Fauna and Flora Terrestrial Ecological Specialist Study

Scoping and Environmental Impact Assessment for the Proposed Development of Phase 1 of the Kuruman Wind Farm, Northern Cape Province:

EIA PHASE REPORT

Report prepared for:

CSIR – Environmental Management Services

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Report prepared by:

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EXECUTIVE SUMMARY

Mulilo Renewable Project Developments (Pty) Ltd is proposing the development of the Kuruman WEF Phase 1 Wind Energy Facility (WEF) located near Kuruman in the Northern Cape Province. It is anticipated that the Kuruman WEF Phase 1 Wind Farm will have a maximum of 47 turbines. The development is currently in the EIA Phase and Mulilo has appointed 3Foxes Biodiversity Solutions to provide a Terrestrial Ecological (Fauna and Flora) specialist assessment study as part of the EIA process. The purpose of the Terrestrial Biodiversity Assessment Report is to describe and detail the ecological features of the proposed site; provide an assessment of the ecological sensitivity of the site and identify and assess the likely impacts associated with the proposed development of the site as a wind energy facility. A full field assessment as well as a desktop review of the available ecological information for the area was conducted in order to identify and characterise the ecological features of the site. This information is used to derive an ecological sensitivity map that presents the ecological constraints and opportunities for development at the site and which has been used to inform the assessed layout. Impacts are assessed for the construction, operation, and decommissioning phases of the development. Cumulative impacts on the broader area are also considered and assessed. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development.

The Kuruman WEF Phase 1 site consists of Kuruman Mountain Bushveld on the rocky hills and Kuruman Thornveld on the lowlands. Both of these vegetation types are of least concern and have have not been significantly impacted by transformation to date. The abundance of plant species of conservation concern at the site is low and the overall impact of the development on vegetation would be low. In terms of fauna, the abundance of species of concern at the site is low. The Mountain Reedbuck *Redunca fulvorufula fulvorufula* (Endangered) is confirmed present at the site and is identified as the mammalian species with the highest potential conflict with the development due to the high degree of overlap between the development footprint and favoured ridge-top habitat of this species. Although it is highly likely that this species will be able to tolerate the presence of the wind farm, it is recommended that a monitoring programme should be set up at the preconstruction phase for this species to monitor for potential impacts from construction and operational activities.

The northern part of the site is located within a CBA 2 which forms a buffer area around the Billy Duvenhage Nature Reserve. The majority of the footprint of the development is however within an Ecological Support Area. The footprint within the CBA 2 area is low and a significant impact on the CBA is not likely. In addition, it is unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view.

Although there are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site, these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.

The sensitivity mapping that was conducted indicates that the steeper slopes of the target ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The plateau and ridge-top habitats where the majority of the development impact would occur are are considered to be moderately sensitive. These areas are considered acceptable for turbine placement and would generate relatively low impacts on most components of biodiversity at the site. Although the access roads must neccesarily traverse some high sensitivity slope areas in order to access the target ridges, with the appropriate erosion control features, these would generate a relatively low impact and are considered to be acceptable.

Ecological Impact Statement:

Overall, the Kuruman Phase 1 site is considered to be an acceptable site for development of a wind energy facility. The impacts associated with the development are likely to be of moderate to low significance after mitigation. No impacts of broader consequence are likely to occur and as such, there do not appear to be any major issues or impacts that should prevent the development from proceeding. From a terrestrial ecology perspective, the development can thus be supported.

Short CV/Summary of Expertise – Simon Todd

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Ecological Solutions for People & the Environment

Simon Todd is Director and principal scientist at 3Foxes Biodiversity Solutions and has over 20 years of experience in biodiversity measurement, management and assessment. He has provided specialist ecological input on more than 200 different developments distributed widely across the country, but with a focus on the three Cape provinces. This includes input on the Wind and Solar SEA (REDZ) as well as the Eskom Grid Infrastructure (EGI) SEA and Karoo Shale Gas SEA. He is on the National Vegetation Map Committee as representative of the Nama and Succulent Karoo Biomes. Simon Todd is a recognised ecological expert and is a past chairman and current deputy chair of the Arid-Zone Ecology Forum. He is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Skills & Primary Competencies

- Research & description of ecological patterns & processes in Nama Karoo, Succulent Karoo, Thicket, Arid Grassland, Fynbos and Savannah Ecosystems.
- Ecological Impacts of land use on biodiversity
- Vegetation surveys & degradation assessment & mapping
- Long-term vegetation monitoring
- Faunal surveys & assessment.
- GIS & remote sensing

Tertiary Education:

- 1992-1994 – BSc (Botany & Zoology), University of Cape Town
- 1995 – BSc Hons, Cum Laude (Zoology) University of Natal
- 1996-1997- MSc, Cum Laude (Conservation Biology) University of Cape Town

Employment History

- 2009 – Present – Sole Proprietor of Simon Todd Consulting, providing specialist ecological services for development and research.
- 2007 Present – Senior Scientist (Associate) – Plant Conservation Unit, Department of Botany, University of Cape Town.

- 2004-2007 – Senior Scientist (Contract) – Plant Conservation Unit, Department of Botany, University of Cape Town
- 2000-2004 – Specialist Scientist (Contract) - South African National Biodiversity Institute
- 1997 – 1999 – Research Scientist (Contract) – South African National Biodiversity Institute

A selection of recent work is as follows:

Strategic Environmental Assessments

Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.

Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.

Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.

Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.

Contributor – Ecological & Conservation components to SKA SEA. CSIR 2017.

Recent Specialist Ecological Studies in the Vicinity of the Current Site

- Kathu Solar PV Facility. Fauna and Flora EIA Process. Cape EAPrac 2015.
- Mogobe Solar PV Facility. Fauna and Flora EIA Proces. Cape EAPrac 2015.
- Logoko Solar PV Facility. Fauna and Flora EIA Proces. Cape EAPrac 2015.
- RE Capital 10 Solar Power Plant, Postmasburg. Fauna and Flora EIA Proces. Cape EAPrac 2015.
- Walk-through study of Kumba Iron Ore expansion area at Dingleton, Northern Cape. MSA Group. 2017.
- Adams PV Project – EIA process and follow-up vegetation survey. Aurora Power Solutions. 2016.
- Mamatwane Compilation Yard. Fauna and Flora EIA process. ERM. 2013.
- Olifantshoek-Emil 132kV power line. Fauna and Flora BA process. Savannah Environmental 2017.

Specialist Declaration

I, ..Simon Todd..., 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 Specialist: ____Simon Todd______________________

Date: ____10 August 2018____________________________

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
SCC	Species of conservation concern
CBA	Critical Biodiversity Area
ESA	Ecological Support Area
NFEPA	National Freshwater Ecosystem Priority Assessment
NPAES	National Protected Area Expansion Strategy
NC-DENC	Northern Cape Department of Environment and Nature Conservation

GLOSSARY

COMPLIANCE WITH THE APPENDIX 6 OF THE 2017 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page *iii*
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page *v*
c) an indication of the scope of, and the purpose for which, the report was prepared;	P5
(cA) an indication of the quality and age of base data used for the specialist report;	P9-10
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	P38-
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	P10
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	P39
g) an identification of any areas to be avoided, including buffers;	P39
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	P39
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	P9
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 1.3
k) any mitigation measures for inclusion in the EMPr;	Section 1.6
l) any conditions for inclusion in the environmental authorisation;	
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.6
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	P56-57
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Main EIA report
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Main EIA report
q) any other information requested by the competent authority.	
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

Table of Contents

LIST OF FIGURES

SPECIALIST FAUNA AND FLORA SCOPING STUDY

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd has appointed CSIR to undertake the required Environmental Impact Assessment (EIA) process for the proposed Kuruman Wind Energy Facility, Phase 1 located southwest of Kuruman in the Northern Cape Province. It is anticipated that the Kuruman Wind Energy Facility, Phase 1 will have up to 47 turbines. A grid connection is also required, but this is assessed as part of an independent Basic Assessment process. The development is currently in the EIA Phase and CSIR has appointed 3Foxes Biodiversity Solutions to provide a specialist Terrestrial Biodiversity EIA Study of the development as part of the EIA process.

The purpose of the Terrestrial Biodiversity Assessment Report is to describe and detail the ecological features of the proposed site; provide an assessment of the ecological sensitivity of the site and identify and assess the likely impacts associated with the proposed development of the site as a wind energy facility. A full field assessment as well as a desktop review of the available ecological information for the area is used to identify and characterise the ecological features of the site. This information is used to derive an ecological sensitivity map that presents the ecological constraints for development at the site. Impacts are assessed for the construction, operation, and decommissioning phases of the development. Cumulative impacts on the broader area are also considered and assessed. 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 Environmental Management Programme (EMPr) for the development. The full scope of the study is detailed below and is in accordance with Appendix 6 - GN R326 of the EIA Regulations of 2014 as amended (which came into effect on 7 April 2017).

1.1.2. Terms of Reference

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 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, limitations 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 for 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:
    - Planning and Construction
    - Operational
    - Decommissioning

1.1.3. Assessment Approach

This assessment is conducted according to Appendix 6 – GN R326 EIA Regulations, as amended 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 (Figure 1);
- 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.

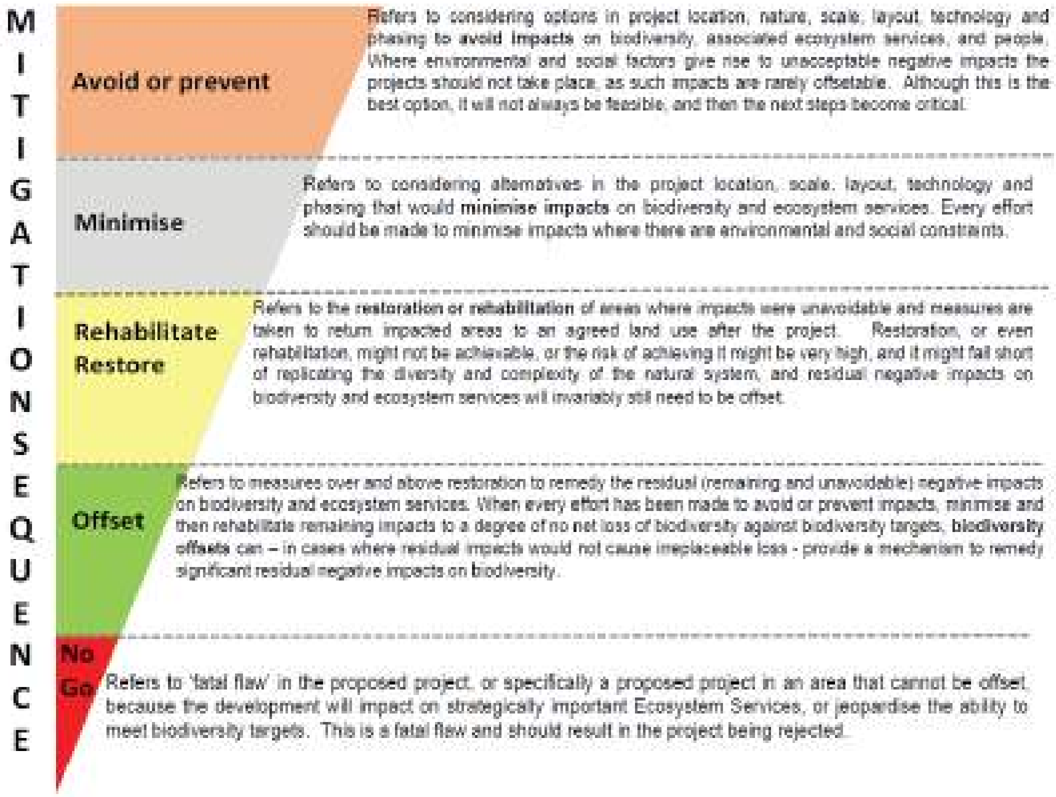

Figure 1. The mitigation hierarchy that is used to guide the study in terms of the priority of different mitigation and avoidance strategies.

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, including:
    - o 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 SCC 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 SCC, 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 SSC and that are known to be:
    - o endemic to the region;
    - o that are considered to be of conservational concern;
    - o that are in commercial trade (CITES listed species); or
    - o are 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.

1.1.4. Assumptions and Limitations

The current study is based on a detailed field assessment as well as a desktop study, which serves to reduce the limitations and assumptions required for the study. The site was visited in the wet season in mid-summer when the vegetation was in an excellent condition for sampling. As a result, the plant species lists obtained for the site are considered reliable and comprehensive. While there are likely some species present at the site which were not observed, this is likely a minority of species and it is unlikely that there are any plant habitats or communities present which were not observed As such, there are no significant limitations with regards to the vegetation assessment for the site.

In terms of fauna, camera trapping for larger mammals, Sherman trapping for small mammals and searches for reptiles and amphibians was conducted. This provides a comprehensive characterization of the faunal community of the site. Although some fauna are rare or difficult to observe in the field, their potential presence at the site was evaluated based on the literature, their habitat preferences and distribution in the wider area according to the available databases In order to ensure a conservative approach in this regard, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site. As a result, there are no significant limitations with regards to the faunal assessment at the site.

1.1.5. Source of Information

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

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006 and 2012 update) as well as the National List of Threatened Ecosystems (2011), where relevant.

- Information on plant and animal species recorded for the area was extracted from the new Plants of South Africa (POSA) database hosted by the South African National Biodiversity Institute (SANBI). Data was extracted for a significantly 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 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 (2017).

Habitats & Ecosystems:

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important protected areas expansion areas were extracted from the Northern Cape Protected Areas Expansion Strategy (NC-NPAES 2017).
- Critical Biodiversity Areas in the study area were obtained from the Northern Cape Conservation Plan (Oosthuysen & Holness 2016).

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, EWT & SANBI (2016) 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 mammals is based on the IUCN Red List Categories (EWT/SANBI 2016), while reptiles are based on the South African Reptile Conservation Assessment (Bates et al. 2013) and amphibians on Minter et al. (2004) as well as the IUCN (2017).

1.1.6. Field Assessment

The site was visited over four days from 18-22 February 2018, with a 1 day follow-up visit on 17 May 2018. During the main site visit, the various affected ridges as well as the lowland areas within the development footprint were sampled in the field. A full plant species list for the different habitats present within the site was developed based on walk-through surveys within the different habitats present. A total of 12 camera traps were distributed across the site, placed along roads, fences, paths and other areas most likely to be frequented by mammals. These will be retrieved before the EIA phase commences and the information on animal presence and habitat use collated and used to inform the final assessment. Small mammal trapping was conducted within different habitats at the site including the lowlands, uplands and rocky hills. A total of 60 Sherman live traps were left out for 3 days, giving a total of 180 trap nights. Additional information on faunal presence at the site was collected through searching for reptiles within areas likely to harbor reptiles as well as through casual observation of fauna at the site while conducting the other field work at the site.

1.1.7. Sensitivity Mapping and Assessment

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available biodiversity information available in the literature and various spatial databases. This includes delineating the habitat units identified in the field and assigning sensitivity values to the units based on their vegetation composition, faunal habitat or conservation value and the potential presence of SCC.

The sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of development can proceed within these areas with little ecological impact.
- **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. These areas usually comprise the bulk of habitats within an area. 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 may occur due to the high flora or faunal habitat value, sensitivity or important ecological role of the area. These areas may contain, or be important habitat for, SCC or provide important ecological services such as water flow regulation or forage provision. Development within these areas is generally undesirable and should proceed with caution as additional specific mitigation and avoidance is usually required to reduce impacts within these areas to acceptable levels. High sensitivity areas are also usually more sensitive to cumulative impact and the total developed footprint within these areas should be kept low.
- **No-Go/Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are considered to be no-go areas from a developmental perspective and should be avoided.

In some situations, areas were also classified between the above categories, such as Medium/High, where it was deemed that an area did not fit well into a certain category but rather fell most appropriately **between** two sensitivity categories. There are however 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.

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO ECOLOGICAL IMPACTS

The project is described in full in the main EIA report and this information is not repeated here, but rather a summary of the relevant components and footprint areas are described briefly below. It is anticipated that the Kuruman Wind Energy Facility Phase 1 will have an output capacity of up to 200MW, which would be generated from a maximum of 47 turbines with a rotor diameter of up 160 m. The basic components of the development that would require vegetation clearing or generate potential impacts include the following:

- A total of up to 50 km of internal gravel surface access roads linking turbines, 8m wide;
- Each turbine would have a reinforced foundation of 25 m x 25 m, with an associated Crane Platform of up to1 ha each;
- A concrete on-site batching plant of 6 ha;
- Operations and maintenance building occupying an area of approximately 2 ha;
- Temporary laydown and construction areas of 6 ha;
- On-site 22/33 kV to132 kV collector substation of approximately 2 ha;

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Vegetation Types

According to the national vegetation map (Mucina & Rutherford 2006/2012), there are only two vegetation types within the boundaries of the study area, with Kuruman Mountain Bushveld occupying the rocky hills and lowlands consisting of Kuruman Thornveld (Figure 2).

The majority of the site is mapped as Kuruman Mountain Bushveld. Kuruman Mountain Bushveld is not widely distributed and has a total mapped extent of 4360 km^2 which is a narrow range for an arid vegetation type. It is distributed in the Northern Cape and North-West Provinces from Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman and re-emerging as isolated hills at Makhubung and around Pomfret. This vegetation unit is associated with rolling hills with gentle to moderate slopes and hill pediment areas and typically consists of an open shrubveld. Soils are shallow sandy soils of the Hutton form and the most common land type is Ib with lesser amounts of Ae, Ic and Ag. Kuruman Mountain Bushveld has been little impacted by transformation and is classified as Least Threatened, but is not currently conserved within any formal conservation areas. One vegetation-type endemic species *Euphorbia planiceps* is known from Kuruman Mountain Bushveld.

The plains of the site are mapped as Kuruman Thornveld. This is also a restricted vegetation type which occupies 5794 km^2 of the Northern Cape and North West Provinces from the vicinity of Postmasburg and Danielskuil in the south, extending via Kuruman to Tsineng and Dewar in the North. It has been little impacted by transformation and more than 98% of the original extent is still intact and it is classified as Least Threatened. This vegetation unit occupies flat rocky plains and sloping hills with a very well developed, closed shrub layer and well-developed tree stratum usually consisting of *Acacia erioloba*. The most important land types are Ae, Ai, Ag and Ah with Hutton soil form. The only endemic taxon known from this vegetation type is *Gnaphalium englerianum.*

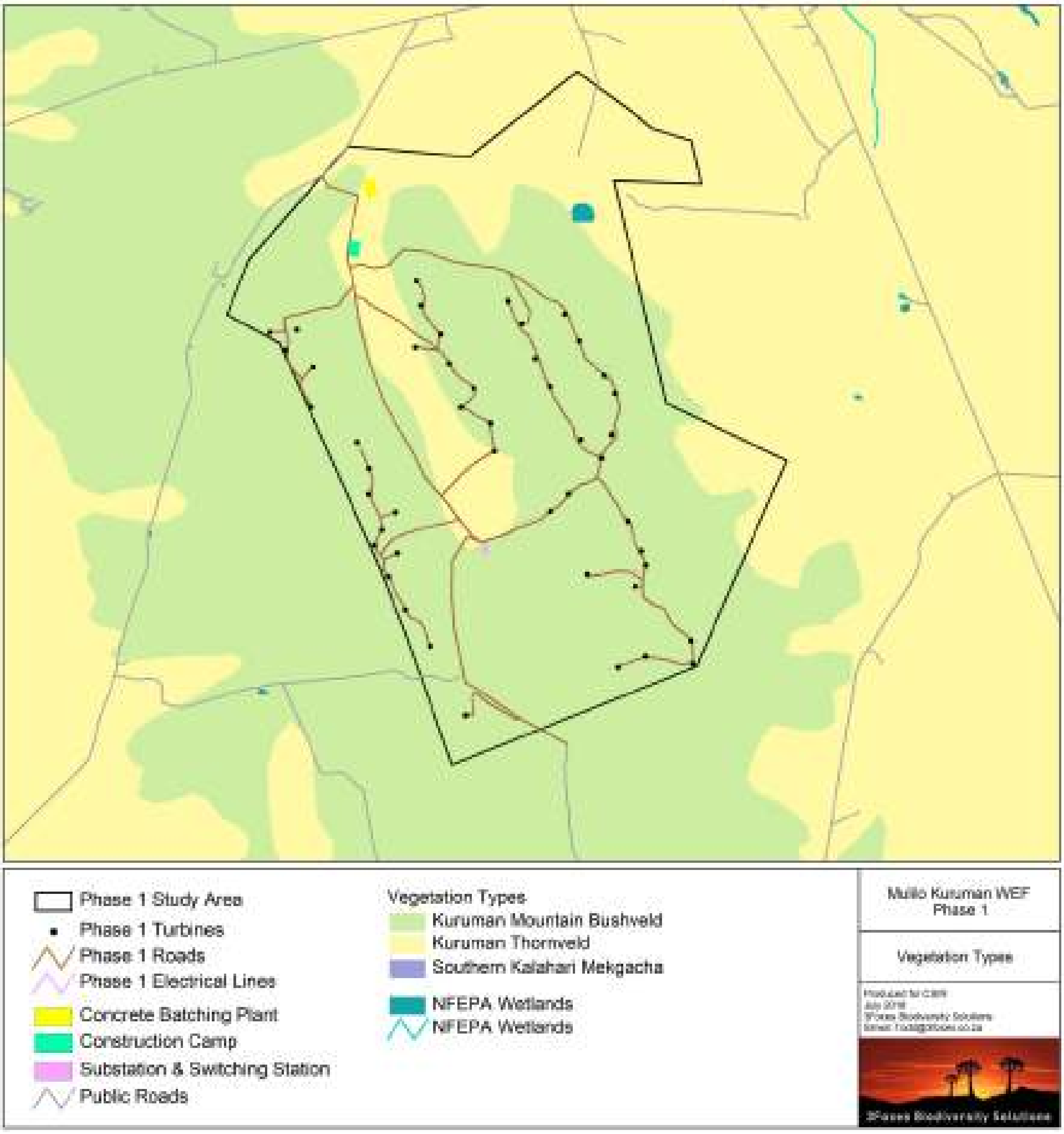

Figure 2. Vegetation map (Mucina and Rutherford 2006 and 2012 Powrie Update) of the Kuruman WEF Phase 1 study area and surrounding area.

1.3.2. Fine-Scale Vegetation Description

Kuruman Mountain Bushveld on Rocky Hills

The site is characterised by the presence of numerous broad rocky ridges which project as much as 200m above the surrounding plains, but are mostly in the order of 100m high. Some of these have flat plateau areas on top, while others are more rounded. The vegetation of the ridges is affected by slope, aspect and elevation, but in general the vegetation is fairly well differentiated from the surrounding more grassy plains. The vegetation of the rocky hills is classified as Kuruman Mountain Bushveld and corresponds well the description of this unit as described by Mucina & Rutherford (2006).

The vegetation of the rocky hills is dominated by a well-developed grass layer with a variable tree and shrub layer. Common and dominant trees and large shrubs include *Searsia lancea*, *Diospyros austro-africana*, *Euclea crispa*, *Olea europea* subsp. *africana*, *Searsia pyroides*, *Searsia tridactyla*, *Searsia ciliata*, *Tarchonanthus camphoratus*, *Buddleja saligna*, *Lantana rugosa*, *Lebeckia macrantha*, *Ehretia alba* and *Wahlenbergia nodosa*. The grass layer is dominated by grasses such as *Diheteropogon amplectens, Heteropogon contortus*, *Eragrostis chloromelas*, *E.nindensis*, *Eustachys paspaloides*, *Oropetium capense*, *Cymbopogon excavatus*, *Aristida meridionalis*, *Aristida congesta*, *Melinis repens*, *Bulbostylis burchellii*, *Anthephora pubescens*, *Themeda triandra*, *Brachiaria nigroperata*, *Brachiaria serrata, Enneapogon scoparius, Triraphis andropogonoides*, *Trichoneura grandiglumis* and *Schizachyrium sanguineum*. Forbs and low shrubs that occur within the grass layer include *Chrysocoma cilliata*, *Felicia clavipilosa*, *Pentzia calcarea*, *Portulaca kermesina*, *Sutera griquensis*, *Chascanum hederaceum*, *Rhynchosia confusa*, *Justicia puberula*, *Pollichia campestris*, *Anthospermum rigidum*, *Striga elegans*, *Hermannia tomentosa*, *Kalanchoe lanceolata*, *Helichrysum zeyheri*, *Dicoma schinzii*, *Gomphocarpus fruticosus*, *Gazania krebsiana*, *Corchorus asplenifolius*, *Monsonia angustifolia* and *Melhania virescens*.

Figure 3. Example of a lower-elevation ridge with a relatively high density of woody species, mostly *Searsia* and *Tarchonanthus*.

Figure 4. The higher elevation ridges have a lower density of woody species and generally consist of relatively open grassland. The target ridges are generally broad-backed and have sufficient space to accommodate the development without encroaching on the steeper slopes which are considered higher sensitivity and vulnerable to disturbance.

Kuruman Thornveld on Plains

The plains of the site consist of Kuruman Thornveld and consist of open to shrub-encroached plains with a well developed grass layer and a tree layer dominated by *Acacia erioloba*. Common and dominant trees and tall shrubs include *Acacia mellifera* subsp. *detinens*, *Ziziyphus mucronta*, *Grewia flava*, *Tachonanthus camphoratus*, *Gymnosporia buxifolia*, *Acacia hebeclada* subsp. *hebeclada*, *Searsia lancea*, *Searsia ciliata*, *Searsia burchellii*, *Acacia haematoxylon*, *Olea europea* subsp. *africana*, *Lebeckia macrantha*, *Diospyros austro-africana* and *Lycium schizocalyx*. Low shrubs include *Monechma divaricatum*, *Ehretia alba*, *Gnidia polycephala*, *Pentzia calcarea*, *Asparagus capensis, Chrysocoma ciliata* and Selago mixta. Forbs present include *Senna italica*, *Elephantorrhiza elephantina*, *Hermannia tomentosa*, *Corchorus asplenifolius* and *Solanum incanum*. Grasses include *Aristida meridionalis*, *A.stipitata* subsp. *stipitata*, *Eragrostis lehmannniana*, *Pogonathria squarrosa*, *Cynodon dactylon*, *Cymbopogon pospischilii*, *Melinis repens*, *Enneapogon scoparius*, *Schmidtia pappophoroides*, *Themeda triandra, Heteropogon contortus*, *Anthephora pubescens* and *Panicum kalaharense*.

Figure 5. Vegetation of the plains, at the location of the on-site substation, showing a relatively dense shrub layer dominated by *Tarchonanthus camphoratus* and *Olea europea* subsp. *africana* with occasional *Acacia haematoxylon*.

Figure 6. Open plains in the south of the site, with scattered *Acacia erioloba.*

1.3.3. Listed and Protected Plant Species

Based on the SANBI POSA database as well as the fieldwork that has been conducted at the proposed Kuruman WEF Phase 1 WEF site, the abundance of listed and protected species at the site is low. No threatened plant species were observed at the site and while the SANBI POSA database also indicates that few such species are present in the wider area, the site is large and it is possible that some red-listed species are present at the site, but if present they would not be common. There are however at least three protected tree species present at the site *Boscia albitrunca*, which is rare and was not observed within the development footprint; *Acacia haematoxylon* which occurs at a low density across the plains and would be affected to some extent by the development; and *Acacia erioloba*, which is a common to dominant species across the plains of the site and would also be impacted to some degree. However, no local populations of any protected species would be compromised by the development and the numbers of individuals lost are well within the tolerable limits.

1.3.4. Faunal Communities

1.3.4.1. Mammals

According to the MammalMap database, 39 mammals are known from the broad area around the site. The affected property is however also used as a game farm and numerous additional large ungulate species are present, but are considered to be part of the farming system as they are not free ranging beyond the property. More than 10 000 images were captured by the camera traps that were set out within the Phase 1 site and provide a reliable indication of the moderate to larger sized mammalian (>1kg) species compostion of the site (Figure 7). Species considered to be part of the farming enterprise which are present include Eland, Gemsbok, Giraffe, Red Hartebeest, Burchells Zebra, Cape Mountain Zebra, Blesbok, Waterbuck, Springbok, Impala, Blue Wildebeest, Black Wildebeest and the introduced Fallow Deer and Barbary Sheep. Naturally-occurring species present at the site includes Kudu, Common Duiker, Steenbok, Cape Hare, Chacma Baboon, Rock Hyrax, Yellow Mongoose, Small Spotted Genet, Warthog, Aardwolf, Aardvark, African Wildcat, Carcal, Black-backed Jackal, Cape Porcupine, Smith's Red Rock Rabbit, Springhare, Suricate and Slender Mongoose. Small mammals trapped or observed at the site includes South African Pouched Mouse, Namaqua Rock Mouse, Four-striped Mouse and Multimammate Mouse (Figure 8).

Species of conservation concern that may occur in the area includes the Southern African Hedgehog *Atelerix frontalis* (NT) as well as Ground Pangolin *Smutsia temminckii* (VU). It is likely that the Hedgehog is present in the area as the habitat is broadly suitable and it is also possible that the Pangolin is present in the area, but this species occurs at a low density the extent of habitat loss for this species would be low. The affected property is also fenced externally and internally with numerous electrified fences, which have a negative impact on this species with the result that it may have been extirpated from the property if previously present. The Mountain Reedbuck *Redunca fulvorufula fulvorufula* is currently classified as Endangered and is confirmed present at the site where it occurs naturally. As the habitat of this species is the high-lying ridges that are also the target of the development, there would certainly be some habitat loss for this species as a result of the development. However, the population is not likely to be impacted to a significant degree by the habitat loss resulting from the development as the on-site population is likely to be regulated by predation and competition with other herbivores rather than being closely tied to the extent of available habitat. Nevertheless some impact may result from all the disturbance generated during construction as well as potentially some aversion to the turbines during operation. When not persecuted, Mountain Reedbuck can however become quite tame and habituated to human presence so it is likely that in the long-term they will be able to tolerate the wind farm development with little long-term consequence for the on-site population. Given the status of the species and the uncertainty regarding the recent large decline in their numbers which has lead to their recent clasfficiation as Endangered, it is recommended that the population on site is monitored annually, to obtain a preconstruction baseline and then verify their perisitence over the lifespan of the facility.

Important habitats for mammals include rocky outcrops and cliffs which provide shelter and habitat for rock-dwelling species and densely-vegetated lowlands along drainage lines which provide cover for numerous species. The only species that appears to be confined to the high-lying ridges that would receive the brunt of the development footprint is the Mountain Reedbuck, which is dealt with above. For most species, the major impact of development would be habitat loss equivalent to the footprint of the facility. Some species may however be wary of the turbines or negatively affected by the noise generated and may avoid them to the greater degree than the actual footprint on the ground. It is however unlikely that any species would be significantly compromised by the development and long-term impacts on mammals are likely to be low to moderate after mitigation.

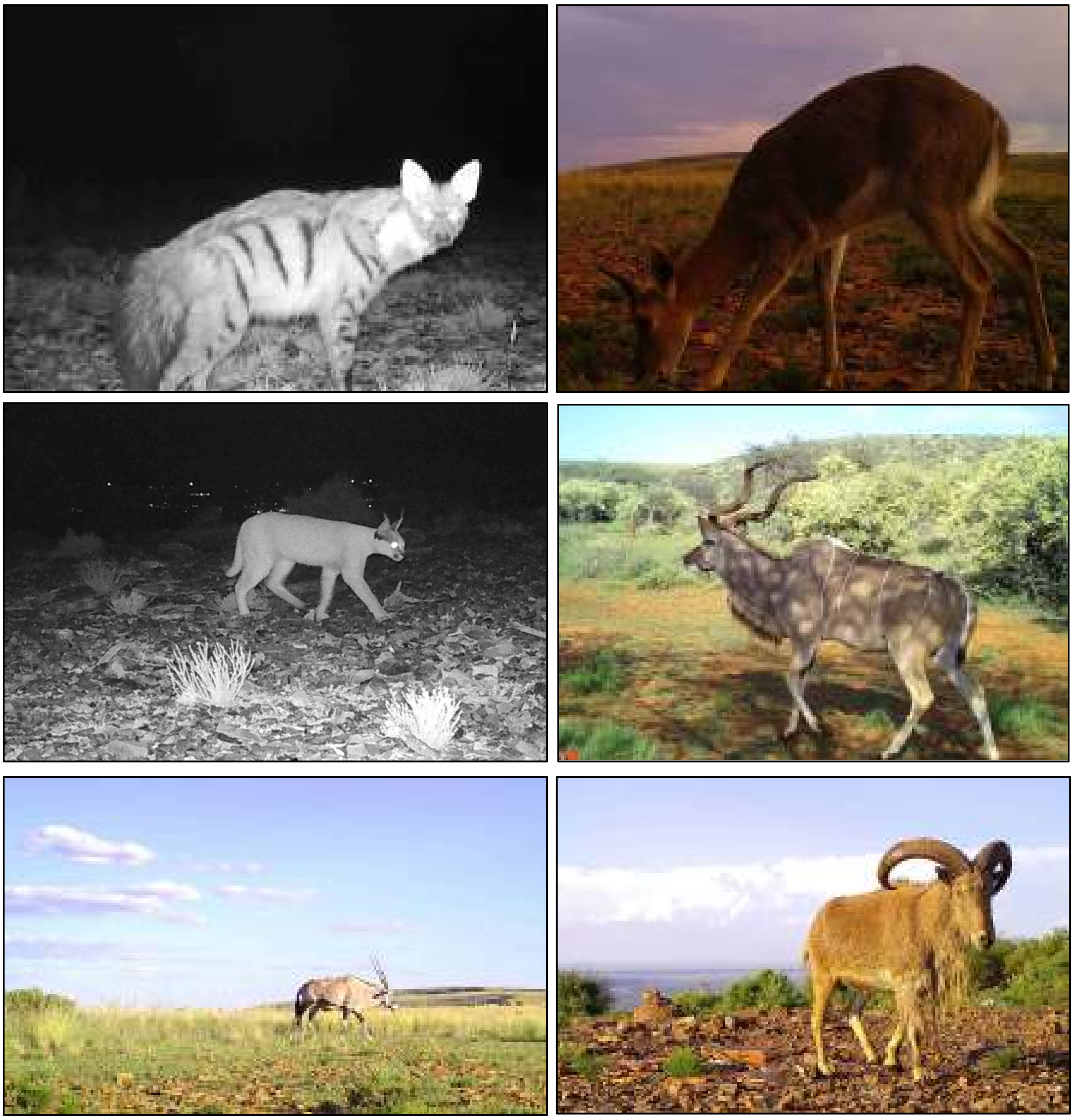

Figure 7. Notable or common species observed with the camera traps include from bottom left, Gemsbok, Caracal, Aardwolf, Mountain Reedbuck, Kudu and the introduced Barbary Sheep.


Figure 8. Small mammals trapped at the site include the Pouched Mouse and Multimammate Mouse.

1.3.4.2. Reptiles

A list of Reptiles known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the ReptileMap database is provided in Appendix 3 of this report and indicates that as many as 38 species are known to occur in the wider area. No reptile species of concern have however been recorded from the area, which can be explained by the ubiquitous nature and broad distribution of the habitats present in the area. Within the site, the rocky hills are likely to have a greater diversity of reptiles than the plains. Species observed at the site (**Figure 9**) include Ground Agama, Boomslang, Rock Monitor, Cape Gecko, Spotted Sand Lizard, Variegated Skink and Leopard Tortoise. There are no habitats of particular concern for reptiles at the site which would be impacted by the development and the species and habitats present are all widely distributed. As a result, the overall impacts of the development on reptiles are likely to be of local significance only and there are no species with a very narrow distribution range or of high conservation concern present at the site which may be compromised by the development.

Figure 9. Reptiles observed at the site include from bottom left, Cape Gecko, Spotted Sand Lizard and Boomslang.

1.3.4.3. Amphibians

There are no natural permanent water sources at the site, although there are numerous earth dams which hold water at least seasonally. Such sites represent the only breeding habitat for most amphibians at the site, although some species such as Bushveld Rain Frogs are independent of water and not dependent on water for breeding purposes and are certainly present within the lowlands of the site. No listed species are known from the area. The Giant Bullfrog occurs widely in the Savannah Biome but there are no records from the vicinity of the Kuruman area, suggesting that this species does not occur in the area. Even if present, no suitable breeding habitat for this species was observed at the site. The only species observed in the area was the Tremelo Sand Frog although some of the other toad species such as Olive Toad are also likely to be present.

Given the paucity of important amphibian habitats at the site and the low diversity of amphibians, a significant impact on frogs and toads is not likely.

1.3.5. Critical Biodiversity Areas

The CBA map for the wider area around the study site is illustrated below in **Figure 10**. The northern parts of the site fall within the Tier 2 CBA which forms a buffer area around the Billy Duvenhage Nature Reserve. The majority of the footprint of the development is within an Ecological

Support Area with some footprint areas such as the substation are within areas that are classified as *other natural areas*. The footprint within the CBA 2 area is low and a significant impact would not occur in this area. It is highly unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view. As a result, the overall impact of the development on CBAs and ESAs is considered to be low and a long-term significant impact is unlikely. In addition, the site does not fall within an area identified as being a priority conservation expansion area under the Northern Cape Protected Area Expansion Strategy (NCPAES) Focus Area (2017).

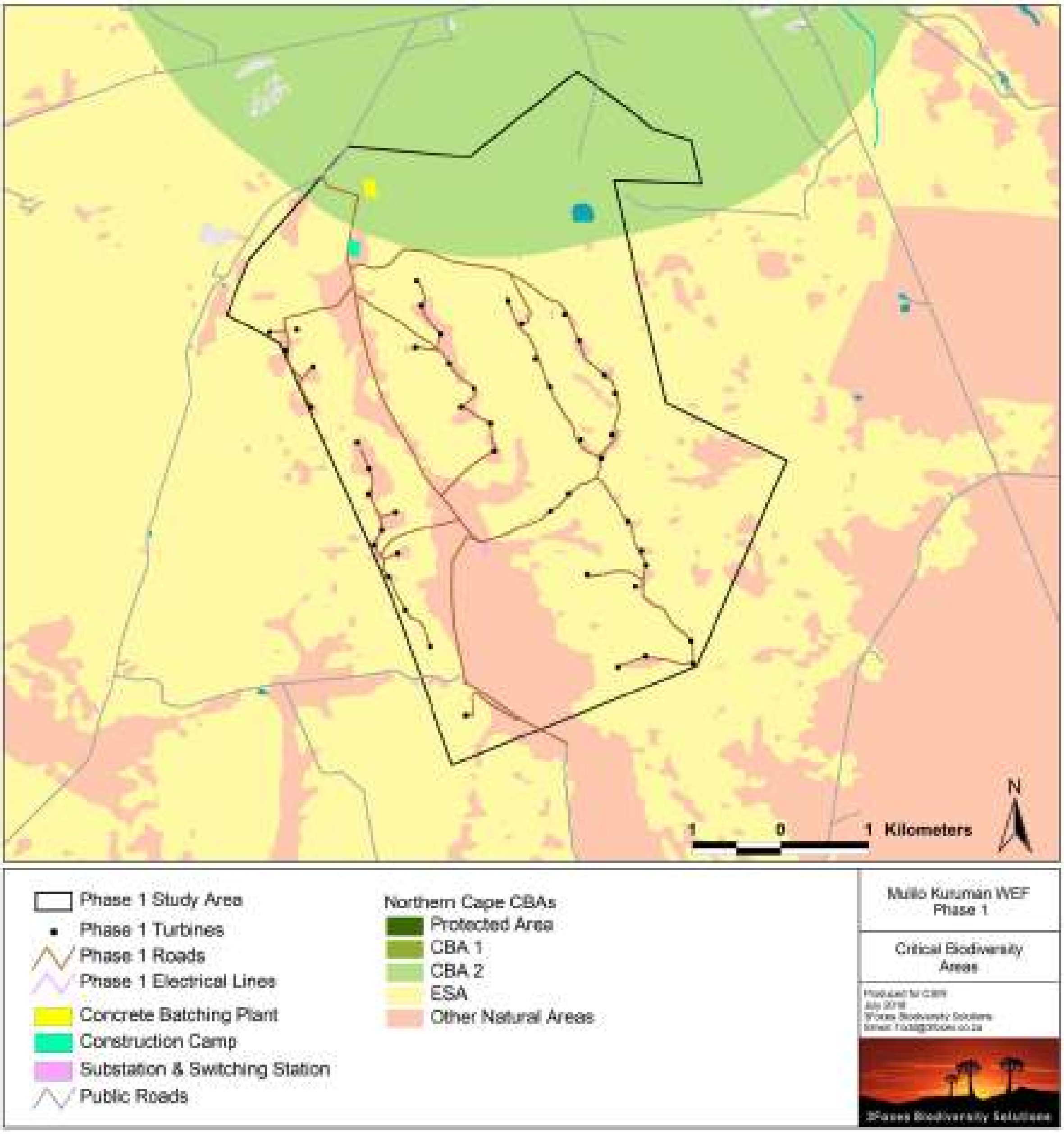

Figure 10. Critical Biodiversity Areas map for the study area, showing that the site lies mostly within Ecological Support Areas, with an area of CBA 2 in the north.

1.3.6. Cumulative Impacts

There are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site (**Figure 11**). However all of these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and is estimated at less than 100ha in total. This would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.

Figure 11. Map of other renewable energy developments in the wide area around the affected Kuruman WEF Phase 1 properties indicated in blue. All existing projects are solar PV projects restricted to the plains of the area.

1.3.7. Site Sensitivity & Results of the Field Study

The ecological sensitivity map for the study area is illustrated below in Figure 12. The slopes of the ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The low-lying plains are considered to be low sensitivity, while the plateau and ridge-top habitats are considered to be moderate sensitivity. The substation is located in an area that is considered to be relatively low sensitivity and the site is considered suitable for the substation. Similarly, the batching plant and construction camp areas were specifically checked in the field and fall within lower sensitivity areas, deemed acceptable for such activities. The turbines are restricted to the upper slopes and hill-top plateaus within areas classified as moderate sensitivity. These areas are considered acceptable for turbine placement and would generate relatively low impacts. Some of the access roads traverse high sensitivity slope areas. This is however usually along existing road alignments and is also unavoidable to access the target ridges. With the appropriate erosion control features, the access roads will generate a relatively low impact and are considered to be acceptable. Overall, the site is considered to be an acceptable site for development of a wind energy facility and the impacts associated with the development are likely to be moderate to low and would be of a local nature only as there are no habitats or species of very high conservation concern that are likely to be associated with the development.

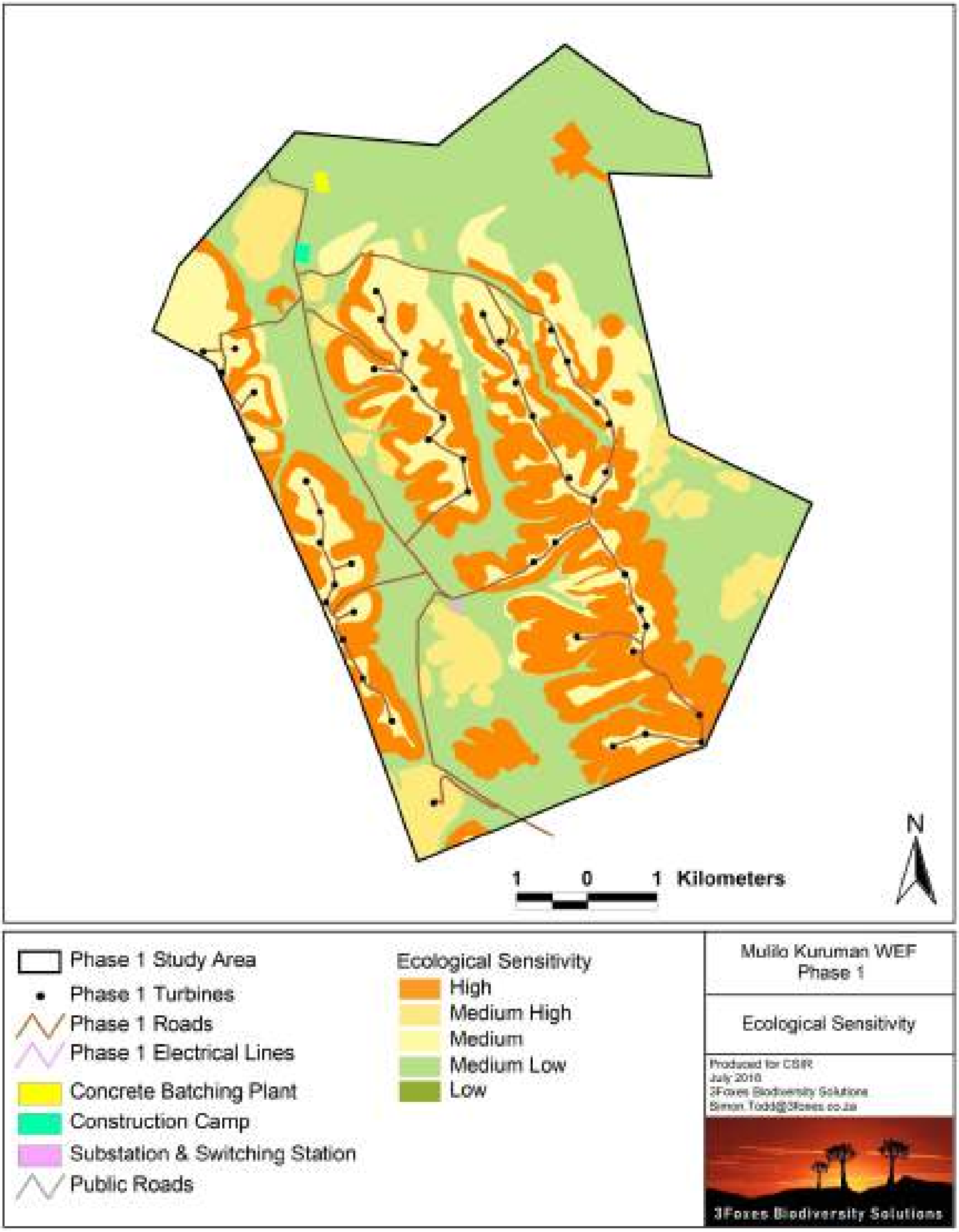

Figure 12. Ecological sensitivity map for the study area, showing the target ridges are largely considered to be moderate sensitivity and considered suitable for development.

