIA	Great Brak
2008	Erongo Uranium Rush SEA	SEA	Namibia
2008	Evander South Gold Mine Preliminary VIA	Mining	Mpumalanga
2008	George Open Spaces System	George SDF	George
2008	GrooteSchuur Heritage Mapping	Mapping	Cape Town
2008	Hartenbos River Park	Residential VIA	Hartenbos
2008	Kaaimans Project	Residential	Wilderness
2008	Lagoon Garden Estate	Residential VIA	Great Brak
2008	Moquini Beach Hotel	Resort	Mossel Bay
2008	NamPower Coal fired Power Station	Power Station	Namibia
2008	Oasis Development	Residential VIA	Plettenberg Bay
2008	RUL Sulpher Handling Facility	Mining	Walvis Bay

2008	Stonehouse Development	Residential VIA	Plettenberg Bay
2008	Walvis Bay Power Station	Structure	Namibia.
2007	Calitzdorp Retirement Village	Residential VIA	Calitzdorp
2007	Calitzdorp Visualisation	Visualisation	Calitzdorp
2007	Camdeboo Estate	Residential VIA	Graaff Reinet
2007	Destiny Africa	Residential	George
2007	Droogfontein Farm 245	Residential VIA	Danabaai
2007	Floating Liquified Natural Gas Facility	Structure tanker	Mossel Bay
2007	George Municipality Densification	George SDF	George
2007	George Municipality SDF	George SDF	George
2007	Kloofsig Development	Residential VIA	Vleesbaai
2007	OCGT Power Plant Extension	Structure Power Plant	Mossel Bay
2007	Oudtshoorn Municipality SDF	Mapping	Oudtshoorn
2007	Oudtshoorn Shopping Complex	Structure Mall	Oudtshoorn
2007	Pezula Infill (Noetzie)	Residential VIA	Knysna
2007	Pierpoint Nature Reserve	Residential VIA	Knysna
2007	Pinnacle Point Golf Estate	Golf/Residential	Mossel Bay
2007	Rheebok Development Erf 252 Apeal	Residential VIA	Great Brak
2007	Rössing Uranium Mine Phase 1	Mining	Namibia
2007	Ryst Kuil/Riet Kuil Uranium Mine	Mining	Beaufort West
2007	Sedgefield Water Works	Structure	Sedgefield
2007	Sulpher Handling Station Walvis Bay Port	Industrial	Namibia
2007	Trekkopje Uranium Mine	Mining	Namibia
2007	Weldon Kaya	Residential VIA	Plettenberg Bay
2006	Fancourt Visualisation Modelling	Visualisation	George
2006	Farm Dwarsweg 260	Residential VIA	Great Brak
2006	Fynboskruin Extention	Residential VIA	Sedgefield
2006	Hanglip Golf and Residential Estate	Golf/Residential	Plettenberg Bay
2006	Hansmoeskraal	Slopes Analysis	George
2006	Hartenbos Landgoed Phase 2	Residential VIA	Hartenbos
2006	Hersham Security Village	Residential VIA	Great Brak
2006	Ladywood Farm 437	Residential VIA	Plettenberg Bay
2006	Le Grand Golf and Residential Estate	Golf/Residential	George
2006	Paradise Coast	Residential VIA	Mossel Bay
2006	Paradyskloof Residential Estate	Residential VIA	Stellenbosch
2006	Riverhill Residential Estate	Residential VIA	Wilderness
2006	Wolwe Eiland Access Route	Road	Victoria Bay
2005	Harmony Gold Mine	Mining	Mpumalanga.
2005	Knysna River Reserve	Residential VIA	Knysna
2005	Kruisfontein Infill	Mapping	Knysna
2005	Lagoon Bay Lifestyle Estate	Residential VIA	Glentana

2005	Outeniquabosch Safari Park	Residential	Mossel Bay
2005	Proposed Hotel Farm Gansevallei	Resort	Plettenberg Bay
2005	Uitzicht Development	Residential VIA	Knysna
2005	West Dunes	Residential VIA	Knysna
2005	Wilderness Erf 2278	Residential VIA	Wilderness
2005	Wolwe Eiland Eco & Nature Estate	Residential VIA	Victoria Bay
2005	Zebra Clay Mine	Mining	Zebra
2004	Gansevallei Hotel	Residential VIA	Plettenberg Bay
2004	Lakes Eco and Golf Estate	Golf/Residential	Sedgefield
2004	Trekkopje Desalination Plant	Structure Plant	Namibia
1995	Greater Durban Informal Housing Analysis	Photogrametry	Durban