1.4. IDENTIFICATION OF KEY ISSUES

1.4.1. Identification of Potential Impacts

The primary source of impact associated with the development is the transformation of currently intact habitat to hard infrastructure associated with the development such as turbine platforms and access roads. A significant proportion of the impact would occur during the construction phase of the development as a result of the direct transformation of intact habitat as well as disturbance associated with construction activities. During operation, impacts associated with the development would be lower and largely restricted to low-level faunal impacts as well as some potential disruption of ecosystem processes such as landscape connectivity. Impacts on CBAs are expected to be low given the low footprint within CBAs. The following activities are identified as being potentially associated with the development:

1.4.1.1. Construction Phase

- Impacts on vegetation and protected tree species
- Direct and indirect faunal impacts

1.4.1.2. Operational Phase

- Increased soil erosion
- Increased alien plant invasion
- Impacts on fauna due to operation
- Impacts on CBA and ESAs

1.4.1.3. Decommissioning Phase

- Increased alien plant invasion
- Increased soil erosion
- Direct and indirect impacts on fauna

1.4.1.4. Cumulative impacts

- Cumulative impacts on habitat loss and broad-scale ecological processes

1.5. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

An assessment of the impacts associated with the development, is provided below, for each identified impact and each phase of the development.

1.5.1. Construction Phase Impact 1. Impacts on vegetation and plant species of conservation concern

- The abundance of plant species of concern at the site is very low, although there are three protected tree species present that would be impacted by the development to a greater or lesser degree. However, the main impact of the development would be the loss of approximately 100 ha of currently intact vegetation. Given the low current levels of impact on the affected vegetation types, the significance of this impact is considered to be of low magnitude and of local significance only.

Without mitigation this impact would be of **Moderate** potential significance.

Essential mitigation measures include:

- No development of turbines, roads of other infrastructure within identified no-go areas.
- Pre-construction walk-through of the development footprint to further refine the layout and further reduce impacts on sensitive habitats and protected species through micro-siting of the turbines and access roads.

With the implementation of the suggested mitigation the impact on vegetation likely be reduced to a **Low** significance.

1.5.2. Construction Phase Impact 2. Direct and indirect faunal impacts

The construction of the development will result in significant habitat loss, noise and disturbance on site. This will lead to direct and indirect disturbance of resident fauna. Some slow-moving or retiring species such as many reptiles would likely not be able to escape the construction machinery and would be killed. There are also several species present at the site which are vulnerable to poaching and there is a risk that these species may be targeted. This impact would be caused by the presence and operation of construction machinery and personnel on the site. This impact would however be transient and restricted to the construction phase, with significantly lower levels of disturbance during the operational phase.

Without mitigation this impact is likely to be of **Moderate** significance.

Essential mitigation measures would include:

- Avoidance of identified areas of high fauna importance.
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Limiting access to the site and ensuring that construction staff and machinery remain within the demarcated construction areas during the construction phase.
- Environmental induction for all staff and contractors on-site.

With the implementation of the suggested mitigation the construction phase impact on fauna can likely be reduced to a **Moderate to Low Significance**.

1.5.3. Operational Phase Impact 1. Increased Soil Erosion

The site has steep slopes and sandy soils that are vulnerable to erosion and the disturbance created during construction will increase erosion risk at the site. The access roads onto the ridges pose a particular risk and specific mitigation would be required to manage erosion risk in these vulnerable areas.

Without mitigation, this impact would potentially be of **Moderate significance**.

Essential mitigation measures would include:

- Avoiding areas of high erosion vulnerability as much as possible.
- Using barriers, geotextiles, active rehabilitation and other measures during and after construction to minimise soil movement at the site.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to an acceptable, **low significance**.

1.5.4. Operational Phase Impact 2. Increased Alien Plant Invasion

There are already several alien species present on the site such as *Prosopis glandulosa* and disturbance created during construction would leave the site vulnerable to further alien plant invasion, especially along the access roads and other areas which receive additional run-off from the hardened surfaces of the development.

Without mitigation this impact would likely be of **Moderate to Low Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the operational phase of the development, which makes provision for regular alien clearing and monitoring.
- Rehabilitation of disturbed areas that are not regularly used after construction.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

1.5.5. Operational Phase Impact 3. Operational Impacts on Fauna

Operational activities as well as the presence of the turbines and the noise they generate may deter some sensitive fauna from the area. In addition, the access roads may function to fragment the habitat for some fauna, which are either unable to or unwilling to traverse open areas. For some species this relates to predation risk as slow-moving species such as tortoises are vulnerable to predation by crows and other predators. In terms of habitat disruption, subterranean species such burrowing snakes and skinks are particularly vulnerable to this type of impact as they are unable to traverse the hardened roads or become very exposed to predation when doing so. This is a low-level continuous impact which could have significant cumulative impact on sensitive species. The majority of the site however consists of rocky terrain where this would have a minimal impact as the soils are already shallow and fragmented.

Without mitigation this impact would likely be of **Moderate to Low Significance**.

Essential mitigation measures would include:

- Open space management plan for the development, which makes provision for favourable management of the facility and the surrounding area for fauna.
- Limiting access to the site to staff and contractors only.
- Appropriate design of roads and other infrastructure where appropriate to minimise faunal impacts and allow fauna to pass through or underneath these features.
- No electrical fencing within 30cm of the ground as tortoises become stuck against such fences and are electrocuted to death.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

1.5.6. Operational Phase Impact 4. Impacts on Critical Biodiversity Areas and ESAs

A part of the site is within a CBA 2 and the majority of the development footprint is within an Ecological Support Area. With mitigation, the wind energy facility is considered compatible with the role of the ESA and a long-term significant impact on CBAs and ESAs is not likely. As such impacts on CBA, ESAs and associated ecological processes are considered to be low. The major mitigation requires to reduce impacts on CBAs and ESAs to a low level is actually to ensure that the mitigation measures suggested for the other impacts are adhered to and well applied in the field as it is low overall impact of the development on the general environment that results in sustainable development and a consequent acceptable impact on the CBAs and ESAs of the area.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Avoid impact to restricted and specialised habitats such as large rocky outcrops.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

1.5.7. Decommissioning Phase Impact 1. Increased Soil Erosion

As already described, the site has steep slopes that are vulnerable to erosion. Decommissioning will remove the hard infrastructure from the site, generating disturbance and leaving areas that are unvegetated and vulnerable to erosion.

Without mitigation, this impact would potentially be of **Moderate significance**.

Essential mitigation measures would include:

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful.
- Using net barriers, geotextiles, active rehabilitation and other measures during and after decommissioning to minimise sand movement at the site.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to an acceptable, **low significance**.

1.5.8. Decommissioning Phase Impact 2. Increased Alien Plant Invasion

There are already some alien species present on the site such as *Prosopis* and disturbance created during decommissioning would leave the site vulnerable to further alien plant invasion.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.
- Rehabilitation of disturbed areas that have been generated by decommissioning.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

1.5.9. Cumulative Impact 1. Cumulative habitat loss and impact on broad-scale ecological processes

There are several other renewable energy developments in the wider area and along with the current development, these would contribute to cumulative impacts on habitat loss and fragmentation and negative impact on broad-scale ecological processes such as dispersal and climate change resilience. However, not all of the developments in the area would impact on the same ridge habitat as the current development and overall, the current levels of cumulative development impact in the wider area is relatively low.

Without mitigation, this impact is likely to be of **Moderate to Low Significance.**

Essential mitigation measures would include:

- Minimise the current development footprint as much as possible and rehabilitate cleared areas after construction.
- Ensure that management of the facility occurs in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

1.6. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 1-1 to 1-4 below. Impacts are assessed for the construction, operational and decommissioning phases of the development as well as for overall cumulative impacts. It is important to note that the pre-mitigation impacts already include some planning-level avoidance as the layout assessed has been produced in response to the sensitivity mapping that has been produced as part of this as well as the other specialist studies. As such, the pre-mitigation impacts are lower than they would otherwise likely have been and it is no longer considered relevant to stipulate avoidance-level mitigation meaures that have been adhered to.

Table 1-1 Impact assessment summary table for the Construction Phase

CONSTRUCTION PHASE													
Direct impacts													
Impact on vegetation													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Habitat Loss	**-**	**Local**	**Long-term**	**Moderate**	**Very Likely**	**Low**	**Moderate**	**Moderate Risk (3)**	**Partly**	**Partly**	**Low**	**4**	**High**
Suggested Mitigation: • No development of turbines, roads or other infrastructure within No-Go areas as has been achieved under the assessed layout. • Preconstruction walk-through with follow-up search and reascue of the development footprint to further refine the layout and reduce impacts on protected species through micro-siting of the turbines and access roads. • Demarcate all areas to be cleared with construction tape or other appropriate and effective means. However caution should be exercised to avoid using material that might entangle fauna.													
Faunal Impacts due to construction													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Habitat Loss	**-**	**Local**	**Short-term**	**Substantial**	**Very Likely**	**Moderate**	**Moderate**	**Moderate Risk (3)**	**Partly**	**Partly**	**Low**	**3**	**High**

Suggested Mitigation:

- Avoidance of identified areas of high faunal importance at the design stage as has been achived with the current layout..
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- 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.
- Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.
- Environmental induction for all staff and contractors on-site.
- 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 facility as well as on the public gravel access roads to the site.
- 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) as far as practically possible, which do not attract insects and which should be directed downwards.
- Initiate a monitoring programme for the Mountain Reedbuck on the site for at least two years prior to construction. This may take the form of structured counts, aerial surveys or camera traps set at designated sites.

Table 1-2 Impact assessment summary table for the Operational Phase

OPERATIONAL PHASE													
Direct impacts													
Increased soil erosion													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Disturbance	**-**	**Local**	**Long-term**	**Moderate**	**Likely**	**Moderate**	**Moderate**	**Moderate Risk (3)**	**Yes**	**Yes**	**Low**	**4**	**High**
Suggested Mitigation: • Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan. • 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. • 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. • All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • All cleared areas should be revegetated with indigenous perennial species from the local area. • Avoid areas of high erosion vulnerability as much as possible. • Use active rehabilitation and other passive measures during and after construction to minimise erosion at the site.													
Increased alien plant invasion													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**

Disturbance	**-**	**Local**	**Medium-term**	**Moderate**	**Likely**	**Moderate**	**Moderate**	**Moderate Risk (3)**	**Yes**	**Yes**	**Low**	**4**	**High**

Suggested Mitigation:

- Alien management plan to be implemented during the operational phase of the development, which makes provision for regular alien clearing and monitoring.
- Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species.
- 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.
- 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.
- Regular alien clearing should be conducted, as needed, using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.

Operational impacts on fauna

Impact pathway	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Noise & Disturbance	**-**	**Local**	**Long-term**	**Moderate**	**Likely**	**Moderate**	**Moderate**	**Moderate Risk (3)**	**Partly**	**Partly**	**Low**	**4**	**High**

Suggested Mitigation:

- Open space management plan for the development, which makes provision for favourable management of the facility and the surrounding area for fauna.
- Limiting access to the site to staff and contractors only.
- Appropriate design of roads and other infrastructure where appropriate to minimise faunal impacts and allow fauna to pass through or underneath these features.
- No electrical fencing within 30cm of the ground as tortoises become stuck against such fences and are electrocuted to death.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs) as far as possible, which do not attract insects.
- 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.
- 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.
- Annual monitoring of the on-site population of Mountain Reedbuck should be conducted and reports submitted to DENC every 3-5 years.

Impacts on Critical Biodiversity Areas and ESAs

Impact pathway	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Habitat loss and disturbance	**-**	**Local**	**Long-term**	**Moderate**	**Likely**	**Moderate**	**Moderate**	**Moderate Risk (3)**	**Partly**	**Partly**	**Low**	**4**	**High**

Suggested Mitigation:

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Avoid impact to restricted and specialised habitats such as drainage areas and rocky outcrops
- Ensure that operational phase noise and disturbance is minimised as far as possible.

Table 1-3 Impact assessment summary table for the Decommissioning Phase

DECOMMISSIONING PHASE													
Direct impacts													
Increased soil erosion													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Habitat loss and disturbance	**-**	**Local**	**Long-term**	**Moderate**	**Likely**	**Low**	**Moderate**	**Moderate Risk (3)**	**Yes**	**Yes**	**Low**	**4**	**High**

Suggested Mitigation:

- All hard infrastructure should be removed and the footprint areas rehabilitated with locally-sourced perennial species.
- The use of net barriers, geotextiles, active rehabilitation and other measures after decommissioning to minimise sand movement and enhance revegetation at the site.
- Monitoring of rehabilitation success at the site for at least 5 years after decommissioning.
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.

Increased alien plant invasion													
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**	**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Habitat loss and disturbance	**-**	**Local**	**Long-term**	**Moderate**	**Likely**	**Low**	**Moderate**	**Moderate Risk (3)**	**Yes**	**Yes**	**Low**	**4**	**High**

Suggested Mitigation:
Suggested Mitigation: • Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for at least 5 years after decommissioning. • Active rehabilitation and revegetation of previously disturbed areas with indigenous species selected from the local environment. • Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after decommissioning activities are complete to encourage natural regeneration of the local indigenous species. • 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. • 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. • 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.

Table 1-4 Impact assessment summary table for Cumulative Impacts

Cumulative Impacts														
Cumulative habitat loss and impact on broad scale ecological processes														
Impact pathway	**Status**	**Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of impact**	**Irreplaceability of receiving environment/ resource**	**Significance of impact/risk = consequence x probability (before mitigation)**	**Can impact be avoided?**	**Can impact be managed or mitigated?**		**Significance of residual risk/impact (after mitigation)**	**Ranking of impact/ risk**	**Confidence level**
Habitat loss and disturbance	**-**	**Regional**	**Long-term**	**Moderate**	**Likely**	**Low**	**Moderate**	**Moderate Risk (3)**	**Partly**	**Partly**		**Low**	**4**	**High**

Suggested Mitigation:

- Minimise the development footprint as far as possible.
- The facility should be managed in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

1.7. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

A description of the key monitoring recommendations for each applicable mitigation measure identified for all phases of the project is provided in tables 16 to 19 below and should be included in the EMPr or environmental authorisation.

Table 1: Key monitoring recommendations for the design phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
A. DESIGN PHASE					
A.1. TERRESTRIAL ECOLOGY IMPACTS					
		▪		▪	

Table 2: Key monitoring recommendations for the construction phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
B. CONSTRUCTION PHASE					
A.1. TERRESTRIAL ECOLOGY IMPACTS					
		▪		▪	

Table 3: Key monitoring recommendations for the operational phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
C. OPERATIONAL PHASE					
A.1. TERRESTRIAL ECOLOGY IMPACTS					
		▪		▪	▪

Table 4: Key monitoring recommendations for the decommissioning phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
D. DECOMMISSIONING PHASE					
A.1. TERRESTRIAL ECOLOGY IMPACTS					
		▪		▪	

1.8. CONCLUSIONS AND RECOMMENDATIONS

The Kuruman WEF Phase 1 site consists of Kuruman Mountain Bushveld on the rocky hills and Kuruman Thornveld on the lowlands. Both of these vegetation types are of least concern and have not been significantly impacted by transformation to date. The abundance of plant species of conservation concern at the site is low and the overall impact of the development on vegetation would be low. In terms of fauna, the abundance of species of concern at the site is generally low. However, the Endangered Mountain Reedbuck *Redunca fulvorufula fulvorufula* is confirmed present at the site and is identified as the mammalian species with the highest potential conflict with the development due to the high degree of overlap between the development footprint and favoured ridge-top habitat of this species. Although it is highly likely that this species will be able to tolerate the presence of the wind farm with little long-term impact, it is recommended that a monitoring programme should be set up at the preconstruction phase for this species to monitor for potential impacts of the development.

The northern part of the site is located within a CBA 2 which forms a buffer area around the Billy Duvenhage Nature Reserve. The majority of the footprint of the development is however within an Ecological Support Area. The footprint within the CBA 2 area is low and a significant impact on the CBA is not likely. In addition, it is unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view.

Although there are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site, these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.

The sensitivity mapping that was conducted indicates that the slopes of the target ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The plateau and ridge-top habitats where the majority of the development impact would occur are are considered to be moderately sensitive. These areas are considered acceptable for turbine placement and would generate relatively low impacts on most components of biodiversity at the site. Although the access roads must neccesarily traverse some high sensitivity slope areas in order to access the target ridges, with the appropriate erosion control features, these would generate a relatively low impact and are considered to be acceptable.

Ecological Impact Statement:

Overall, the Kuruman Phase 1 site is considered to be an acceptable site for development of a wind energy facility and the impacts associated with the development are likely to be of moderate to low significance after mitigation. No impacts of broader consequence are likely to occur and as such, there do not appear to be any major issues or impacts that cannot be mitigated to a low level. From a terrestrial ecology perspective, the development can be supported.

1.9. REFERENCES

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1.10. APPENDICES

1.10.1. Appendix 1. List of Plants

List of plant species known from the broad area around the Kuruman WEF Phase 1 based on the SANBI POSA database. .

Family	Genus	Species	Rank	Subspecies	IUCN	Family	Genus	Species	Rank	Subspecies	IUCN
Acanthaceae	*Barleria*	*lichtensteiniana*				Acanthaceae	*Barleria*	*macrostegia*			
Acanthaceae	*Glossochilus*	*burchellii*				Acanthaceae	*Hypoestes*	*forskaolii*			
Acanthaceae	*Justicia*	*divaricata*				Acanthaceae	*Barleria*	*bechuanensis*			LC
Acanthaceae	*Barleria*	*media*				Acanthaceae	*Justicia*	*australis*			
Acanthaceae	*Justicia*	*incana*				Acanthaceae	*Justicia*	*puberula*			
Aizoaceae	*Nananthus*	*aloides*			LC	Aizoaceae	*Plinthus*	*sericeus*			LC
Aizoaceae	*Trianthema*	*parvifolia*	var.	*parvifolia*	LC	Aizoaceae	*Trichodiadema*	*pomeridianum*			LC
Aizoaceae	*Prepodesma*	*orpenii*				Aizoaceae	*Ruschia*	*calcarea*			DD
Amaranthaceae	*Aerva*	*leucura*			LC	Amaranthaceae	*Amaranthus*	*thunbergii*			LC
Amaranthaceae	*Chenopodium*	*hederiforme*	var.	*undulatum*	LC	Amaranthaceae	*Hermbstaedtia*	*fleckii*			LC
Amaranthaceae	*Hermbstaedtia*	*odorata*	var.	*albi-rosea*	NE	Amaranthaceae	*Hermbstaedtia*	*odorata*	var.	aurantiaca	NE
Amaranthaceae	*Hermbstaedtia*	*odorata*	var.	*odorata*	NE	Amaranthaceae	*Pupalia*	*lappacea*	var.	lappacea	LC
Amaranthaceae	*Salsola*	*rabieana*			LC	Amaranthaceae	*Salsola*	*tuberculata*			LC
Amaranthaceae	*Sericorema*	*remotiflora*			LC	Amaranthaceae	*Achyranthes*	*aspera*	var.	pubescens	Alien
Amaranthaceae	*Achyranthes*	*aspera*	var.	*aspera*	Alien	Amaranthaceae	*Amaranthus*	*hybridus*	subsp.	hybridus	Alien
Amaranthaceae	*Atriplex*	*semibaccata*			Alien invasive	Amaranthaceae	*Dysphania*	*cristata*			Alien invasive
Amaryllidaceae	*Nerine*	*laticoma*			LC	Amaryllidaceae	*Strumaria*	*gemmata*			LC
Anacampserotaceae	*Avonia*	*albissima*				Anacampserotaceae	*Anacampseros*	*filamentosa*	subsp.	filamentosa	
Anacardiaceae	*Searsia*	*ciliata*				Anacardiaceae	*Searsia*	*lancea*			
Anacardiaceae	*Searsia*	*dregeana*				Anacardiaceae	*Searsia*	*tridactyla*			
Apiaceae	*Afrosciadium*	*magalismontanum*			LC	Apiaceae	*Berula*	*thunbergii*			LC
Apiaceae	*Deverra*	*burchellii*			LC	Apocynaceae	*Brachystelma*	*circinatum*			LC
Apocynaceae	*Gomphocarpus*	*fruticosus*	subsp.	*fruticosus*	LC	Apocynaceae	*Gomphocarpus*	*tomentosus*	subsp.	tomentosus	LC
Apocynaceae	*Piaranthus*	*decipiens*			LC	Araliaceae	*Hydrocotyle*	*verticillata*			LC

Asparagaceae	*Asparagus*	*cooperi*			LC	Asparagaceae	*Asparagus*	*laricinus*			LC
Asparagaceae	*Asparagus*	*nelsii*			LC	Asparagaceae	*Asparagus*	*suaveolens*			LC
Asphodelaceae	*Aloe*	*bergeriana*			DD	Asphodelaceae	*Aloe*	*claviflora*			LC
Asphodelaceae	*Aloe*	*grandidentata*			LC	Asphodelaceae	*Bulbine*	*abyssinica*			LC
Asphodelaceae	*Bulbine*	*frutescens*			LC	Asphodelaceae	*Trachyandra*	*laxa*	var.	laxa	LC
Aspleniaceae	*Asplenium*	*adiantum-nigrum*	var.	*adiantum-nigrum*	LC	Aspleniaceae	*Asplenium*	*cordatum*			LC
Asteraceae	*Amphiglossa*	*triflora*			LC	Asteraceae	*Arctotis*	*leiocarpa*			LC
Asteraceae	*Athrixia*	*phylicoides*			LC	Asteraceae	*Chrysocoma*	*ciliata*			LC
Asteraceae	*Cineraria*	*vallis-pacis*			LC	Asteraceae	*Dicoma*	*anomala*	subsp.	gerrardii	LC
Asteraceae	*Dicoma*	*schinzii*			LC	Asteraceae	*Dimorphotheca*	*cuneata*			LC
Asteraceae	*Erlangea*	*misera*			LC	Asteraceae	*Felicia*	*clavipilosa*	subsp.	clavipilosa	LC
Asteraceae	*Felicia*	*filifolia*	subsp.	*filifolia*	LC	Asteraceae	*Felicia*	*muricata*	subsp.	muricata	LC
Asteraceae	*Felicia*	*muricata*	subsp.	*cinerascens*	LC	Asteraceae	*Foveolina*	*dichotoma*			LC
Asteraceae	*Gazania*	*krebsiana*	subsp.	*arctotoides*	LC	Asteraceae	*Gazania*	*krebsiana*	subsp.	serrulata	LC
Asteraceae	*Geigeria*	*brevifolia*			LC	Asteraceae	*Geigeria*	*filifolia*			LC
Asteraceae	*Geigeria*	*ornativa*	subsp.	*ornativa*	LC	Asteraceae	*Helichrysum*	*argyrosphaerum*			LC
Asteraceae	*Helichrysum*	*caespititium*			LC	Asteraceae	*Helichrysum*	*cerastioides*	var.	cerastioides	LC
Asteraceae	*Helichrysum*	*lineare*			LC	Asteraceae	*Helichrysum*	*nudifolium*	var.	nudifolium	LC
Asteraceae	*Helichrysum*	*spiciforme*			LC	Asteraceae	*Helichrysum*	*zeyheri*			LC
Asteraceae	*Hirpicium*	*echinus*			LC	Asteraceae	*Kleinia*	*longiflora*			LC
Asteraceae	*Leysera*	*tenella*			LC	Asteraceae	*Nidorella*	*hottentotica*			LC
Asteraceae	*Nolletia*	*ciliaris*			LC	Asteraceae	*Osteospermum*	*microphyllum*			LC
Asteraceae	*Osteospermum*	*muricatum*	subsp.	*muricatum*	LC	Asteraceae	*Pegolettia*	*retrofracta*			LC
Asteraceae	*Pentzia*	*argentea*			LC	Asteraceae	*Pentzia*	*calcarea*			LC
Asteraceae	*Pteronia*	*mucronata*			LC	Asteraceae	*Pulicaria*	*scabra*			LC
Asteraceae	*Rosenia*	*humilis*			LC	Asteraceae	*Senecio*	*consanguineus*			LC
Asteraceae	*Senecio*	*inaequidens*			LC	Asteraceae	*Tarchonanthus*	*camphoratus*			LC
Asteraceae	*Tolpis*	*capensis*			LC	Asteraceae	*Ursinia*	*nana*	subsp.	nana	LC
Asteraceae	*Dicoma*	*kurumanii*			LC	Asteraceae	*Eriocephalus*	*glandulosus*			LC

Asteraceae	*Gnaphalium*	*englerianum*			LC	Asteraceae	*Osteospermum*	*leptolobum*			LC
Asteraceae	*Pentzia*	*quinquefida*			LC	Asteraceae	*Pteronia*	*glauca*			LC
Asteraceae	*Senecio*	*burchellii*			LC	Asteraceae	*Tarchonanthus*	*obovatus*			LC
Asteraceae	*Bidens*	*pilosa*			Alien	Asteraceae	*Zinnia*	*peruviana*			Alien
Asteraceae	*Sonchus*	*oleraceus*			Alien invasive	Aytoniaceae	*Plagiochasma*	*rupestre*	var.	rupestre	
Bignoniaceae	*Catophractes*	*alexandri*			LC	Bignoniaceae	*Rhigozum*	*obovatum*			LC
Bignoniaceae	*Rhigozum*	*trichotomum*			LC	Boraginaceae	*Anchusa*	*riparia*			LC
Boraginaceae	*Ehretia*	*alba*			LC	Boraginaceae	*Heliotropium*	*ovalifolium*			LC
Boraginaceae	*Heliotropium*	*strigosum*			LC	Brassicaceae	*Erucastrum*	*strigosum*			LC
Brassicaceae	*Heliophila*	*suavissima*			LC	Brassicaceae	*Brassica*	*tournefortii*			Alien invasive
Bryaceae	*Bryum*	*apiculatum*				Bryaceae	*Rosulabryum*	*capillare*			
Campanulaceae	*Wahlenbergia*	*androsacea*			LC	Campanulaceae	*Wahlenbergia*	*denticulata*	var.	transvaalensis	LC
Campanulaceae	*Wahlenbergia*	*nodosa*			LC	Caryophyllaceae	*Dianthus*	*namaensis*	var.	dinteri	
Caryophyllaceae	*Pollichia*	*campestris*				Celastraceae	*Gymnosporia*	*buxifolia*			LC
Celastraceae	*Putterlickia*	*pyracantha*			LC	Celastraceae	*Putterlickia*	*saxatilis*			LC
Cleomaceae	*Cleome*	*angustifolia*	subsp.	*diandra*	LC	Cleomaceae	*Cleome*	*conrathii*			NT
Cleomaceae	*Cleome*	*kalachariensis*			LC	Cleomaceae	*Cleome*	*oxyphylla*	var.	oxyphylla	LC
Colchicaceae	*Ornithoglossum*	*vulgare*				Commelinaceae	*Commelina*	*africana*	var.	lancispatha	LC
Commelinaceae	*Commelina*	*africana*	var.	*barberae*	LC	Commelinaceae	*Commelina*	*livingstonii*			LC
Convolvulaceae	*Evolvulus*	*alsinoides*			LC	Convolvulaceae	*Ipomoea*	*obscura*	var.	obscura	LC
Convolvulaceae	*Ipomoea*	*suffruticosa*			LC	Convolvulaceae	*Seddera*	*suffruticosa*			LC
Convolvulaceae	*Xenostegia*	*tridentata*	subsp.	*angustifolia*		Crassulaceae	*Crassula*	*capitella*	subsp.	nodulosa	
Crassulaceae	*Crassula*	*lanceolata*	subsp.	*transvaalensis*	LC	Crassulaceae	*Kalanchoe*	*brachyloba*			
Crassulaceae	*Kalanchoe*	*lanceolata*				Crassulaceae	*Kalanchoe*	*rotundifolia*			
Crassulaceae	*Crassula*	*subaphylla*	var.	*subaphylla*		Cucurbitaceae	*Acanthosicyos*	*naudinianus*			LC
Cucurbitaceae	*Citrullus*	*lanatus*			LC	Cucurbitaceae	*Coccinia*	*sessilifolia*			LC
Cucurbitaceae	*Cucumis*	*africanus*			LC	Cucurbitaceae	*Kedrostis*	*africana*			LC
Cucurbitaceae	*Cucumis*	*heptadactylus*			LC	Cyperaceae	*Bulbostylis*	*burchellii*			LC

Cyperaceae	*Bulbostylis*	*humilis*			LC	Cyperaceae	*Cladium*	*mariscus*	subsp.	jamaicense	LC
Cyperaceae	*Cyperus*	*bellus*			LC	Cyperaceae	*Cyperus*	*fulgens*			LC
Cyperaceae	*Cyperus*	*longus*	var.	*tenuiflorus*	NE	Cyperaceae	*Cyperus*	*margaritaceus*	var.	margaritaceus	LC
Cyperaceae	*Cyperus*	*marginatus*			LC	Cyperaceae	*Cyperus*	*marlothii*			LC
Cyperaceae	*Cyperus*	*sphaerospermus*			LC	Cyperaceae	*Scleria*	*dregeana*			LC
Cyperaceae	*Kyllinga*	*alba*			LC	Cyperaceae	*Afroscirpoides*	*dioeca*			
Cyperaceae	*Cyperus*	*capensis*			LC	Dipsacaceae	*Scabiosa*	*columbaria*			LC
Ebenaceae	*Diospyros*	*austro-africana*	var.	*microphylla*		Ebenaceae	*Diospyros*	*lycioides*	subsp.	lycioides	
Ebenaceae	*Euclea*	*crispa*	subsp.	*ovata*		Ebenaceae	*Euclea*	*undulata*			
Elatinaceae	*Bergia*	*pentheriana*			LC	Equisetaceae	*Equisetum*	*ramosissimum*	subsp.	ramosissimum	LC
Euphorbiaceae	*Croton*	*gratissimus*	var.	*gratissimus*	LC	Euphorbiaceae	*Euphorbia*	*spartaria*			LC
Euphorbiaceae	*Euphorbia*	*duseimata*			LC	Euphorbiaceae	*Euphorbia*	*juttae*			LC
Euphorbiaceae	*Euphorbia*	*rhombifolia*			LC	Euphorbiaceae	*Euphorbia*	*peplus*			Alien
Fabaceae	*Bolusia*	*acuminata*			LC	Fabaceae	*Calobota*	*cuspidosa*			LC
Fabaceae	*Chamaecrista*	*biensis*			LC	Fabaceae	*Chamaecrista*	*mimosoides*			LC
Fabaceae	*Crotalaria*	*leubnitziana*			LC	Fabaceae	*Crotalaria*	*podocarpa*			LC
Fabaceae	*Crotalaria*	*spartioides*			LC	Fabaceae	*Crotalaria*	*sphaerocarpa*	subsp.	sphaerocarpa	LC
Fabaceae	*Crotalaria*	*virgultalis*			LC	Fabaceae	*Elephantorrhiza*	*elephantina*			LC
Fabaceae	*Indigofera*	*alternans*	var.	*alternans*	LC	Fabaceae	*Indigofera*	*comosa*			LC
Fabaceae	*Indigofera*	*daleoides*	var.	*daleoides*	NE	Fabaceae	*Indigofera*	*flavicans*			LC
Fabaceae	*Indigofera*	*hololeuca*			LC	Fabaceae	*Indigofera*	*sessilifolia*			LC
Fabaceae	*Indigofera*	*vicioides*	var.	*vicioides*	LC	Fabaceae	*Leobordea*	*divaricata*			LC
Fabaceae	*Lessertia*	*frutescens*	subsp.	*frutescens*	LC	Fabaceae	*Lotononis*	*crumanina*			LC
Fabaceae	*Lotononis*	*divaricata*			NE	Fabaceae	*Lotononis*	*laxa*			LC
Fabaceae	*Melolobium*	*calycinum*			LC	Fabaceae	*Melolobium*	*macrocalyx*	var.	macrocalyx	LC
Fabaceae	*Otoptera*	*burchellii*			LC	Fabaceae	*Parkinsonia*	*africana*			LC
Fabaceae	*Ptycholobium*	*biflorum*	subsp.	*biflorum*	LC	Fabaceae	*Requienia*	*pseudosphaerosperma*			LC
Fabaceae	*Requienia*	*sphaerosperma*			LC	Fabaceae	*Rhynchosia*	*confusa*			NE
Fabaceae	*Rhynchosia*	*holosericea*			LC	Fabaceae	*Rhynchosia*	*totta*	var.	venulosa	

Fabaceae	*Rhynchosia*	*totta*	var.	*rigidula*		Fabaceae	*Rhynchosia*	*totta*	var.	totta	LC
Fabaceae	*Senegalia*	*hereroensis*			LC	Fabaceae	*Senegalia*	*mellifera*	subsp.	detinens	LC
Fabaceae	*Senna*	*italica*	subsp.	*arachoides*	LC	Fabaceae	*Tephrosia*	*burchellii*			LC
Fabaceae	*Tephrosia*	*lupinifolia*			LC	Fabaceae	*Tephrosia*	*purpurea*	subsp.	leptostachya	NE
Fabaceae	*Vachellia*	*erioloba*			LC	Fabaceae	*Vachellia*	*haematoxylon*			LC
Fabaceae	*Vachellia*	*hebeclada*	subsp.	*hebeclada*	LC	Fabaceae	*Vachellia*	*karroo*			LC
Fabaceae	*Vigna*	*unguiculata*	subsp.	*unguiculata*	NE	Fabaceae	*Argyrolobium*	*incanum*			LC
Fabaceae	*Melolobium*	*exudans*			LC	Fabaceae	*Medicago*	*laciniata*	var.	laciniata	Alien
Fabaceae	*Melilotus*	*albus*			Alien	Fabaceae	*Caesalpinia*	*gilliesii*			Alien invasive
Fissidentaceae	*Fissidens*	*erosulus*				Gentianaceae	*Chironia*	*palustris*	subsp.	palustris	LC
Geraniaceae	*Monsonia*	*angustifolia*			LC	Geraniaceae	*Pelargonium*	*myrrhifolium*	var.	myrrhifolium	LC
Gisekiaceae	*Gisekia*	*africana*	var.	*africana*	LC	Hyacinthaceae	*Albuca*	*seineri*			
Hyacinthaceae	*Albuca*	*tortuosa*				Hyacinthaceae	*Dipcadi*	*marlothii*			
Iridaceae	*Babiana*	*bainesii*			LC	Iridaceae	*Gladiolus*	*permeabilis*	subsp.	edulis	LC
Iridaceae	*Moraea*	*polystachya*			LC	Iridaceae	*Psilosiphon*	*sandersonii*	subsp.	sandersonii	
Juncaceae	*Juncus*	*exsertus*			LC	Juncaceae	*Juncus*	*rigidus*			LC
Lamiaceae	*Leonotis*	*pentadentata*			LC	Lamiaceae	*Mentha*	*aquatica*			LC
Lamiaceae	*Salvia*	*disermas*			LC	Lamiaceae	*Stachys*	*burchelliana*			LC
Lamiaceae	*Salvia*	*stenophylla*				Lentibulariaceae	*Utricularia*	*gibba*			LC
Limeaceae	*Limeum*	*arenicolum*			LC	Limeaceae	*Limeum*	*fenestratum*	var.	fenestratum	LC
Limeaceae	*Limeum*	*sulcatum*	var.	*sulcatum*	LC	Limeaceae	*Limeum*	*aethiopicum*	var.	intermedium	NE
Limeaceae	*Limeum*	*aethiopicum*	var.	*aethiopicum*	NE	Limeaceae	*Limeum*	*viscosum*	subsp.	transvaalense	LC
Lobeliaceae	*Lobelia*	*erinus*			LC	Lobeliaceae	*Lobelia*	*thermalis*			LC
Lophiocarpaceae	*Lophiocarpus*	*polystachyus*			LC	Loranthaceae	*Septulina*	*ovalis*			LC
Loranthaceae	*Tapinanthus*	*oleifolius*			LC	Malpighiaceae	*Sphedamnocarpus*	*pruriens*	subsp.	pruriens	LC
Malpighiaceae	*Triaspis*	*hypericoides*	subsp.	*hypericoides*	LC	Malvaceae	*Abutilon*	*dinteri*			LC
Malvaceae	*Abutilon*	*rehmannii*			LC	Malvaceae	*Corchorus*	*asplenifolius*			LC
Malvaceae	*Corchorus*	*pinnatipartitus*			LC	Malvaceae	*Grewia*	*flava*			LC
Malvaceae	*Hermannia*	*bicolor*			LC	Malvaceae	*Hermannia*	*comosa*			LC

Malvaceae	*Hermannia*	*geniculata*			LC	Malvaceae	*Hermannia*	*linnaeoides*			LC
Malvaceae	*Hermannia*	*stellulata*			LC	Malvaceae	*Hermannia*	*tomentosa*			LC
Malvaceae	*Melhania*	*burchellii*			LC	Malvaceae	*Melhania*	*prostrata*			LC
Malvaceae	*Melhania*	*virescens*			LC	Malvaceae	*Pavonia*	*burchellii*			LC
Malvaceae	*Sida*	*chrysantha*			LC	Malvaceae	*Sida*	*cordifolia*	subsp.	cordifolia	LC
Malvaceae	*Waltheria*	*indica*			LC	Malvaceae	*Hermannia*	*quartiniana*			LC
Malvaceae	*Hermannia*	*linearifolia*			LC	Malvaceae	*Hibiscus*	*marlothianus*			LC
Menispermaceae	*Antizoma*	*angustifolia*			LC	Molluginaceae	*Suessenguthiella*	*scleranthoides*			LC
Nymphaeaceae	*Nymphaea*	*nouchali*	var.	*caerulea*		Oleaceae	*Olea*	*europaea*	subsp.	cuspidata	
Orobanchaceae	*Alectra*	*pumila*			LC	Orobanchaceae	*Striga*	*bilabiata*	subsp.	bilabiata	LC
Orobanchaceae	*Striga*	*elegans*			LC	Orobanchaceae	*Striga*	*gesnerioides*			LC
Oxalidaceae	*Oxalis*	*depressa*			LC	Oxalidaceae	*Oxalis*	*lawsonii*			LC
Oxalidaceae	*Oxalis*	*corniculata*			Alien invasive	Papaveraceae	*Argemone*	*ochroleuca*	subsp.	ochroleuca	Alien invasive
Passifloraceae	*Adenia*	*repanda*			LC	Pedaliaceae	*Ceratotheca*	*triloba*			LC
Pedaliaceae	*Harpagophytum*	*procumbens*	subsp.	*procumbens*	NE	Pedaliaceae	*Sesamum*	*capense*			LC
Phyllanthaceae	*Phyllanthus*	*loandensis*			LC	Phyllanthaceae	*Phyllanthus*	*maderaspatensis*			LC
Phyllanthaceae	*Phyllanthus*	*parvulus*	var.	*parvulus*	LC	Phyllanthaceae	*Phyllanthus*	*pentandrus*			LC
Plantaginaceae	*Veronica*	*anagallis-aquatica*			LC	Poaceae	*Agrostis*	*lachnantha*	var.	lachnantha	LC
Poaceae	*Andropogon*	*chinensis*			LC	Poaceae	*Andropogon*	*eucomus*			LC
Poaceae	*Andropogon*	*schirensis*			LC	Poaceae	*Anthephora*	*argentea*			LC
Poaceae	*Anthephora*	*pubescens*			LC	Poaceae	*Aristida*	*congesta*	subsp.	congesta	LC
Poaceae	*Aristida*	*congesta*	subsp.	*barbicollis*	LC	Poaceae	*Aristida*	*engleri*	var.	ramosissima	LC
Poaceae	*Aristida*	*meridionalis*			LC	Poaceae	*Aristida*	*mollissima*	subsp.	mollissima	LC
Poaceae	*Aristida*	*stipitata*	subsp.	*stipitata*	LC	Poaceae	*Aristida*	*stipitata*	subsp.	spicata	LC
Poaceae	*Aristida*	*stipitata*	subsp.	*graciliflora*	LC	Poaceae	*Aristida*	*vestita*			LC
Poaceae	*Brachiaria*	*marlothii*			LC	Poaceae	*Brachiaria*	*nigropedata*			LC
Poaceae	*Brachiaria*	*serrata*			LC	Poaceae	*Bromus*	*pectinatus*			LC
Poaceae	*Cenchrus*	*ciliaris*			LC	Poaceae	*Chrysopogon*	*serrulatus*			LC
Poaceae	*Coelachyrum*	*yemenicum*			LC	Poaceae	*Cymbopogon*	*caesius*			LC

Poaceae	*Cymbopogon*	*pospischilii*			NE	Poaceae	*Cynodon*	*dactylon*			LC
Poaceae	*Digitaria*	*eriantha*			LC	Poaceae	*Digitaria*	*polyphylla*			LC
Poaceae	*Digitaria*	*seriata*			LC	Poaceae	*Diheteropogon*	*amplectens*	var.	amplectens	LC
Poaceae	*Eleusine*	*coracana*	subsp.	*africana*	LC	Poaceae	*Elionurus*	*muticus*			LC
Poaceae	*Enneapogon*	*cenchroides*			LC	Poaceae	*Enneapogon*	*desvauxii*			LC
Poaceae	*Enneapogon*	*scoparius*			LC	Poaceae	*Eragrostis*	*capensis*			LC
Poaceae	*Eragrostis*	*chloromelas*			LC	Poaceae	*Eragrostis*	*curvula*			LC
Poaceae	*Eragrostis*	*echinochloidea*			LC	Poaceae	*Eragrostis*	*gummiflua*			LC
Poaceae	*Eragrostis*	*homomalla*			LC	Poaceae	*Eragrostis*	*lehmanniana*	var.	lehmanniana	LC
Poaceae	*Eragrostis*	*micrantha*			LC	Poaceae	*Eragrostis*	*nindensis*			LC
Poaceae	*Eragrostis*	*obtusa*			LC	Poaceae	*Eragrostis*	*pallens*			LC
Poaceae	*Eragrostis*	*procumbens*			LC	Poaceae	*Eragrostis*	*rigidior*			LC
Poaceae	*Eragrostis*	*trichophora*			LC	Poaceae	*Eragrostis*	*viscosa*			LC
Poaceae	*Eustachys*	*paspaloides*			LC	Poaceae	*Fingerhuthia*	*africana*			LC
Poaceae	*Hemarthria*	*altissima*			LC	Poaceae	*Heteropogon*	*contortus*			LC
Poaceae	*Hyparrhenia*	*anamesa*			LC	Poaceae	*Imperata*	*cylindrica*			LC
Poaceae	*Megaloprotachne*	*albescens*			LC	Poaceae	*Melinis*	*nerviglumis*			LC
Poaceae	*Melinis*	*repens*	subsp.	*grandiflora*	LC	Poaceae	*Melinis*	*repens*	subsp.	repens	LC
Poaceae	*Oropetium*	*capense*			LC	Poaceae	*Panicum*	*coloratum*			LC
Poaceae	*Panicum*	*kalaharense*			LC	Poaceae	*Panicum*	*maximum*			LC
Poaceae	*Panicum*	*stapfianum*			LC	Poaceae	*Pogonarthria*	*squarrosa*			LC
Poaceae	*Schizachyrium*	*sanguineum*			LC	Poaceae	*Schmidtia*	*pappophoroides*			LC
Poaceae	*Setaria*	*sphacelata*	var.	*torta*	LC	Poaceae	*Sporobolus*	*acinifolius*			LC
Poaceae	*Sporobolus*	*fimbriatus*			LC	Poaceae	*Stipagrostis*	*amabilis*			LC
Poaceae	*Stipagrostis*	*hirtigluma*	subsp.	*patula*	LC	Poaceae	*Stipagrostis*	*uniplumis*	var.	neesii	LC
Poaceae	*Stipagrostis*	*uniplumis*	var.	*uniplumis*	LC	Poaceae	*Themeda*	*triandra*			LC
Poaceae	*Tragus*	*berteronianus*			LC	Poaceae	*Tragus*	*koelerioides*			LC
Poaceae	*Tragus*	*racemosus*			LC	Poaceae	*Tricholaena*	*monachne*			LC
Poaceae	*Trichoneura*	*grandiglumis*			LC	Poaceae	*Triraphis*	*andropogonoides*			LC

Poaceae	*Triraphis*	*schinzii*			LC	Poaceae	*Urelytrum*	*agropyroides*			LC
Poaceae	*Eragrostis*	*amabilis*			LC	Poaceae	*Leptochloa*	*fusca*			LC
Poaceae	*Cynodon*	*incompletus*			LC	Poaceae	*Eragrostis*	*pseudobtusa (x)*			NE
Poaceae	*Eragrostis*	*barrelieri*			Alien	Poaceae	*Eragrostis*	*mexicana*	subsp.	virescens	Alien
Poaceae	*Paspalum*	*dilatatum*			Alien	Polygalaceae	*Polygala*	*leptophylla*	var.	leptophylla	LC
Polygonaceae	*Oxygonum*	*alatum*	var.	*alatum*	LC	Polygonaceae	*Oxygonum*	*dregeanum*	subsp.	canescens	NE
Polygonaceae	*Persicaria*	*lapathifolia*			Alien	Polygonaceae	*Rumex*	*crispus*			Alien invasive
Portulacaceae	*Portulaca*	*quadrifida*				Pottiaceae	*Syntrichia*	*ammonsiana*			
Pteridaceae	*Actiniopteris*	*radiata*			LC	Pteridaceae	*Cheilanthes*	*eckloniana*			LC
Pteridaceae	*Cheilanthes*	*multifida*	var.	*multifida*	LC	Pteridaceae	*Pellaea*	*calomelanos*	var.	calomelanos	LC
Pteridaceae	*Cheilanthes*	*hirta*	var.	*brevipilosa*	LC	Ranunculaceae	*Clematis*	*brachiata*			LC
Rhamnaceae	*Helinus*	*spartioides*			LC	Ricciaceae	*Riccia*	*albolimbata*			
Ricciaceae	*Riccia*	*okahandjana*				Rosaceae	*Rubus*	*rosifolius*			Alien
Rubiaceae	*Anthospermum*	*rigidum*	subsp.	*rigidum*	LC	Rubiaceae	*Anthospermum*	*rigidum*	subsp.	pumilum	LC
Rubiaceae	*Galium*	*capense*	subsp.	*capense*	LC	Rubiaceae	*Kohautia*	*caespitosa*	subsp.	brachyloba	LC
Rubiaceae	*Vangueria*	*infausta*	subsp.	*infausta*	LC	Ruscaceae	*Eriospermum*	*corymbosum*			LC
Santalaceae	*Thesium*	*resedoides*			LC	Santalaceae	*Viscum*	*rotundifolium*			
Scrophulariaceae	*Aptosimum*	*elongatum*			LC	Scrophulariaceae	*Aptosimum*	*indivisum*			LC
Scrophulariaceae	*Aptosimum*	*marlothii*			LC	Scrophulariaceae	*Buddleja*	*saligna*			LC
Scrophulariaceae	*Chaenostoma*	*halimifolium*			LC	Scrophulariaceae	*Jamesbrittenia*	*atropurpurea*	subsp.	atropurpurea	LC
Scrophulariaceae	*Jamesbrittenia*	*atropurpurea*	subsp.	*pubescens*	LC	Scrophulariaceae	*Jamesbrittenia*	*aurantiaca*			LC
Scrophulariaceae	*Jamesbrittenia*	*integerrima*			LC	Scrophulariaceae	*Peliostomum*	*leucorrhizum*			LC
Scrophulariaceae	*Selago*	*mixta*			LC	Scrophulariaceae	*Sutera*	*griquensis*			LC
Solanaceae	*Lycium*	*hirsutum*			LC	Solanaceae	*Lycium*	*schizocalyx*			LC
Solanaceae	*Solanum*	*campylacanthum*	subsp.	*panduriforme*	LC	Solanaceae	*Solanum*	*catombelense*			LC
Solanaceae	*Solanum*	*retroflexum*			LC	Solanaceae	*Solanum*	*supinum*	var.	supinum	LC
Solanaceae	*Solanum*	*tomentosum*	var.	*tomentosum*	LC	Solanaceae	*Withania*	*somnifera*			LC
Solanaceae	*Solanum*	*nigrum*			Alien	Tecophilaeaceae	*Cyanella*	*lutea*			
Theophrastaceae	*Samolus*	*valerandi*			LC	Thymelaeaceae	*Lasiosiphon*	*burchellii*			LC

Thymelaeaceae	*Lasiosiphon*	*polycephalus*			LC	Verbenaceae	*Chascanum*	*adenostachyum*			
Verbenaceae	*Chascanum*	*hederaceum*	var.	*hederaceum*		Verbenaceae	*Chascanum*	*pinnatifidum*	var.	pinnatifidum	
Verbenaceae	*Lantana*	*rugosa*				Verbenaceae	*Verbena*	*brasiliensis*			Alien invasive
Zygophyllaceae	*Roepera*	*lichtensteiniana*				Zygophyllaceae	*Roepera*	*pubescens*			
Zygophyllaceae	*Tribulus*	*terrestris*			LC	Zygophyllaceae	*Tribulus*	*zeyheri*	subsp.	zeyheri	LC

1.10.2. Appendix 2. List of Mammals

List of Mammals known from the broad area around the Kuruman WEF Phase 1 site, based on the MammalMap Database (http://vmus.adu.org.za), with species confirmed present at the site indicated in **bold.**

Family	Scientific name	Common name	Red list category
Bathyergidae	***Cryptomys hottentotus***	**Southern African Mole-rat**	**Least Concern**
Bovidae	***Aepyceros melampus***	**Impala**	**Least Concern**
Bovidae	***Alcelaphus buselaphus caama***	**Red Hartebeest**	**Least Concern**
Bovidae	***Connochaetes gnou***	**Black Wildebeest**	**Least Concern**
Bovidae	***Kobus ellipsiprymnus***	**Waterbuck**	**Least Concern**
Bovidae	***Oryx gazella***	**Gemsbok**	**Least Concern**
Bovidae	***Sylvicapra grimmia***	**Bush Duiker**	**Least Concern**
Bovidae	***Taurotragus oryx***	**Common Eland**	**Least Concern**
Canidae	***Canis mesomelas***	**Black-backed Jackal**	**Least Concern**
Cercopithecidae	***Papio ursinus***	**Chacma Baboon**	**Least Concern**
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened
Felidae	*Felis nigripes*	Black-footed Cat	Least Concern
Herpestidae	***Cynictis penicillata***	**Yellow Mongoose**	**Least Concern**
Herpestidae	***Suricata suricatta***	**Meerkat**	**Least Concern**
Hystricidae	***Hystrix africaeaustralis***	**Cape Porcupine**	**Least Concern**
Leporidae	***Lepus capensis***	**Cape Hare**	**Least Concern**
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern
Leporidae	***Pronolagus rupestris***	**Smith's Red Rock Hare**	**Least Concern**
Macroscelididae	*Elephantulus myurus*	Eastern Rock Elephant Shrew	Least Concern
Macroscelididae	*Elephantulus rupestris*	Western Rock Elephant Shrew	Least Concern
Macroscelididae	*Macroscelides proboscideus*	Short-eared Elephant Shrew	Least Concern
Muridae	*Aethomys chrysophilus*	Red Veld Aethomys	Least Concern
Muridae	***Aethomys namaquensis***	**Namaqua Rock Mouse**	**Least Concern**
Muridae	*Desmodillus auricularis*	Cape Short-tailed Gerbil	Least Concern
Muridae	*Gerbilliscus leucogaster*	Bushveld Gerbil	Data Deficient
Muridae	*Mastomys coucha*	Southern African Mastomys	Least Concern
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
Muridae	*Otomys auratus*	Southern African Vlei Rat	
Muridae	*Parotomys brantsii*	Brants's Whistling Rat	Least Concern
Muridae	***Rhabdomys pumilio***	**Xeric Four-striped Grass Rat**	**Least Concern**
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern
Nesomyidae	***Saccostomus campestris***	**Southern African Pouched Mouse**	**Least Concern**
Orycteropodidae	***Orycteropus afer***	**Aardvark**	**Least Concern**

Pedetidae	***Pedetes capensis***	**South African Spring Hare**	**Least Concern**
Procaviidae	***Procavia capensis***	**Cape Rock Hyrax**	**Least Concern**
Sciuridae	***Xerus inauris***	**South African Ground Squirrel**	**Least Concern**
Soricidae	*Crocidura cyanea*	Reddish-gray Musk Shrew	Data Deficient
Soricidae	*Crocidura hirta*	Lesser Red Musk Shrew	Data Deficient
Suidae	***Phacochoerus africanus***	**Common Warthog**	**Least Concern**

1.10.3. Appendix 3. List of Reptiles

List of Reptiles known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the ReptileMap database. Conservation status is from Bates *et al*. 2013.

Family	Scientific name	Common name	Red list category
Agamidae	***Agama aculeata aculeata***	**Common Ground Agama**	**Least Concern**
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern
Amphisbaenidae	*Zygaspis quadrifrons*	Kalahari Dwarf Worm Lizard	Least Concern
Chamaeleonidae	*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon	Least Concern
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern
Colubridae	***Dispholidus typus typus***	**Boomslang**	**Least Concern**
Colubridae	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	Least Concern
Elapidae	*Aspidelaps scutatus scutatus*	Speckled Shield Cobra	Least Concern
Gekkonidae	*Lygodactylus capensis capensis*	Common Dwarf Gecko	Least Concern
Gekkonidae	***Pachydactylus capensis***	**Cape Gecko**	**Least Concern**
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard	Least Concern
Lacertidae	*Meroles squamulosus*	Common Rough-scaled Lizard	Least Concern
Lacertidae	*Nucras intertexta*	Spotted Sandveld Lizard	Least Concern
Lacertidae	***Pedioplanis lineoocellata lineoocellata***	**Spotted Sand Lizard**	**Least Concern**
Lacertidae	*Pedioplanis namaquensis*	Namaqua Sand Lizard	Least Concern
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern
Lamprophiidae	*Atractaspis bibronii*	Bibron's Stiletto Snake	Least Concern
Lamprophiidae	*Atractaspis duerdeni*	Duerden's Stiletto Snake	Least Concern
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	Least Concern
Lamprophiidae	*Psammophis brevirostris*	Short-snouted Grass Snake	Least Concern
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	Least Concern
Lamprophiidae	*Pseudaspis cana*	Mole Snake	Least Concern
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	
Pelomedusidae	*Pelomedusa subrufa*	Central Marsh Terrapin	Least Concern
Pythonidae	*Python natalensis*	Southern African Python	Least Concern
Scincidae	*Panaspis wahlbergi*	Wahlberg's Snake-eyed Skink	Least Concern
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern
Scincidae	*Trachylepis spilogaster*	Kalahari Tree Skink	Least Concern

Scincidae	*Trachylepis sulcata sulcata*	Western Rock Skink	Least Concern
Scincidae	***Trachylepis variegata***	**Variegated Skink**	**Least Concern**
Testudinidae	*Psammobates oculifer*	Serrated Tent Tortoise	Least Concern
Testudinidae	***Stigmochelys pardalis***	**Leopard Tortoise**	**Least Concern**
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern

1.10.4. Appendix 4. List of Amphibians

List of Amphibians known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the FrogMap database. Conservation status is from Minter et al. 2004.

Family	Scientific name	Common name	Red list
Brevicepitidae	*Breviceps adspersus*	Bushveld Rain Frog	Least Concern
Bufonidae	*Sclerophrys garmani*	Olive Toad	Least Concern
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	Least Concern
Bufonidae	*Sclerophrys poweri*	Power's Toad	Least Concern
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	Least Concern
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern

SPECIALIST FRESHWATER ASSESSMENT REPORT:

Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

Report prepared by:

EnviroSwift (Pty) Ltd.

22 Leiden Cresent

Cape Town, 7550

South Africa

July 2018

SPECIALIST EXPERTISE

Natasha van de Haar

SACNASP Professional Natural Scientist (Registration number: 400229/11)
Natasha is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (SACNASP). She also holds a Masters Degree in Science (M.Sc.) in the field of Botany. Over the course of Natasha's career, she completed a number of floral identification short courses and also obtained a certificate of competence for wetland assessments from Rhodes University. She is also a member of the South African Wetland Society, Botanical Society of SA as well as the Western Cape Wetlands Forum.

Her career kicked off as a field ecologist in 2009, focusing on floral biodiversity and ecological functioning, with special mention of wetland ecology and functioning within South Africa (all provinces). She further worked as a specialist project member in Mauritius, Lesotho and Ghana. During the course of her career she obtained extensive experience in conducting terrestrial as well as wetland related surveys in the mining, residential and infrastructure development industries as well as development of several alternative energy facilities. Natasha also gained experience in Biodiversity Offset Initiatives as well as RDL/protected plant permit applications. Presently her main focus is wetland assessments including delineation as well as present ecological state and function assessments

Louise Zdanow

SACNASP Professional Natural Scientist (Registration number:114072)
Louise is the Managing Director of EnviroSwift KZN (Pty) Ltd. She has a BSc Honours degree in Botany from the University of Cape Town. She began working as an environmental specialist in 2012 and has since gained extensive experience in conducting freshwater as well as botanical assessments in the residential, mining and infrastructure development industries. Louise is a registered Professional Natural Scientist (Pr. Sci. Nat.) with the South African Council for Natural Scientific Professions (SACNASP, Reg. no. 114072), and is an accredited SASS5 practitioner. She is a member of the South African Wetland Society and the International Association of Impact Assessments South Africa. She has received a certificate of competence for the Tools for Wetland Assessments course attended at Rhodes University, and has attended a soil classification course presented by Jon Atkinson of the KZN Department of Agriculture and Rural Development.

SPECIALIST DECLARATION

I, Louise Zdanow, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended in 2017), 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: LZdanow

Name of Specialist: Louise Zdanow

Date: 18/06/2018

EXECUTIVE SUMMARY

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, “Mulilo”) has appointed EnviroSwift (PTY) Ltd (hereafter, “EnviroSwift”) to undertake a specialist assessment of the impact that the development of Phase 1 of the proposed Kuruman Wind Energy Facility (WEF) could have on freshwater features. The farms earmarked for the development of Phase 1 include:

- Portion 2 and 4 of the Farm Carrington 440;
- Portion 1 of the Farm Hartland 381;
- Remaining Extent of Woodstock Farm 441; and
- Remaining Extent of Rossdale Farm 382.

Jointly, all the properties above will be referred to as the ‘study area’ in this report. The study area is situated in the north-eastern parts of the Northern Cape Province, near the town Kuruman within the Ga-Segonyana Local Municipality. Kuruman is located approximately 236km (by road) to the north-west of the provincial capital, Kimberley

47 Turbines are proposed as part of Phase 1, and additional infrastructure required includes:

- Roads:
  - New internal roads will be constructed with a width of 5m and will connect all turbines;
  - Existing access roads to be used within the study area will be extended to a width of 8m.
- Distribution lines will consist of 33kV underground lines and will be located within the reserve of the road network for Phase 1;
- Collector substation extending over 2ha with a height of 5m; and
- Three construction lay down areas of 2 ha each extending over approximately 6ha.

<u>Summary of Background Information</u>

The quaternary catchments indicated for the study area are D41L and D41K and the study area falls within the Southern Kalahari Ecoregion, within the Lower Vaal Water Management Area (WMA) and within the Molopo sub-Water Management Area (sub-WMA) as defined by the National Freshwater Ecosystem Priority Areas project (NFEPA, 2011).

The nearest river system is a tributary of the Kuruman River located approximately 4km north east of the study area, with the Kuruman River itself located approximately 6,6km from the study area boundary. The tributaries of the Kuruman River located within the catchment of the study area have been classified as Class C (moderately modified) (Northern Cape Provincial Spatial Development Framework, 2012).

The sub-quaternary catchment in which the study area is located was selected as an Upstream Management Area. Upstream Management Areas, are sub -quaternary catchments in which human activities need to be managed to prevent degradation of downstream river Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Areas (FSAs).

A single natural seep wetland extending over approximately 13ha is located within the study area, indicated to fall within an AB wetland condition (natural or good) and only one smaller artificial feature, approximately 0.38ha, is located within 500m of the study area boundary (Northern Cape Critical Biodiversity Areas, 2016 and NFEPA, 2011). The topography has however resulted in the formation of numerous small ephemeral drainage lines throughout the study area (Chief Directorate Surveys and Mapping August 2015).

<u>Summary of Freshwater Specialist Assessment Results</u>

Two ridges run along the center of the study area in a north-south direction. Multiple ephemeral drainage lines originate at the crests along the length of the ridges.

Ephemeral drainage lines occurring on steep hillslopes associated with the ridges can be defined as A Section channels. “A sections are those headward channels that are situated well above the zone of saturation at its highest level and because the channel bed is never in contact with the zone of saturation, these channels do not carry baseflow. They do however carry storm runoff during fairly high rainfall events but the flow is of short duration because there is no baseflow component”(DWAF, 2005). The lack of baseflow and short duration of stormwater runoff within the channels are not conducive for the formation of riparian zones.

Additional ephemeral drainage lines extend through the flat valleys at the bases of hillslopes and are augmented by the A section channels. These ephemeral drainage lines can be defined as 'arid drainage lines' and are often characterised by poorly defined or discontinuous channels due to lower annual rainfall, longer rainfall intervals, high evapotranspiration and high infiltration in areas with sandy soils (Lichvar *et al*., 2004 and Grobler, 2016). Poorly defined riparian zones are only associated with isolated areas along some of the larger arid drainage lines.

The natural seep wetland, indicated by NFEPA, was also investigated during the field survey. However, it was found to be a small artificial pond used for recreational purposes and will not be disturbed as a result of the proposed development related activities.

The primary surrounding land use is stock farming (cattle and sheep) and the study area itself is currently utilised as a game farm. The low regional rainfall in combination with the absence of perennial rivers near the study area is not favorable for extensive crop cultivation. As a result, natural vegetation has remained in a good condition within most of the study area, with the exception of isolated areas near watering points, roads and fences where natural vegetation cover decreases. The most noteworthy present impact on ephemeral drainage lines is erosion. This is particularly relevant in areas characterised by poor land use management practices.

The River Index of Habitat Integrity Assessment (IHIA) was used to assess the Present Ecological State (PES) of the ephemeral drainage lines. Ephemeral drainage lines were divided into groups according to perceived degree of disturbance and each group was assessed accordingly:

- Group 1: A Section channels on hillslopes which have remained largely undisturbed due to their inaccessible nature.
- Group 2: A Section channels on hillslopes which have been disturbed as a result of the development of informal access roads or fences through the features. An increased level of erosion of the bed and banks of these features was noted.
- Group 3: Arid drainage lines within valleys which have remained largely undisturbed. Small areas of erosion and trampling of vegetation were noted in isolated areas near watering points within a few of the features.
- Group 4: Arid drainage lines within valleys at the bases of hillslopes which are associated with a greater level of disturbance due to informal access road development and increased grazing pressure. This disturbance has resulted in an increased level of erosion of the bed and banks of the features.

The instream scores calculated for the ephemeral drainage lines within Group 1 and Group 3 fall within IHIA Category A (Unmodified, natural); and the instream scores calculated for the ephemeral drainage lines within Group 2 and Group 4 fall within IHIA Category C (Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged).

The ephemeral drainage lines calculated an overall low Ecological Importance and Sensitivity (EIS) score and are considered to be of low sensitive in terms of water yield and quality (Macfarlane *et al.*, 2014). However, these features still provide valuable functions such as attenuation of floodwaters and retention of excess sediments.

The development of ephemeral drainage line crossings will result in the removal of vegetation and in the disturbance of soils. The PES of the portions of the ephemeral drainage lines in the vicinity of the crossing areas is therefore likely to decrease. However, it is considered possible to maintain the PES of the features as a whole with the implementation of the recommendations as listed in within Section 1.6 of this report.

The most recent guideline for buffer allocation in South Africa (Macfarlane and Bredin, 2017) does not apply to channels which lack active channel characteristics i.e. channels which are not in contact with the zone of saturation and which do not have base flow (Macfarlane *et al.*, 2014). The minimum buffer zone requirements for electricity generation works is 20m (Macfarlane and Bredin, 2017). It is however the opinion of the specialist that, as far as possible, a buffer of at least 30m be provided for all drainage lines in order to reduce the risk of erosion.

Impact Assessment

The potential freshwater issues identified for this EIA process include:

- Disturbance of the bed and banks of ephemeral drainage lines during the construction of access road and underground distribution line crossing areas;
- Alteration of the hydrological regime of ephemeral drainage lines due to an increase in runoff from hardened surfaces, ultimately resulting in the erosion of drainage lines;
- Alteration of flow patterns through ephemeral drainage lines at crossing areas;
- Water quality impairment at crossing areas due to the runoff of solutes and sediment; and
- Proliferation of alien and invasive species.

Impacts considered to be likely during the construction, operational and decommissioning phase of the WEF include:

Construction Phase
- Potential **direct** impact 1 – Disturbance of drainage lines;
- Potential **direct** impact 2 – Alteration of flow patterns; and
- Potential **direct** impact 3 – Impairment of water quality.

Operational Phase
- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Alteration of the natural hydrological regime.

Decommissioning Phase
- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Impairment of water quality.

Cumulative impacts considered to be likely following authorisation of Phase 1 of the WEF include:

Cumulative impacts
- Cumulative impact 1 – Proliferation of alien and invasive species; and
- Cumulative impact 2 – Erosion of drainage lines.

Table A: Impact Assessment table

Impact	Before mitigation	After mitigation
Construction Phase		
Disturbance of drainage lines	Moderate	Low
Alteration of flow patterns	Moderate	Low
Impairment of water quality	Moderate	Very Low
Operational Phase		
Degradation of drainage lines	Moderate	Low
Alteration of natural hydrological regime	Moderate	Low
Decommissioning Phase		
Degradation of drainage lines	Moderate	Low
Impairment of water quality	Low	Very Low
Cumulative impact		
Proliferation of alien and invasive species and erosion of drainage lines	Low	Low

Conclusion

The study area is associated with multiple ephemeral drainage lines. The current impact to these features is largely limited to erosion as a result of increased grazing pressure and the development of access roads and fence lines through the features. The drainage lines were therefore calculated to fall within PES Categories A (unmodified, natural) and C (moderately modified). Although the ephemeral drainage lines calculated an overall low EIS score and are considered to be of low sensitivity in terms of water yield and quality

(Macfarlane *et al.*, 2014), these features do still provide valuable functions such as attenuation of floodwaters and retention of excess sediments. The unnecessary disturbance of these drainage lines must therefore be avoided, and a buffer zone of at least 30m is therefore considered important wherein only essential activities should be allowed during construction or upgrading of roads and placement of distribution lines.

Prior to the implementation of mitigation measures, impacts associated with the proposed development activities were calculated to be of a low to moderate (negative) significance. However, with the effective implementation of the mitigation measures as provided within Section 1.6 of this report, it is the opinion of the freshwater specialist that all impacts may be reduced to **very low and low (negative) significance**. It is therefore the opinion of the specialist that authorisation be granted for the proposed development. It should however be noted that an application for an Environmental Authorisation in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations (2014, amended in 2017) will be required as proposed development related activities will occur within 32m of a watercourse. Furthermore, the proposed development will require authorisation from the Department of Water and Sanitation (DWS) in terms of Section 21 (c) and (i) of the National Water Act (NWA).

LIST OF ABBREVIATIONS

Table 1: Abbreviations.

ASL	Above Sea Level
BGIS	Biodiversity Geographic Information System
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Programme
EMPr	Environmental Management Programme
EO	Environmental Officer
ES	Ecological Sensitivity
FEPA	Freshwater Ecosystem Priority Area
GPS	Global Positioning System
HGM	Hydrogeomorphic
LUDS	Land Use Decision Support Tool
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NFA	National Forest Act
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
NWA	National Water Act
PES	Present Ecological State
PSDF	Provincial Spatial Development Framework
WEF	Wind Energy Facility
WMA	Water Management Area
WMS	Water Management Systems
WUL	Water Use License

GLOSSARY

Table 2: Glossary.

Active channel bank	The bank of the channel(s) that has been inundated at sufficiently regular intervals to maintain channel form and to keep the channel free of established terrestrial vegetation.
Alluvial Fan	An alluvial deposit that is typically fan-shaped that is formed by a stream or watercourse where its velocity is abruptly decreased, as at the mouth of a ravine or at the foot of a slope.
Alluvial Material / Deposits	Deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Baseflow	Long-term flow in a river that continues after storm flow has passed.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals, and micro-organisms, the genes they contain, the evolutionary history and potential they encompass, and the ecosystems, ecological processes, and landscapes of which they are integral parts.
Buffer	Strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.

Catchment	The area contributing to runoff at a particular point in a river system.
Chroma	The relative purity of the spectral colour, which decreases with increasing greyness.
Cumulative impact	The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Delineation	(of a wetland or riparian zone): to determine the boundary of a water resource (wetland or riparian area) based on soil and vegetation (wetland) or geomorphological and vegetation (riparian zone) indicators.
Environmental Impact Assessment (EIA)	In relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application as defined in National Environmental Management Act.
Ephemeral	A river or watercourse that only flows at the surface periodically, especially those drainage systems that are only fed by overland flow (runoff).
Episodic	Relating to rivers and watercourses typically located within arid or semi-arid environments that only carry flow in response to isolated rainfall events.
Fluvial	Pertaining to rivers and river flow and associated erosive activity.
Gleying	A soil process resulting from prolonged soil saturation, which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Hydric Soils	(= Hydromorphic soils) Soils formed under conditions of saturation, flooding or ponding for sufficient periods of time for the development of anaerobic conditions and thus favouring the growth of hydrophytic vegetation.
Hydrology	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorhpy	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Intermittent flow	Flows only for short periods.
Phreatophyte	A plant with a deep root system that draws its water supply from near the water table.
Reach	A portion of a river.
Riparian Area	(as defined by the National Water Act): includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils (deposited by the current river system), and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.
Stream Order	A morphometric classification of a drainage system according to a hierarchy or orders of the channel segments. Within a drainage network the un-branched channel segments which terminate at the stream head are termed as “first order streams”
Understorey	The part of the forest / woodland which grows at the lowest height level below the canopy

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- **a) details of-** **i. the specialist who prepared the report; and** **ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;**	Page 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 2
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.3 and Section 1.6.4
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.4
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.3.6
g) an identification of any areas to be avoided, including buffers;	Section 1.3.8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 1.3.8
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 1.6 and Section 1.7
k) any mitigation measures for inclusion in the EMPr;	Section 1.8
l) any conditions for inclusion in the environmental authorisation;	Section 1.6
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8
n) a reasoned opinion- **i. whether the proposed activity, activities or portions thereof should be authorised;** **(iA) regarding the acceptability of the proposed activity or activities and** **ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;**	Section 1.6, Section 1.8 and Section 1.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

TABLE OF CONTENTS

TABLES AND FIGURES

LIST OF TABLES

LIST OF FIGURES

KURUMAN WIND ENERGY FACILITY: PHASE 1

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, “Mulilo”) has appointed EnviroSwift (PTY) Ltd (hereafter, “EnviroSwift”) to undertake a specialist assessment of the potential impact of the proposed Kuruman Phase 1 Wind Energy Facility (WEF) on freshwater features. The farms earmarked for the development of Phase 1 include:

- Portion 2 and 4 of the Farm Carrington 440;
- Portion 1 of the Farm Hartland 381;
- Remaining Extent of Woodstock Farm 441; and
- Remaining Extent of Rossdale Farm 382.

Jointly, all the properties above will be referred to as the ‘study area’ in this report. The study area is situated in the north-eastern parts of the Northern Cape Province, near the town Kuruman within the Ga-Segonyana Local Municipality. Kuruman is located approximately 236 km (by road) to the north-west of the provincial capital, Kimberley (Figure 1 and 2).

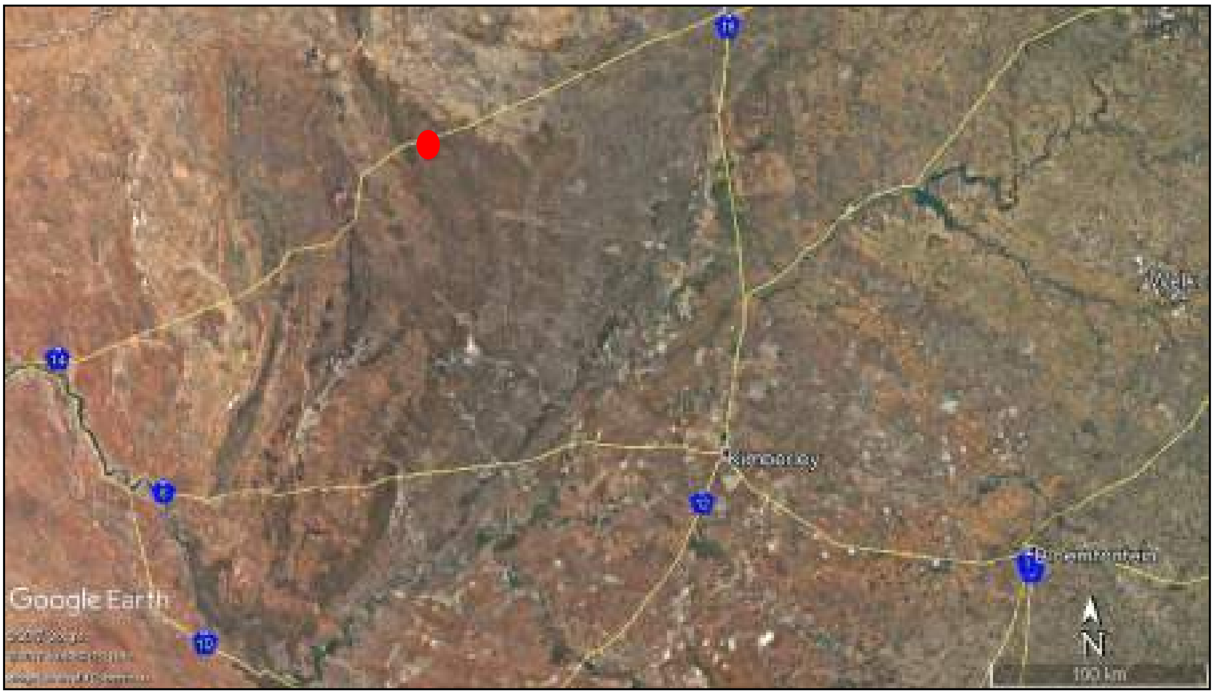

Figure 1: Location of the study area indicated with a red circle.

Figure 2: Locality of the various farm portions proposed for development of Phase 1 of the WEF in relation to the town Kuruman.

47 Turbines are proposed as part of Phase 1, and additional infrastructure required includes:

- Roads:
    - New internal roads will be constructed with a width of 5m and will connect all turbines;
    - Existing access roads to be used within the study area will be extended to a width of 8m.
- Distribution lines will consist of 33kV underground lines and will be located within the reserve of the road network for Phase 1;
- Collector substation extending over 2ha with a height of 5m; and
- Three laydown areas / construction yards of 2 ha each extending over approximately 6ha.

This report serves as the Freshwater Impact Assessment Report for Phase 1 of the Kuruman Wind Energy Facility.

1.1.2. Terms of Reference

The terms of reference as part of the Freshwater Impact Assessment included the following:

- Desktop delineation of wetland features with the use of digital satellite imagery (Google Earth Pro) and available contour maps was undertaken during the scoping phase of the project. Due to the size of the study area it was not considered practical to do a walkdown of each drainage line, and areas of interest were therefore carefully selected within the study area. A physical site survey was undertaken during which each of the areas of interest were investigated and delineated according to the method supplied by the Department of Water Affairs and Forestry (DWAF,2005 updated in 2008) in order to groundtruth the accuracy of the desktop delineations, as well as to verify the perceived level of sensitivity.
- Presentation of final delineated features on maps - also provided as shape files.
- Assessment of freshwater features according to applicable/site specific methodology:

    a) Classification of freshwater systems according to Ollis *et al*., 2013;

    b) Application of the river Index of Habitat Integrity Assessment (IHIA, Kemper, 1999); and

c) Determination of the Ecological Importance and Sensitivity based on the approach adopted by the DWA as detailed in the document "Resource Directed Measures for Protection of Water Resources" (1999).

- Impact assessment of all potential freshwater impacts (construction, operation and decommissioning phases) associated with the proposed project. The ''No Go'' scenario as well as the cumulative impact were also assessed.
- Providing mitigation measures and recommendations in line with the National Water Act (NWA) as well as National Environmental Management Act (NEMA).

1.1.3. Approach and Methodology

1.1.3.1 Desktop Assessment

Available national and provincial databases were utilised in order to determine the high level conservation significance of wetlands and rivers located within each of the farms earmarked for Phase 1. Primary resources which were utilised are listed within Section 1.1.5.

The information obtained from the various databases was used in combination with Google Earth Pro (2017) digital satellite imagery to desktop delineate all watercourses[1]. Due to the size of the study area it was not considered practical to do a walkdown of each watercourse. Areas of interest were therefore carefully selected within the study area, as well as within 500m of the study area boundary. The site selection process ensured that at least three representative areas of all variable freshwater habitat, degree of transformation as well as Hydrogeomorphic (HGM) Unit were included.

1.1.3.2 Watercourse Delineation

The desktop assessment was followed by a physical site survey undertaken in mid-January 2018 during which each of the areas of interest was investigated in order to groundtruth the accuracy of the desktop delineations, as well as to verify the perceived level of sensitivity.

For the purpose of the identification of water resources, the definition as provided by the NWA (Act no. 36, 1998) was used to guide the site survey. The NWA defines a water resource as a watercourse, surface water, estuary or aquifer, of which the latter two are not applicable to this assessment due to an estuary being associated with the sea and, in line with best practice guidelines, wetland and riparian assessments only include the assessment of the first 50 cm from the soil surface, therefore aquifers are excluded. In addition, reference to a watercourse as provided above includes, where relevant, its bed and banks.

In order to establish if the watercourses in question can be classified as 'wetland habitat' or 'river habitat', the definitions as drafted by the NWA (Act no. 36, 1998)[2] were taken into consideration:

- A 'wetland' is 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 typically adapted to life in saturated soil; and
- 'Riparian' habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support

[1] The National Water Act (Act No. 36 of 1998) defines a watercourse as -
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse,
and a reference to a watercourse includes, where relevant, its bed and banks;
[2] The definitions as provided by the NWA (Act No. 36 of 1998) are the only legislated definitions of wetlands in South Africa.

vegetation of species with a composition and physical structure distinct from those of adjacent areas'.

Watercourses were identified with the use of the definitions provided above and the delineation took place according to the method supplied by DWAF (2005, updated 2008). No wetland areas as defined by the NWA were encountered within the study area or within 500m of the study area boundary. However, numerous ephemeral drainage lines were encountered.

Several indicators are prescribed in the watercourse delineation guideline to facilitate the delineation of the riparian zone of watercourses.

Indicators used to determine the boundary of the riparian zone include:

1) Landscape position;
2) Alluvial soils and recently deposited material;
3) Topography associated with riparian areas; and
4) Vegetation associated with riparian areas.

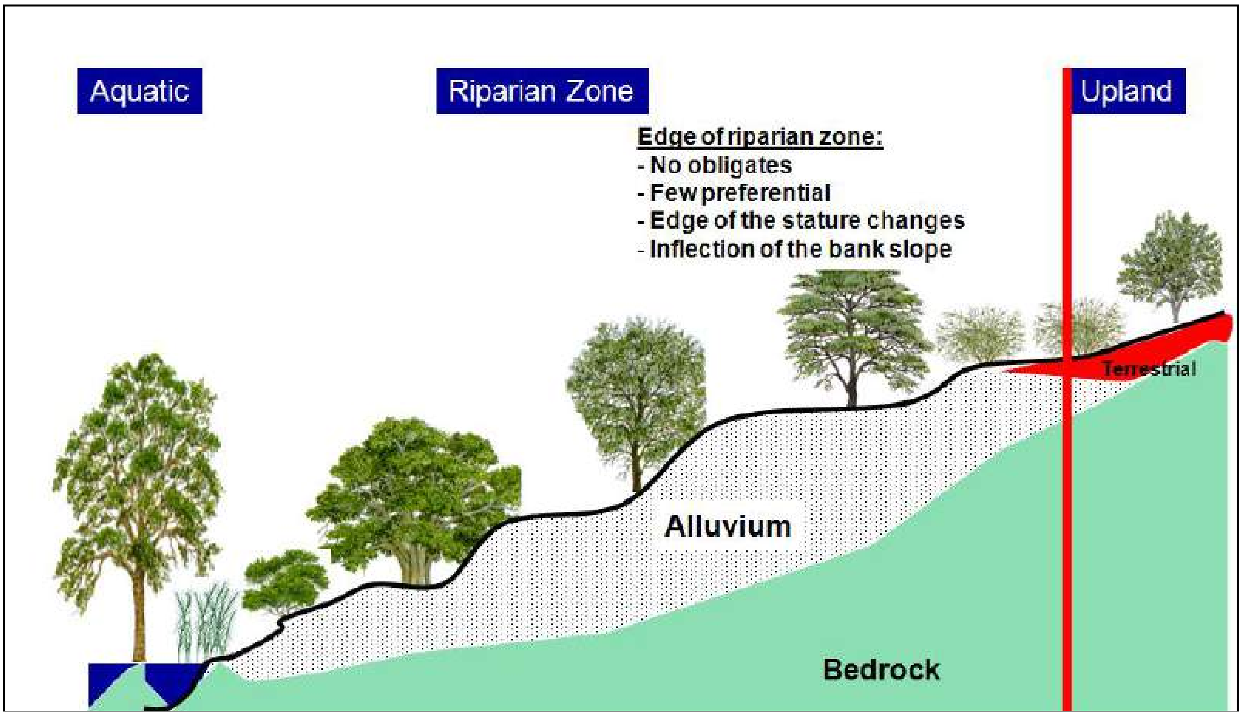

Figure 3: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWAF, 2008).

1.1.3.3 Watercourse Classification

The 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' developed by Ollis *et al*., (2013) encompasses all aquatic ecosystems, including wetlands, except for deep marine systems. Ollis *et al.* defines aquatic ecosystems as ecosystems that are permanently or periodically inundated by flowing or standing water, or which have soils that are permanently or periodically saturated within 0.5 m of the soil surface.

The inland component of the Classification System has a six-tiered structure presented in the figure below.

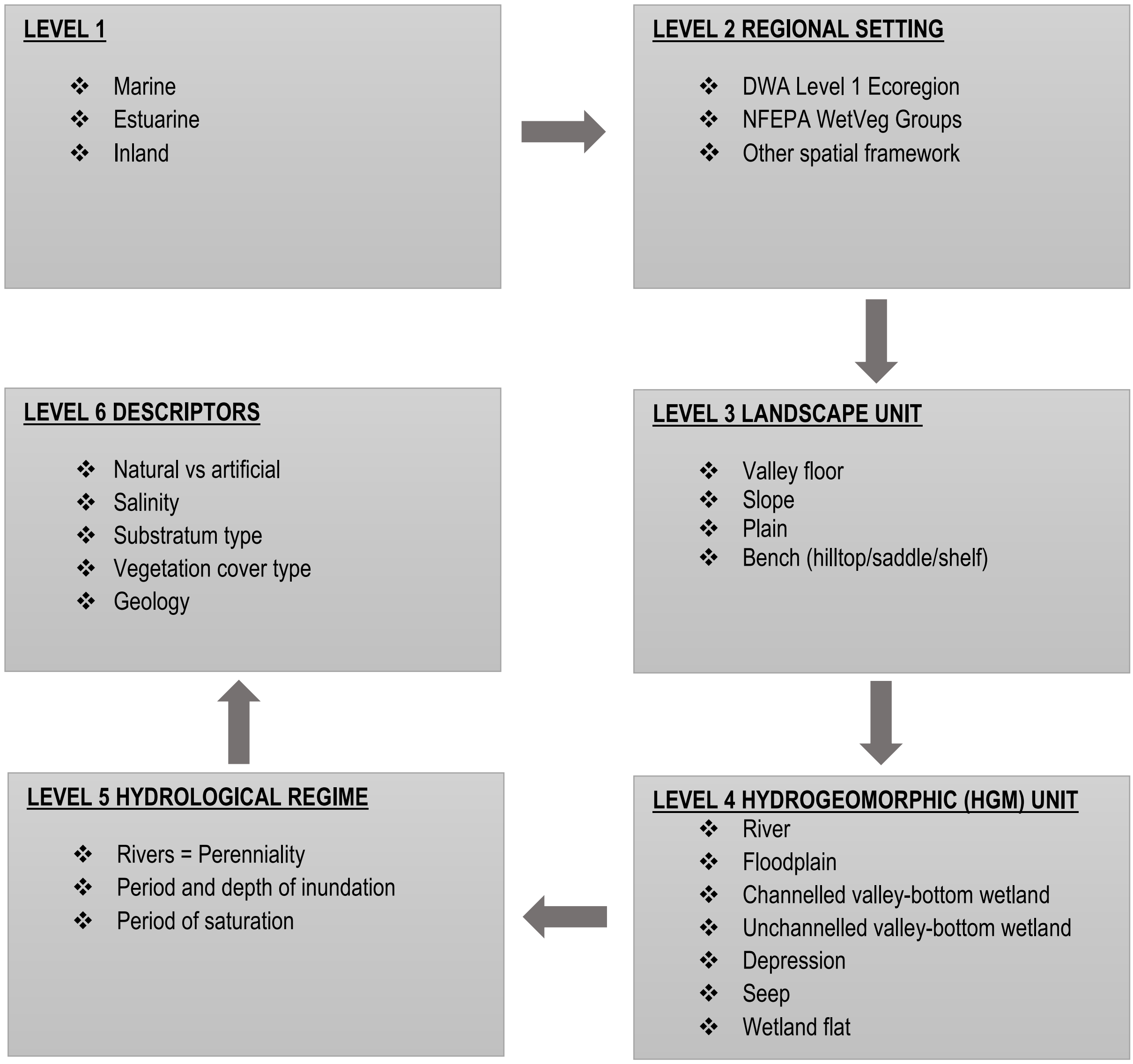

Figure 4: Classification System for wetlands and other aquatic ecosystems in South Africa.

1.1.3.4 River Index of Habitat Integrity

The river IHIA is utilised in order to determine the Present Ecological State (PES) of rivers. The river IHIA is based on two components of the watercourse, the riparian zone and the instream channel. Assessments are made separately for both aspects, but data for the riparian zone is primarily interpreted in terms of the potential impact on the instream component.

1.1.3.5 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) method applied to rivers is based on the approach adopted by the DWAF as detailed in the document “Resource Directed Measures for Protection of Water Resources” (1999). In the method a series of determinants are assessed on a scale of 0 to 4, where “0” indicates no importance and “4” indicates very high importance.

It should be noted that the EIS assessment was done solely based on the attributes found at the study area and immediate surroundings. Furthermore, the precautionary principle was applied during the EIS assessment, due to only one field survey being undertaken and the consequent probability of overlooking faunal and floral species. However, the field survey results were supplemented by background information and therefore the conclusions are considered representative of the features that were assessed.

1.1.3.6 Recommended Ecological Category (REC)

The REC is determined by the PES score as well as importance and/or sensitivity. Water resources which have a PES falling within an E or F ecological category are deemed unsustainable. In such cases the REC must automatically be increased to a D. Where the PES is determined to be within an A, B, C or D ecological category, the EIS components must be evaluated to determine if any of the aspects of importance and sensitivity are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated and either set at the same ecological category or higher depending on feasibility. This is recommended to enable important and/or sensitive water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

1.1.3.7 Buffer determination

The recently published Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (Macfarlane and Bredin, 2016), allows the user to rate key elements such as threats posed by land use / activities on the water resource, climatic factors, the sensitivity of the water resource (i.e. river, wetland or estuary), and buffer zone attributes in order to determine the size a buffer would need to be in order to sufficiently protect a river, wetland or estuary. However, it should be noted that the buffer tool cannot be applied to ephemeral systems which lack active channel characteristics i.e. channels which are not in contact with the zone of saturation and which do not have base flow (Macfarlane *et al*., 2014).

1.1.4. Assumptions and Limitations

The extent of the study area (7 333ha) did not allow for the physical on-site delineation of all watercourses. Desktop delineations were therefore undertaken with the use of background information and digital satellite imagery (Google Earth Pro, 2017). As a result, some discrepancies relating to the extent of the watercourse boundaries may be possible. However, pre-selected areas of interest were groundtruthed in order to determine accuracy of the desktop delineations, and the findings as presented within this report were considered sufficient in order to inform the outcomes of the study and the impact assessment.

Only digital satellite imagery (Google Earth Pro, 2017) was utilised in inaccessible areas where new road infrastructure has been proposed. However, only a small selection of areas was entirely inaccessible, and the digital satellite imagery was considered sufficient to surmise the impact potential on the ephemeral drainage lines.

The accuracy of the Global Positioning System (GPS) utilised at pre-selected areas of interest will affect the accuracy of the delineation. A Garmin GPSMap 64 was used which has an estimated accuracy rating of 3-5 meters. EnviroSwift is of the opinion however that this limitation is of no material significance and that the freshwater-related constraints have been adequately identified.

The assessment was confined to the top 50 cm of soil, in line with the delineation guideline provided by DWAF (updated 2008). Therefore, groundwater was not considered as part of this assessment.