11 ANNEXURE 3: QUESTIONNAIRES AND VRM TERMINOLOGY

11.1 Methodology Detail

Viewshed

The visible extent, or viewshed, is 'the outer boundary defining a view catchment area, usually along crests and ridgelines' *(Oberholzer, 2005).* This reflects the area, or extent, where the landscape modification would probably be seen. However, visibility tends to diminish exponentially with distance, which is well recognised in visual analysis literature. Therefore the views of a landscape modification would not necessarily influence the landscape character within all areas of the viewshed. The information for the terrain used in the 3D computer model on which the visibility analysis is based on the Advanced Spaceborne Thermal Emission and Reflection (ASTER) Radiometer Data, a product of Japan's Ministry of Economy, Trade and Industry (METI) and National Aeronautics and Space Administration (NASA) in USA. (NASA, 2009)

Receptor Exposure

The area where a landscape modification starts to influence the landscape character is termed the Zone of Visual Influence (ZVI) and is defined by the U.K. Institute of Environmental Management and Assessment's (IEMA) *'Guidelines for Landscape and Visual Impact Assessment'* as 'the area within which a proposed development may have an influence or effect on visual amenity (of the surrounding areas).'

The inverse relationship of distance and visual impact is well recognised in visual analysis literature *(Hull, R.B. and Bishop, I.E., 1988)*. According to Hull and Bishop, exposure, or visual impact, tends to diminish exponentially with distance. The areas where most landscape modifications would be visible are located within 2 km from the site of the landscape modification. Thus the potential visual impact of an object diminishes at an exponential rate as the distance between the observer and the object increases due to atmospheric conditions prevalent at a location, which causes the air to appear greyer, thereby diminishing detail. For example, viewed from 1000 m from a landscape modification, the impact would be 25% of the impact as viewed from 500 m from a landscape modification. At 2000m it would be 10% of the impact at 500 m. The relationship is indicated in the following graph generated by Hull and Bishop.

The VRM methodology also takes distance from a landscape modification into consideration in terms of understanding visual resource. Three distance categories are defined by the Bureau of Land Management. The distance zones are:

i. ***Foreground / Middle ground***, up to approximately 6km, which is where there is potential for the sense of place to change;
ii. ***Background areas***, from 6km to 24km, where there is some potential for change in the sense of place, but where change would only occur in the case of very large landscape modifications; and
iii. ***Seldom seen areas***, which fall within the Foreground / Middle ground area but, as a result of no receptors, are not viewed or are seldom viewed.

Scenic Quality

In terms of the VRM methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and distance of the proposed landscape modification from key receptor points. The scenic quality is determined making use of the VRM scenic quality questionnaire (refer to addendum). Seven scenic quality criteria area scored on a 1 (low) to 5 (high) scale. The scores are totalled and assigned a A (High), B (Moderate) or C (low) based on the following split:
A= scenic quality rating of ≥19;
B = rating of 12 – 18,
C= rating of ≤11

The seven scenic quality criteria are defined below:

- **Land Form:** Topography becomes more of a factor as it becomes steeper, or more severely sculptured.
- **Vegetation:** Primary consideration given to the variety of patterns, forms, and textures created by plant life.
- **Water:** That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration.
- **Colour:** The overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) are considered as they appear during seasons or periods of high use.
- **Scarcity:** This factor provides an opportunity to give added importance to one, or all, of the scenic features that appear to be relatively unique or rare within one physiographic region.
- **Adjacent Land Use:** Degree to which scenery and distance enhance, or start to influence, the overall impression of the scenery within the rating unit.
- **Cultural Modifications:** Cultural modifications should be considered, and may detract from the scenery or complement or improve the scenic quality of an area.

Receptor Sensitivity

Sensitivity levels are a measure of public concern for scenic quality. Receptor sensitivity to landscape change is determined by rating the following factors in terms of Low to High:

- **Type of Users:** Visual sensitivity will vary with the type of users, e.g. recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
- **Amount of Use:** Areas seen or used by large numbers of people are potentially more sensitive.
- **Public Interest:** The visual quality of an area may be of concern to local, or regional, groups. Indicators of this concern are usually expressed via public controversy created in response to proposed activities.
- **Adjacent Land Uses:** The interrelationship with land uses in adjacent lands. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be as visually sensitive.
- **Special Areas:** Management objectives for special areas such as Natural Areas, Wilderness Areas or Wilderness Study Areas, Wild and Scenic Rivers, Scenic Areas,

Scenic Roads or Trails, and Critical Biodiversity Areas frequently require special consideration for the protection of their visual values.

- **Other Factors:** Consider any other information such as research or studies that include indicators of visual sensitivity.

Visual Resource Management (VRM) Classes

The VRM Classes represent the relative value of the visual resources of an area and are determined making use of the VRM Class Matrix see Table 8 below:

i. **Classes I and II** are the most valued;
ii. **Class III** represents a moderate value; and
iii. **Class IV** is of least value.