A single field survey was undertaken in January 2018[3]. Therefore, the field survey was undertaken within the optimum season for Freshwater Assessments as prescribed by DWAF (updated 2008). However, seasonal variation in watercourses and vegetation characteristics was not considered as

[3] The region receives most of it's rainfall during summer and autumn. However, rainfall prior to the field survey was low.

part of this assessment. There is therefore the possibility that some aspects and species may have been missed, however general findings and results were considered sufficient to inform the PES and EIS assessment of the freshwater features.

All watercourses which were groundtruthed are intermittent systems, therefore no instream ecological assessment (South African River Health Programme protocols) and on-site collection and testing of water samples was undertaken.

In assessing the identified potential construction phase impacts, it has been assumed that good housekeeping measures (listed below) will be implemented through adherence to the Environmental Management Programme (EMPr):

- Clean up any spillages (e.g. concrete, oil, fuel), immediately. Remove contaminated soil and dispose of it appropriately;
- Service vehicles and machinery within demarcated areas, preferably off-site;
- Use bunded surfaces within designated areas for re-fuelling vehicles. Direct runoff from these areas towards a collection area and dispose contaminated water and soil at an appropriate registered facility. Vehicles should preferably be refueled off site;
- Provide adequate temporary toilets for the duration of the construction phase, these should be located at least 30 m from all delineated watercourse boundaries;
- Prohibit the washing of vehicles, tools or machinery in watercourses or associated buffer areas;
- Store fuel, chemicals and other hazardous substances in suitable, secure, weather-proof containers and within an area with impermeable and bunded floors, preferably within areas earmarked for construction at least 30 m from the delineated edge of any watercourse and within an already disturbed area, as far as practically possible.
- Inspect all storage facilities and vehicles on a regular basis for the early detection of deterioration or leaks;
- Locate fuel and chemical storage facilities outside areas prone to flooding;
- Protect stockpiles, if required, from erosion using tarp or erosion blankets;
- Ensure that no standing water gathers at stockpile sites, to reduce erosion as well as the contamination of the water by nutrients/ toxics;
- Cover storage piles to limit dust generation;
- Restrict the dumping or storage of construction material to the footprint of construction areas. These areas should be located at least 30 m from all delineated watercourse boundaries;
- Dispose of used oils, wash water from cement and other pollutants at an appropriately licensed landfill site;
- Remove all construction material and waste upon completion of the project; and
- Remove all contaminated soil from storage and maintenance areas, thereafter rip, profile and monitor until indigenous vegetation has established.

1.1.5. Source of Information

Primary information sources used to inform the desktop assessment included:

- Northern Cape Provincial Spatial Development Framework; PSDF (2012);
- The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org;
- The National Freshwater Ecosystem Priority Areas project (NFEPA, 2011);
- Google Earth Pro (2017) and Vector data received from the Chief Directorate Surveys and Mapping (2015); and
- The vegetation of South Africa, Lesotho and Swaziland as compiled by Mucina and Rutherford (2006).

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO FRESHWATER IMPACTS

WEF construction related aspects (activities) that could result in the identified direct and cumulative impacts discussed in Section 1.6.1 include:

1) Clearance of vegetation within drainage lines and the recommended buffer zones prior to the construction of new road crossings (5m wide) or widening of existing roads (8m wide) and placement of underground distribution lines; vegetation clearing for the construction yard, substation, and for each of the sites earmarked for the turbines.

2) Disturbance of vegetation e.g. edge effects as well as indiscriminate movement of construction vehicles and personnel.

3) Site preparation following the removal of vegetation such as levelling and compacting of soil, stripping of soil and stockpiling.

4) Construction or upgrading of the watercourse crossings.

5) Use of concrete during construction of watercourse crossings as well as accidental spillage of hazardous chemicals.

WEF operation related aspects (activities) that could result in the identified direct and cumulative impacts discussed in section 1.6.2. include:

1) Inadequate maintenance of watercourse crossings.

2) Lack of ongoing eradication of alien and invasive vegetation.

Decommissioning related aspects (activities) that could result in the identified direct and cumulative impacts discussed in section 1.6.3. and section 1.6.4, respectively, include:

1) Earth moving activities in the vicinity of drainage lines or associated buffer zones.

2) Lack of follow-up monitoring and erosion control where needed.

2) Lack of follow-up management of alien and invasive vegetation within disturbed areas.

No aspect that could potentially result in a fatal flaw or indirect impact was identified as part of the Freshwater Impact Assessment.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Baseline Description of the Receiving Environment

The study area is situated in the north-eastern parts of the Northern Cape Province, near the town Kuruman within the Ga-Segonyana Local Municipality. Kuruman is located approximately 236km (by road) to the north-west of the provincial capital, Kimberley. The Northern Cape Province can be described as being semi-arid in the east, to arid in the central region, to hyper-arid in the far western parts of Namaqualand (PSDF, 2012).

Approximately 97,69% of the Ga-Segonyana Local Municipality has been classified as 'remaining natural habitat' and the applicable terrestrial ecosystems have been listed as Least Threatened (information retrieved from The Land Use Decision Support Tool (LUDS, 2014) available on www.bgis.co.za).

The study area is located within a transitional zone of the Kuruman Thornveld and Kuruman Mountain Bushveld vegetation types (Figure 5) at a varying altitude of between 1 300 to 1 600m above sea level (ASL). Both vegetation types are known for summer and autumn rainfall with very dry winters. The Mean Annual Precipitation (MAP) documented for the Kuruman Mountain Bushveld is between 250 to 500mm and for the Kuruman Thornveld 300 to 450mm (Mucina and Rutherford, 2006, updated 2012). Kuruman Mountain Bushveld is associated with the Kuruman and Asbestos Hills which consist of banded iron formations with jaspilite, chert and riebeckite asbestos of the Asbestos Hills Subgroup of the Griqualand West Supergroup. Soils are shallow, sandy soils of the Hutton form. The geology of the Kuruman Thornveld is associated with Campbell Group dolomite and chert and mostly younger, superficial, Kalahari Group sediments, with red, wind-blown sand of the Hutton form. Locally rock pavements are formed in places. Additional attributes of the region are provided in Table 3.

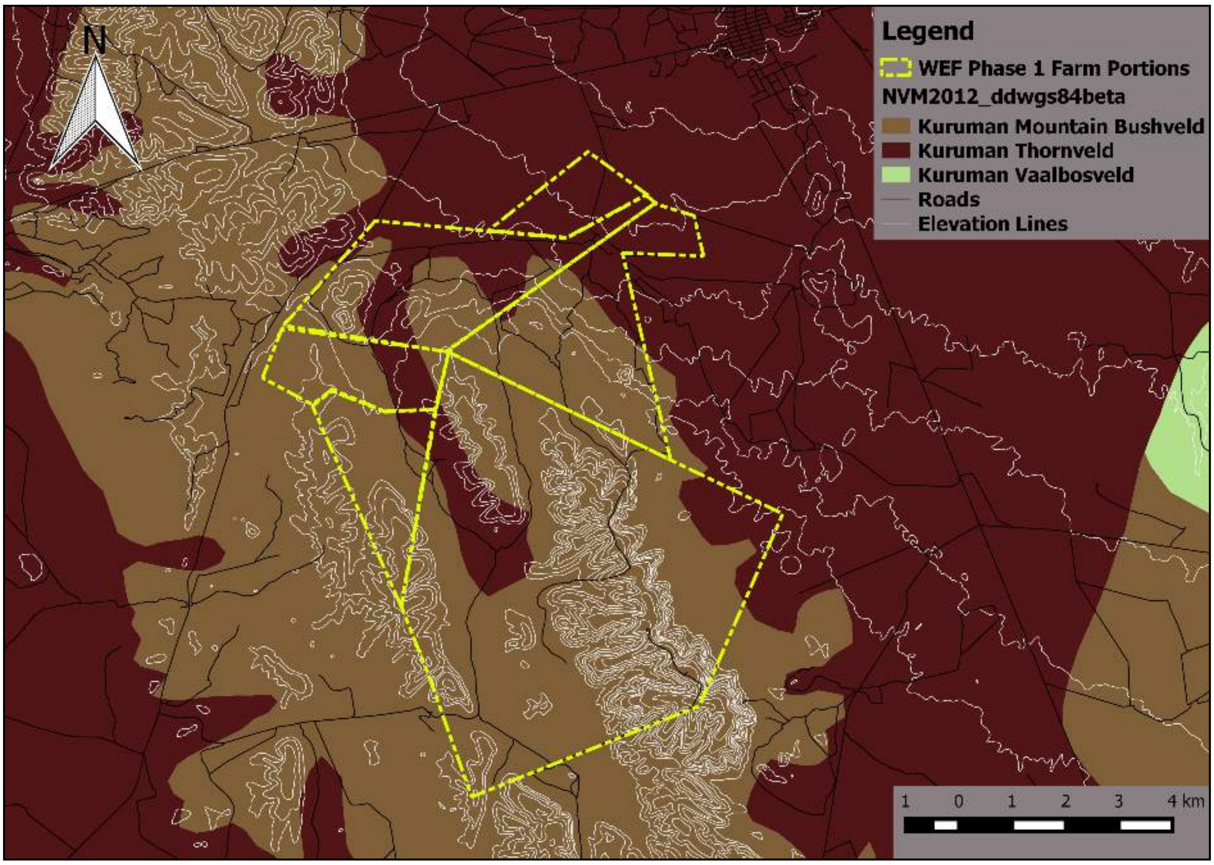

Figure 5: Vegetation types applicable to the study area (Mucina and Rutherford, 2006).

Undisturbed Kuruman Mountain Bushveld is characterised by rolling hills with gently to moderately steep slopes, and hill pediment areas with a well-developed grass layer and patches of open shrubveld dominated by *Lebeckia macrantha.* In contrast, undisturbed Kuruman Thornveld is characterised by flat rocky plains and some sloping hills with a very well developed closed shrub layer and well developed open tree stratum consisting of *Acacia erioloba* (Mucina and Rutherford, 2006).

The quaternary catchments indicated for the study area are D41L and D41K and the study area falls within the Southern Kalahari Ecoregion (Figure 6) and within the Lower Vaal Water

Management Area (WMA) (Figure 7) and the Molopo sub-Water Management Area (sub-WMA) as defined by NFEPA (2011).

Table 3: Attributes of the region (Macfarlane and Bredin, 2016 and Mucina and Rutherford, 2006).

Attributes	
Inherent erosion potential (K factor) of catchment soils	0.62 – 0.63 (moderately high)
Rainfall seasonality	Summer to autumn
Mean annual precipitation (mm)	400 - 600 mm
Mean annual temp. (°C)	24 °C
Rain intensity	High

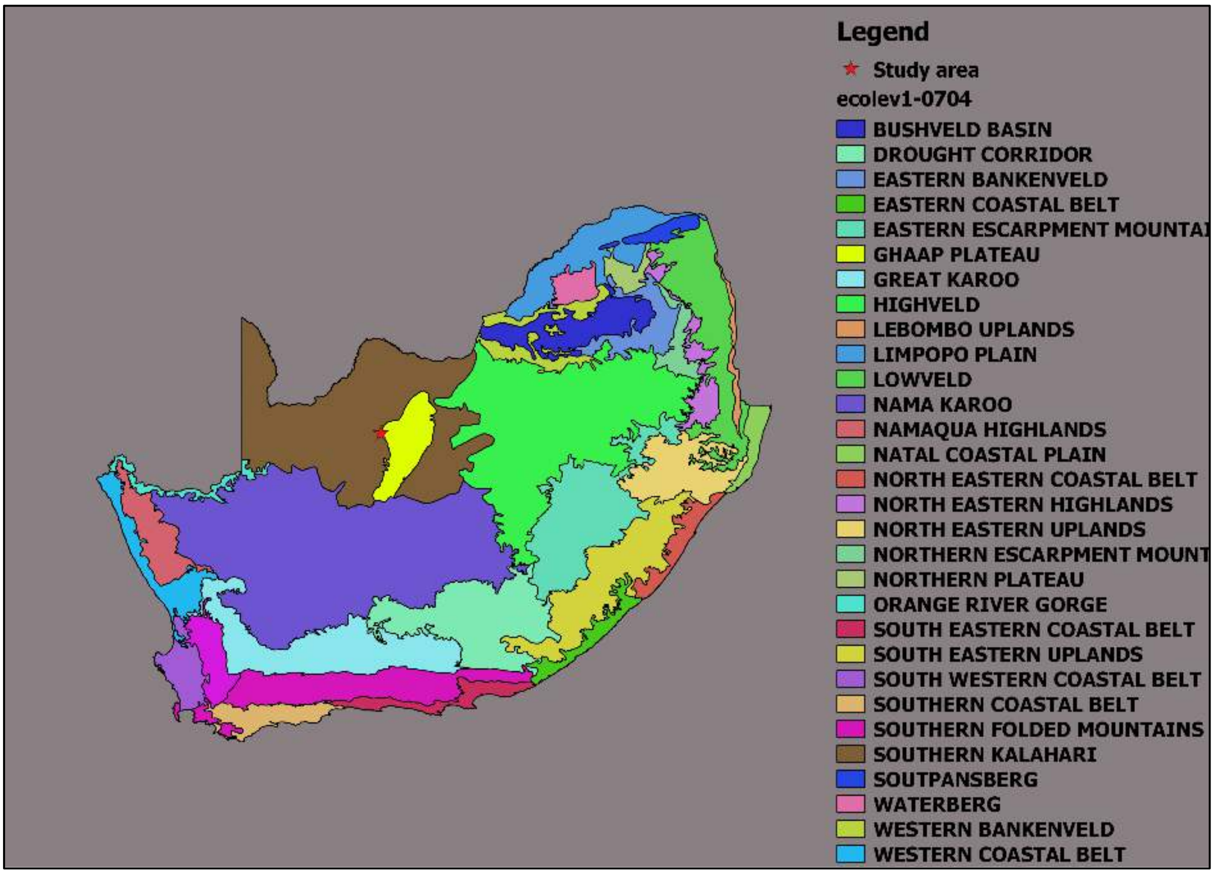

Figure 6: South African Ecoregions in relation to the study area.

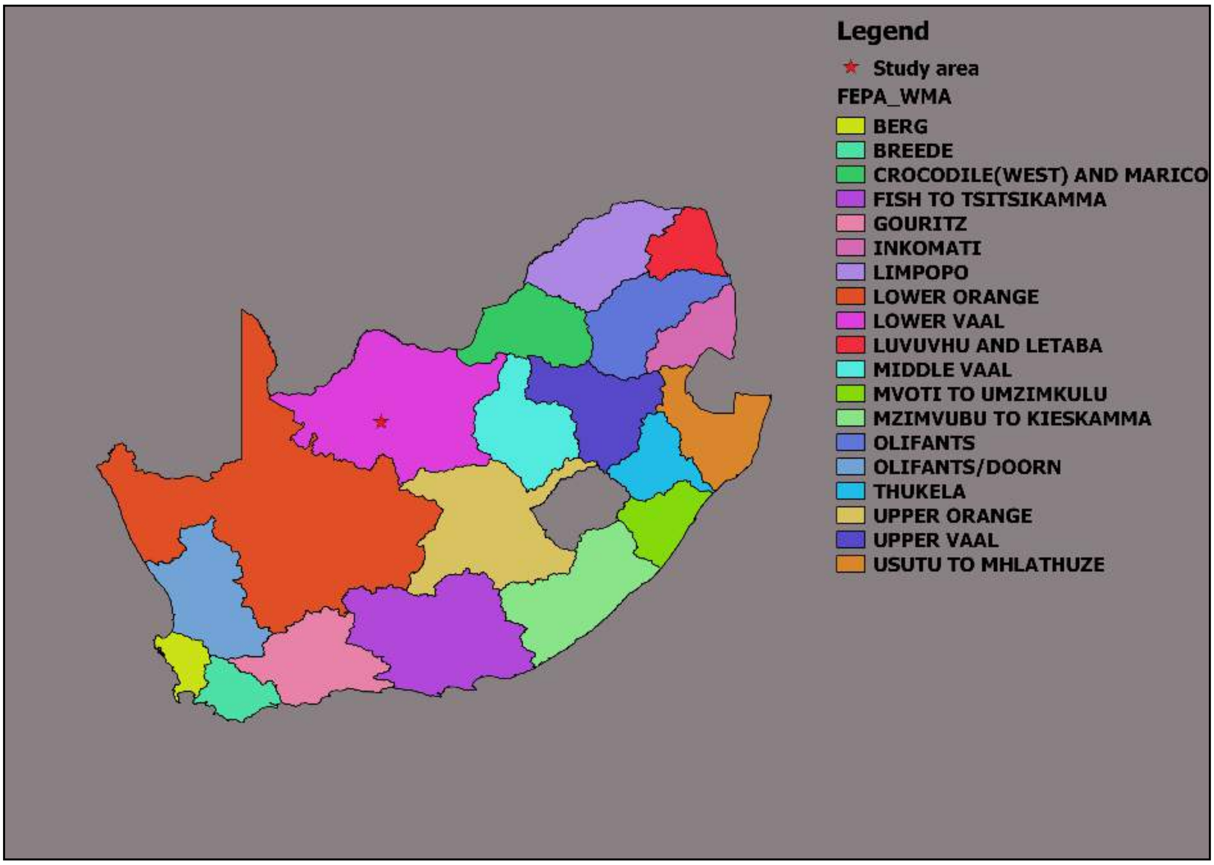

Figure 7: NFEPA WMA in relation to the study area.

Only the Kuruman River and one of its larger tributaries, the Ga-Mogara River, traverse the Ga-Segonyana Local Municipality. The Kuruman River originates east of Kuruman where it receives water from several springs of which the Great Koning Eye, Little Koning Eye and the Kuruman Eye are the largest (Zitholile, 2015). The confluence of the Kuruman River with the Molopo River is situated approximately 360km upstream of the study area. Both the Kuruman River and the Ga-Mogara River are usually dry, flowing only for short periods following sufficient rainfall.

The nearest river system is a tributary of the Kuruman River located approximately 4km north east of the study area, with the Kuruman River itself located approximately 6,6km from the study area boundary. The Kuruman River as well as the tributary are ephemeral watercourses indicated to be within a Class B (largely natural) PES (NFEPA, 2011). The Ga-Mogara River with its associated tributaries are located south west of the study area, the closest of which is the Vlermuisleegte tributary approximately 25km from the boundary of the study area. The tributaries of the Kuruman River located within the catchment of the study area have been classified as Class C (moderately modified) (Northern Cape PSDF, 2012) (Figure 8).

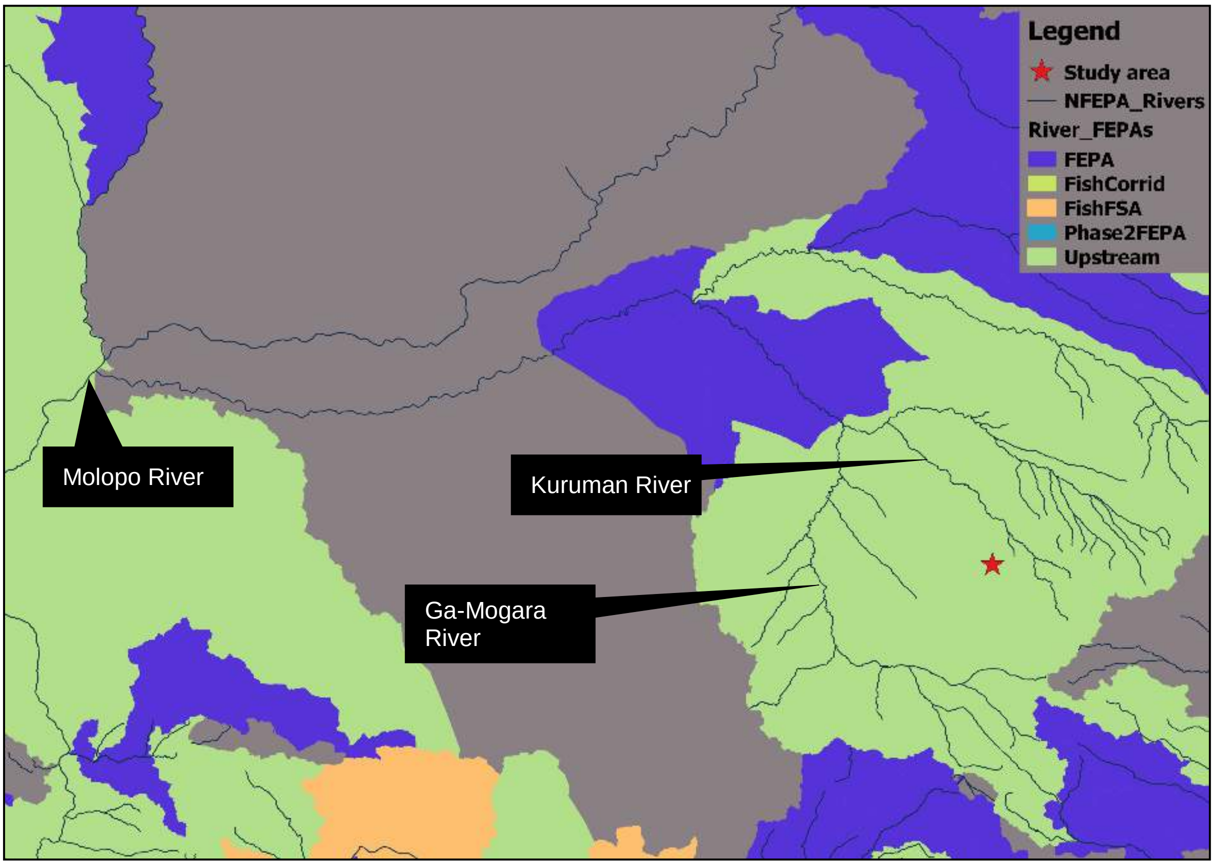

Figure 8: Freshwater Ecosystem Priority Areas and major rivers.

The sub-quaternary catchment in which the study area is located was selected as an Upstream Management Area (Figure 8). Upstream Management Areas, are sub -quaternary catchments in which human activities need to be managed to prevent degradation of downstream river Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Areas (FSAs). The sub-quaternary catchment located downstream of the confluence of the Ga-Mogara River with the Kuruman River was selected as a river FEPA and therefore requires adequate protection. River FEPAs achieve biodiversity targets for river ecosystems and fish species, and are identified in rivers that are currently in a good condition (A or B ecological category).

The applicable wetland vegetation units for seeps and depressions, which is the only wetland habitat within the study area indicated by background information, is the Eastern Kalahari Bushveld Group 3 and 4 (Figure 9) both listed as 'Least Threatened' (NFEPA, 2011). A single natural seep wetland extending over approximately 13ha is located within the study area, indicated to fall within an AB wetland condition (natural or good) and only one smaller artificial feature, approximately 0.38ha, is located within 500m of the study area boundary (Northern Cape Critical Biodiversity Areas, 2016 and NFEPA, 2011). The topography has however resulted in the formation of numerous small ephemeral drainage lines throughout the study area (Figure 9; Chief Directorate Surveys and Mapping attained August 2015).

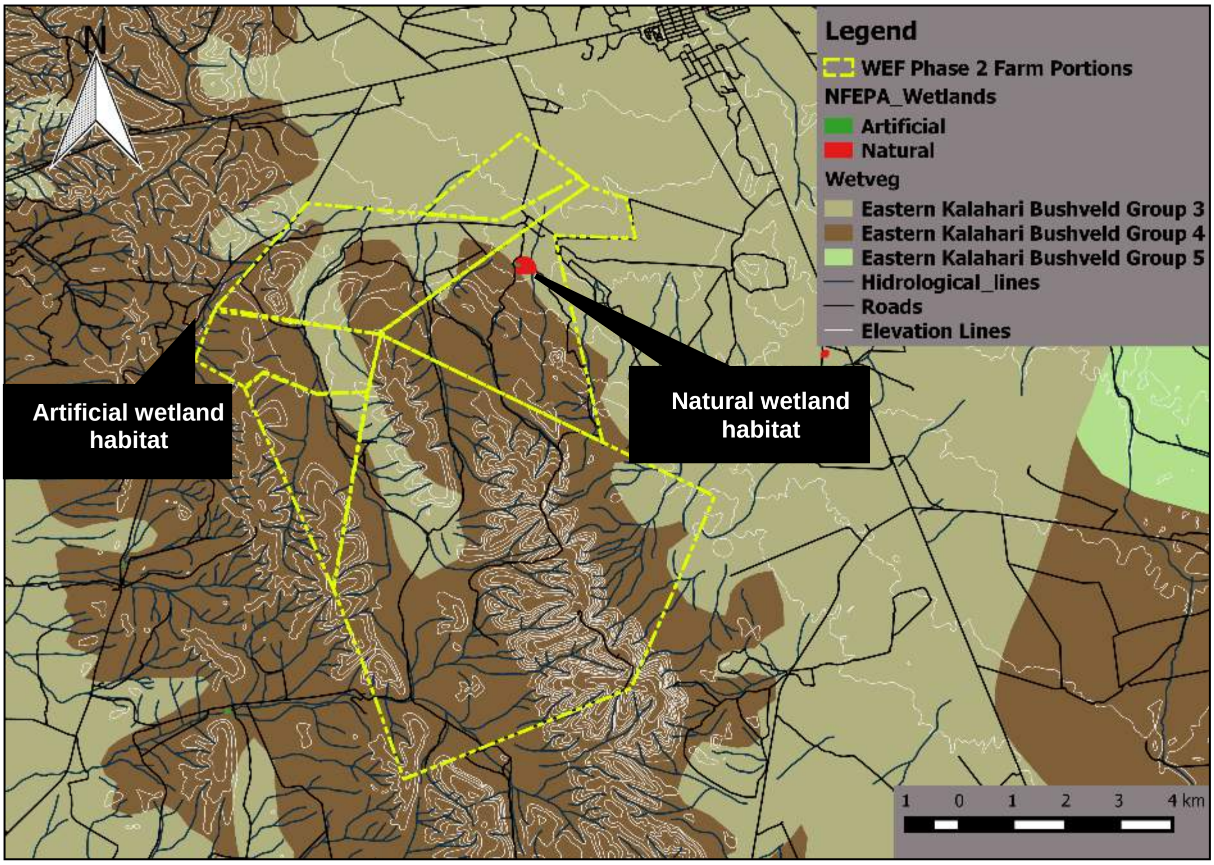

Figure 9: Wetland vegetation units and wetland habitat (NFEPA, 2011) as well as hydrological lines[4].

1.3.2. Results of the Field Study

Two ridges run along the center of the study area in a north-south direction. Multiple ephemeral drainage lines originate at the crests along the length of the ridges. Some of these drainage lines steadily increase in size as they confluence with each other. However, drainage lines were also encountered which do not accumulate sufficient water volumes and which dissipate at the base of the ridge.

Ephemeral drainage lines occurring on steep hillslopes associated with the ridges can be defined as A Section channels. “A sections are those headward channels that are situated well above the zone of saturation at its highest level and because the channel bed is never in contact with the zone of saturation, these channels do not carry baseflow. They do however carry storm runoff during fairly high rainfall events but the flow is of short duration because there is no baseflow component.” (DWAF, 2005). Many of these channels are located at gradients too steep to allow deposition of alluvial soil or overtopping of banks which in turn would be conducive of the formation of riparian zones.

[4] Vector data received from the Chief Directorate Surveys and Mapping August 2015.

Figure 10: Representative photos of A Section channels (indicated by white arrows).

Additional ephemeral drainage lines extend through the flat valleys at the bases of hillslopes and are augmented by the A section channels. These ephemeral drainage lines can be defined as 'arid drainage lines' and are often characterised by poorly defined or discontinuous channels due to lower annual rainfall, longer rainfall intervals, high evapotranspiration and high infiltration in areas with sandy soils (Lichvar *et al*., 2004 and Grobler, 2016). The lack of sufficient surface water flow within the majority of the arid drainage lines in combination with the absence of shallow groundwater resources (pers. communication with Mr. du Plessis) is not conducive to the formation of 'riparian zones.

Poorly defined riparian zones are only associated with isolated areas along some of the larger arid drainage lines. Although the tree community is sparse within these isolated areas, trees such as *Vachellia erioloba* (Camel thorn) and *Ziziphus mucronata* (Buffalo thorn) provide shelter for avifauna as well as nutrient concentrations that enable the persistence of understory's which in turn provide foraging and breeding habitat for ground dwelling faunal species (van Rooyen, 2001).

Figure 11: Representative photos of arid drainage lines (a, b, c and d), and representative photos of the isolated areas along some of the larger drainage lines with ill-defined riparian zones (c and d).

The natural seep wetland, indicated by NFEPA (Figure 9) was also investigated during the field survey. It was found to be a small artificial pond used for recreational purposes. Considering the terrain unit and soil matrix[5] it is considered possible that this seep existed historically. However, no additional wetland characteristics as defined by DWAF (2008) were identified within the immediate surroundings of the pond or any other area of interest during the field survey. **No infrastructure is proposed near the natural seep wetland; therefore, no impact to this feature is expected should, WEF Phase 1 be authorised.**

Figure 12: Representative photos of artificial pond.

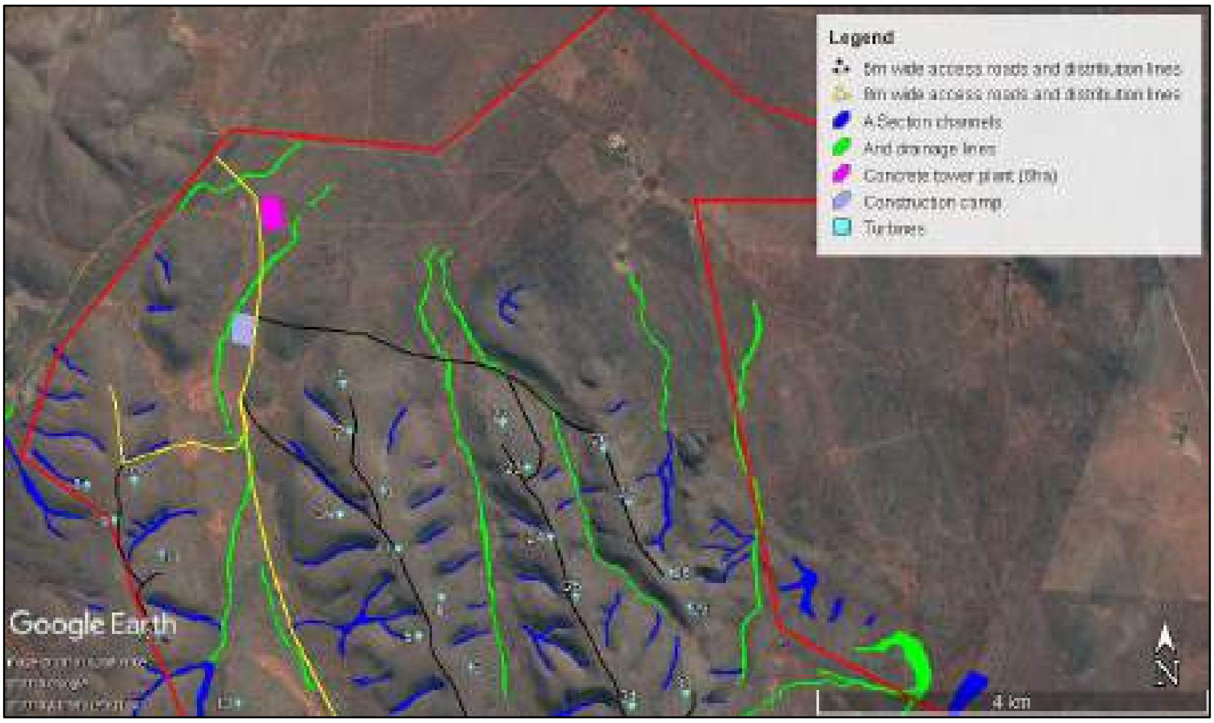

Figure 13: Ephemeral drainage lines (including A section channels and arid drainage lines) associated with the study area (northern extent).

[5] Soil matrix is the portion of the soil layer (usually more than 50%) which has the predominant colour.

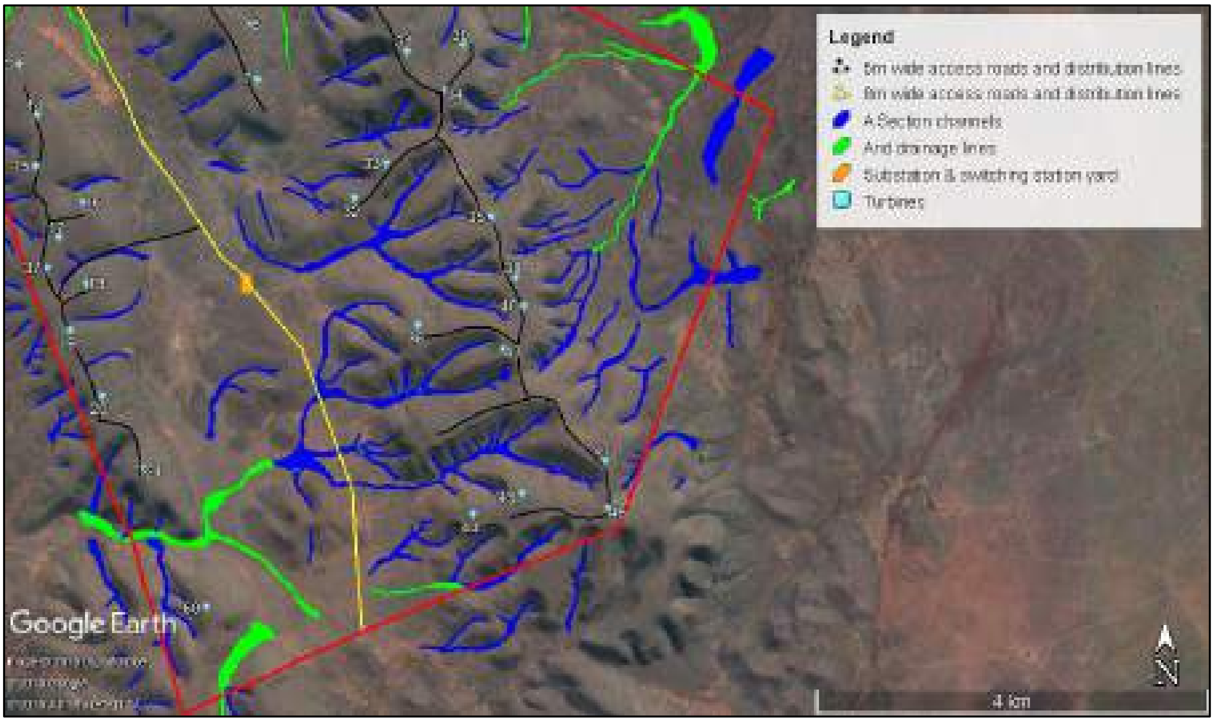

Figure 14: Ephemeral drainage lines (including A section channels and arid drainage lines) associated with the study area (southern extent).

1.3.3. Aquatic Ecosystem Classification

All ephemeral drainage lines are located within a valley floor landscape which occurs at the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate (Ollis *et al*. 2013). The table below summarise the results from **Level 4** through to **Level 6**.

Table 4: Aquatic ecosystem classification (Ollis *et al*., 2013)

	Ephemeral drainage lines
Level 4	**River**: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit[6].
Level 5	**Intermittent:** water flows for a relatively short time of less than one season's duration.
Level 6	**Natural**: existing in, or produced by nature; not made or caused by humankind.

1.3.4. Watercourse Delineation

Due to the size of the study area it was not considered practical to do a walkdown of each of the ephemeral drainage lines. Ephemeral drainage lines were therefore desktop delineated with the use of background information and digital satellite imagery (Google Earth Pro). Vector data obtained from the Chief Directorate Surveys and Mapping (August 2015) was overlain on Google Earth Pro imagery in order to determine the potential locality of watercourses. Changes in topography and evidence of water moving through the landscape, such as channels, changes in soil colour and changes in vegetation structure, were utilized in order to desktop delineate the boundaries of the

[6] The ephemeral drainage lines encountered are not considered to be representative of typical rivers with riparian zones, however, of the definitions provided by the classification system, the 'river' definition best describes these features.

ephemeral drainage lines. The desktop assessment was followed by a physical site survey undertaken mid-January 2018 during which pre-selected areas of interest was investigated in order to groundtruth the accuracy of the desktop delineations.

According to DWAF (2008), indicators used to determine the boundary of the riparian zone of watercourses include: landscape position; alluvial soils and recently deposited material; topography associated with riparian areas; and vegetation associated with riparian areas. However, due to a lack of a distinctive riparian zone, indicators such as landscape position and topography were utilized as the primary indicators when delineating the boundary of ephemeral drainage lines. The majority of the ephemeral drainage lines were characterised by the presence of poorly defined or discontinuous channels and, where present, the banks of these channels were utilised to define the extent of the watercourses.

Figure 15: Representative images of ephemeral drainage lines associated with the study area. Note poorly defined channels utilized when determining the extent of the watercourses.

1.3.5. Present Ecological State (PES)

In order to determine the PES of the ephemeral drainage lines, the river IHIA was applied (refer to methodology in section 1.1.3.4). The IHIA is founded on the assessment of two separate modules of a watercourse namely riparian habitat and instream habitat. However, due to a lack of riparian habitat within the ephemeral drainage lines, the riparian habitat module of the IHIA could not be applied and to some degree aspects assessed as part of the instream assessment would not be entirely applicable either. However, to obtain an estimated PES category for these drainage lines, the IHIA instream module was applied.

The primary surrounding land use is stock farming (cattle and sheep) and the study area itself is currently utilised as a game farm. The low regional rainfall in combination with the absence of perennial rivers near the study area is not favorable for extensive crop cultivation. As a result, natural vegetation has remained in a good condition within most of the study area, with the exception of isolated areas near watering points, roads and fences where natural vegetation cover decreases. The most noteworthy present impact on ephemeral drainage lines is erosion. This is particularly relevant in areas characterised by poor land use management practices.

Ephemeral drainage lines were divided into groups according to perceived degree of disturbance and each group was assessed accordingly:

- Group 1: A Section channels on hillslopes which have remained largely undisturbed due to their inaccessible nature.
- Group 2: A Section channels on hillslopes which have been disturbed as a result of the development of informal access roads or fences through the features. An increased level of erosion of the bed and banks of these features was noted.
- Group 3: Arid drainage lines within valleys which have remained largely undisturbed. Small areas of erosion and trampling of vegetation were noted in isolated areas near watering points within a few of the features.
- Group 4: Arid drainage lines within valleys at the bases of hillslopes which are associated with a greater level of disturbance due to informal access road development and increased grazing pressure. This disturbance has resulted in an increased level of erosion of the bed and banks of the features.

The instream scores calculated for the ephemeral drainage lines within Group 1 and Group 3 fall within IHIA Category A (unmodified, natural); and the instream scores calculated for the ephemeral drainage lines within Group 2 and Group 4 fall within IHIA Category C (Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged).

Table 5: Descriptive classes for the assessment of modifications to habitat integrity (after IHIA, 1999).

IMPACT CATEGORY	DESCRIPTION	SCORE
None	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability is also very small.	1 - 5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is also limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11 - 15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area is affected. Only small areas are not influenced.	16 - 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section is influenced detrimentally.	21 - 25

Table 6: IHIA results for ephemeral drainage lines falling within Group 1.

GROUP 1	Impact score	Weight	IHI Score	Impact Category	Confidence
Instream criteria					
Water abstraction	0	14	0	None	M
Flow modification	0	13	0	None	M
Bed modification	2	13	1.04	Small	H
Channel modification	2	13	1.04	Small	H
Water quality	0	14	0	None	L
Inundation	0	10	0	None	M
Exotic macrophytes	0	9	0	None	H
Exotic fauna	0	8	0	None	L
Solid waste disposal	0	6	0	None	H
Provisional Instream Habitat Integrity		100	97.92		
IHIA Category			**A**		

Table 7: IHIA results for ephemeral drainage lines falling within Group 2.

GROUP 2	Impact score	Weight	IHI Score	Impact Category	Confidence
Instream criteria					
Water abstraction	0	14	0	None	M
Flow modification	14	13	7.28	Moderate	M
Bed modification	14	13	7.28	Moderate	H
Channel modification	14	13	7.28	Moderate	H
Water quality	0	14	0	None	L
Inundation	0	10	0	None	M
Exotic macrophytes	0	9	0	None	H
Exotic fauna	0	8	0	None	L
Solid waste disposal	0	6	0	None	H
Provisional Instream Habitat Integrity		100	78.16		
IHIA Category			**C**		

Table 8: IHIA results for ephemeral drainage lines falling within Group 3.

GROUP 3	Impact score	Weight	IHI Score	Impact Category	Confidence
Instream criteria					
Water abstraction	0	14	0	None	M
Flow modification	0	13	0	None	M
Bed modification	5	13	2.6	Small	H
Channel modification	5	13	2.6	Small	H
Water quality	0	14	0	None	L
Inundation	0	10	0	None	M
Exotic macrophytes	0	9	0	None	H
Exotic fauna	0	8	0	None	L
Solid waste disposal	0	6	0	None	H
Provisional Instream Habitat Integrity		100	94.8		
IHIA Category			**A**		

Table 9: IHIA results for ephemeral drainage lines falling within Group 4.

GROUP 4	Impact score	Weight	IHI Score	Impact Category	Confidence
Instream criteria					
Water abstraction	0	14	0	None	M
Flow modification	16	13	8.32	Moderate	M
Bed modification	15	13	7.8	Moderate	H
Channel modification	15	13	7.8	Moderate	H
Water quality	0	14	0	None	L
Inundation	0	10	0	None	M
Exotic macrophytes	0	9	0	None	H
Exotic fauna	0	8	0	None	L
Solid waste disposal	0	6	0	None	H
Provisional Instream Habitat Integrity		100	76.08		
IHIA Category			**C**		

Figure 16: Evidence of erosion encountered within ephemeral drainage lines.

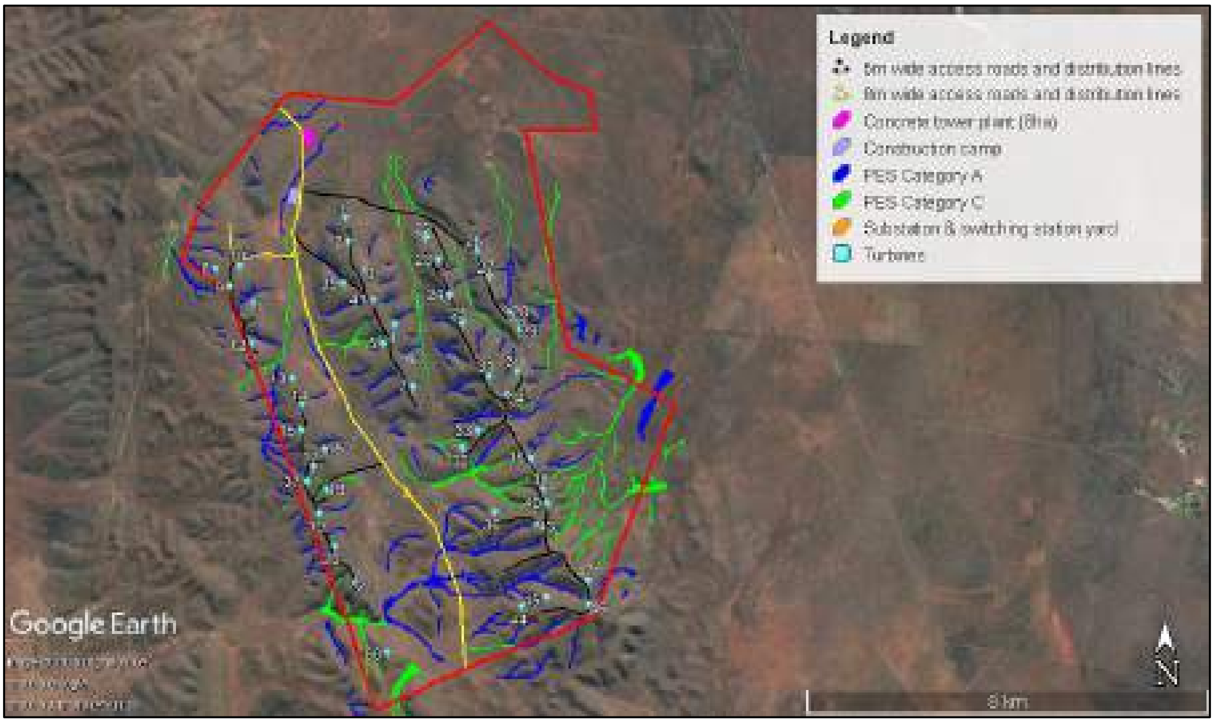

Figure 17: PES of ephemeral drainage lines associated with the study area.

1.3.6. Ecological Importance and Sensitivity (EIS)

The EIS method of assessment for rivers is based on the approach adopted by the DWA as detailed in the document "Resource Directed Measures for Protection of Water Resources" (1999). Due to their similar characteristics and nature, all ephemeral drainage lines were considered in a single assessment. Although the PES of the various features differed slightly, this does not have a significant impact on the overall EIS of the features.

Ephemeral drainage lines associated with the study area are situated above the zone of saturation and therefore do not carry baseflow. Due to the absence of baseflow these drainage lines only flow for short intervals after sufficient rainfall and are not associated with a diversity of habitat units such as riffles, runs or rapids. Furthermore, the lack sufficient surface water flow in combination with the absence of shallow groundwater resources (pers. communication with Mr. du Plessis) is not conducive to the formation of riparian zones. The poor diversity of instream habitat units and the lack of riparian areas decreases the ability of the drainage lines to support a high diversity of species or to provide refugia to aquatic biota. The poor diversity of habitat units also decreases the sensitivity of the features to flow changes and flow related water quality changes. Furthermore, the lack of flowing water within the features for the majority of the year decreases the importance of the drainage lines in terms of the provision of migration corridors for aquatic biota.

The ephemeral drainage lines were not found to support rare and endangered species or unique populations of species. It is also considered highly unlikely that the drainage lines will support biota which are intolerant to changes in flow due to the highly ephemeral nature of the features. However, the drainage lines are located within a natural area and provide the habitat to support individuals of protected species such as *Acacia erioloba* (Camel Thorn) and *Nerine* sp. which increases the importance of the features slightly.

Although the ephemeral drainage lines calculated an overall low EIS score and are considered to be of low sensitivity in terms of water yield and quality (Macfarlane *et al.*, 2014), these features do still provide valuable functions such as attenuation of floodwaters and retention of excess sediments. Furthermore, the drainage lines provide the habitat to support protected floral species. The unnecessary disturbance of these features must therefore be avoided.

Table 10: EIS results for the ephemeral drainage lines

	Ephemeral drainage lines	Confidence
Rare and endangered biota	1	3
Populations of unique biota	0	3
Intolerant biota	0	3
Species/taxon richness	1	3
Diversity of habitat types or features*	1	4
Refuge value of habitat types	1	4
Sensitivity of habitat to flow changes	1	4
Sensitivity to flow related water quality changes	1	4
Migration route/corridor for instream and riparian biota	0	3
National parks, Wilderness areas, Nature reserves, Natural Heritage sites, and Natural areas	1	4
TOTAL	**6**	
MEDIAN	**1**	
OVERALL EIS	**Low/Marginal**	

Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1
* a rating of zero is not appropriate in this context.

1.3.7. Recommended Ecological Category (REC)

The development of ephemeral drainage line crossings will result in the removal of vegetation and in the disturbance of soils. The PES of the portions of the ephemeral drainage lines in the vicinity of the crossing areas is therefore likely to decrease. However, it is considered possible to maintain the PES of the features as a whole[7] with the implementation of the recommendations as listed in Section 1.6 below. These recommendations include amongst others; limiting the extent of the construction footprint area to avoid unnecessary disturbance; making use of existing access roads where possible, construction of roads and underground distribution lines crossing ephemeral drainage lines outside of the rainfall season; alien and invasive species control; rehabilitation of any areas **outside** of the direct construction footprint which have been disturbed

[7] The PES of the remainder of the longitudinal systems can be maintained.

as a result of construction related activities; monitoring of ephemeral drainage line crossings during the operational phase in order to avoid erosion of the features or alteration of the natural flow patterns through the features; and rehabilitation of all crossing areas during the decommissioning phase of the development.

1.3.8. Buffer Requirements

The most recent guideline for buffer allocation in South Africa does not apply to channels which lack active channel characteristics i.e. channels which are not in contact with the zone of saturation and which do not have base flow (Macfarlane *et al*., 2014). The minimum buffer zone requirements for electricity generation works is 20m (Macfarlane and Bredin, 2017). It is however the opinion of the specialist that a buffer of at least 30m be provided for all drainage lines in order to reduce the risk of erosion. Preferably, no turbine footprints or laydown areas should be sited within any of the 30m buffers. In addition, the advocated buffers should be designated ''No Go'' zones within the study area wherein only essential activities should be allowed during construction or upgrading of roads and placement of distribution lines.

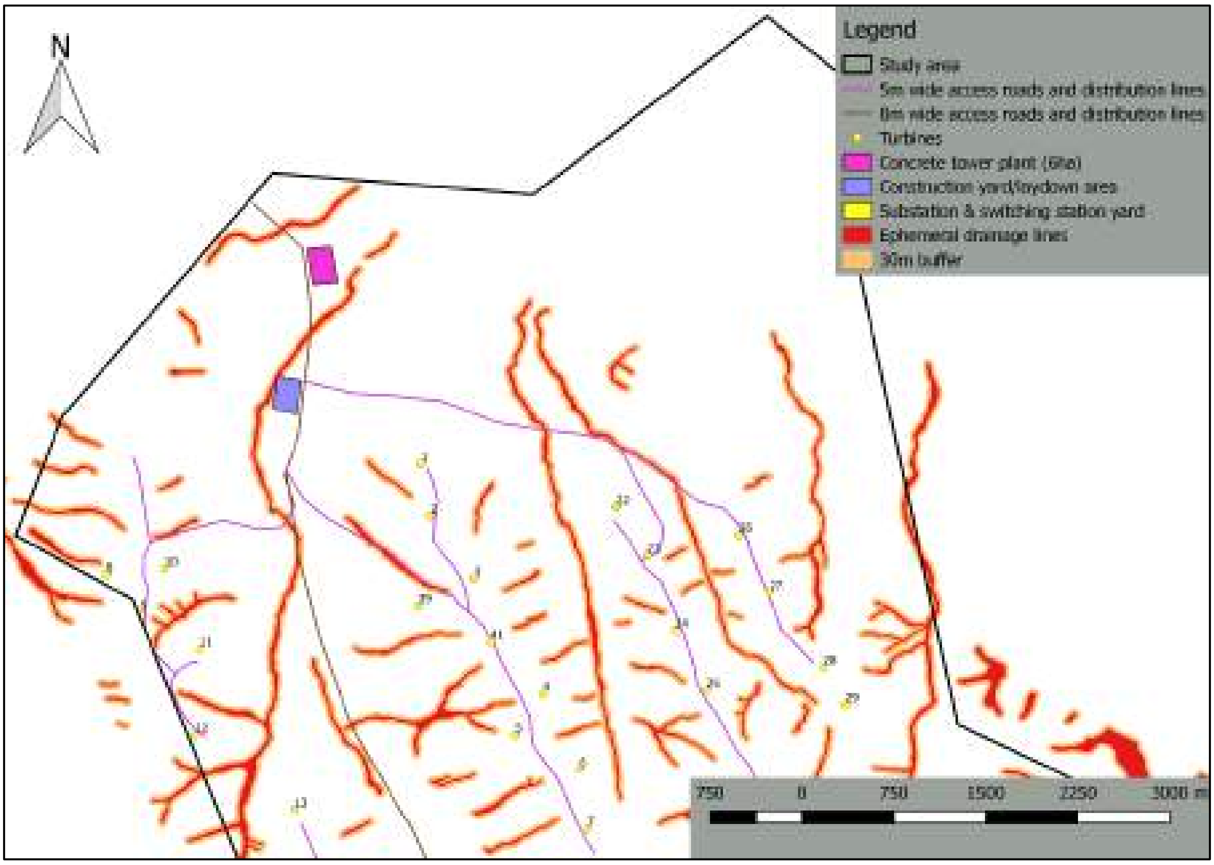

Figure 18: Ephemeral drainage lines and associated 30m buffer area (northern extent).

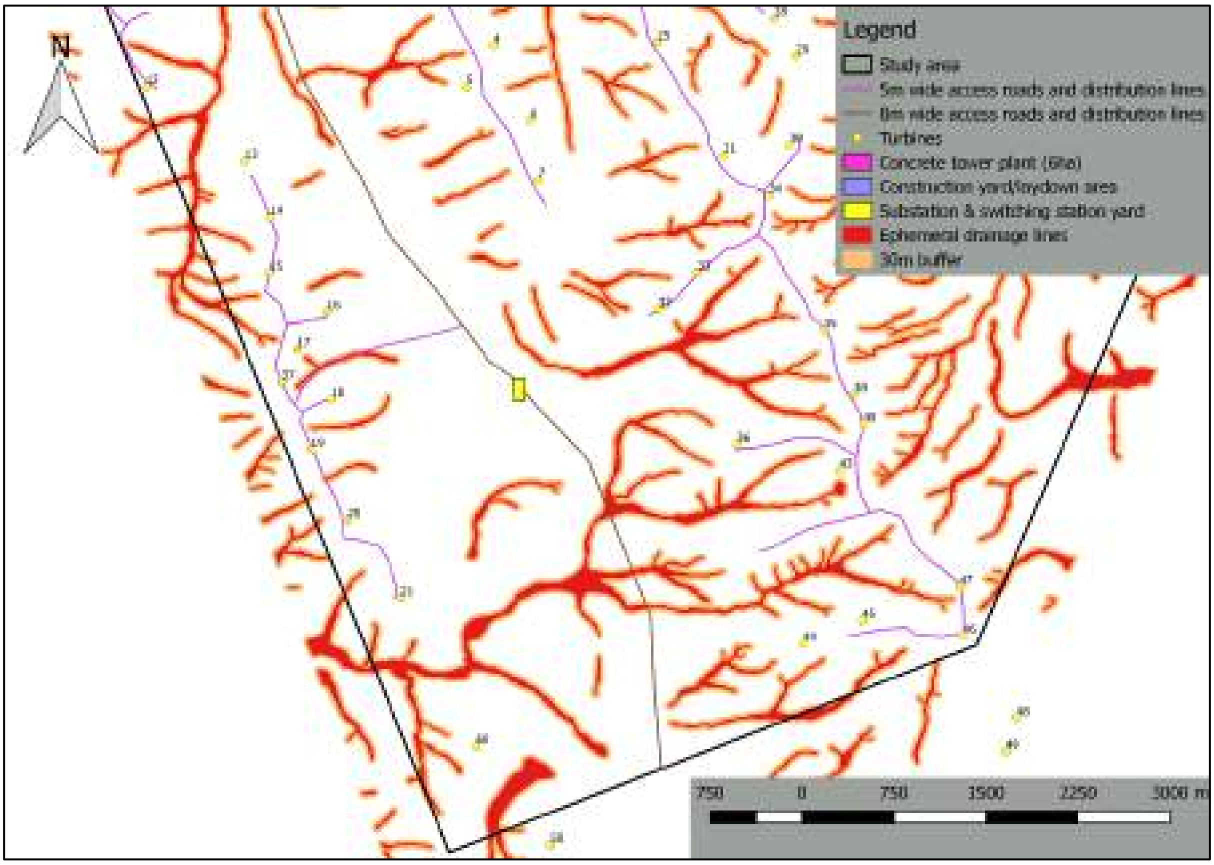

Figure 19: Ephemeral drainage lines and associated 30m buffer area (southern extent).

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

1.4.1. National Environmental Management Act, 1998 (Act No. 107 of 1998)

Any development within the extent of a watercourse may require Environmental Authorisation in terms of the NEMA 107 of 1998 and subsequent amendments to the Act.

A watercourse is defined in the Act as:

(a) River or spring;

(b) A natural channel in which water flows regularly or intermittently;

(c) A wetland, pan, lake or dam into which, or from which, water flows; and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act (NWA, 1998) (Act No. 36 of 1998).

Note that a reference to a watercourse includes, where relevant, its bed and banks; and

“wetland” means 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 typically adapted to life in saturated soil.

“dam” when used in these Regulations means any barrier dam and any other form of impoundment used for the storage of water, excluding reservoirs.

1.4.2. National Water Act (Act No 36 of 1998)

The crossing of watercourses e.g. roads and cables is considered to be a water use as defined within the NWA and would require the authorisation from the Department of Water and Sanitation (DWS). In terms of the proposed project, water uses listed within Section 21 that will most likely require authorisation include -
(c) impeding or diverting the flow of water in a watercourse; and
(i) altering the bed, banks, course or characteristics of a watercourse.

It is important to note that "Altering the beds, banks, course or characteristics of a watercourse" means any change affecting the resource quality within the riparian habitat or 1:100 year flood line, whichever is the greater distance.

1.4.3. National Forest Act (Act No 84 of 1998)

The removal of *Acacia erioloba* or any other tree listed within the National Forest Act (NFA) 84 of 1998 at watercourse crossing points will require a tree removal permit which can be obtained from the Department of Agriculture, Forestry and Fisheries (DAFF).

1.4.4. National Environmental Management Biodiversity Act (Act No. 10 of 2004) Alien and Invasive Species Regulations (GN R598 of 2014)

According to the National Environmental Management Biodiversity Act (NEMBA, Act No. 10 of 2004) Alien and Invasive Species Regulations (GN R598 of 2014) alien and invasive species must be eradicated and managed according to the category and criteria specified.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1. Key Issues Identified

The potential freshwater issues identified during this EIA process include:

- Disturbance of the bed and banks of ephemeral drainage lines during the construction of access road and underground distribution line crossing areas;
- Alteration of the hydrological regime of ephemeral drainage lines due to an increase in runoff from hardened surfaces, ultimately resulting in the erosion of drainage lines;
- Alteration of flow patterns through ephemeral drainage lines at crossing areas;
- Water quality impairment at crossing areas due to the runoff of solutes and sediment; and
- Proliferation of alien and invasive species.

1.5.2. Identification of Potential Impacts

Sections 21 (c) and (i) of the NWA, refer to the physical changes that are made to a watercourse. Watercourses in context to this project include all delineated ephemeral drainage lines presented in Figure 14. It is a requirement of the WUA (Water Use Authorisation) process that potential impact on the following characteristics be determined:

- Impact on the flow regime;
- Impact on the water quality;
- Impact on biota - the animal and plant life of a particular region or habitat; and
- Impact on riparian habitat.

These four direct impacts therefore formed the foundation of the freshwater impact assessment however, any additional potential impacts were also identified and assessed. The proponent did not provide an alternative layout plan for Phase 1 of the proposed WEF and therefore only the impact significance for the layout plan provided was assessed.

Impacts considered to be likely during the construction, operational and decommissioning phase of the WEF include:

1.5.2.1. Construction Phase

- Potential **direct** impact 1 – Disturbance of drainage lines;
- Potential **direct** impact 2 – Alteration of flow patterns; and
- Potential **direct** impact 3 – Impairment of water quality.

1.5.2.2. Operational Phase

- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Alteration of the natural hydrological regime.

1.5.2.3. Decommissioning Phase

- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Impairment of water quality.

Cumulative impacts considered to be likely following authorisation of Phase 1 of the WEF include:

1.5.2.4. Cumulative impacts

- Cumulative impact 1 – Proliferation of alien and invasive species; and
- Cumulative impact 2 – Erosion of drainage lines.

It is the opinion of the specialist that any potential indirect impact can be avoided with strict adherence to mitigation measures provided for direct impacts. No indirect impacts were identified as part of the EIA phase of assessment.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

In assessing the identified potential construction phase impacts, it has been assumed that good housekeeping measures (listed in Section 1.1.4.) will be implemented through adherence to the EMPr.

1.6.1. Construction Phase Impact

1.6.1.1. Potential Impact 1 - Disturbance of drainage lines

a) Nature of the impact:

No turbines will be located within ephemeral drainage lines, however, the construction of drainage line crossings, including access roads as well as trenches for underground distribution lines, will result in disturbance of the bed and banks and the lowering of the PES of ephemeral drainage lines in the vicinity of crossing areas.

The boundary of a construction yard / laydown area is also located within an ephemeral drainage line and will result in an impact to the bed and banks of the feature (Figure 20).

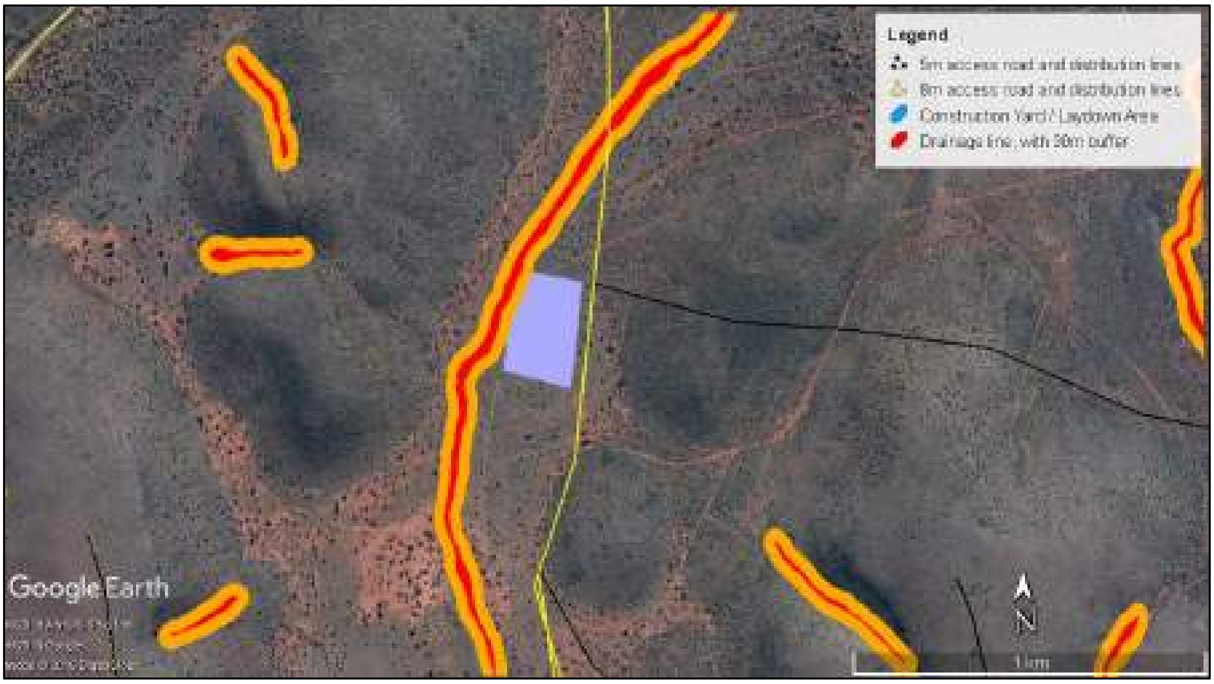

Figure 20: Portion of the construction yard extending into an ephemeral drainage line and its associated buffer area presented with orange (Google Earth Pro, 2018).

Removal of larger trees, will result in a change in the composition of the understory vegetation assemblage due to increased sunlight as well as proliferation of pioneer and invasive species.

Removal of larger trees and shrubs along drainage lines will also increase accessibility to livestock, leaving banks vulnerable to trampling and erosion.

Movement of construction vehicles through ephemeral drainage lines will result in the compaction of soils which may impact on vegetation and result in erosion.

Edge effects and indiscriminate driving, fires and dumping of construction material and spoil will also result in disturbance, it is therefore important that access into areas bordering the designated crossings is strictly prohibited.

Proliferation of alien vegetation as well as bush encroachment are also considered highly likely if not adequately managed.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- The following recommendations are made regarding the removal of vegetation and disturbance of ephemeral drainage lines at crossing areas:
  - o Limit the extent of the construction footprint area to avoid unnecessary disturbance;
  - o If possible, crossing areas should be developed at 90 degree angles to ephemeral drainage lines in order to limit the area of disturbance;
  - o A maximum construction working servitude of 3m should be allowed to either side of ephemeral drainage line crossing areas;

  - Demarcate each construction footprint located within each drainage line, clearly. All material used for demarcation purposes should be removed after construction has been completed;
  - Allow only essential construction related activities within the demarcated areas;
  - Strictly prohibit any construction related activity outside the demarcated areas;
  - Limit the movement of construction personnel and construction vehicles through ephemeral drainage lines during the construction of road and underground distribution line crossings to that which is absolutely necessary;
  - Make use of existing access roads where possible and any turning areas required must be located outside of the buffer zone;
  - Where widening of existing access roads located adjacent to ephemeral drainage lines is required, widening must take place on the opposite side of the existing road to the drainage line only;
  - Where possible, proposed new roads running along the lengths of drainage lines should be relocated to areas outside of the drainage lines and associated buffer zones;
  - The requirements for new road crossing structures such as wearing courses, bridges or culverts should be determined upon consultation with an engineer;
  - Prevent excessive disturbance of the bed and banks during culvert/bridge development (if used);
  - Limit the number of trees and shrubs removed as far as practically possible;
  - Minimise the extent of infilling within the drainage lines as far as possible;
  - The construction yard must be realigned so that its boundaries are located outside of ephemeral drainage line and its buffer area;
  - Prohibit the dumping of excavated material within the channel. Spoil material must be appropriately disposed of at a registered waste disposal facility;
  - Store topsoil and vegetation removed from the construction footprint at designated stockpile areas for use in rehabilitation activities. Designated stockpile areas must be located outside of the buffer areas of ephemeral drainage lines, preferably within already disturbed areas. Vegetation should be cut rather than uprooted in order to make way for stockpile areas. This will prevent further disturbance of soils;
  - Stockpile topsoil and subsoil removed during construction separately for future rehabilitation; and
  - Appoint an Environmental Control Officer (ECO) to inspect the crossings on a weekly basis (at least) and take measures to address unforeseen disturbances to the ephemeral drainage lines.
- The following recommendations are made regarding underground distribution line crossings:
  - Trenches traversing ephemeral drainage lines must be dug by hand in order to avoid any unnecessary disturbance and compaction of soils;
  - Topsoil and subsoil removed during excavation of trenches must be stockpiled separately at designated stockpile areas (see above) for future rehabilitation activities;
  - Replace soil in the correct order e.g. subsoil below and topsoil above, as soon as possible after distribution lines have been placed;
  - Compact subsoil and spread the topsoil as evenly as possible over the subsoil. The creation of permanent depressions or mounds above distribution lines must be avoided; and
  - Revegetate disturbed areas above distribution lines with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil. A botanical specialist should advise on appropriate species to be utilized during revegetation.
- Rehabilitate any areas **outside** of the direct construction footprint which have been disturbed as a result of construction related activities. A rehabilitation plan must be developed including rehabilitation measures such as:

    - Reshape and reprofile the banks of the drainage line to either side of each crossing so that they tie in with the surrounding channel banks both longitudinally and perpendicularly (height, slope and structure);
    - Rip and loosen compacted soils associated with the bank to a depth of 100mm in order to aid in the establishment of vegetation;
    - Redistribute stockpiled topsoil across the banks;
    - Prevent erosion of the channel banks by covering and stabilizing any steep or unstable reshaped channel banks with a geotextile such as Geojute or BioJute, or with the use of sandbags or silt fences at the break in slope;
    - Revegetate disturbed areas with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil and stabilizing of soils. A botanical specialist should advise on appropriate species to be utilized during revegetation; and
    - Strictly prohibit the use of alien vegetation during rehabilitation activities.
- Alien and Invasive species control:
    - Appoint an ECO to check the construction footprint and immediately adjacent areas for alien and invasive species weekly and alien species noted must be removed;
    - Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
    - Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;
    - Remove vegetation before seed is set and released;
    - Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles; and
    - Appoint an Environmental Officer (EO) to monitor the site, twice a year for three consecutive years once construction has been finalised, in order to determine whether any additional alien vegetation control measures will be required.
- Prohibit personnel from starting informal fires for cooking purposes.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

1.6.1.2. Potential Impact 2 - Alteration of flow patterns

a) Nature of the impact:

Due to the ephemeral nature of the drainage lines over which crossings will be required, water flow will likely be restricted to the rainfall season, directly after sufficient rainfall events. Obstruction of surface and subsurface waterflow during construction can therefore be largely avoided if construction of the drainage line crossings takes place outside of the rainfall season. However, in practice this is not always achievable. As a result, impact significance, after mitigation, was rated assuming that this timeframe will not be feasible.

Reduction of infiltration capacity and increase in runoff volume and intensity from areas earmarked for buildings, turbine foundations and support structures will result in an increase in the volume of water reaching the ephemeral drainage lines and will ultimately result in an increase in the erosion of drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Design and planning related mitigation measures:
  - The ephemeral drainage line crossing designs must allow for sufficient dispersion of water through the ephemeral drainage lines to prevent the concentration of flow and the resultant scouring and incision of the channels of the features;
  - During the design of crossings, allowance should be made for the movement of subsurface and surface flow;
  - Erosion control measures at each crossing should be adapted to the velocity and volume of water expected within each drainage line during the operational phase; and
  - Ensure that the crossings are stable and appropriately protected so as to withstand flood events.
- Mitigation measures for construction within flowing ephemeral drainage lines:
  - Strictly prohibit the excavation of a new channel or drainage canals for the diversion of water away from the construction area;
  - Utilise sandbags in order to divert surface water from the construction footprint.
  - Sandbags utilised for the diversion of surface water must be in good condition so as to avoid the bursting of the bags and sedimentation of downstream areas;
  - Care must be taken so as to avoid the erosion of the ephemeral drainage line banks due to the diversion of water;
  - Once construction of the road crossing is complete the diversion must be removed and the ephemeral drainage line must follow its natural course. Any disturbance to the ephemeral drainage lines bed and banks as a result of the diversion must be immediately rehabilitated.
- General construction related mitigation measures:
  - Prohibit any vehicle or activity outside of the demarcated construction footprint area;
  - Minimise the duration of construction activities within the ephemeral drainage lines as far as possible;
  - Limit the footprint of construction activities required as far as practically possible;
  - Strategically divert stormwater away from the construction footprint area. Stormwater must not be discharged into ephemeral drainage lines and their associated buffer areas. Stormwater should rather be discharged as diffuse flow at multiple discharge points into well vegetated areas outside of the buffer, and energy dissipaters (such as areas of rock riprap grassed with indigenous vegetation or similar structures) must be constructed where stormwater is released in order to reduce the runoff velocity and therefore erosion;
  - Install many small, shallow mitre type drains, cut off drains or berms at regular intervals along access roads into ephemeral drainage lines. Drains should be protected from erosion with the use of riprap grassed with indigenous vegetation or similar structures. These drains/berms will direct surface water off the access roads and will prevent the concentration of flows and the erosion of the road surface and the ephemeral drainage lines during both the construction phase and the operational phase;
  - Implement erosion control measures where required (e.g. covering steep/unstable/erosion prone areas with geotextiles; stabilising areas susceptible to erosion with sandbags; covering areas prone to erosion with brush packing, straw bales, mulch; diverting stormwater away from areas susceptible to erosion *etc*). This is of particular importance where roads and crossings are located on steep hillsides which are prone to erosion; and
  - The bed and the banks of the ephemeral drainage lines must be rehabilitated to as close to their original condition as possible. Ensure that the beds of the features are restored to their natural base level in order to prevent erosion or upstream ponding (i.e. the base of roads/culverts must tie in with the natural base level of the ephemeral drainage lines).

- The ECO must check ephemeral drainage lines for erosion damage after every heavy rainfall event. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

1.6.1.3. Potential Impact 3 - Impairment of water quality

a) Nature of the impact:

The term water quality is used to describe the concentration of dissolved salts (solutes) and of particulate (clastic) sediment (Macfarlane *et al.*, 2007). Therefore, accidental spillage of hazardous material including chemicals and hydrocarbons such as fuel, and oil, the use of cement within watercourses as well as sediment originating from disturbed areas, were all considered contributors to this impact. Construction areas located outside of the delineated drainage lines may also be a source of sedimentation, if the buffer zones[8] are not kept intact.

It has been assumed that all housekeeping measures listed for the construction phase will be implemented through adherence to the EMPr, by so doing impact resulting from solutes will largely be addressed. However, construction material required at crossings and sediment laden runoff will still need to be adequately managed.

Due to the presence of permeable substratum along ephemeral drainage lines, impairment of the quality of surface water may also pose a risk to groundwater resources.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

Solutes:

- Avoid the use of infill material or construction material with pollution / leaching potential when constructing or widening roads across drainage lines;
- Dispose of concrete and cement-related mortars in an environmental sensitive manner (can be toxic to aquatic life). Washout should not be discharged into drainage lines. A washout area should be designated at least 30m from any buffer zone, and wash water should be treated on-site;
- Prohibit the mixing of concrete on exposed soils. Concrete must be mixed on an impermeable surface in an area of low environmental sensitivity identified by the ECO outside of the buffer area;
- Construct temporary bunds around areas within drainage lines where cement is to be cast in-situ; and

[8] Buffer zones will intercept sediment laden stormwater and decrease runoff velocities.

- Develop a construction method statement which indicates how the contractor will minimise the passage of contaminants such as fuel and cement into the ephemeral drainage lines at crossings and ensure it is signed off by the ECO.

Sediment:

- Minimise the area of disturbance and the amount of earthworks;
- Construct silt fences and earthen dikes / diversions at operation footprint areas where sheet flow is expected, to retain and divert sediment-laden runoff;
- Place silt fences / traps strategically on the periphery of the construction footprint area including the construction camp, cleared areas, storage areas, soil stockpile areas and laydown areas. Ensure runoff is not channeled directly into the drainage lines;
- Install silt fences / traps downstream of crossings, if construction takes place during the rainfall season, to trap any sediment produced during construction activities. The ECO must be consulted on the number and location of silt fences, and silt fences must not result in any unnecessary disturbance to the ephemeral drainage line channel and banks;
- Appoint an ECO to check all sediment trapping devices weekly and to ensure devices are cleared and repaired when needed;
- Use gabion baskets / reno mattresses strategically for erosion protection, as required;
- Use excavators instead of bulldozers where ephemeral drainage line crossings are constructed / upgraded to reduce sedimentation and consolidate the entry and exit points to reduce scouring;
- Engineer disturbed areas to coincide as closely as possible to original contours. Ensure that excavated vegetation and soil mounds are not left unattended (recreate original contours); and
- The contractor / ECO must check each crossing for erosion damage and sedimentation after every heavy rainfall event for the duration of the construction phase. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Very Low (negative) significance.

1.6.2. Operational Phase Impact

1.6.2.1. Potential Impact 1 - Degradation of drainage lines

a) Nature of the impact:

Degradation of natural vegetation due to alien vegetation encroachment and erosion of banks both related to lack of effective management will result in ongoing degradation of drainage lines and will likely result in a decrease in the PES of drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Eradicate alien and weed vegetation at each crossing as well as any areas accidentally disturbed:
  - Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
  - Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;
  - Remove vegetation before seed is set and released; and
  - Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles.
- Appoint an EO to inspect the crossings twice a year as well as after heavy rainfall events for the duration of the operational phase in order to determine whether any additional erosion control measures are required. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

1.6.2.2. Potential Impact 2 - Alteration of the natural hydrological regime

a) Nature of the impact:

It is considered likely that ephemeral drainage line crossings could result in long term obstruction of surface and subsurface flow, if not appropriately catered for as part of design. In addition, culverts/pipes (if needed) not cleared of debris would also hamper the surface flow following adequate rainfall. The impact would not be restricted to the ephemeral drainage line crossing and could potentially impact downstream features.

An increase in hardened surfaces developed during the construction phase will result in an increase in the runoff of stormwater into ephemeral drainage lines when compared to the current scenario. An increase in stormwater runoff may result in the erosion and sedimentation of ephemeral drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Implement all construction phase hydrological/flow related mitigation measures in order to prevent operational phase impacts;
- Stormwater from the hardened road surfaces traversing the ephemeral drainage lines must be directed to the outer edges of the roads and must be passed through filter strips/energy dissipaters (e.g. areas of rock riprap grassed with indigenous vegetation) before being released into the ephemeral drainage lines.

- Appoint an EO to inspect the crossings twice a year as well as after heavy rainfall events for the duration of the operational phase in order to determine whether there is a build-up of debris and sediment. Any debris noted must be removed.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

1.6.3. Decommissioning Phase Impact

1.6.3.1. Potential Impact 1 - Degradation of drainage lines

a) Nature of the impact:

Any disturbed area, not adequately rehabilitated, will result in proliferation of alien and weed vegetation and erosion.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Clearly demarcate each decommissioning footprint within a drainage line or buffer zone. All material used for demarcation purposes should be removed after decommissioning has been completed;
- Allow only essential activities within the demarcated areas;
- Remove all foreign material from each drainage line or buffer zone before moving to the next area;
- Undertake rehabilitation concurrently with decommissioning activities, as far as practically possible;
- Rehabilitate all areas disturbed during decommissioning activities. A rehabilitation plan must be developed including rehabilitation measures such as:
  - Reshape and reprofile the banks of drainage lines to either side of each crossing so that they tie in with the surrounding channel banks both longitudinally and perpendicularly (height, slope and structure);
  - Rip and loosen compacted soils of the banks of the drainage lines to a depth of 100mm in order to aid in the establishment of vegetation;
  - Redistribute stockpiled topsoil across the banks;
  - Prevent erosion of the banks by covering and stabilizing any steep or unstable reshaped channel banks with a geotextile such as Geojute or BioJute, or with the use of sandbags or silt fences at the break in slope;
  - Revegetate disturbed areas with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil and stabilizing of soils; and
  - Strictly prohibit the use of alien vegetation during rehabilitation activities.
- Eradicate alien and weed vegetation within the drainage lines as well as within any additionally disturbed areas. Follow-up clearing must be done until indigenous vegetation returns to the site:
  - Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
  - Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;

  - o Remove vegetation before seed is set and released; and
  - o Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles.
- The contractor/EO must check each area where decommissioning has taken place within an ephemeral drainage line or associated buffer zone for alien vegetation proliferation and erosion damage once a year and after every heavy rainfall event, until an indigenous vegetation cover of at least 50% has been reached within disturbed areas. Any alien species noted must be removed immediately by hand. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

1.6.3.2. Potential Impact 2 – Impairment of water quality

a) Nature of the impact:

It has been assumed that all good housekeeping measures listed for the construction phase will be implemented in the decommissioning phase as well. Therefore, sediment originating from areas where infrastructure is removed is the main concern associated with impairment of water quality during the decommissioning phase.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- Minimise the area of disturbance and the amount of earthworks;
- Decommissioning activities should be undertaken during the dry season, However, if this is not possible the following mitigation measures are recommended:
  - o Divert stormwater runoff from disturbed areas into sediment trapping devices. Ensure stormwater is not channeled directly into a drainage line;
  - o Construct silt fences and earthen dikes / diversions at areas where sheet flow is expected, to retain and divert sediment-laden runoff;
  - o Construct silt fences / traps in areas prone to erosion, to retain sediment-laden runoff;
  - o Appoint an EO to check all sediment trapping devices weekly to ensure devices are cleared and repaired when needed;
- Use excavators instead of bulldozers where required to remove construction material from drainage lines; consolidate the entry and exit points to reduce scouring;
- Engineer disturbed areas to coincide as close as possible to original contours. Ensure that excavated vegetation and soil mounds are not left unattended (recreate original contours); and
- The contractor/EO must check each area where decommissioning has taken place within an ephemeral drainage line or associated buffer zone for erosion damage and sedimentation once a year and after every heavy rainfall event, until an indigenous vegetation cover of at least 50% has been reached within disturbed areas. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may

include filling of erosion gullies and rills and the stabilization of gullies with silt fences. Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern;

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Very Low (negative) significance.

1.6.4. Cumulative Impact

a) Nature of the impact:

Inherent erosion potential (K factor) of catchment soils were documented as moderately high (refer to Section 1.3.1.) and erosion within disturbed areas along drainage lines was considered significant at the time of the field survey. Alien vegetation is also a known threat to indigenous floral communities and watercourses within the Northern Cape (Van den Berg, 2010).

Numerous solar energy facilities are in the process of being developed within the Northern Cape Province. Renewable energy applications which are currently registered with DEA within a 50km radius around the proposed WEF are listed in the table to follow. The development of access roads and the clearing of vegetation for infrastructure development has likely resulted in the spread of alien and invasive species as well as erosion within watercourses associated with these projects. In addition, the proposed development of the Phase 2 Kuruman Wind Energy Facility and associated infrastructure is also likely to result in the disturbance of ephemeral drainage lines and in the spread of alien and invasive species.

Table 11: Renewable energy facilities proposed within a 50km radius of the proposed Kuruman Phase 1 WEF

Name	DEA reference number	Status
Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province	14/12/16/3/3/1/475	Approved
Solar farm for Bestwood, Kgalagadi District Municipality, NC	12/12/20/1906	Approved
Kathu Solar PV Energy Facility	14/12/16/3/3/2/911	Approved
75 MW AEP Legoko Photovoltaic Solar Facility	14/12/16/3/3/2/819	Approved
75 MW AEP Mogobe Photovoltaic Solar Facility	14/12/16/3/3/2/820	Approved
Kalahari Solar Power Project	12/12/20/1994/AM4	Approved
San Solar Energy Facility	14/12/16/3/3/2/273/AM1	Approved
115 Megawatt (MW) Boitshoko Solar Power Plant	14/12/16/3/3/2/935	Approved
25MW Kathu2 Solar Energy Facility, Northern Cape Province	12/12/20/1858/2/AM2	Approved
Sishen Solar Farm	12/12/20/1977	Lapsed/ withdrawn
150mw Adams Photo-Voltaic Solar Energy Facility	12/12/20/2567	Approved
Proposed renewable energy generation project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park	14/12/16/3/3/2/616	Approved
Phase 1 Kuruman Wind Energy Facility	N/A	N/A

Exacerbation of erosion in already eroded areas associated with Phase 1 as well as additional erosion of disturbed drainage lines would most likely add to the cumulative impact of alien vegetation encroachment within, and erosion of drainage lines in the Northern Cape.

Mitigation measures have been provided in an attempt to limit alien vegetation proliferation and erosion within disturbed areas. It is however considered unlikely to be entirely successful, this project would therefore contribute to the cumulative impact posed by alien and invasive species and erosion along drainage lines within the region

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- No mitigation measures in addition to those advocated for the construction, operational and decommissioning phase are available.

d) Significance of impact with mitigation measures:

Impact significance will remain Low (negative).

1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 12 to 15 below. It should be noted that significance ratings were assessed based on the information available at the time of the assessment.

Table 12: Impact assessment summary table for the Construction Phase.

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
General edge effects as well as indiscriminate driving and removal of vegetation	Disturbance of drainage lines	Negative	Local	Long-term	Substantial	Very Likely	Moderate	Moderate	Refer to Section 1.6.1.1	Moderate		4	High
		Negative	Site	Short-term	Moderate	Very Likely	High	Moderate			Low	4	Medium
Construction or upgrading of the ephemeral drainage line crossings as well as compacting soil within other construction footprints	Alteration of flow patterns	Negative	Local	Long-term	Substantial	Very Likely	Low	Moderate	Refer to Section 1.6.1.2	Moderate		4	Medium
		Negative	Site	Long-term	Moderate	Very Likely	Moderate	Moderate			Low	4	Medium
Use of concrete and accidental spillage of hazardous chemicals, generation of sediment	Impairment of water quality	Negative	Local	Short-term	Substantial	Very Likely	High	Moderate	Refer to Section 1.6.1.3	Moderate		5	High
		Negative	Site	Very short-term	Slight	Unlikely	High	Moderate			Very Low	5	High

Table 13: Impact assessment summary table for the Operational Phase.

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Inadequate maintenance and monitoring	Degradation of drainage lines	Negative	Local	Long-term	Substantial	Very likely	Moderate	Moderate	Refer to Section 1.6.2.1	Moderate		4	High
		Negative	Site	Medium-term	Moderate	Unlikely	Moderate	Moderate			Low	4	Medium
Inadequate maintenance and monitoring	Alteration of the natural hydrological regime	Negative	Local	Long-term	Substantial	Very likely	High	Moderate	Refer to Section 1.6.2.2	Moderate		4	High
		Negative	Local	Short-term	Moderate	Unlikely	High	Moderate			Low	4	Medium

Table 14: Impact assessment summary table for the Decommissioning Phase.

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Inadequate rehabilitation	Degradation of drainage lines	Negative	Local	Permanent	Substantial	Very Likely	Low	Moderate	Refer to Section 1.6.3.1	Moderate		4	High
		Negative	Local	Medium-term	Moderate	Likely	Moderate	Moderate			Low	4	High

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Removal of infrastructure	Impairment of water quality	Negative	Site	Permanent	Moderate	Very Likely	High	Moderate	Refer to Section 1.6.3.2	Low		5	Medium
		Negative	Site	Short-term	Slight	Unlikely	High	Moderate			Very Low	5	Medium

Table 15: Cumulative impact assessment summary table.

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Authorisation of Phase 1	Proliferation of alien and invasive species and erosion of drainage lines	Negative	Local	Long-term	Moderate	Likely	Moderate	Moderate	N/A	Low	Low	4	Medium

1.8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

A description of the key monitoring recommendations for each applicable mitigation measure identified for all phases of the project is provided in tables 15 to 18 below and should be included in the EMPr or environmental authorisation;

Table 16: Key monitoring recommendations for the design phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
A. DESIGN PHASE					
A.1. FRESHWATER ECOLOGY IMPACTS					
Potential impact on ephemeral drainage lines as a result of the proposed development of the Phase 1 WEF	Avoid or minimize impacts on ephemeral drainage lines.	▪ Ensure that the design of the proposed WEF takes the sensitivity mapping of the freshwater specialist into account to avoid and reduce impacts on ephemeral drainage lines. ▪ Make use of existing access roads where possible and any turning areas required must be located outside of the buffer zone. ▪ Where widening of existing access roads located adjacent to ephemeral drainage lines is required, widening must take place on the opposite side of the existing road to the drainage line only. ▪ Where possible, proposed new roads running along the lengths of drainage lines should be relocated to areas outside of the drainage lines and associated buffer zones. ▪ The requirements for new road crossing structures such as wearing courses, bridges or culverts should be determined upon consultation with an engineer.	▪ Ensure that specified mitigation actions are taken into consideration during the planning and design phase.	▪ During design cycle and before construction commences.	▪ Project developer and appointed freshwater specialist.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		▪ Construction yards must be located outside of ephemeral drainage lines and their buffer areas.			

Table 17: Key monitoring recommendations for the construction phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
B. CONSTRUCTION PHASE					
A.1. FRESHWATER ECOLOGY IMPACTS					
Disturbance of drainage lines	Avoid or minimize disturbance of ephemeral drainage lines.	▪ Refer to Section 1.6.1.1	▪ Inspect the ephemeral drainage line crossings and take measures to address unforeseen disturbances to the ephemeral drainage lines. ▪ Check the construction footprint as well as immediately adjacent areas for alien and invasive species and alien species noted must be removed.	▪ On a weekly basis (at least) during the construction phase.	▪ ECO
Alteration of flow patterns	Prevent the alteration of flow patterns through ephemeral drainage lines.	▪ Refer to Section 1.6.1.2	▪ Check ephemeral drainage lines for erosion damage. ▪ Should erosion of channels be noted, immediate corrective measures must be undertaken.	▪ After every heavy rainfall event during the construction phase.	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
			▪ Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. ▪ Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.		
Impairment of water quality	Prevent the impairment of water quality within ephemeral drainage lines.	▪ Refer to Section 1.6.1.3	▪ Check all sediment trapping devices and ensure devices are cleared and repaired when needed. ▪ Check each crossing for erosion damage and sedimentation. ▪ Should erosion or sedimentation be noted immediate corrective measures must be undertaken. ▪ Rehabilitation measures may include filling of erosion	▪ On a weekly basis (at least) during the construction phase. ▪ After every heavy rainfall event during the construction phase.	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
			gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. ▪ Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern. ▪ Check construction footprint areas in order to ensure that concrete for support structure foundations is being mixed on an impermeable surface and that washout is not being discharged into drainage lines.		

Table 18: Key monitoring recommendations for the operational phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
C. OPERATIONAL PHASE					
A.1. FRESHWATER ECOLOGY IMPACTS					
Degradation of drainage lines	Avoid or minimize degradation of ephemeral drainage lines.	▪ Refer to Section 1.6.2.1	▪ Monitor the site, including all ephemeral drainage line crossing areas, in order to determine whether any additional alien vegetation control measures will be required. ▪ Check each crossing for erosion damage and sedimentation. ▪ Should erosion or sedimentation be noted immediate corrective measures must be undertaken. ▪ Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. ▪ Additional erosion control measures must then be applied in order to avoid any	▪ Bi-monthly during the operational phase (for alien vegetation). ▪ Twice a year as well as after heavy rainfall events during the operational phase (for erosion and sedimentation).	▪ EO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
			further disturbance. Erosion measures will need to be adapted according to each concern.		
Alteration of the natural hydrological regime	Prevent the alteration of the natural hydrological regime of ephemeral drainage lines.	▪ Refer to Section 1.6.2.2	▪ Inspect crossing areas in order to determine whether any additional erosion control measures are required. ▪ Should erosion or sedimentation be noted immediate corrective measures must be undertaken. ▪ Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures. ▪ Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.	▪ Twice a year as well as after heavy rainfall events during the operational phase.	▪ EO

Table 19: Key monitoring recommendations for the decommissioning phase.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
D. DECOMMISSIONING PHASE					
A.1. FRESHWATER ECOLOGY IMPACTS					
Degradation of drainage lines	Avoid or minimize degradation of ephemeral drainage lines.	▪ Refer to Section 1.6.3.1	▪ Check each area where decommissioning has taken place within an ephemeral drainage line or associated buffer zone for alien vegetation proliferation and erosion damage. ▪ Any alien species noted must be removed immediately by hand. ▪ Should erosion or sedimentation be noted immediate corrective measures must be undertaken. ▪ Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the implementation of these measures.	▪ Once a year and after every heavy rainfall event, until an indigenous vegetation cover of at least 50% has been reached within disturbed areas.	▪ Contractor/EO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
			▪ Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.		
Impairment of water quality	Prevent the impairment of water quality within ephemeral drainage lines.	▪ Refer to Section 1.6.3.2	▪ Check all sediment trapping devices to ensure devices are cleared and repaired when needed. ▪ Check each area where decommissioning has taken place within an ephemeral drainage line or associated buffer zone for erosion damage and sedimentation. ▪ Should erosion or sedimentation be noted immediate corrective measures must be undertaken. ▪ Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences. ▪ Care must be taken to prevent additional disturbance to the ephemeral drainage lines during the	▪ Weekly during the decommissioning phase. ▪ Once a year and after every heavy rainfall events, until an indigenous vegetation cover of at least 50% has been reached within disturbed areas.	▪ Contractor/EO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			implementation of these measures. ▪ Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern.		