The Classes are not prescriptive and are utilised as a guideline to determine visual carrying capacity. The Visual Inventory Classes are defined using the matrix below and with motivation, can be adjusted to Visual Resource Management Classes:

The visual objectives of each of the classes is listed below:

- The Class I objective is to preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low, and must not attract attention. Class I is assigned when a specialist decision is made to maintain a natural landscape.
- The Class II objective is to retain the existing character of the landscape and the level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer, and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.
- The Class III objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- The Class IV objective is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the landscape can be high, and these management activities may dominate the view and be the major focus of the viewer’s (s’) attention.

Key Observation Points (KOPs)

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

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

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

Contrast Rating

The contrast rating, or impacts assessment phase, is undertaken to determine if the VRM Class Objectives are met. The suitability of landscape modification is assessed by comparing the degree of potential contrast from the proposed activity in comparison to the existing contrast created by the existing landscape. This is done by evaluating the level of change to the existing landscape by assessing the line, colour, texture and form, in relation to the visual objectives defined for the area. The following criteria are utilised in defining the DoC:

- **None**: The element contrast is not visible or perceived.
- **Weak**: The element contrast can be seen but does not attract attention.
- **Moderate**: The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- **Strong**: The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

As an example, in a Class I area, the visual objective is to preserve the existing character of the landscape, and the resultant contrast to the existing landscape should not be notable to the casual observer and cannot attract attention. In a Class IV area example, the objective is to provide for proposed landscape activities which require major modifications of the existing character of the landscape. Based on whether the VRM objectives are met, mitigations, if required, are defined to avoid, reduce or mitigate the proposed landscape modifications so that the visual impact does not detract from the surrounding landscape sense of place.

Photo Montages and 3D Visualisation

- As a component in this contrast rating process, visual representation, such as photo montages are vital in large-scale modifications, as this serves to inform Interested & Affected Parties and decision-making authorities of the nature and extent of the impact associated with the proposed project/development. There is an ethical obligation in this process, as visualisation can be misleading if not undertaken ethically. In terms of adhering to standards for ethical representation of landscape modifications, VRMA subscribes to the Proposed Interim Code of Ethics for Landscape Visualisation developed by the Collaborative for Advanced Landscape Planning (CALP). (Sheppard, 2000) This code states that professional presenters of realistic landscape visualisations are responsible for promoting full understanding of proposed landscape changes, providing an honest and neutral visual representation of the expected landscape, by seeking to avoid bias in responses and demonstrating the legitimacy of the visualisation process. Presenters of landscape visualisations should adhere to the principles of:

- Access to Information
- Accuracy
- Legitimacy
- Representativeness
- Visual Clarity and Interest

The Code of Ethical Conduct states that the presenter should:

- Demonstrate an appropriate level of qualification and experience.
- Use visualisation tools and media that are appropriate to the purpose.
- Choose the appropriate level of realism.
- Identify, collect and document supporting visual data available for, or used in, the visualisation process.
- Conduct an on-site visual analysis to determine important issues and views.
- Seek community input on viewpoints and landscape issues to address in the visualisations.
- Provide the viewer with a reasonable choice of viewpoints, view directions, view angles, viewing conditions and timeframes appropriate to the area being visualised.
- Estimate and disclose the expected degree of uncertainty, indicating areas and possible visual consequences of the uncertainties.
- Use more than one appropriate presentation mode and means of access for the affected public.
- Present important non-visual information at the same time as the visual presentation, using a neutral delivery.
- Avoid the use, or the appearance of, 'sales' techniques or special effects.
- Avoid seeking a particular response from the audience.
- Provide information describing how the visualisation process was conducted and how key decisions were taken *(Sheppard, S.R.J., 2005)*.

11.2 Questionnaires

Scenic Quality Rating Questionnaire

KEY FACTORS	**RATING CRITERIA AND SCORE**		
SCORE	**5**	**3**	**1**
Land Form	High vertical relief as expressed in prominent cliffs, spires or massive rock outcrops, or severe surface variation or highly eroded formations or detail features that are dominating and exceptionally striking and intriguing.	Steep-sided river valleys, or interesting erosion patterns or variety in size and shape of landforms; or detail features that are interesting, though not dominant or exceptional.	Low rolling hills, foothills or flat valley bottoms; few or no interesting landscape features.
Vegetation	A variety of vegetative types as expressed in interesting forms, textures and patterns.	Some variety of vegetation, but only one or two major types.	Little or no variety or contrast in vegetation.
Water	Clear and clean appearing, still or cascading white water, any of which are a dominant factor in the landscape.	Flowing, or still, but not dominant in the landscape.	Absent, or present but not noticeable.
Colour	Rich colour combinations, variety or vivid colour: or pleasing contrasts in the soil, rock, vegetation, water.	Some intensity or variety in colours and contrast of the soil, rock and vegetation, but not a dominant scenic element.	Subtle colour variations contrast or interest: generally mute tones.
Adjacent Scenery	Adjacent scenery greatly enhances visual quality.	Adjacent scenery moderately enhances overall visual quality.	Adjacent scenery has little or no influence on overall visual quality.
Scarcity	One of a kind: unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing etc.	Distinctive, though somewhat similar to others within the region.	Interesting within its setting, but fairly common within the region.
SCORE	**2**	**0**	**-4**
Cultural Modification	Modifications add favourably to visual variety, while promoting visual harmony.	Modifications add little or no visual variety to the area, and introduce no discordant elements.	Modifications add variety but are very discordant and promote strong disharmony.