1.9. CONCLUSION AND RECOMMENDATIONS

The study area is associated with multiple ephemeral drainage lines. The current impact to these features is largely limited to erosion as a result of increased grazing pressure and the development of access roads and fence lines through the features. The drainage lines were therefore calculated to fall within PES Categories A (unmodified, natural) and C (moderately modified). Although the ephemeral drainage lines calculated an overall low EIS score and are considered to be of low sensitivity in terms of water yield and quality (Macfarlane *et al.*, 2014), these features do still provide valuable functions such as attenuation of floodwaters and retention of excess sediments. The unnecessary disturbance of these drainage lines must therefore be avoided, and buffer areas of 30m have been applied to the features wherein only essential activities should be allowed during construction or upgrading of roads and placement of distribution lines.

Prior to the implementation of mitigation measures, impacts associated with the proposed development activities were calculated to be of a low to moderate (negative) significance (Table 15 below). However, with the effective implementation of the mitigation measures as provided within Section 1.6 of this report, it is the opinion of the freshwater specialist that all impacts may be reduced to very low and low (negative) significances. It is therefore the opinion of the freshwater specialist that authorisation be granted for the proposed development. It should however be noted that an application for an Environmental Authorisation in terms of the NEMA EIA Regulations (2014, amended in 2017) will be required as proposed development related activities will occur within 32m of a watercourse. Furthermore, the proposed development will require authorisation from the DWS in terms of Section 21 (c) and (i) of the NWA.

Table 20: Impact assessment summary table.

Impact	Before mitigation	After mitigation
Construction Phase		
Disturbance of drainage lines	Moderate	Low
Alteration of flow patterns	Moderate	Low
Impairment of water quality	Moderate	Very Low
Operational Phase		
Degradation of drainage lines	Moderate	Low
Alteration of natural hydrological regime	Moderate	Low
Decommissioning Phase		
Degradation of drainage lines	Moderate	Low
Impairment of water quality	Low	Very Low
Cumulative impact		
Proliferation of alien and invasive species and erosion of drainage lines	Low	Low

1.10. REFERENCES

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GEOHYDROLOGICAL ASSESSMENT:

Scoping and Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape: EIA REPORT

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05/09/2018

SPECIALIST EXPERTISE

CURRICULUM VITAE – Daniel Mulder

GENERAL

Nationality:	South African
Profession:	Geohydrologist
Specialization:	Groundwater exploration, regional development, monitoring and management, geohydrological impact assessment including GIS and Remote Sensing expertise.
Position in firm:	Geohydrologist at GEOSS - Geohydrological and Spatial Solutions International (Pty) Ltd
Date commenced:	1st September 2017
Language skills:	English (good – speaking, reading and writing) Afrikaans (good - speaking, reading and writing).

KEY SKILLS

- Groundwater exploration, development, monitoring and management.
- Arc GIS software (ESRI products)
- Proficient in working with regional groundwater development and management.

RELEVANT EXPERIENCE

- Numerous groundwater exploration, development, monitoring and management projects.
- Groundwater impact assessments

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2016	BSc Hon –Hydrogeology; North West University, Potchefstroom Campus, South Africa
2015	BSc – Geology & Geography; North West University, Potchefstroom Campus, South Africa

Memberships

- Ground Geological Society of South Africa (GSSA) / Groundwater Division of the Geological Society of South Africa

EMPLOYMENT RECORD

September 2017 – present:	GEOSS (Geohydrological and Spatial Solutions International (Pty) Ltd
January 2017 – August 2017:	AGES (Africa Geo-Environmental Engineering and Science) (Pty) Ltd, Potchefstroom

CURRICULUM VITAE - Julian Edward Conrad

GENERAL

Nationality:	South African
Profession:	Geohydrologist
Specialization:	Groundwater exploration, development, management and monitoring and the application of spatial technologies for geohydrological assessment and management purposes
Position in firm:	Director & geohydrologist: GEOSS - Geohydrological and Spatial Solutions International (Pty) Ltd
Language skills:	English (mother tongue), Afrikaans (average).

Key skills

- Project leadership and management for the delivery of contract projects on brief, budget and time.
- Groundwater Resource Directed Measures (RDM) projects, including Reserve determinations; Classification; and Resource Quality Objectives. Groundwater Catchment Management Strategies as well as groundwater Validation and Verification. Legal compliance of groundwater use.
- Groundwater management and monitoring – database design, development and analysis of groundwater level and quality data.
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater exploration - (aerial photo interpretation, resistivity, magnetic and EM34 geophysical surveys for borehole siting purposes)
- Specialization in Geographical Information Systems (GIS) for geohydrological application.

Educational and professional status
Qualifications

1995: M.Sc. (Hydrogeology and GIS), University of Rhode Island, United States of America
1985: B.Sc. (Hon) (Engineering geology), University of Natal, Durban, South Africa
1984: B.Sc. (Geology), University of Natal, Durban, South Africa.

Courses

2010	Introduction to QGIS (GISSA) / Skills Presentation (Elsabé Daneel Productions cc)
2006	South African Groundwater Decision Tool (SAGDT)
2004	Fractured Rock Aquifer Assessment / 2001 Isotope Techniques in Catchment Management
2000	Groundwater Recharge
1999	Remote Sensing and Geohydrology / Applied 3D Groundwater Modelling (MODFLOW)
1997	Avenue Programming / 1995 ArcView (GIMS)
1991	Advanced training on Arc/Info (DWA&F) / 1990 Pump test analysis (IGS-UOFS).

Memberships

- International Association of Hydrogeologists (IAH)
- Geological Society of South Africa (GSSA) / Groundwater Division of the Geological Society of South Africa
- Water Institute of South Africa (WISA)
- Geo-Information Society of South Africa (GISSA)
- South African Council for Natural Scientific Professions (SACNASP)

EMPLOYMENT ECORD

- 1 March 2001 – present: Founded GEOSS – a company specializing in geohydrology.
- 1 May 1990 – 28 Feb. 2001 Hydrogeologist with Environmentek, Groundwater Group, CSIR.
- Jan. 1986 – Dec. 1988 Geotechnical geologist with Rőssing Uranium Limited, Namibia.

RELEVANT EXPERIENCE

- 28 years' experience in geohydrology, including the development of the GRDM and Water Resources Classification methodologies. This includes work in Validation and Verification projects and the development of the groundwater component of Catchment Management Strategies.
- Numerous groundwater exploration; development; monitoring and management projects have been completed.
- Numerous Environmental Impact Assessment (EIA) projects have been completed, that have triggered groundwater studies, both at the Scoping and EIA phases.
- Project management of numerous groundwater projects and large projects that have included many sub-consultants and specialists, especially RDM studies.

PUBLICATIONS

(Details on request).

CURRICULUM VITAE - Neville Paxton

GENERAL

Nationality:	South African
Profession:	Geohydrologist
Specialization:	Groundwater exploration, development, sampling and monitoring.
Position in firm:	Geohydrologist
Year of birth & ID #:	1986 - 861228 5151 084
Language skills:	Afrikaans (very good), English (mother tongue)

KEY SKILLS

- Groundwater sampling, soil sampling, field measurements, borehole logging, data logging for groundwater monitoring, borehole depth and water level measurements, augering for piezometer installation, groundwater geophysics, yield test management and conducting hydrocensus studies.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2014	BSc (Hons) (Environmental & Engineering Geology- specialization: Hydrogeology) University of Pretoria
2013	BSc Bridging Course (Geology) University of Pretoria
2009	BSc (Geography) University of Pretoria

Memberships

- Groundwater Division of the Geological Society of South Africa
- NICOLA - Network for Industrially Contaminated Land in Africa

EMPLOYMENT RECORD

- 5 January 2015 to present GEOSS, geohydrologist
- Mar 2014 – Dec 2014 Student geohydrologist at GCS (Groundwater Consulting Services)
- 2012 - 2014 University of Pretoria, GIS Assistant.

SPECIALIST DECLARATION

I, **Julian E Conrad,** 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: GEOSS - Geohydrological & Spatial Solutions International (Pty) Ltd.

Professional Registration (including number): SACNASP - 400159/05
Date: 09 July 2018

EXECUTIVE SUMMARY

Mulilo Renewable Project Developments (Pty) Ltd is proposing to develop the Kuruman Wind Energy Facility (WEF) (Phase 1). Phase 1 refers to a specific geographical area. Phase 2 is adjacent to the Phase 1 site.

The area receives most of its rainfall during the summer months with an average rainfall of 266 mm per year with increased evaporation rates during the summer months as well. Rainfall typically occurs during late afternoon as thunder showers (sometimes even as hail storms). It typically receives no rainfall in June (i.e. the mid-winter month). Temperatures range from a low of 1.3 ^{o}C in July to 31.1 ^{o}C in January.

The regional geological setting consists of red wind-blown sands and alluvium deposits underlain by five distinct yet quite complex geological formations consisting of lavas / jasper / jaspilite (a metamorphosed banded ironstone) / ironstone and dolomite (from youngest to oldest).

According to the regional scale groundwater map, the greater portion of the study area hosts a:

- "fractured" aquifer (i.e. fractures within the bedrock constitutes as an aquifer) with borehole yields between 0.1 and 0.5 L/s and a
- "karst" aquifer (i.e. dissolution cavities that constitutes an aquifer) towards the north-west with boreholes yields of > 5 L/s in the extreme north-eastern portion of the study area.

Data obtained in the field indicates that borehole yields across the study area vary significantly, with yields as low as 0.2 L/s to yields as high as 30 L/s (in the dolomitic terrain in the north-eastern portion of the study area). Groundwater levels range from 14 to 87 metres below ground level.

The regional groundwater quality (using Electrical Conductivity (EC) as an indicator) shows that in general the quality is "good" (EC < 70 mS/m). This correlates with data obtained in the field where the EC varied from 16.2 mS/m to a maximum of 90.6 mS/m.

The groundwater vulnerability indicates that the larger study area is classified as having a "low" vulnerability rating, with a small portion towards the north-east being classified as having a "high" rating to surface based contaminants. The "high" vulnerability zone is linked to the dolomitic geological setting.

Groundwater is being considered for use during all phases of the project; however the requirement is very low and highly unlikely to impact groundwater levels.

The potential pollution impacts on the groundwater can be from:

- storm water outflows,
- accidental oil spillages or fuel leakages.

All of these sources need to be managed and potential groundwater impacts completely minimized.

The authors consider groundwater to be a viable source for use during the construction, operational and decommissioning phases of this project. All boreholes being used during the above mentioned phases should yield tested; sampled (including analysis for asbestos); authorized and equipped with water level and water quality monitoring infrastructure; as well as a flow meter, prior to use. The planned groundwater use is within the General Authorization so the groundwater use need only be registered.

In terms of the geohydrological assessment, the proposed activity will essentially have no impact on the groundwater of the area and from a groundwater perspective can be authorized.

LIST OF ABBREVIATIONS

bh	Borehole
ch	collar height
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
GEOSS	Geohydrological & Spatial Solutions International (Pty) Ltd.
GIS	Geographic Information System
ha	Hectare
L/s	litres per second
m	Meters
MAP	Mean Annual Precipitation
mbch	metres below collar height
mbgl	metres below ground level
mg/L	milligrams per litre
mm/a	millimetres per annum
mS/m	milliSiemens per meter
mV	milliVolts
NGA	National Groundwater Archive
ORP	Oxygen Reduction Potential
TDS	Total Dissolved Solids
temp	Temperature
WEF	Wind Energy Facility
WL	water level
WP	wind pump
WULA	Water Use License Application

GLOSSARY

Definitions	
Aquifer	A geological formation that has structures or textures that hold water or permit appreciable water movement through them.
Borehole	includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].
DRASTIC	An acronym for a groundwater vulnerability assessment methodology: D = depth to groundwater / R = recharge/ A = aquifer media type / S = soil type / T = topography / I = impact of the unsaturated zone / C = hydraulic conductivity. The methodology uses a rating and weighting approach and was developed by the Environmental Protection Agency (USA)
Fractured aquifer	Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Intergranular aquifer	Generally unconsolidated but occasionally semi-consolidated aquifers. Groundwater occurs within intergranular interstices in porous medium. Typically occur as alluvial deposits along river terraces.
Intergranular and fractured aquifers	Largely medium to coarse grained granite, weathered to varying thicknesses, with groundwater contained in intergranular interstices in the saturated zone, and in jointed and occasionally fractured bedrock.
Karst aquifer	Generally known as a bedrock having water bearing properties due to the formation of dissolution cavities. Usually highly soluble rock, in which the landforms are formed primarily by dissolution/precipitation of the rock.
Vadose zone	Unsaturated zone – geological stratum above the water table where interstices and voids contain a combination of air and water.[
Vulnerability	The tendency or likelihood for contaminants to reach a specified position in the ground-water system after introduction at some location above the uppermost aquifer.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 1, 2, 3, 4
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 5
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1.1.
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.1.5.
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.2
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3.3.
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.1.1. Section 1.1.1.2. Section 1.1.1.3.
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.6.1.1. Section 1.6.1.2. Section 1.6.1.3. Section 1.6.1.4.
g) an identification of any areas to be avoided, including buffers;	Section 1.3.4.
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Appendix A: Map 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.1.4.
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 1.6.1.1. Section 1.6.1.2. Section 1.6.1.3. Section 1.6.1.4. Section 1.7
k) any mitigation measures for inclusion in the EMPr;	Section 1.7
l) any conditions for inclusion in the environmental authorisation;	Section 1.2
m) any monitoring requirements for inclusion in the EMPr n) or environmental authorisation;	Section 1.9
o) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 1.9
p) a description of any consultation process that was undertaken during the course of preparing the specialist report;	-
q) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
r) any other information requested by the competent authority.	-
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	-

TABLE OF CONTENTS

TABLES AND FIGURES

GEOHYDROLOGICAL ASSESSMENT

This chapter presents the findings of the Geohydrological Assessment that was prepared by Mr. Daniel Mulder, Mr. Julian Conrad and Mr. Neville Paxton (Geohydrological and Spatial Solutions International (PTY) Ltd (GEOSS)) as part of the Environmental Impact Assessment (EIA) for the proposed Phase 1 Kuruman Wind Energy Facility (WEF) project within the Northern Cape Province, South Africa.

1.1. INTRODUCTION AND METHODOLOGY

1.1.1.1. *Scope and Objectives*

The project Applicant intends to make use of boreholes as a water source for the construction, operational and decommissioning phases of the project. During the construction phase (which is anticipated to be 18 months, the highest groundwater usage will be during the first 6 months at an average usage of 409,640 liters per week (i.e. 0.7 L/s continuous use). The groundwater is planned to be used for the construction of turbine bases, roads and for dust suppression. During the operational phase it will be used mainly for toilet and security facilities. This use amounts to only about 100 L / week. This phase is anticipated to continue for 20 years. In the decommissioning phase water will also be required in the toilet and security facilities as well as for dust-suppression, when large trucks will remove the equipment. Groundwater will be stored in suitable containers or reservoir tanks (or similar) on site.

One of the objectives of this Geohydrological Assessment is to confirm whether the groundwater is in fact sufficient and suitable for use (i.e. in terms of quantity (i.e. borehole yields) and quality). This study, therefore aims at providing a clear indication on the feasibility of groundwater utilization from existing and possibly new boreholes. Thereafter civil engineers will be able to complete the pipeline design.

The overall scope of this Geohydrological Assessment is to determine the potential impact of the proposed project on the geohydrology of the site as well as to recommend mitigation measures to reduce the significance of potential negative impacts.

For this specialist study, a desktop study was conducted based on existing maps and reports of the geology and geohydrology of the study area. Groundwater data, including groundwater levels and groundwater quality data, was obtained from the National Groundwater Archive (NGA) for the area surrounding the proposed study site. This was followed by a site visit to collect field data, samples and anecdotal information for completion of the Geohydrological Assessment.

1.1.1.2. *Terms of Reference*

The Scope of Work (i.e. this Geohydrological Assessment) is based on the following groundwater specific Terms of Reference:

- Identify significant features or disturbances within the proposed Phase 1 project area and define any environmental risks in terms of geohydrology and the proposed project infrastructure;
- Conduct a desktop study and describe the existing environment in terms of geohydrology (including hydrogeological characterization of aquifers types, sensitivity and vulnerability), and groundwater (quality, quantity, use, potential for industrial or domestic use) in the area surrounding the proposed development;
- Conduct an on-site assessment to determine the location of any boreholes and to collect groundwater samples (where possible) to ascertain the water quality;
- Develop a sensitivity map indicating the presence of sensitive areas, “no-go” areas, setbacks/buffers, as well as the identification of red flags or risks associated with geohydrological impacts;
- Highlight any gaps in baseline data and provide a description of confidence levels;
- Assess potential direct, indirect and cumulative impacts resulting from the construction, operational and decommissioning phases of the proposed project on the surrounding geohydrology;
- Identify any relevant legal and permit requirements that may be required in terms of groundwater/geohydrological impacts likely to be generated as a result of the proposed project;
- Provide mitigation, monitoring and management measures in order to minimize any negative geohydrological impacts and enhance the positive impacts;
- Assess the consequences and significance of potential groundwater contamination; and
- If necessary, recommend groundwater management and monitoring for the proposed site.

1.1.1.3. *Approach and Methodology*

The specialist study was completed as follows:

Task 1: A desktop study and relevant literature review pertaining to the site was completed. Borehole data was obtained from the National Groundwater Archive (NGA) and a project GIS was established.

Task 2: A site visit was completed on 23, 24 and 25 January 2018. The field work included a hydrocensus, which extended to 1 km from the outline of the Phase 1 and Phase 2 property boundaries. The objective of this task was three-fold:

- To locate the NGA boreholes and complete a borehole field assessment.
- To locate boreholes not yet recorded on the NGA and complete field assessments.
- To collect anecdotal information from the land owners in the area as well as from discussions with other geohydrologists who have knowkledge of the area. It is essential to collect as much information as possible relating to groundwater quality, groundwater levels and borehole yields.

Task 3: All the data obtained from the desktop review and fieldwork was assessed and the impacts relating to the site evaluated.

Task 4: The findings of the investigation, potential risks, any potential mitigation measures, monitoring requirements as well as relevant recommendations have been included in this report.

1.1.1.4. *Assumptions and Limitations*

The following assumptions and limitations apply:

- The geohydrological assessment is based on previous studies and available literature for the study area. Regional scale Geographic Information System (GIS) datasets based on 1: 500 000 scale and previous hydrogeological work completed in the area has been assumed to be correct.
- No drill records or yield test data exists for production boreholes or wind pumps to clarify yields and geological logs.
- The acquisition of accurate groundwater levels proved to be difficult, therefore data was limited to information obtained from local parties. Nonetheless these limitations have not significantly reduced the confidence of the conclusions of this report.

The information obtained was sufficient to provide comprehensive geohydrological characterization of the study area.

1.1.1.5. *Source of Information*

The geological information has been obtained from geological maps produced by the Council for Geoscience and documented by Slabbert et al, (1999).

The groundwater related data and maps were obtained from the 1: 500 000 Hydrogeological map series of the Republic of South Africa (Department of Water Affairs and Forestry (DWAF, 2002).

The report compiled by GEOSS (2016) as part of a contamination risk assessment for a proposed tailings dam south-west of the study area, within a similar geological setting, was also reviewed and relevant information was used in this report, where applicable.

From the field visit (completed on the 23, 24 and 25 January 2018) the existing data sets were assessed and new data sourced. Data was collected on borehole/wind pump positions; depth to groundwater levels; and field chemistry (i.e. pH; temperature; electrical conductivity (EC); total dissolved solids (TDS); salinity and oxygen reduction potential (ORP)). The field data obtained from the site visit was useful as it enabled the assessment of the more regional existing data sets and provides valuable insights into the geohydrology of the area. Where possible groundwater was sampled and submitted for inorganic chemical analysis to a SANAS accredited laboratory (Bemlab) in the Western Cape. The chemistry analysis has been classified according to the SANS241-1: Standards for Drinking Water (2015).

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE GEOHYDROLOGICAL ASSESSMENT

As mentioned above, Mulilo intends to make use of existing boreholes to source groundwater (if available and suitable) for the construction, operational and decommissioning phases. Groundwater will be trucked and stored on site in suitable containers or reservoir tanks.

In general, groundwater can be impacted negatively in two manners, namely:

- Over-abstraction (where groundwater abstraction exceeds recharge rates) which can result in groundwater levels dropping leading to the alteration of groundwater flow directions and gradients. Dropping water levels within a Karst aquifer may result in dolines or sinkholes.
- Quality deterioration (i.e. from anthropogenic activities negatively impacting groundwater quality).

There is currently minimal groundwater abstraction taking place in the area. Groundwater is mostly used for drinking purposes (human consumption) and for livestock watering. The low rainfall and high evapotranspiration rates within the study area are likely to be limiting factors in terms of aquifer recharge for the study area.

The groundwater requirement for the project can be met by using the existing boreholes. However, agreements will have to be put in place with the current land owners for the use of groundwater. These agreements will have to be legally valid documents and the necessary endorsements will be required from the Department of Water and Sanitation (DWS). If no such agreements can be put in place, then additional boreholes will need to be drilled on the WEF property, followed by yield and water quality testing, and then authorization from DWS to use the groundwater will be required. The groundwater will need to be stored in water tanks on site (5 to 10 x 10,000 litre tanks will be required).

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1.1. *Introduction*

The nearest town to the study area is Kuruman, approximately 10 km to the north-east **Map 1 – Appendix A**. The landscape is arid consisting of red wind-transported sands occurring widely along plains with ironstone rich mountains which stretch from north to south.

1.3.1.2. *Rainfall and temperature*

The study area is located in a summer rainfall district. The area receives approximately 266 mm of rain per year. It typically receives no rainfall in June (i.e. the mid-winter month) and the highest rainfall (~ 52 mm) falls in February (the peak-summer) month. Rainfall typically occurs during late afternoon as thunder showers (sometimes even as hail storms). During the summer months the study area has the highest evaporation rate, whilst in winter evaporation is lowest. There is a clear correlation between the rainfall and the evaporation of the study area **(Figure 1)**.

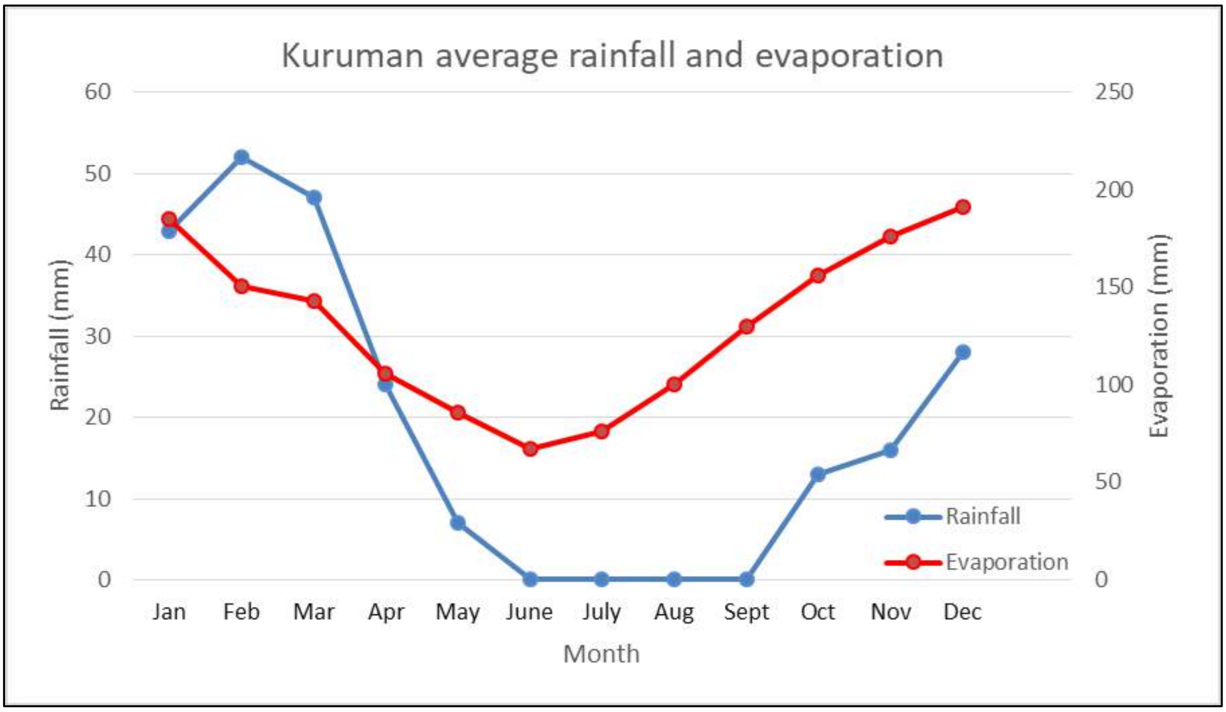

Figure 1: Long-term Rainfall for Kuruman (1950 -2000). (Source: Cape Farm Mapper; https://gis.elsenburg.com/apps/cfm/)

The monthly distribution of average minimum and maximum temperatures (**Figure 2**) shows that the temperatures range from the lowest 1.3 ^{o}C in July to 31.1 ^{o}C in January. Usually the coldest month is July where sometimes sub-zero temperatures have been recorded.

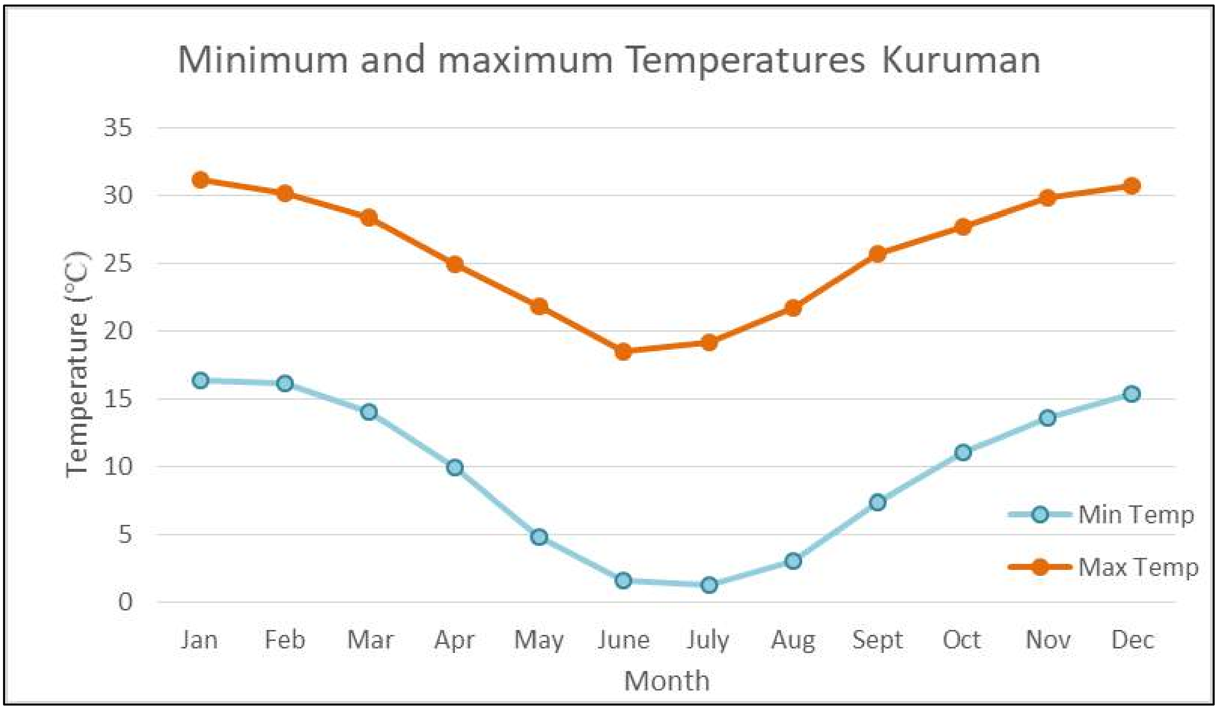

Figure 2: Long term rainfall for Kuruman (1950 – 2000). (Source: Cape Farm Mapper; https://gis.elsenburg.com/apps/cfm/)

1.3.1.3. *Regional Geology*

The Geological Survey of South Africa (now the Council for Geoscience) has mapped the area at 1:250 000 scale (2722 - Kuruman). The geological setting is shown in **Map 2 (Appendix A)**. The main geology of the area is listed in **Table 1**. The stratigraphic sequence across the regional setting consists of sedimentary deposits and five distinct yet quite complex geological formations (as numbered in **Table 1**)

Table 1: Geological formation within the study area

Symbol	Lithology	Group	Formation
Qs	Red to buff coloured windblown sand	N/A Quaternary deposits	
▽△△	Alluvium	N/A Quaternary deposits	
Vo	Amygdaloidal andesitic lava with layers of tuff, agglomerate, chert and red jasper	Olifantshoek	Ongeluk (1)
Vm	Diamictite banded jasper, siltstone, mudstone, sandstone, grit and dolomite with chert	-	Gamagara (2)
Vad	Yellow-brown banded or massive jaspilite with crocidolite; flat-pebble conglomerate	Griquatown	Danielskuil (3)
Vak	Banded ironstone with subordinate amphibolite; crocidolite; ferruginised brecciated banded ironstone (blink-klip breccia. At base in places; brown jaspilite and chert.		Kuruman (4)
Vgd	Fine and coarse- grained dolomite, chert and dolomitic limestone with prominent inter-bedded chert, limestone and banded ironstone; chert breccia at top (siliceous breccia or manganese marker)	Campbell	Ghaap Plateau (5)

The geological formations are overlain by Quaternary Age deposits which comprises of younger red to buff coloured wind-blown sands and older alluvial material. This is underlain by (in order of youngest to oldest):

- volcanic rocks consisting of amygdaloidal andesitic lavas (the Ongeluk Formation)
- diamictite banded jasper that outcrops towards the west of the study area (the Gamagara Formation)
- the yellow brown banded or massive jaspilite (the Danielskuil Formation)
- banded ironstone (with subordinate amphibolite; crocidolite; and ferruginised brecciated banded ironstone) of the Kuruman Formation.
- The fine to coarse - grained dolomite with interbedded chert of the Ghaap Plateau Formation (which is part of the Campbell Group).

The Danielskuil and Kuruman Formations are part of the Griquatown Group and form the distinctive north-south trending ironstone rich mountain ranges of the larger Kuruman area.

The proposed Kuruman Phase 1 WEF is located in an area where there are two faults trending from north-west towards the south-east. These faults are prominent in the Danielskuil and Kuruman Formations resulting in fracturing of the bedrock (**Map 2, Appendix A**). These faults are good target zones if further groundwater development is going to take place. They are not likely to result in instability of the area or the proposed WEF.

Historically, the larger Kuruman area has been mined for iron ore and asbestos.

The mining of iron ore, which still takes place, occurs towards the south-west of the study area (Kathu), where large quantities of iron ore is being mined from rocks of the Griquatown Group. The dewatering of these mines, significantly impacts the local aquifers located close to the mining activity in terms of dropping groundwater levels. The iron ore mining areas are approximately 40 km away from the proposed WEF and do not impact the study area.

Currently, there are no active asbestos mines in the area.

1.3.1.4. ***Regional Hydrogeology***

According to the 1:500 000 scale groundwater map of Kuruman (2723) the northern portion of the study area hosts a karst aquifer with an average borehole yield of 0.1 – 0.5 L/s and > 5 L/s for the most northern portion. The central portion of the study area hosts a fractured aquifer with an average borehole yield of 0.1 – 0.5 L/s **(Map 3 Appendix A).**

Groundwater quality is expected to be good with greatest recharge occurring in the mountainous areas. The regional 1:500 000 groundwater quality maps **(Map 4, Appendix A)** indicate that the study area's groundwater quality is classified as "good" with an associated electrical conductivity (EC) of < 70 mS/m.

Both these classifications are based on regional datasets, and therefore only provide a broad indication of conditions to be expected.

1.3.1.5. ***Results of the Field Study***

An initial desktop study was completed using the National Groundwater Archive (NGA) and a 1 km search radius. No boreholes were located on the NGA for the study area, including the additional 1 km search radius.

From the field hydrocensus conducted on 23, 24 and 25 January 2018, fourteen boreholes were located within the broader study area. The broader study area comprises the Phase 1 and Phase 2 sites – as well as an additional 1 km search radius. Details of the hydrocensus boreholes (HBH) are summarized in **Table 2** and shown on **Map 5 (Appendix. A**).

It was requested that the site visit is only to be carried out on the farms affected by the proposed Mulilo wind farms (i.e. Kuruman Phase 1 and 2). However some of the surrounding farms were visited and boreholes located on these non-Mulilo properties. They have been included in this study as they provide useful additional data. Sufficient information with regards to the regional geohydrological setting was obtained from the site visit. Communication with the landowners of the farms proved to be valuable to understanding more about the regional geohydrology. Consultation with land owners is always important for site specific data and anecdotal information. Mr Albutt (the occupier of farms reserved for Phase 1) was very helpful in this regard.

Natural groundwater levels (which range from 14 to 87 metres below ground level) within the study area and do not vary much seasonally. Therefore, groundwater information can be gathered any time, irrespective of the season. Groundwater quality also does not vary significantly temporally or spatially across the study area.

The following information was collected in the field:

- Fourteen boreholes were located.
- Seven of the fourteen boreholes were equipped with submersible pumps, with groundwater being abstracted either by means of solar power or electricity. The boreholes were being used daily (for different lengths of time depending on the water requirements).

- Three sites were equipped with mono pumps and are in regular use, mostly for livestock watering.
- Four sites were equipped with wind pumps however are actually not in use. They are either damaged or blocked.
- Groundwater levels and field chemistry was measured where possible.
    - It was difficult to measure water levels as most boreholes were equipped with pumps.
    - Samples of the groundwater were collected where possible and submitted for testing to determine the chemical groundwater characteristics of the area. All samples measured in the field had an EC of approximately 70 mS/m. Borehole HBH10 had the highest EC (field measurement EC = 91 mS/m).

Photos of the hydrocensus sites are included in **Appendix B.**

Boreholes located in the fractured aquifer, which forms the greater portion of the study area have similar yields, whereas boreholes located in the karst aquifer environment are highly variable yields.

Table 2: Hydrocensus boreholes (23 – 25 January 2018)

BH_ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	WL (mbgl)	pH	EC (mS/m)	TDS (mg/L)	Temp (°C)	Yield (L/s)	Status	Comments	Phase Applicable
HBH1	-27,53495°	23,33459°	-	-	-	-	-	-	Not in Use	Wind pump. No access point for WL	N/A
HBH2	-27,53500°	23,33444°	-	-	-	-	-	-	Not in Use	Wind pump. No access point for WL	N/A
HBH3	-27,53503°	23,33483°	87,1	-	-	-	-	-	Not in Use	Wind pump.	N/A
HBH4	-27,50562°	23,40556°	-	8,38	31,6	202	21	-	In Use	Submersible pump equipped.	Phase 1
HBH5	-27,50587°	23,40571°	14,37	-	-	-	-	-	In Use	Submersible pump equipped.	Phase 1
HBH6	**-27,50251°**	**23,40132°**	**31**	**7,61**	**42,1**	**282**	**23,4**	**-**	**In Use**	**Submersible pump equipped.**	**Phase 1**
HBH7	-27,49538°	23,39873°	31,2	8,03	21,9	140	25,6	~30	In Use	Submersible pump equipped.	Phase 1
HBH8	-27,52362°	23,35946°	-	7,42	16,9	112	23,8	4,5	In Use	Submersible pump equipped, solar power.	Phase 1
HBH9	-27,54420°	23,37337°	-	7,43	9	48,2	22,3	0,8	In Use	Submersible pump equipped, solar power.	Phase 1
HBH10	**-27,57643°**	**23,37623°**	**-**	**7,92**	**90,6**	**50,1**	**23,7**	**0,2**	**In Use**	**Submersible, pump equipped, solar power. BH depth ~ 240 m**	**Phase 1**
HBH11	**-27,65011°**	**23,40659°**	**-**	**8,36**	**20,7**	**157**	**22,2**	**-**	**In Use**	**Old Mono. BH depth ~120 m**	**Phase 2**
HBH12	-27,60462°	23,39927°	-	7,41	18,13	124	22,3	-	In Use	Old Mono. BH depth ~180 m	Phase 2
HBH13	-27,62941°	23,43610°	-	-	-	-	-	-	Not in Use	Unequipped and blocked	Phase 2
HBH14	**-27,62883°**	**23,44548°**	**-**	**7,5**	**16,2**	**111,1**	**22,3**	**-**	**In Use**	**Equipped, Old mono.**	**Phase 2**

HBH = hydrocensus borehole
WL = water level
m = metres
Temp = temperature
EC = electrical conductivity

TDS = total dissolved solids
mbgl = metres below ground level
mg/L = milligrams per litre
mS/m = milliSiemens per metre
Boreholes in bold font were sampled

1.3.1.6. *Geochemical analysis*

Samples were collected from four boreholes within the broader study area of the Kuruman WEF (i.e. Phase 1 and Phase 2 and the 1 km search radius) and submitted for inorganic chemical analysis to a SANAS accredited laboratory (Bemlab) in the Western Cape. The certificate of analysis for all the samples is presented in **Appendix C.**

The chemistry results obtained have been classified according to the SANS241-1: 2015 standards for domestic water. **Table 3** enables an evaluation of the water quality with regards to the various limits. **Table 4** presents the water chemistry analysis results, colour coded according to the SANS241-1: 2015 drinking water assessment standards for the two sampled boreholes within the Phase 1 area.

Table 3: Classification table for specific limits

Acute Health
Aesthetic
Chronic health
Operational
Acceptable

Table 4: Localised groundwater results classified according the SANS241-1:2015

Analyses	HBH6	HBH10	SANS 241-1:2015
pH (at 25 ºC)	6.9	8.1	≥5 - ≤9.7 Operational
Conductivity (mS/m) (at 25 ºC)	42.0	68.0	≤170 Aesthetic
Total Dissolved Solids (mg/L)	252.0	409.0	≤1200 Aesthetic
Sodium (mg/L as Na)	9.7	12.0	≤200 Aesthetic
Potassium (mg/L as K)	2.7	8.3	N/A
Magnesium (mg/L as Mg)	10.1	47.6	N/A
Calcium (mg/L as Ca)	60.7	62.7	N/A
Chloride (mg/L as Cl)	22.7	14.0	≤300 Aesthetic
Sulphate (mg/L as SO_4)	7.0	30.0	≤250 Aesthetic ≤500 Acute Health
Nitrate & Nitrite Nitrogen (mg/L as N)	4.5	0.5	≤12 Acute Health
Fluoride (mg/L as F)	0.1	0.2	≤1.5 Chronic Health
Iron (mg/L as Fe)	0.1	0.1	≤0.3 Aesthetic ≤2 Chronic Health
Zinc (mg/L as Zn)	0.0	0.0	≤5 Aesthetic

The chemistry results obtained have also been classified according to the DWAF (1998) standards for domestic water. **Table 5** enables an evaluation of the water quality with regards to the various parameters measured (DWAF, 1998). **Table 6** presents the water chemistry analysis results colour coded according to the DWAF drinking water assessment standards.

Table 5 Classification table for the localised groundwater results (DWAF, 1998)

Blue	**(Class 0)**	**Ideal water quality** - suitable for lifetime use.
Green	**(Class I)**	**Good water quality** - suitable for use, rare instances of negative effects.
Yellow	**(Class II)**	**Marginal water quality** - conditionally acceptable. Negative effects may occur.
Red	**(Class III)**	**Poor water quality** - unsuitable for use without treatment. Chronic effects may occur.
Purple	**(Class IV)**	**Dangerous water quality** - totally unsuitable for use. Acute effects may occur.

Table 6: Classified local groundwater results

Sample Marked :	**HBH6**	**HBH10**	**DWA (1998) Drinking Water Assessment Guide**				
			Class 0	**Class I**	**Class II**	**Class III**	**Class IV**
pH	6.9	8.1	5-9.5	4.5-5 & 9.5-10	4-4.5 & 10-10.5	3-4 & 10.5-11	< 3 & >11
Conductivity (mS/m)	42	68	<70	70-150	150-370	370-520	>520
(mg/L)							
Total Dissolved Solids	252	409	<450	450-1000	1000-2400	2400-3400	>3400
Sodium (as Na)	9.7	12	<100	100-200	200-400	400-1000	>1000
Potassium (as K)	2.7	8.3	<25	25-50	50-100	100-500	>500
Magnesium (as Mg)	10.1	47.6	<70	70-100	100-200	200-400	>400
Calcium (as Ca)	60.7	62.7	<80	80-150	150-300	>300	
Chloride (as Cl)	22.7	14	<100	100-200	200-600	600-1200	>1200
Sulphate (as SO4)	7	30	<200	200-400	400-600	600-1000	>1000
Nitrate& Nitrite (as N)	4.53	0.45	<6	6.0-10	10.0-20	20-40	>40
Iron (as Fe)	0.1	0.1	<0.5	0.5-1.0	1.0-5.0	5.0-10.0	>10
Zinc (as Zn)	0.03	0.03	<20	>20			

From the results presented in **Table 4** and **Table 6** it is clear that the groundwater quality of the respective boreholes is good, in terms of dissolved mineral concentrations. None of the water samples analysed have dissolved mineral concentrations that will have a negative effect on human or animal health once consumed. Note that for the samples collected and submitted for analysis, neither asbestos nor microbiological content was analysed for.

A number of chemical diagrams have been plotted for all four water samples and these are useful for chemical characterisation of the water. The chemistry of the samples has been plotted on a tri-linear diagram known as a Piper diagram (**Figure 3**). This diagram indicates the distribution of cations and anions in separate triangles and then a combination of the chemistry in the central diamond. All four samples have been plotted as this shows the chemical variation across the broader study area in terms of the mineral composition.

From **Figure 3** (central diamond) the sample is classified as having mainly calcium-chloride/sulphate hydrofacies.

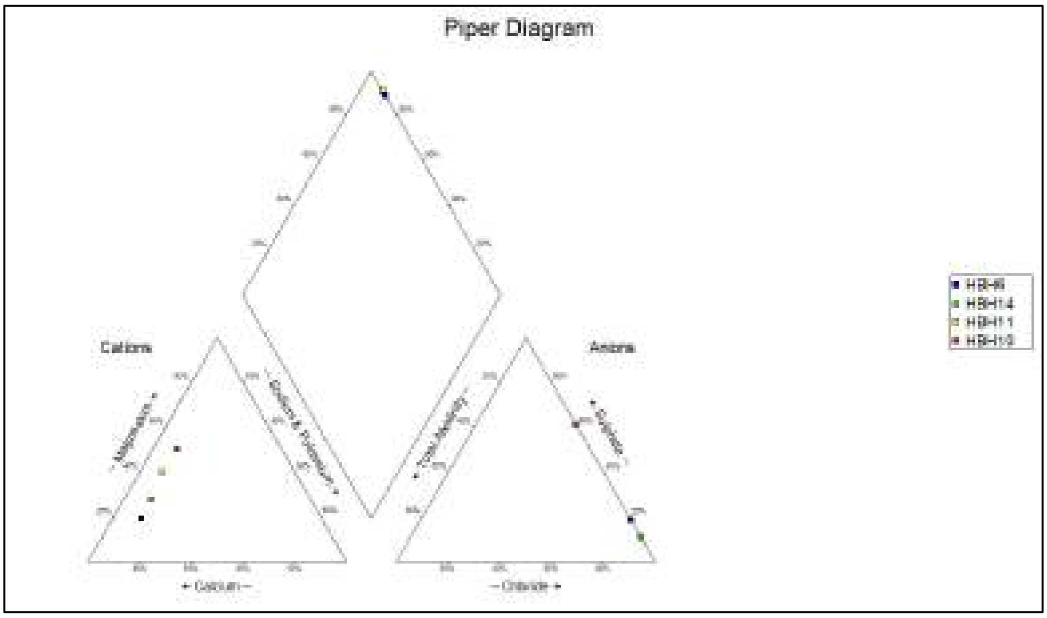

Figure 3: ***Piper diagram of the groundwater samples***

The following Stiff diagrams are graphical representations of the relative concentrations of the cations (positive ions) and anions (negative ions). This diagram shows concentrations of cations and anions relative to each other (not as a percentage as with Piper) and direct reference can be made to specific salts in the water. The Stiff diagram for the HBH6, HBH10, HBH11 and HBH14 are shown in **Figure 4.**

From the shape of the Stiff diagram the major ions present in the water can be compared. Studying the "shape" of the Stiff diagrams it is clear that HBH11 and HBH14's water source is from similar geological environments, as it has similar cation and anion concentrations; with high calcium and low bicarbonate (alkalinity) with secondary magnesium, sodium and potassium. HBH10 shows that the water has high concentration of calcium and low bicarbonate (alkalinity) with high magnesium concentration in comparison to the other samples. HBH6 shows that the water has high concentration of calcium with very little bicarbonate (alkalinity) with secondary magnesium, sodium and potassium.

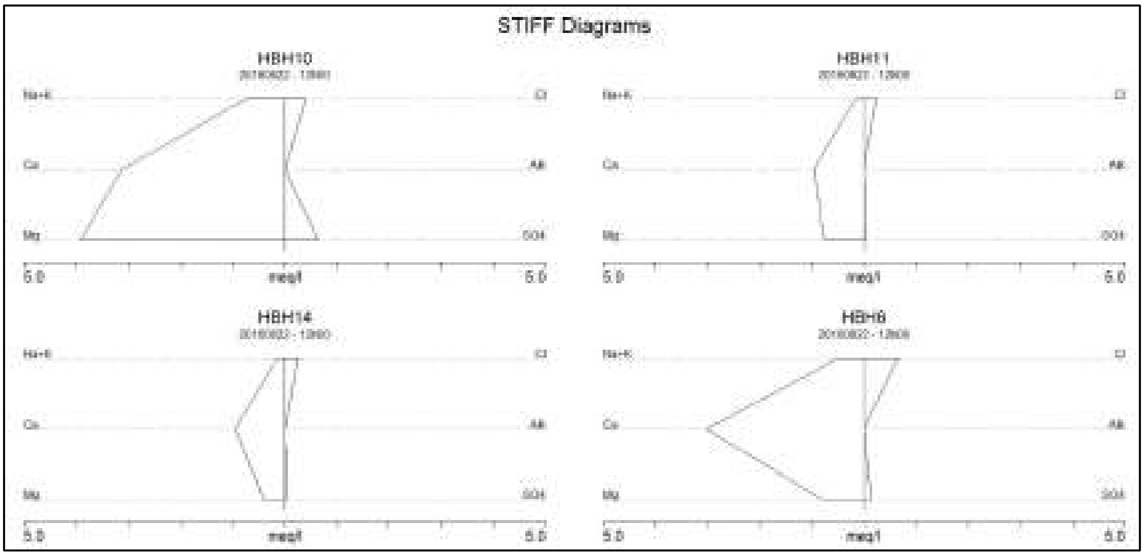

Figure 4: Stiff diagrams of borehole samples from hydrocensus.

1.3.1.7. ***Geohydrological Characterisation (Aquifer Vulnerability)***

The new proposed site for the Kuruman Wind Energy Facility (Phase 1) hosts both a fractured and karst aquifer that possess water bearing properties due to fracturing and dissolution cavities within the rocks respectively. Due to the secondary porosity of these aquifers contaminants may be transmitted at a higher rate, especially for the karst environment. Several methods have been developed to classify an aquifer's vulnerability. The DRASTIC method (Aller et al., 1987) has been applied to this study.

1.3.1.8. ***Aquifer Vulnerability (DRASTIC)***

Groundwater vulnerability can be defined as the "tendency for contaminants to reach a specified position in the groundwater system after introduction at some location" (Vrba and Zaporozec, 1994). Key physical parameters which determine groundwater vulnerability include lithology, thickness, effective porosity, groundwater flow direction, age and residence time of water. Generally, the residence time of a contaminant in groundwater and the distance that it travels in the aquifer are considered important measures of vulnerability.

There are two main groups of methods for assessing groundwater vulnerability, namely:

- Index or subjective rating methods,
- Statistical or process-based methods.

The "index or subjective rating method" is relatively easily addressed within a GIS framework. The cell-based layer approach facilitates the assignment of ratings and weights and rapid achievement of a final result of relative groundwater vulnerability. This approach also means that the algorithm can easily be repeated as new or more detailed data sets are obtained or if ratings and weightings need to be adjusted as a result of a sensitivity analysis for example. The most well-known "index or subjective rating method" is the "DRASTIC" method (Aller et al., 1987). The DRASTIC method of Aller et al. (1987) uses the typical overlay technique often applied in subjective rating methods. The DRASTIC approach is based on four major assumptions:

- The contaminant is introduced at ground surface
- The contaminant is flushed into the groundwater by precipitation
- The contaminant has the mobility of water
- The area evaluated using DRASTIC is 40.5 ha or larger.

The implication of these assumptions is that DRASTIC should not be used for contaminants that do not have the mobility of water or for point assessment (such as storage tanks). In addition, groundwater conditions in South Africa are dominated by secondary/fracture-controlled flow conditions. The DRASTIC method does not consider local preferential flow paths of fractured aquifer systems particularly well. The DRASTIC method takes into account the following factors:

D	=	depth to groundwater	(5)
R	=	recharge	(4)
A	=	aquifer media	(3)
S	=	soil type	(2)
T	=	topography	(1)
I	=	impact of the vadose zone	(5)
C	=	conductivity (hydraulic)	(3)

The number indicated in parenthesis at the end of each factor description is the weighting or relative importance at that factor.

Groundwater vulnerability maps developed using the DRASTIC method have been produced in many parts of the world. In spite of the widespread use of DRASTIC, the effectiveness of the method has been met with mixed success due to hydrogeological heterogeneity and the many assumptions that need to be made in determining groundwater vulnerability. In addition, the use of a generic vulnerability map only gives a broad indication of relative vulnerability and in many instances detailed scale, contaminant specific vulnerability assessments are required. From the assumptions outlined by Aller et al. (1987), DRASTIC can only be applied to non-point source pollution, as DRASTIC is inaccurate in point source assessments.

As part of the Groundwater Resources Assessment Project (DWAF, 2005), numerous data sets were produced and this enabled the mapping of groundwater vulnerability at the national scale on a 1 km by 1 km cell (pixel) size basis (Conrad and Munch, 2007). This national scale map indicates the relative vulnerability of groundwater resources throughout the country and provides project planners a clear idea of what level of groundwater protection is required.

A national scale map of groundwater vulnerability has been completed for South Africa (DWAF, 2005). The groundwater vulnerability for the study area is shown in **Map 6 -Appendix A**. The larger portion of the study area has low groundwater vulnerability to surface based contamination, however the vulnerability is classified as high towards the north-eastern portion of the study area.

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

1.4.1. The National Water Act (NWA)

The National Water Act (1998) is administered by the Department of Water and Sanitation (DWS) and is the main legislation for managing water resources in South Africa. The purpose of the NWA is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorization and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

The Phase 1 area is within quaternary catchment D41L. The groundwater General Authorisation (GA) for this catchment is 45 m^3/ha/a. The Phase 1 area is approximately 580 hectares, thus 26 100 m^3/a of groundwater can be abstracted under the GA. This equates to approximately 0.8 L/s (continuous abstraction) for the entire Phase 1 area. The proposed groundwater use is less than this (peak usage is 0.7 L/s for only 6 months) and will thus fall within the GA. Only a registration process will have to be followed for the groundwater use; i.e. Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) is applicable.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1.1. *Key Issues Identified During the Scoping Phase*

The potential groundwater issues identified during the Scoping Phase of this EIA Process for Phase 1 included:

- High groundwater vulnerability, towards the north-east, to surface based contaminants as a result of construction, operational and decommissioning activities

1.5.1.2. *Identification of Potential Impacts*

The following potential impacts on groundwater of the proposed project activities are as follows:

- Lowering of the groundwater level due to abstraction (during the first 6 months of the construction phase)
- Potential impact of increased storm water outflows during the construction, operational and decommission phases; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages during the construction, operational and decommissioning phases.

Any construction activities such as the excavation and installation of foundations and piling (narrow diameter holes for foundation purposes) will have minimal to no impact on the groundwater of the site or region, as the groundwater level is approximately 15 – 30 mbgl.

The potential impacts identified during the EIA Phase are:

1.5.1.3. *Construction Phase*

- Potential lowering of the groundwater level;
- Potential impact of increased storm water outflows; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

1.5.1.4. *Operational Phase*

- Potential impact of increased storm water outflows; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

1.5.1.5. *Decommissioning Phase*

- Potential lowering of the groundwater level
- Potential impact of increased storm water outflows; and
- Potential impact on groundwater quality as a result of accidental oil spillages and fuel leakages.

1.5.1.6. *Cumulative impacts*

- None pertaining to the site activities.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1.1. *Groundwater impact as a result of groundwater abstraction. (Construction, Operational and Decommissioning Phase)*

This impact is essentially only applicable during the construction phase and possibly the decommissioning phase (when water for dust suppression may be required due to the additional traffic); as the groundwater use during the operational phase is minimal. Even at the peak requirement the proposed groundwater abstraction is low relative to the aquifer storage and transmissivity.

The status of this impact is rated as negative with a site specific spatial extent and a long-term duration (i.e. for the life of the project). The consequence and probability of the impact is respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated low. The significance of the impact without the implementation of mitigation measures is rated as low. With effective implementation of prevention / mitigation actions (i.e. to adhere to the borehole's safe yield and to monitor water levels and flow), the impact of the proposed abstraction on groundwater is predicted to be of very low significance.

1.6.1.2. *Groundwater impact as a result of increased storm water outflows (Construction, Operational and Decommissioning Phase)*

Due to the nature of the rainfall – which occurs in high intensity summer thunderstorms – the overland flow will be a significant component of the rainfall (and the groundwater recharge will be limited). For this reason the overland flow will have to be properly managed and channeled – ensuring no erosion occurs. It is highly unlikely that the storm water flows will be contaminated (due to the type of activity being proposed) and for this reason alone it poses no threat to the groundwater levels or quality. The Phase 1 area has a low vulnerability to surface based contaminants and the groundwater levels are deep (just to the west of the Phase 1 the groundwater level is 87 mbgl. In the north-east portion of the study area the groundwater vulnerability is high with groundwater levels between 14 and 31 mbgl. This is the also the topographically lower portion of the study area (the dolomites occur in this area and they weather more easily than the banded ironstone formations) so the stormwater will flow towards this area. The dolomite exposure within the study area is very limited and it is mainly beneath an alluvial material. Stormwater run-off will be absorbed by the alluvial material, which will act as a type of sponge and the direct infiltration into the dolomite will be extremely limited.

The status of this impact is rated as negative with a site specific spatial extent and long-term duration (i.e. the impact and risk will be experienced for the entire WEF life span (20 years)). The consequence and probability of the impact is respectively rated as slight and very unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as low. The impact of the proposed project on groundwater as a consequence of the presence of the storm water is predicted to be very low significance from a groundwater contamination perspective.

1.6.1.3. *Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages (Construction, Operational and Decommissioning Phases)*

If there is an accidental oil spill or fuel leakage during the construction, operational or decommissioning phases, then the low permeability of the unsaturated zone will provide significant attenuation capacity. In addition the shallowest groundwater level on site is 14 mbgl (within the high vulnerability area) and this is considered deep enough not to be impacted by an accidental spillage. The status of this impact (for the construction, operation and decommissioning phases) is rated as negative with a site specific spatial extent and long-term duration (i.e. for the life of the facility). The consequence and probability of the impact is respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as low.

A precautionary approach must be implemented and reasonable measures must be undertaken to prevent oil spillages and fuel leakages from occurring. During the construction phase, vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable concrete surface in a bunded area. Construction vehicles and equipment should also be refueled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refueling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.

With effective implementation of these prevention / mitigation actions, the impact of the project on groundwater as a consequence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

1.6.1.4. ***Cumulative Impacts***

The wind turbines and associated infrastructure at the Kuruman WEF is being built on the high lying areas (which are geologically very stable). No infrastructure is being built on the dolomitic area. The planned groundwater usage is low. There is no need to implement a groundwater level or groundwater quality monitoring network.

1.7. IMPACT ASSESSMENT SUMMARY

The following tables provide a summary of the impact the proposed wind farm will play on groundwater within the study area

Table 7: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct and Indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Abstraction of groundwater	Dropping groundwater levels	Negative	Site	Medium-term (first 6 months – highest abstraction will occur))	Slight	Unlikely	High	Low	Ensure boreholes are only abstracted at rates according to safe yield calculations	Low	Very low	5	High
Stormwater outflows	Groundwater contamination	Negative	Site	Medium-term (18 months)	Slight	Very Unlikely	High	Low	All surfaces draining towards the stormwater system should be inspected on a regular basis for any materials that could contaminate groundwater. This includes solvents, paints, oils and fuel products. Ensure the stormwater does not create any erosion channels.	Very low	Very low	5	High

Construction Phase													
Direct and indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probabilit y**	**Reversibility of Impact**	**Irreplaceabilit y**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Manageme nt	**With Mitigation/ Manageme nt (Residual Impact/ Risk)**		
Accidental oil spillage / fuel leakage	Groundwater contamination	Negative	Site	Medium-term (18 months)	Slight	Extremely unlikely	High	Low	Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Construction vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes	Low	Very low	5	High

Table 8: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct and Indirect Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Abstraction of groundwater	Dropping groundwater levels	Negative	Site	Long- term (20 years)	Slight	Unlikely	High	Low	Ensure boreholes are only abstracted at rates according to safe yield calculations	Low	Very low	5	High
Storm water outflow impact on groundwater	Groundwater contamination	Negative	Site	Long- term (20 years)	Slight	Very Unlikely	High	Low	All surfaces draining towards the stormwater system should be inspected on a regular basis for any materials that could contaminate groundwater. This includes solvents, paints, oils and fuel products.	Very low	Very low	5	High

Operational Phase													
Direct and Indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Accidental oil spillage / fuel leakage	Groundwater contamination	Negative	Site	Long- term (20 years)	Slight	Extremely unlikely	High	Low	Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays (1 – 2 months). Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes	Low	Very low	5	High

Table 9: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Abstraction of groundwater	Dropping groundwater levels	Negative	Site	Short- term (6 months)	Slight	Unlikely	High	Low	Ensure boreholes are only abstracted at rates according to safe yield calculations	Low	Very low	5	High
Storm water outflow impact on groundwater	Groundwater contamination	Negative	Site	Short- term (6 months)	Slight	Very Unlikely	High	Low	All surfaces draining towards the stormwater system should be inspected on a regular basis for any materials that could contaminate groundwater. This includes solvents, paints, oils and fuel products.	Very low	Very low	5	High

Accidental oil spillage / fuel leakage	Groundwater contamination	Negative	Site	Short- term (6 months)	Slight	Extremely unlikely	High	Low	Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays (1 – 2 months). Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes	Low	Very low	5	High

Table 10: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
None	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a

1.8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

Certain measures need to be put in place to ensure that the local and regional aquifers' groundwater does not get impacted. The following aspects are considered to be applicable to the Kuruman WEF:

1.8.1.1. *Groundwater abstraction*

- The production boreholes that are put into use should be yield tested prior to use (according to SANS10299) so that the correct pump sizes and installation depths can be determined.
- The planned production boreholes should also be sampled and chemically and microbiologically analysed by a SANAS accredited laboratory. Samples should also be analysed for asbestos content.
- Once the boreholes are in use they should be equipped with:
    - observation pipes - so that the water levels can be measured (either manually or by data loggers)
    - Flow meters – to assess how much water is used and thereby all authorisations in place for use of the water are adhered to.
    - Sampling tap – to enable annual sampling to ensure the groundwater is safe for continued use – especially if it to be used as drinking water at the security buildings.

1.8.1.2. *Stormwater management*

- All surfaces draining towards the stormwater system should be inspected on a regular basis for any materials that could contaminate groundwater. This includes solvents, paints, oils and fuel products.
- Visual inspection should also be carried out in the dolomitic area to ensure there is no formation of dolines (surface depressions).

1.8.1.3. *Accidental oil spillage / fuel leakages*

- All vehicles and other equipment (generators etc.) must be regularly serviced to ensure they do not spill oil. Vehicles should be refuelled on paved (impervious) areas, optimally off-site. If liquid product is being transported it must be ensured this does not spill during transit.
- Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.
- Diesel fuel storage tanks must be above ground on a concrete surface in a bunded area.
- Engines that stand in one place for an excessive length of time must have drip trays.
- Vehicle and washing areas must also be on paved surfaces and the by-products removed to an evaporative storage area or a hazardous waste disposal site (if the material is hazardous).

1.9. CONCLUSION AND RECOMMENDATIONS

The area experiences summer thunderstorms and experiences a wide range in temperatures. The nature of the rainfall means that surface run-off will be high during rain events. During the winter no rainfall occurs.

Geologically the site is interesting with alluvial material overlying a sequence of lavas, jasper and banded ironstones forming the mountainous area. In the north-eastern portion of the study site the oldest geological formation is exposed in the area. This is dolomite which results in a more subdued low –lying topography, as it is more easily weathered than the younger rock types.

Groundwater does occur on site, to a limited extent within the mountainous area (within a fractured aquifer setting), however it is quite deep. In the dolomitic area the groundwater levels are shallower and boreholes higher yielding (a typical karst type aquifer). Across the site the groundwater quality is good is suitable for human consumption and general use in terms of quality according to the SANS241-1: 2015 drinking water assessment standards Groundwater use is currently minimal within the study area and the primary use is small scale stock watering and domestic use.

The water requirements for the Kuruman WEF can be met by using groundwater. However, agreements will have to be put in place with the current land owners for the use of groundwater. These agreements will have to be legally valid documents and the necessary endorsements will be required from the Department of Water and Sanitation (DWS). If no such agreements can be put in place, then additional boreholes will need to be drilled on the WEF property, followed by yield and water quality testing, and then authorization from DWS to use the groundwater will be required. The groundwater should also be tested to determine whether it is safe for consumption. The samples should be analysed for the chemical and microbiological content and the presence of asbestos should also be screened for.

The groundwater vulnerability rating is low for the main portion of the study area, including where all the facilities are to be constructed. However in the dolomitic area the groundwater vulnerability is high – however no facilities are to be constructed in this area.

With regard to the potential impacts – it must be ensured the groundwater use is sustainable and authorised. Attention needs to be given to the storm water run-off as the extent of hardened and impermeable surfaces will be increased, thus increasing the run-off to above natural conditions.

Any fuels / oils etc must be carefully handled on site and all measures to put in place to prevent spillages and possibly hydrocarbon s entering the ground. If this happens the spill must be cleaned up immediately and reported.

It is highly unlikely the proposed Kuruman WEF will impact on the groundwater resources of the site, especially if all safety and preventative measures are put in place. From a groundwater perspective the Kuruman WEF can certainly proceed. For the life of the facility it will be good to annually assess the groundwater quality from the production borehole/s and to regularly inspect the site to ensure the stormwater run-off is not resulting in erosion channels.

1.10. REFERENCES

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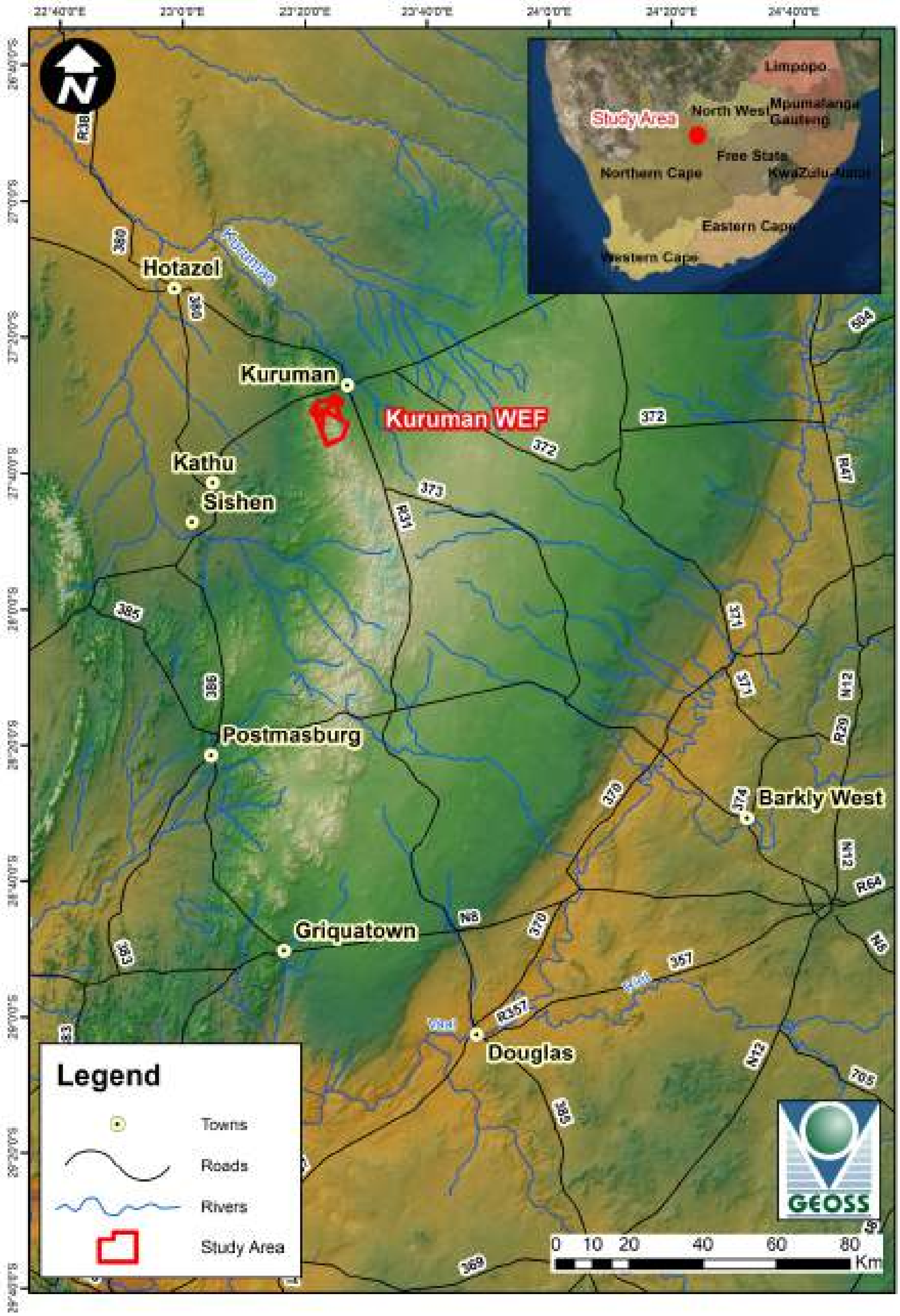
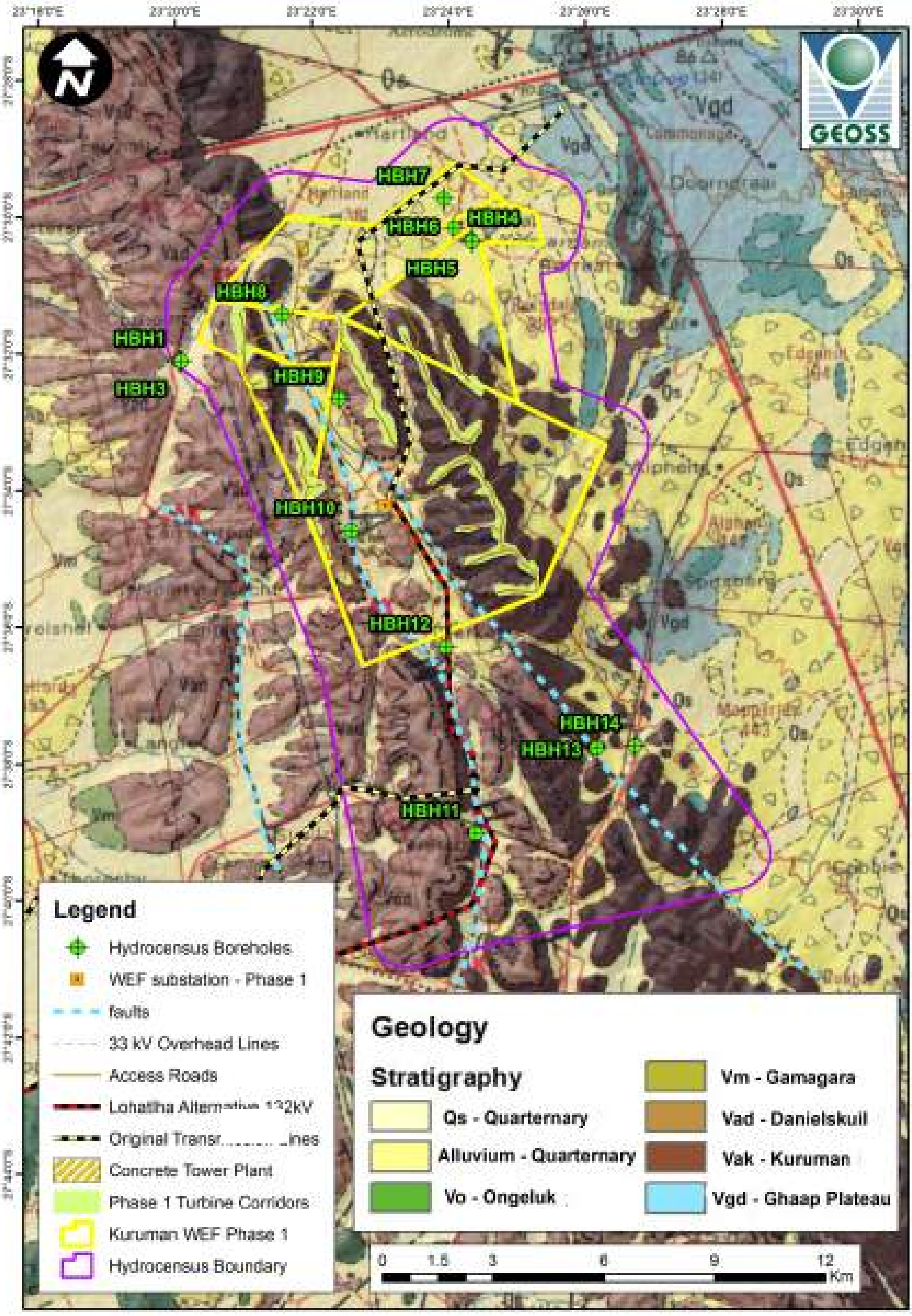
1.11. APPENDICES

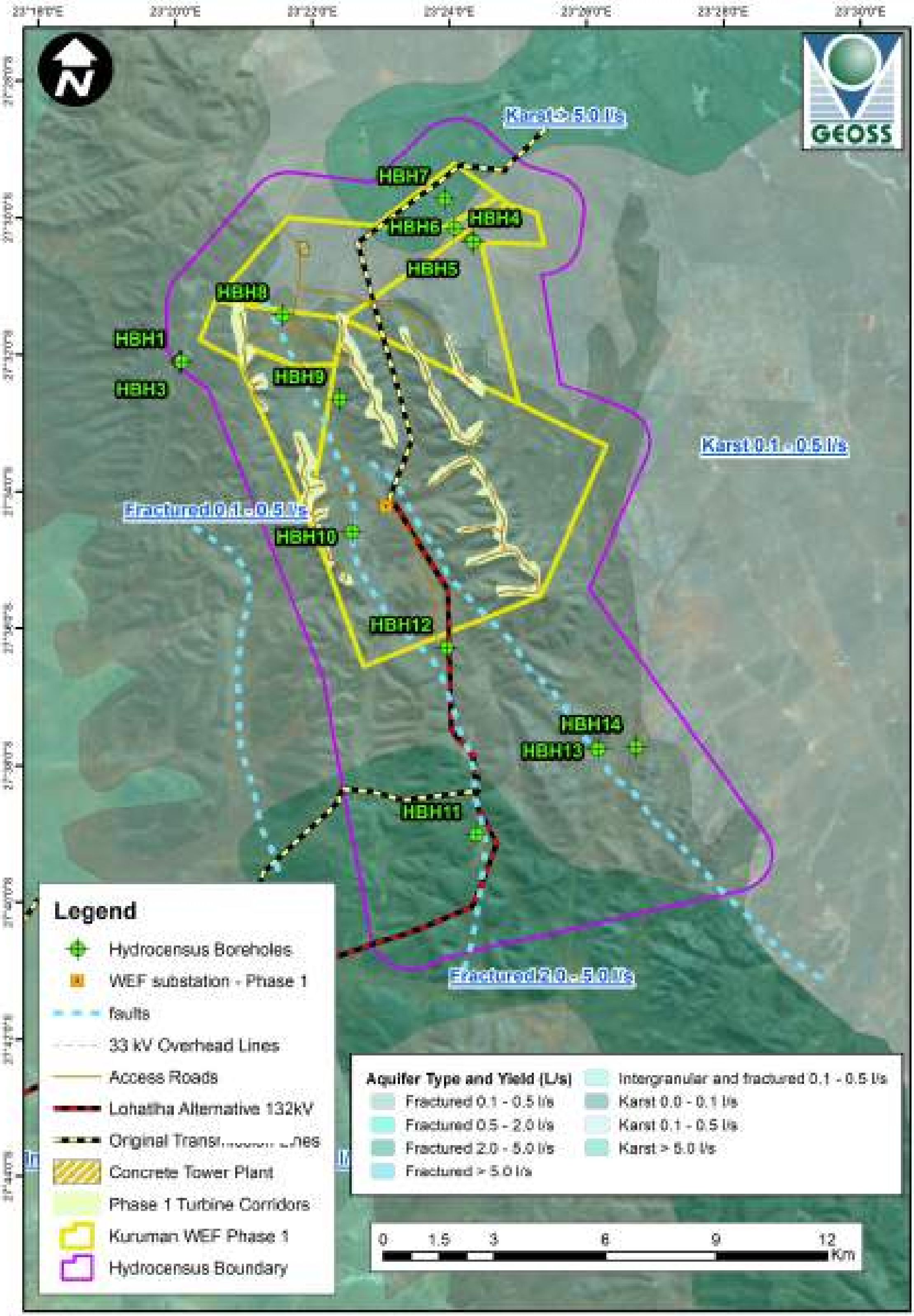
- ***APPENDIX A: Maps***



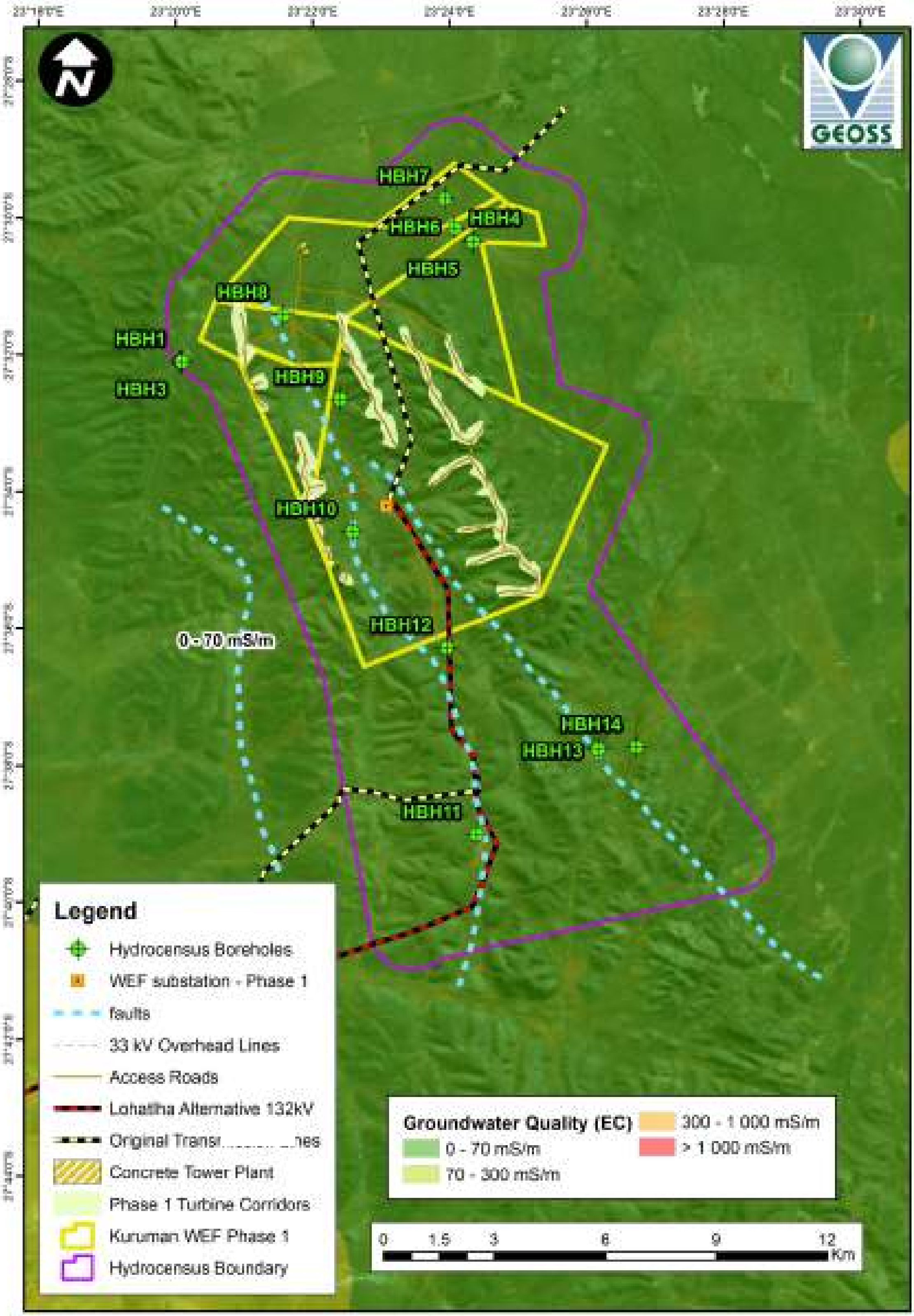
Map 1: Locality map of the study area within a regional setting



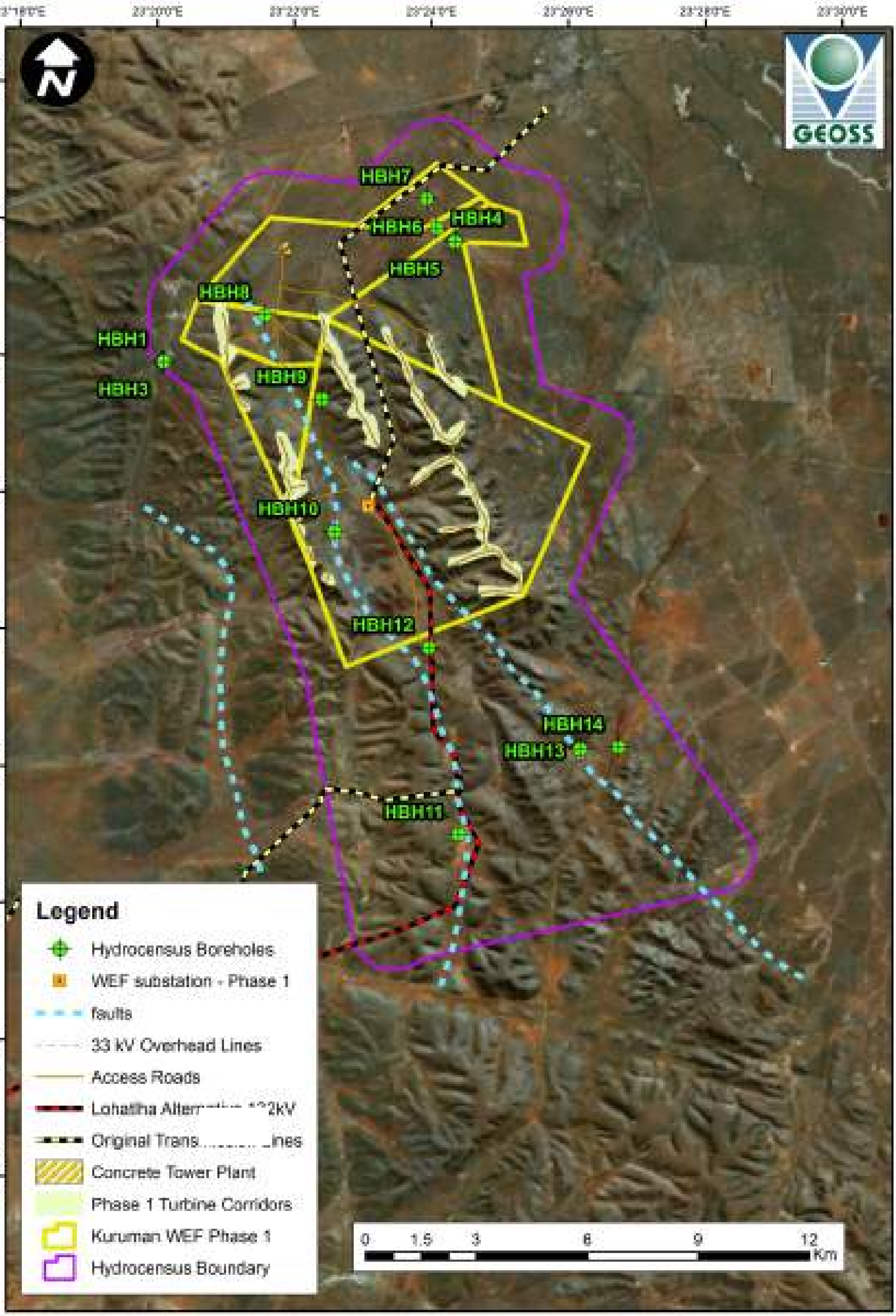
Map 2: Geological setting of the study area (CGS map: 1:250 000 scale 2922 – Prieska).



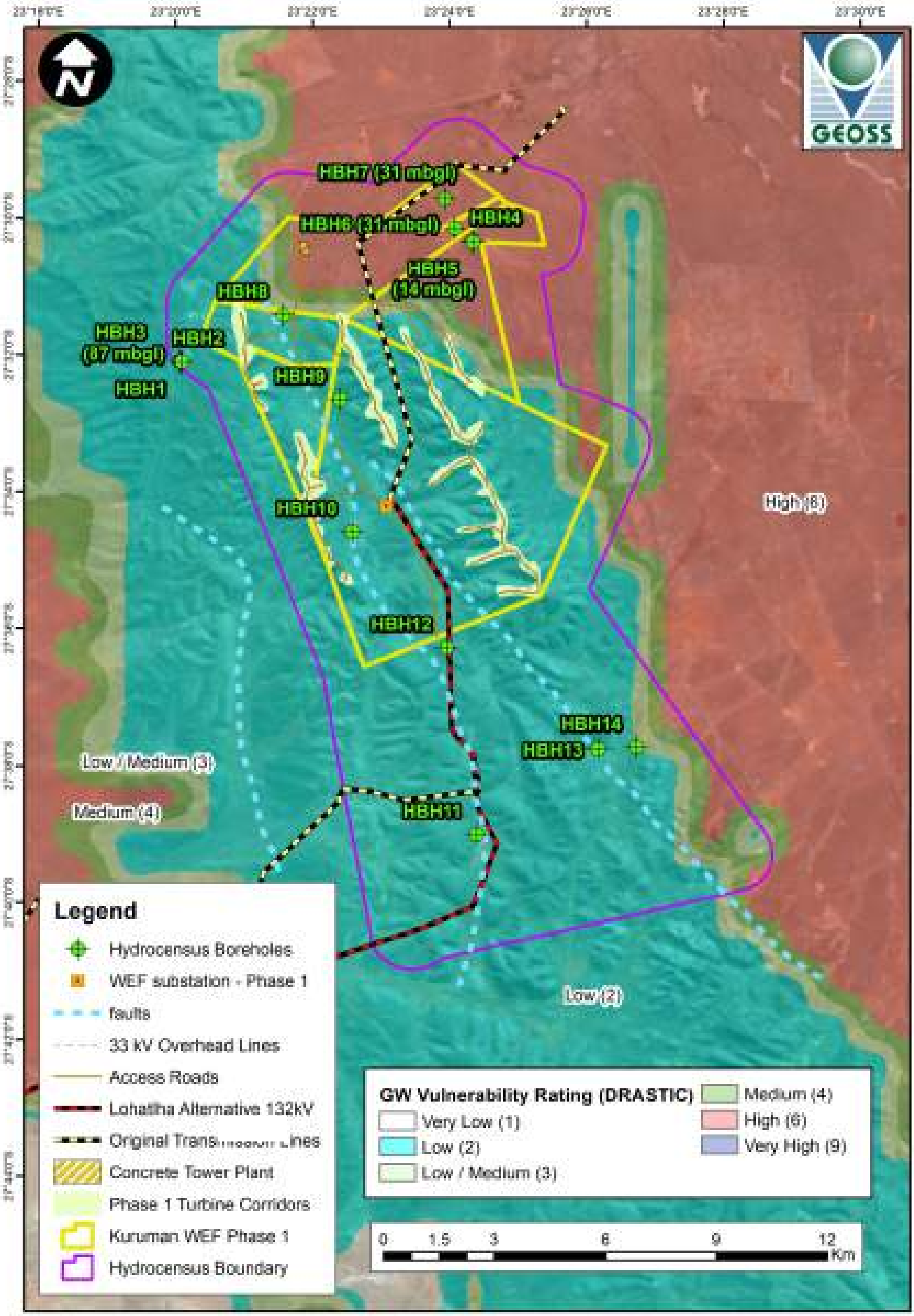
Map 3: Hydrogeological setting of the study area: Aquifer type and yield (DWAF, 2722 Kuruman)



Map 4: Regional groundwater quality (Department of Water Affairs groundwater map: 1:500 000 scale 2722 - Kuruman)



Map 5: Setting of the study area superimposed on an aerial photograph (source ESRI, 2018), showing hydrocensus boreholes.



Map 6: National groundwater vulnerability (calculated according to the DRASTIC methodology) and boreholes with groundwater level depths (DWAF, 2005).

- ***APPENDIX B: site photos***

Table 7: Photos of hydrocensus boreholes identified during site visit.

BH_ID	Photo
HBH1	
HBH2	
HBH3	
HBH4	No Photo Available
HBH5	No Photo Available

HBH6	
HBH7	
HBH8	
HBH9	

HBH10	
HBH11	
HBH12	
HBH13	

HBH14	

- ***APPENDIX C: Laboratory certificates***

bemlab
www.bemlab.co.za
Part of PathCare

sanas
T0654

16 Van der Berg Crescent
Gant's Centre
Strand

Tel. (021) 853-1490
Fax (021) 853-1423

E-Mail admin@bemlab.co.za

P O Box 684
Somerset Mall,
7137

Vat Reg. Nr. 4200161414

CERTIFICATE OF ANALYSES

Report Nr.: **WT003423.DOC**

Julian Conrad
GEOSS (Pty) Ltd
Unit 19, Technostell Building
9 Quantum Street, Technopark
Stellenbosch
7600

Date received: **29-01-2018**
Order nr.: **#2575 KURUMAN**

Sampled by client

Water Analyses Report

SANS241

Origin	Lab. Nr.	pH @ 25°C	EC @ 25°C mS/m	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Fe mg/l	Cl mg/l	SO_4 mg/l	B mg/l	Mn mg/l	Cu mg/l	Zn mg/l	P mg/l	NH_4-N mg/l	NO_3-N mg/l	*NO_2-N mg/l	*F mg/l
HBH 6	3423	6.9	42	9.7	2.7	60.7	10.1	0.1	22.7	7	0.29	<0.03	<0.02	<0.03	0.01	<0.28	4.53	0.01	0.1
HBH 10	3424	8.1	68	12.0	8.3	62.7	47.6	0.1	14.0	30	0.54	<0.03	<0.02	<0.03	0.02	<0.28	0.45	0.01	0.2
HBH 11	3425	7.9	20	3.0	1.5	19.5	9.2	0.1	8.6	<1.43	0.29	<0.03	<0.02	<0.03	<0.01	<0.28	0.78	0.01	0.1
HBH 14	3426	7.3	15	3.1	1.1	18.9	5.1	0.1	9.0	<1.43	0.28	<0.03	<0.02	0.72	<0.01	<0.28	0.84	0.01	0.1
Norm		≥5.0-≤9.7	≤170	≤200.0				≤2.0	≤300.0	≤500	≤2.40	≤0.40	≤2.00	≤5.00		≤1.50	≤11.00	≤0.90	≤1.5

Origin	Lab. Nr.	*TDS mg/l	Alkalinity as CaCo3 (mg/l)	Al µg/l	As µg/l	Ba µg/l	Cd µg/l	Co µg/l	Cr µg/l	*Hg µg/l	Ni µg/l	Pb µg/l	Sb µg/l	Se µg/l	*U µg/l	V µg/l	*CN µg/l	Date Sampled
HBH 6	3423	252.0	143.42	<30	<5	<5	<3.1	1.0	<27	3.4	0.5	<7	<2	<12	<13.8	0.4	11.0	23/01/2018
HBH 10	3424	409.0	377.13	<30	<5	8.4	<3.1	1.9	27.9	4.9	<0.03	<7	3.7	<12	<13.8	0.8	9.0	23/01/2018
HBH 11	3425	118.4	90.90	<30	<5	<5	<3.1	<1	<27	3.2	7.6	<7	<2	<12	<13.8	0.5	12.0	24/01/2018
HBH 14	3426	88.6	74.74	<30	<5	<5	<3.1	1.3	<27	6.0	2.1	<7	<2	<12	<13.8	0.2	10.0	24/01/2018
Norm		≤1200.0		≤300.00	≤10.0	≤700.0	≤3.0		≤50.0	≤6.0	≤70.0	≤10.0	≤20.0	≤40.0	≤30.0		≤200.0	

Origin	Lab. Nr.	Temperature at reception (°C)	*Colour mg/l Pt	*Turbidity NTU	*TOC mg/l	*Cl_2 (Free) mg/l	Date Analysed
HBH 6	3423	20.1	<1	0.00	19.50	0.16	07/02/2018
HBH 10	3424	19.0	<1	0.00	43.50	0.16	07/02/2018
HBH 11	3425	19.6	<1	0.00	12.00	0.09	07/02/2018
HBH 14	3426	20.2	<1	0.44	11.30	0.16	07/02/2018
Norm			≤15	≤5	≤10.00	≤5.00	

** = Not SANAS Accredited*

Norms according to SANS 241-1:2015.