Sensitivity Level Rating Questionnaire

FACTORS	QUESTIONS	
Type of Users	**Maintenance of visual quality is:**	
	A major concern for most users	High
	A moderate concern for most users	Moderate
	A low concern for most users	Low
Amount of use	**Maintenance of visual quality becomes more important as the level of use increases:**	
	A high level of use	High
	Moderately level of use	Moderate
	Low level of use	Low
Public interest	**Maintenance of visual quality:**	
	A major concern for most users	High
	A moderate concern for most users	Moderate
	A low concern for most users	Low
Adjacent land Users	**Maintenance of visual quality to sustain adjacent land use objectives is:**	
	Very important	High
	Moderately important	Moderate
	Slightly important	Low
Special Areas	**Maintenance of visual quality to sustain Special Area management objectives is:**	
	Very important	High
	Moderately important	Moderate
	Slightly important	Low

11.3 VRM Terminology

FORM	LINE	COLOUR	TEXTURE
Simple	Horizontal		Smooth
Weak	Vertical		Rough
Strong	Geometric		Fine
Dominant	Angular		Coarse
Flat	Acute		Patchy
Rolling	Parallel		Even
Undulating	Curved	Dark	Uneven
Complex	Wavy	Light	Complex
Plateau	Strong	Mottled	Simple
Ridge	Weak		Stark
Valley	Crisp		Clustered
Plain	Feathered		Diffuse
Steep	Indistinct		Dense
Shallow	Clean		Scattered
Organic	Prominent		Sporadic
Structured	Solid		Consistent

Simple	Basic, composed of few elements	**Organic**	Derived from nature; occurring or developing gradually and naturally
Complex	Complicated; made up of many interrelated parts	**Structure**	Organised; planned and controlled; with definite shape, form, or pattern
Weak	Lacking strength of character	**Regular**	Repeatedly occurring in an ordered fashion
Strong	Bold, definite, having prominence	**Horizontal**	Parallel to the horizon
Dominant	Controlling, influencing the surrounding environment	**Vertical**	Perpendicular to the horizon; upright
Flat	Level and horizontal without any slope; even and smooth without any bumps or hollows	**Geometric**	Consisting of straight lines and simple shapes
Rolling	Progressive and consistent in form, usually rounded	**Angular**	Sharply defined; used to describe an object identified by angles
Undulating	Moving sinuously like waves; wavy in appearance	**Acute**	Less than 90°; used to describe a sharp angle
Plateau	Uniformly elevated flat to gently undulating land bounded on one or more sides by steep slopes	**Parallel**	Relating to or being lines, planes, or curved surfaces that are always the same distance apart and therefore never meet
Ridge	A narrow landform typical of a highpoint or apex; a long narrow hilltop or range of hills	**Curved**	Rounded or bending in shape
Valley	Low-lying area; a long low area of land, often with a river or stream running through it, that is surrounded by higher ground	**Wavy**	Repeatedly curving forming a series of smooth curves that go in one direction and then another
Plain	A flat expanse of land; fairly flat dry land, usually with few trees	**Feathered**	Layered; consisting of many fine parallel strands
Steep	Sloping sharply often to the extent of being almost vertical	**Indistinct**	Vague; lacking clarity or form
Prominent	Noticeable; distinguished, eminent, or well-known	**Patchy**	Irregular and inconsistent;
Solid	Unadulterated or unmixed; made of the same material throughout; uninterrupted	**Even**	Consistent and equal; lacking slope, roughness, and irregularity
Broken	Lacking continuity; having an uneven surface	**Uneven**	Inconsistent and unequal in measurement irregular
Smooth	Consistent in line and form; even textured	**Stark**	Bare and plain; lacking ornament or relieving features
Rough	Bumpy; knobbly; or uneven, coarse in texture	**Clustered**	Densely grouped
Fine	Intricate and refined in nature	**Diffuse**	Spread through; scattered over an area
Coarse	Harsh or rough to the touch; lacking detail	**Diffuse**	To make something less bright or intense