Statement: The reported results may be applied only to samples received. Any recommendations included with this report are based on the assumption that the samples were representative of the source from which they were taken.

Notes:

To ensure sample integrity, samples are stored only for seven days after release of the report. Thereafter it is disposed of and a fresh sample will be required if additional analyses are requested.

Results marked with "**Not SANAS Accredited**" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. These results relate to the items tested.

This test report shall not be reproduced except in full, without written approval of the laboratory.

Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.

Refer to website for uncertainty of measurement and referenced methods.

Sample condition: Samples received in good condition.

Sandisiwe Mbula
Technical Signatory(Water chemistry)

14-02-2018
Date reported

———END OF REPORT———

Heritage Specialist Assessment:

Scoping and Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape
EIA REPORT

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

Report prepared by:

CTS Heritage

34 Harries Street

Plumstead, Cape Town

7800

August 2018

Specialist Expertise

Jenna Lavin

Tel: 083 619 0854 (c)
E-mail address: jenna.lavin@ctsheritage.com
ID number: 8512050014089

EDUCATION:
Tertiary

2014	M.Phil in Conservation of the Built Environment (University of Cape Town) - Not completed as of 2018
2011	Continued Professional Development Course in Urban Conservation Management (University of Cape Town) Part I and Part II
2010	M.Sc. with Distinction in Archaeology (University of Cape Town) Title: *Palaeoecology of the KBS member of the Koobi Fora Formation: Implications for Pleistocene Hominin Behaviour*.
2007	B.Sc. Honours in Archaeology (University of Cape Town) Title: *The Lost Tribes of the Peninsula: An Investigation into the historical distribution of Chacma baboons (Papio ursinus) at the Cape Peninsula, South Africa.* Koobi Fora Field School, Rutgers University (U.S.A.)/ National Museums of Kenya
2006	B.Sc. Archaeology (University of Cape Town) B.Sc. Environmental and Geographic Science (University of Cape Town)

EMPLOYMENT HISTORY:

PROFESSIONAL DEVELOPMENT
Environmental and Heritage Management:

Director: Heritage for CTS heritage and member of OpenHeritage NPC.
July 2016 to present

Assistant Director for Policy, Research and Planning at Heritage Western Cape (HWC).
August 2014 to June 2016

Heritage Officer for Palaeontology and for the Mpumalanga Province at the South African Heritage Resources Agency (SAHRA).
January 2013 to June 2014

Heritage Officer for Archaeology, Palaeontology and Meteorites at Heritage Western Cape (HWC).
September 2010 to December 2012

Heritage Officer for the Archaeology, Palaeontology and Meteorites Unit of the South African Heritage Resources Agency (SAHRA) as part of a three month contract.
January 2010 to March 2010

SPECIALIST DECLARATION

I, Jenna Lavin., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- act as the independent specialist in this application;
- 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;
- 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;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- 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;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- 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 Specialist: _Jenna Lavin_________________________

Date: ______20 July 2018__________________________________

EXECUTIVE SUMMARY

The study site for the proposed Phase 1 Kuruman WEF (i.e. turbine location sites, access roads, substations, laydown areas) is not a sensitive archaeological landscape. A limited number of stone implements (isolated and dispersed scatters of Later Stone Age tools including retouched and utilized flakes, chunks, and a few cores in locally available banded ironstone), occur on some of the high hill top sites and access roads. Archaeological artefacts are located among extensive scatters of ironstone gravels which are ubiquitous in the surrounding area. No settlement sites, quarry sites, or evidence of human occupation were identified. Banded ironstone is a ready source of raw material across the entire study area. The hilltop sites are not conducive to pre-colonial settlement due to their high elevation, lack of caves as well as their isolated, exposed, cold and windy nature. The proposed development is unlikely to impact significant archaeological resources as long as the recommendations are implemented.

Given the low palaeosensitivity of the proposed footprint, it is concluded that in terms of palaeontological heritage resources the impact significance of the Kuruman WEF Phase 1 is *low* (*negative*), both before and after mitigation. This assessment applies to the construction phase and to all relevant components of the WEF infrastructure (*e.g.* wind turbines, internal and external access roads, underground cabling, on-site substation and construction yards). No significant impacts during the operational and de-commissioning phases are anticipated. None of the fossil sites identified fall inside the WEF development footprint and no specialist palaeontological mitigation is therefore proposed here. Small stromatolite-rich outcrop areas of Campbell Rand carbonates to the east of the WEF footprint (areas outlined in red in Figures 8a, b and c) should be designated as no-go Areas and protected from any disturbance or development.

Recommendations

It is recommended that a Heritage Conservation Management Plan (CMP) be developed for the WEF to ensure that heritage resources are continuously managed throughout the construction and operational phases of the development. This CMP must be required as a condition of Environmental Authorisation.

Rock Art

- All rock art sites (Sites KUR28, KUR36, KUR37, KUR44, KUR45, KUR46), must be avoided and should not be visited. Location of rock art sites should not be made public. The location of these sites can be identified in site development plans and in the CMP.
- A no-go buffer zone of 20m must be kept around each rock art site

Burial Grounds and Graves

- These sites must not be impacted by the proposed development and are considered no-go sites for development.
- A 50m buffer area also be kept around these sites, and that access to these sites be permitted to relatives and friends of the deceased wishing to pay their respects.
- Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during preparation of the lands for cultivation, these must immediately be reported to the South African Heritage Resources Agency (Ms Natasha Higgit 021 462 4502), or the McGregor Museum (Att Dr David Morris 053 8392707 / 082 2224777). Burials, etc. must not be removed or disturbed until inspected by the archaeologist

Palaeontology
All of the palaeontologically significant fossil sites identified are associated with small outcrop areas of Campbell Rand Subgroup carbonate bedrocks that lie *outside* and east of the WEF development footprint. These areas should be designated as no-go areas and protected from any disturbance or development during the construction phase.

Should substantial fossil remains be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency as soon as possible (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone : +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.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 proponent's expense. A procedure for Chance Fossil Finds is tabulated in Appendix 2. These recommendations must be incorporated in the Environmental Management Programme for the WEF project.

The above recommendations must be incorporated into the Environmental Management Programme (EMPr) for the proposed development.

LIST OF ABBREVIATIONS

AIA	Archaeological Impact Assessment
CSIR	Council for Scientific and Industrial Research
DARD	Department of Agriculture and Rural Development (KwaZulu-Natal)
DEA	Department of Environmental Affairs (National)
DEADP	Department of Environmental Affairs and Development Planning (Western Cape)
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism (Eastern Cape)
DEDECT	Department of Economic Development, Environment, Conservation and Tourism (North West)
DEDT	Department of Economic Development and Tourism (Mpumalanga)
DEDTEA	Department of economic Development, Tourism and Environmental Affairs (Free State)
DENC	Department of Environment and Nature Conservation (Northern Cape)
DMR	Department of Mineral Resources (National)
EMPr	Environmental Management Programme
HIA	Heritage Impact Assessment
MPRDA	Mineral and Petroleum Resources Development Act, no 28 of 2002
NEMA	National Environmental Management Act, no 107 of 1998
NHRA	National Heritage Resources Act, no 25 of 1999
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
VIA	Visual Impact Assessment

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- (a) details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 1 and Appendix 5
(b) declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 2
(c) an indication of the scope of, and the purpose for which, the report was prepared;	1.1
(cA) an indication of the quality and age of base data used for the specialist report;	1.3, 1.4, 1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	2
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	1.3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	1.3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	5.2
(g) an identification of any areas to be avoided, including buffers;	8
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	6.1
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	1.4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	6
(k) any mitigation measures for inclusion in the EMPr;	8
(l) any conditions for inclusion in the environmental authorisation;	8
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	8
(n) a reasoned opinion- (i) as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	9
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	NA
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	NA

(q) any other information requested by the competent authority.	Appendix HIA Report
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Noted

Table of Contents

TABLES AND FIGURES

HERITAGE IMPACT ASSESSMENT

1. INTRODUCTION AND METHODOLOGY

1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, “Mulilo”) has proposed to build the Kuruman Wind Energy Facility (WEF) in two phases (1&2). The objective of this assessment is to provide insight into the possible impacts of Phase 1 of this WEF to heritage resources, including the identification of these resources within the proposed development area as well as recommended mitigation strategies.

Number of turbines to be completed in Phase 1: 47. Each turbine has a maximum output of 4.5 to 5.5 MW, blade height of 140m and blade length of 80m.

Additional infrastructure assessed for the EIA will include 5m wide connecting roads and widening of existing roads to 8m. New roads constructed will connect all turbines.

The WEF will also be connected to the grid via two 132kV overhead powerlines to Kuruman (Segame Substation, 10km in length) and Kathu (Ferrum Substation, 50km in length). This 132kV powerline is subject to a separate Basic Assessment process. In addition, 33kV underground line will run along jeep tracks as service roads below the overhead lines.

A collector substation (Eskom Metering Station) reaching a height of 15m over a 2ha footprint will be constructed in the Phase 1 inclusion zone. A new switching station would have to be constructed next to the existing Eskom substation, for the project to connect into it.

Three construction yards will be established. It is anticipated that each construction yard will consist of the following:

-Welfare facilities:
- Canteen
- Toilets
- Changing rooms
- Offices
- Meeting rooms
- Parking

- Storage including;
- Bunded fuel areas
- Oil storage areas

- General stores (containers)
- Skips

Average weekly water requirements will comprise 409,640 litres. High water use is only anticipated for the first 6 months of the 18-month construction phase of turbine bases, roads and dust suppression. Operational phase average weekly water requirement: 100 litres. Source is expected to be from borehole water.

<u>Depth of excavation (m):</u> 3m
<u>Height of development (m):</u> 140m turbines, 15m collector substation
<u>Expected years of operation before decommissioning:</u> 20 years

1.2 Terms of Reference

The Terms of Reference for this specialist study includes:

- A description of the regional and local heritage resources,
- A field survey to identify sites and areas of heritage significance that may be directly or indirectly impacted by the proposed development
- Mapping of the identified heritage resources and an assessment of their cultural significance,
- Assessing (identifying and rating) the potential direct and cumulative impacts of the proposed development on these heritage resources,
- Assessing alternatives,
- Identification of relevant legislation and legal requirements; and
- Providing recommendations on possible mitigation measures and management guidelines.

1.3 Approach and Methodology

Heritage Screening Assessment

As part of the Scoping Phase, a Heritage Screening Assessment was conducted for the proposed development (Appendix A). The Heritage Screener summarises the heritage impact assessments and studies previously undertaken within the area of the proposed development and its surroundings. Heritage resources identified in these reports were then assessed by our team during the screening process.

Based on the results of the Heritage Screening Assessment, it was recommended that, as the proposed development is likely to impact on heritage resources, a complete Heritage Impact Assessment including a detailed field assessment is required that assesses impacts to landscape character, secondary (and possibly primary) impacts on built environment resources, archaeological resources, graves and burial grounds, fossil heritage and mining heritage.

Field Assessment

An archaeologist conducted a survey of the site and its environs in June 2018 to determine what heritage resources are likely to be impacted by the proposed development (Appendix 1 to the HIA), and a Palaeontological Field Assessment was completed in February 2018 to assess likely impacts to palaeontology (Appendix 2 to the HIA).

The identified heritage resources were assessed to evaluate their heritage significance in terms of the grading system outlined in section 3 of the NHRA (Act 25 of 1999). These identified resources have been mapped relative to the proposed development layout to determine likely impacts and to inform relevant buffers areas, no-go zones and other mitigation strategies.

1.4 Assumptions and Limitations

The following aspects have a direct bearing on the investigation and the resulting report:

- The *significance* of the sites and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

- It should be noted that archaeological deposits often occur below ground level. Should artefacts or skeletal material be revealed at the site during construction, such activities should be halted, and it would be required that the heritage consultants are notified for an investigation and evaluation of the find(s) to take place.

In addition, the archaeologist conducting the field assessment noted the following:

1. Access to hill top sites was limited and some sites were completely inaccessible
2. Access to the WEF study area was not allowed on one day because of a hunting party

However, despite these challenges, sufficient time and expertise was allocated to provide an accurate assessment of the archaeological sensitivity of the area.

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.
2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant (“mappable”) bedrock units as well as major areas of superficial “drift” deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
4. The extensive relevant palaeontological “grey literature” - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies;
5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.
6. In the case of palaeontological desktop studies without supporting field assessments these limitations may variously lead to either:
    a. underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
    b. overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the various loop and borrow pit study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the present study area near Kuruman in the Northern Cape exposure of potentially fossiliferous bedrocks is very limited, due to extensive cover by superficial sediments and vegetation. However, sufficient exposures were examined to allow a confident assessment of their palaeontological sensitivity (See Appendix 1 of the HIA) so confidence levels for this assessment are medium. Comparatively few academic palaeontological studies have been carried out in the region so any new data from impact studies here are of scientific interest.

1.4a Limiting/Restricting factors

The investigation has been influenced by the following factors related to the overall EIA:

- Availability and reliability of baseline information about the affected area;
- Unpredictability of buried archaeological/palaeontological remains (absence of evidence does not mean evidence of absence);

1.5 Source of Information

Field work

Archaeological and Palaeontological fieldwork was undertaken for the EIA Phase of the project. This study draws on desktop research from several approved heritage impact assessments and specialist studies from the area as well as from the results of the field assessments.

In addition, the combined desktop and field-based Heritage Impact Assessment report is based on:

- A review of the relevant scientific literature, including previous archaeological and palaeontological impact assessments in the broader region;
- Published topographical and geological maps and accompanying sheet explanations (1: 250 000 Sheet 2722 Kuruman) as well as Google Earth© satellite imagery;
- Two Heritage Scoping reports for the Kuruman WEF projects (CTS Heritage 2018a, 2018b) *plus* a preceding short palaeontological heritage screening report (CTS Heritage 2017);
- A five-day field study of the consolidated Kuruman WEF and associated transmission line study area by an archaeologist and palaeontologist
- The palaeontological specialists extensive field experience with the formations concerned and their palaeontological heritage (*cf* Almond *et al.* 2008).
- The archaeological specialists extensive field experience with the formations concerned and their archaeological heritage

Desktop study

Information was obtained from various impact assessment reports and specialist studies. The body of literature is listed below in the reference section.

2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO HERITAGE IMPACTS

Activities associated with the development of the proposed WEF that are likely to impact on heritage resources include:

- Vegetation clearing
- Road construction

- Excavation and dredging activities
- Infrastructure construction activities

Phase 1 of the WEF is located on a number of farms in the vicinity of Kuruman in the Northern Cape. This area had not been surveyed previously. Prior to the field assessment, it was anticipated that heritage resources such as ruined farm infrastructure, possible old mines, ESA, MSA and LSA open site scatters of artefacts and possibly more rock art sites in overhangs would be identified.

In terms of geology, the WEF and powerline footprint is underlain by Precambrian sediments and lavas of the Transvaal Supergroup, including the Ghaap Group (marine carbonates of the Campbell Rand Subgroup followed by banded iron formations of the Asbestos Hills Subgroup) and Postmasburg Group (Ongeluk Formation lavas). Most of these rock units are of low palaeontological sensitivity. However, the Campbell Rand carbonates near Kuruman may be stromalite-rich (high sensitivity). Late Caenozoic superficial sediments include windblown sands (Kalahari Group), colluvial and other surface gravels, alluvium and pedocretes (e.g. calcretes). Most of these younger sediments are of low sensitivity but older alluvial deposits along major drainage lines as well as calcretes need to be inspected for fossils (e.g. mammalian remains).

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The Kuruman Hills have historically been used for small scale pastoralist farming activities with goats and sheep, a practice which extends back possibly as much as 2000 years ago when Khoekhoe herders first entered the area. Three sites with possible herder art (TK1, TK3 & TK5) were found in association with Later Stone Age artefact assemblages on the Tierkop farm. These sites were recorded during a survey by Dave Halkett and Jayson Orton (Halkett 2009) for the potential impacts of iron and manganese ore mining on Bramcote farm (No 446). Wonderwerk Cave, a National Heritage Site containing archaeological traces stretching back over 2 million years, is located ~25km to the southeast of the WEF.

The inclusion zone is situated within the Savanna Biome. The Savanna Biome comprises 46 percent of southern Africa’s land mass, therefore is the largest Biome in southern Africa. This Biome is characterized by C4-type grasses in plains areas, which is indicative of a summer rainfall zone. In addition, distinct upper layer of woodland and bushveld are observable on mountainous and intermediate areas respectively. The Kruger and Kalahari Gemsbok National Parks contain this vegetation type; therefore, Savanna Biome vegetation is effectively conserved. However, only 5 percent of the total vegetation Biome is formally conserved.

Approximately 35km to the southwest of the inclusion zone is Kathu, where a large Camel Thorn Tree (*Vachellia erioloba*) forest is conserved. Known as the Kathu Forest, it is approximately 4000ha and has been declared a National Heritage Site. Camel Thorns provide ecological support for the Sociable Weaver and their large nests and are depended upon by several other bird and animal species, many of which are listed endemic and protected species. As the inclusion zone is proximal to the Kathu forest, it likely also hosts areas of vegetation that is ecologically sensitive.

The archaeologist who conducted the field assessment indicated that the study site for the proposed Phase 1 Kuruman WEF (i.e. turbine location sites, access roads, substations, laydown areas) is not a sensitive archaeological landscape. A limited number of stone implements (isolated and dispersed scatters of Later Stone Age tools including retouched and utilized flakes, chunks, and a few cores in locally available banded ironstone), occur on some of the high hill top sites and access roads. Archaeological artefacts are located among extensive scatters of ironstone gravels which are ubiquitous in the surrounding area. No settlement sites, quarry sites, or evidence of human occupation were identified. Banded ironstone is a ready source of raw material across the entire study area. The hilltop sites are not conducive to pre-colonial settlement due to their high elevation, lack of caves as well as their isolated, exposed, cold and windy nature.

4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Section 38 of the National Heritage Resources Act (25 of 1999) applies.

This study constitutes a heritage scoping investigation linked to the environmental impact scoping and impact assessment required for the development. The proposed development is a listed activity in terms of Section 38 (1) of the NHRA.

Section 38 (2)(a) of the National Heritage Resources Act (Act 25 of 1999) requires the submission of a heritage impact assessment report for authorization purposes to the responsible heritage resources agency, SAHRA. Heritage conservation and management in South Africa (excluding KwaZulu-Natal on a provincial level) is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA) and falls under the jurisdiction of the South African Heritage Resources Agency (SAHRA) and its provincial offices and counterparts.

Section 38 of the NHRA requires a Heritage Impact Assessment (HIA) be conducted by an independent heritage management consultant for the following development categories:

38. (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

> (a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
> (b) the construction of a bridge or similar structure exceeding 50m in length;
> (c) any development or other activity which will change the character of a site—
>> (i) exceeding 5 000 m^2 in extent; or
>> (ii) involving three or more existing erven or subdivisions thereof; or
>> (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
>> (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
>
> (d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
> (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

Should the proposed development fall within any of the categories described in Section 38(1), the appropriate heritage authority may require a Heritage Impact Assessment in terms of Section 38(3) of the NHRA. According to Section 38(3);

The responsible heritage resources authority must specify the information to be provided in a heritage report required provided that the following must be included:

> (a) The identification and mapping of all heritage resources in the area affected;
> (b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
> (c) an assessment of the impact of the development on such heritage resources;

(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development.

As the proposed development is subject to an EIA in terms of NEMA, Section 38(8) of the NHRA applies. Section 38(8) states that:

“The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent.”

In addition, section 38(10) states that: “Any person who has complied with the other requirements referred to in subsection (8), must be exempted from compliance with all other protections in terms of this Part, but any existing heritage agreements made in terms of section 42 must continue to apply.”

5. IDENTIFICATION OF KEY ISSUES

5.1 Key Issues Identified During the Scoping Phase

Based on the previously mentioned historical significance regarding the Kuruman Hills history of small scale pastoralist farming activities with goats and sheep, along with three sites where possible herder art were found in association with Later Stone Age artefact assemblages on the Tierkop farm, the potential footprint of the proposed development will impact heritage resources.

- Destruction of archaeological artefacts.
- Destruction of pastoralist cultural landscape of heritage and historical significance.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites).
- Destruction of burial grounds and graves, and sacred spaces
- Destruction of archaeological artefacts during operational activities or upgrades.
- Destruction of pastoralist cultural landscape of heritage and historical significance. A loss of ‘sense of place’.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites) during operational activities or upgrades.
- Destruction of burial grounds and graves, and sacred spaces
- Changes in the aesthetics of the cultural landscape.
- Destruction of other heritage resources

5.2 Identification of Potential Impacts

The potential impacts identified during the EIA assessment are:

5.2.1 Construction Phase

- Destruction of archaeological artefacts.
- Destruction of pastoralist cultural landscape of heritage and historical significance.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites).
- Destruction of burial grounds and graves, and sacred spaces

5.2.2 Operational Phase

- Destruction of archaeological artefacts during operational activities, maintenance or upgrades.
- Destruction of pastoralist cultural landscape of heritage and historical significance. A loss of 'sense of place' resulting from the wind turbine placement on the landscape
- Destruction of palaeontological material (mainly of Precambrian Stromatolites) during operational activities, maintenance or upgrades.
- Limitations regarding access to burial grounds and graves for friends and family

5.2.3 Decommissioning Phase

- Destruction of heritage resources during decommissioning (archaeological and palaeontological resources)

5.2.4 Cumulative impacts

- Changes in the aesthetics of the cultural landscape.
- Destruction of heritage resources

6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

6.1 Results of the Field Study

The proposed WEF substations and laydown areas do not constitute a sensitive archaeological or palaeontological landscape.

Structures and Places

No old buildings, ruined structures, typical grave features (i.e. stone mounds), formal farm cemeteries were noted. A modern residential farm house, outbuildings, worker cottages, hunting lodge, butcher, etc are all located way outside the footprint area of the wind energy farm. The ACO (Halkett, 2009) identified a number of farming-related burial grounds as well as historic farm werfs (TK2, 2A, 7, 8 and 9), however these are located outside of the footprint for the Kuruman Phase 1 WEF. In their report, they describe these resources as:

"Older, partly ruined structures represent an earlier farm dwelling (TK2) and a structure related to mining/prospecting (BR8). The building at TK 2 could be the oldest formal structure that we saw and is built with ironstone quarried adjacent to the house. The use of this abundant natural building material is typical for the area and kraals, walls and houses alike are built with it. As is common with farming settlements, a number of graves were identified with the help of the farmers and workers. One grave at BR2 is highly formalised with an engraved headstone, while all others were simple stone covered mounds representing the burial places of the farm workers (6 graves at BR6 and 8 graves at TK7). We believe that another grave is to be found close to the old farmhouse (TK2a), also marked by a stone covered mound, while another is found close to the existing workers cottages on Tierkop."

Evidence for historical mining does occur (refer to 1:50 000 topographical map 2723CB Strelley), while evidence for more recent mining and / or prospecting is present in the form of pits mostly on hill slopes at lower elevations. These location sites were not visited by us.

Archaeology

Overall, the results indicate low density/dispersed scatters, and isolated tools, of low (Not Conservation-Worthy or NCW - see Appendix 1 of HIA) significance. Stone implements are dominated by locally available banded ironstone; gravels are widespread in the surrounding landscape. Some chert and siliceous stone found on Bothaskop (outside study area) and at Rock Art site KUR28. But overall, the numbers are very low.

Cultural landscape is dominated by stone tools assigned to the Later Stone Age, with a few Middle Stone and Early Stone Age elements occurring.

Rock art sites have been rated as having high significance. Apart from Site KUR28, all the rock art sites are located in the eastern portion of Woodstock Farm, <u>outside</u> the footprint area of the proposed wind energy farm. Art is dominated by late Herder elements (mainly finger paintings, and geometric images, but earlier LSA hunter-gatherer style i. e. indeterminate human figures, `cave scenes' `formlings', are evident at some of the sites). LSA tools in banded ironstone/jasperlite, chert, CCS occur in all the rock art sites, but no pottery was found. No stone walling/animal enclosures either.

Paintings are all comparable to Bramcote rock art sites located by the ACO (Halkett, 2009).

Table 1: Archaeological observations of heritage significance (see Appendix 1 of HIA for full list)

Description	Grading	Mitigation	Site Name	Site No.
Banded ironstone rock overhang / shelter on steep north facing grass covered slope. Very faded rock art (finger stripes) in red ochre. Small collection of LSA stone tools including denticulate flake, retouched flakes, chunks, convex scraper, core in chert , banded ironstone, indurated shale and chert. No pottery or OES	Grade IIIA	None required, will not be impacted by proposed construction activities.	Kuruman WEF 28	KUR 28
Rock art site – banded ironstone overhang at base of cliff. Shallow, trampled, disturbed bedrock archaeological deposit. Relatively large number of LSA tools inside shelter and rocky boulder covered slopes. Mostly in banded iron stone, CCS & chert. No pottery or OES. Extensive, enigmatic rock art, geometric finger painted images, finger stripes, finger dots, superimposing, `formlings', indeterminate faded human figures, possible bags; ?cave scene (aggregation site). All monochrome red ochre, but some orange. Large site runs alongside the base of the cliff for about 75/80m; extensive concentrated rock art on wall and ledges. Possibly earlier LSA and later ?Herder style	Grade IIIA	None required, will not be impacted by construction activities All rock art sites to be avoided	Kuruman WEF 36	KUR 36

Rock art site, shallow trampled bedrock archaeological deposit. Small number of LSA tools in shelter, and on steep rocky and grass covered slope. Enigmatic and faded monochrome art (painted geometric finger strips) in red ochre. No pottery. One fragment of weathered OES.	Grade IIIA	None required, will not be impacted by construction activities	Kuruman WEF 37	KUR 37
Shallow banded ironstone shelter / overhang at base of cliff; very faded, indeterminate monochrome art (red ochre), faded geometric painted images / stripes; trampled bedrock archaeological deposit, a few LSA stone flakes inside overhang and on steep rocky slopes	Grade IIIA	None required, will not be impacted by construction activities	Kuruman WEF 44	KUR 44
Large, painted, tiered rock shelter ± 60-70m long, above steep rocky and grass covered slope. Relatively well preserved paintings (but also faded art), including inverted crescents, serpent like shapes, geometric finger paintings/stripes. `formlings', superimposition and indeterminate art. Possible human figures; bags/?tassels; cave scene. Extensive panel of rock art. Red, yellow and orange ochre. Possible Karros clad (hook headed) figures. Shallow trampled bedrock archaeological deposit, with stone artefacts, inc. CCS, ?lydianite, and some banded ironstone. No pottery or OES. Art possibly earlier LSA and later ?Herder style. Maybe another aggregation site	Grade IIIA	None required, will not be impacted by construction activities	Kuruman WEF 45	KUR 45
Small, painted rock shelter / overhang with shallow bedrock deposit and stone implements in CCS and banded ironstone. No pottery. Enigmatic art, geometric finger paintings, faded and indeterminate ?human figures in red, orange and white ochre	Grade IIIA	None required, will not be impacted by construction activities	Kuruman WEF 46	KUR 46
Several banded ironstone flakes and chunks among surface outcropping of banded ironstone on slight elevation in powerline servitude. Large Acacia marks the site	Grade IIIC	None required	Kuruman WEF 53	KUR 53
Scatter on Bothaskop – CCS/chert LSA blades chunks, flakes	Grade IIIC	None required	Kuruman WEF 59	KUR 59
Rock overhang on boundary of Woodstock Farm, some extremely faded art	Grade IIIA	None required	Kuruman WEF 66	KUR 66

Palaeontology

The project area for the Kuruman Wind Energy Facility Phase 1, situated in the hilly Kurumanberge region of the Northern Cape, is largely underlain by sedimentary bedrocks of Precambrian (Late Archaean – Early Proterozoic) age assigned to the Ghaap Group (Transvaal Supergroup). These sediments were laid down in shallow inshore to deep offshore marine settings on the margins of the ancient Kaapvaal Craton some 2.5 to 2.4 Ga (= billion years ago). Carbonate sediments (limestones, dolomites) of the Campbell

Rand Subgroup crop out at several points along the eastern edge of the Kurumanberge but outside of the WEF Project area. Good exposures here are very limited due to scree cover. The outcropped sediments are of high palaeobiological significance because they show several unusual and interesting geological and palaeontological features of early Precambrian platform carbonates, including a range of stromatolites (fossil microbial mounds). These fossiliferous carbonates will not be directly impacted by the proposed WEF development. These include a range of stromatolite (microbial mound) forms (*e.g*. giant elongate stromatolites > 10 m wide), evidence for modified evaporite deposits (*e.g.* gypsum), fossil microbial assemblages and datable tuffs (volcanic ashes). These carbonate rock exposures are of high conservation significance (high geo- and palaeosensitivity) but lie entirely *outside* the WEF footprint.

The great majority of the WEF footprint overlies Proterozoic banded iron formation (BIF) of the Asbestos Hills Subgroup (Kuruman and Daniëlskuil Formations). These interlaminated basinal cherts and iron ores may contain microfossils, but no evidence of body fossils, trace fossils or bio-sedimentary structures such as stromatolites has ever been recorded within these units, so their palaeosensitivity is rated as low. The largely unconsolidated superficial sediments that mantle the Precambrian bedrocks in the WEF project area include widespread cherty surface gravels and scree, gravelly to sandy alluvium and soils (*e.g.* on the floor of the central valley within the Kurumanberge as well as lining drainage courses) and ferricrete. In addition, carbonate-cemented breccias, calcrete and calc-tufa or flowstone overlie the Campbell Rand outcrop outside the project footprint. These Late Caenozoic sediments are generally of low palaeontological sensitivity and no fossils were recorded within them during the present field study. Pockets of high palaeosensitivity – for example assemblages of micromammal and other vertebrate remains embedded within karstic fissure-infill and tufa deposits – *might* occur here, by analogy with Precambrian carbonate outcrops elsewhere in southern Africa (*e.g.* Namibia), but are impossible to predict.

Given the low overall low palaeosensitivity of the proposed footprint, it is concluded that in terms of palaeontological heritage resources the impact significance of the Kuruman WEF Phase 1 is *low* (*negative*), both before and after mitigation. This assessment applies to the construction phase and to all relevant components of the WEF infrastructure (*e.g.* wind turbines, internal and external access roads, underground cabling, on-site substation and construction yards). Significant impacts during the operational and de-commissioning phases are not anticipated. None of the fossil sites identified fall inside the WEF development footprint and no specialist palaeontological mitigation is therefore proposed here. Small stromatolite-rich outcrop areas of Campbell Rand carbonates to the east of the WEF footprint should be designated as No-Go Areas and protected from any disturbance or development.

Table 2: Fossil heritage in the Kuruman WEF and grid connection study area

GEOLOGICAL UNIT	**ROCK TYPES & AGE**	**FOSSIL HERITAGE**	**PALAEONTOLOGICAL SENSITIVITY**	**RECOMMENDED SPECIALIST MITIGATION**
Gordonia Formation KALAHARI GROUP **Plus** **SURFACE CALCRETE, CALC TUFA**	Mainly aeolian sands plus minor fluvial gravels, freshwater pan deposits, calcretes, calc tufa / flow stone, karstic fissure infill breccias PLIO-PLEISTOCENE to RECENT	calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (e.g. tortoise, micromammal) bones, teeth, plant remains. freshwater units associated with diatoms, molluscs, stromatolites etc	GENERALLY LOW with exception of rare pockets of fossiliferous fissure infill, karst breccia **(HIGH sensitivity)**	None recommended Any substantial fossil finds to be reported by ECO to SAHRA

Makganyene & Ongeluk Fms **POSTMASBURG GROUP**	Glacial diamictites (tillites), volcanic lavas, dolomites, ironstones EARLY PROTEROZOIC (c. 2.2 Ga)	Stromatolites associated with glacial deposits within the Makganyene Formation (Prieska Sub-basin)	GENERALLY LOW with exception of stromatolitic units	Reporting and documentation of ancient stromatolites in surface exposures of Makganyene Fm
Asbestos Hills Subgroup (Kuruman & Daniëlskuil Fms) **GHAAP GROUP**	BIF (banded iron formations) with cherty bands EARLY PROTEROZOIC (c. 2.5-2.4 Ga)	Important early microfossil biotas No macrofossils reported to date	LOW	None recommended
Campbell Rand Subgroup (Kogelbeen, Gamohaan & Tsineng Fms) **GHAAP GROUP**	Limestones, dolomites, subordinate cherts & tuffs LATE ARCHAEAN – EARLY PROTEROZOIC (c. 2.6-2.5 Ga)	Range of microbialites including various forms of stromatolite, organic-walled microfossils within cherts	**HIGH**	Stromatolite-rich exposures to be protected as No-Go areas. Specialist recording and mitigation of Chance Fossil Finds.

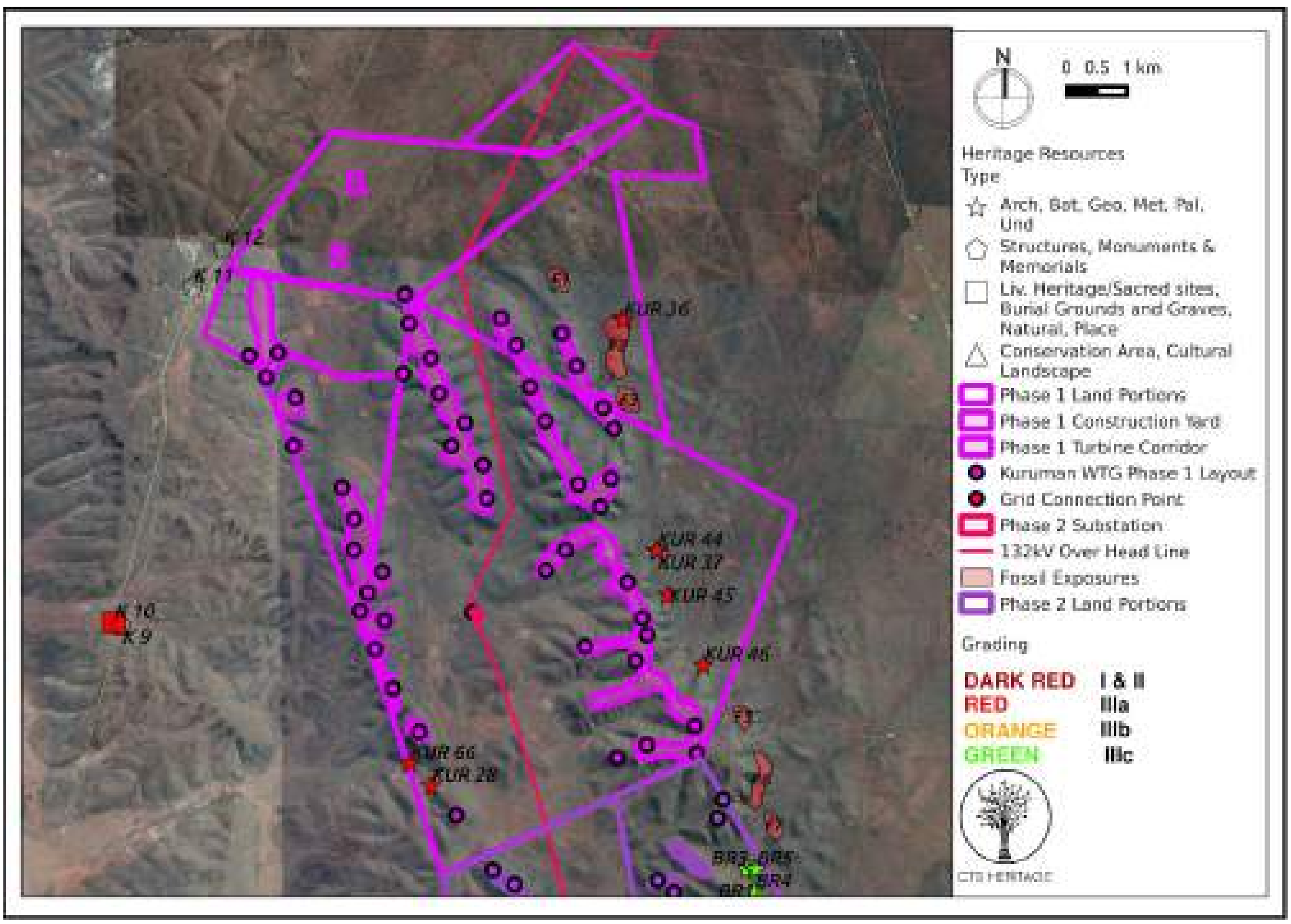


Figure 1: Map of all known significant heritage resources in relation to the proposed Phase 1 WEF development

Cumulative Impacts

Of the 72 known heritage studies conducted within 50km of the proposed development area (Table 3), none are for Wind Energy Facilities and only 13 relate to the proposed development of Solar Energy Facilities and PV Plants (highlighted in blue). The remaining assessments relate to the development of housing, road and electricity infrastructure associated with the expansion of Kathu town and the development of new mines and the extension of existing mines. From this it is assumed that the proposed Kuruman WEF Phase 1 project is unique in this area. As such, cumulative impacts on the cultural landscape are limited at this stage. Comparatively few palaeontological impact assessments are available for proposed and authorised alternative energy projects within a 50 km radius of the Kuruman WEF project area; most impact assessments in this region refer to mining and railway developments. Reports by Almond (2015a, 2015b, 2018) refer to small-scale solar energy projects near Kathu, while Almond (2012b, 2014a and preceding PIA reports listed therein) dealt with solar energy developments in the Postmasburg – Daniëlskuil region, situated some 75 km south of the present study area. Field studies on similar Precambrian bedrock units to those encountered in the Kuruman WEF project area – notably the Campbell Rand and Asbestos Hills Subgroups - are covered by Almond (2012b, 2013a and 2014b) in particular. In general, the carbonate bedrocks proved to be stromatolitic, and hence palaeontologically sensitive, while the BIF of the Kuruman and Daniëlskuil Formations contained no identifiable macrofossils. It is concluded that, in the context of these other alternative energy developments in the broader region, cumulative impacts posed by the Kuruman WEF (Phase 1), which are almost entirely underlain by unfossiliferous Asbestos Hills Subgroup BIFs, are of *low* impact significance.

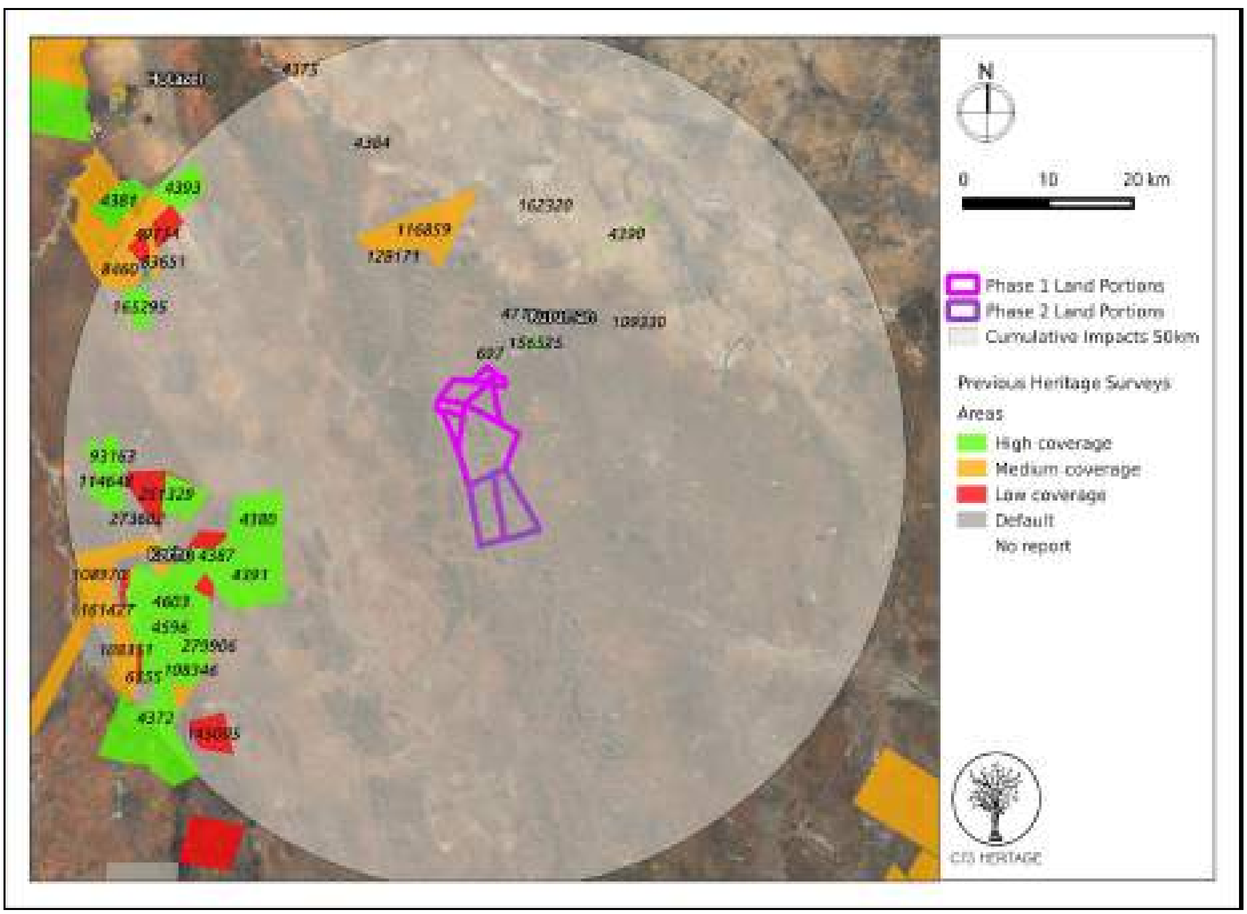


Figure 2: Map of all known heritage studies conducted within 50km of the proposed development area

Table 3: HIA's conducted within 50km of the proposed development area

Heritage Impact Assessments within 50km				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
471	AIA Phase 1	Anton Pelser	01/06/2012	A REPORT ON ARCHAEOLOGICAL IMPACT ASSESSMENTS (AIA'S) FOR PROPOSED HOUSING DEVELOPMENTS ON ERVEN 83 AND 2467, KURUMAN, IN THE NORTHERN CAPE
697	AIA Phase 1	Udo Kusel	02/06/2011	Cultural Heritage Resources Impact Assessment of Erf 5041 (Portion of Erf 1) Kuruman Municipality Ga-Segonyana Administrative District Northern Cape
4116	AIA Phase 1	Peter Beaumont	06/02/2008	Phase 1 Heritage Impact Assessment Report on a Portion of the Remainder of the Farm Sekgame 461, Kathu, Gamagara Municipality, Northern Cape Province
4117	AIA Phase 1	Peter Beaumont	07/02/2008	Phase 1 Heritage Impact Assessment Report on Portion 463/8 of the Farm Uitkoms 463, near Kathu, Kgalagadi Municipality, Northern Cape Province
4372	AIA Phase 1	David Morris	01/02/2005	Report on a Phase 1 Archaeological Assessment of Proposed Mining Areas of the Farms Bruce, King, Mokaning and Parson, Between Postmasburg and Kathu, Northern Cape
4373	AIA Phase 1	Cobus Dreyer	20/06/2005	Archaeological and Historical Investigation of the Proposed New Road from Vergenoeg to Maruping (Moropeng), Kuruman District, Northern Cape
4374	AIA Phase 1	Cobus Dreyer	20/06/2005	Archaeological and Historical Investigation of the Site for the Proposed New Maruping Sport Stadium, Kuruman District, Northern Cape
4375	AIA Phase 1	Cobus Dreyer	20/06/2005	Archaeological and Historical Investigation of the Proposed New Sport Stadium at Geelboom, Kuruman District, Northern Cape
4376	AIA Phase 1	Peter Beaumont	30/04/2006	Phase 1 Heritage Impact Assessment Report on Erf 1439, Remainder of Erf 2974 and Remainder of Portion 1 of the Farm Uitkoms No 463, and Farms Kathu 465 and Sims 462 at and near Kathu in the Northern Cape Province
4378	AIA Phase 1	Peter Beaumont	30/05/2006	Phase 1 Heritage Impact Assessment Report on Portion 5 of the Farm Uitkoms 463, Kgalagadi District, Northern Cape Province
4379	AIA Phase 1	Peter Beaumont	31/05/2006	Phase 1 Heritage Impact Assessment Report on Portions A and B of the Farm Sims 462, Kgalagadi District, Northern Cape Province
4380	AIA Phase 1	Cobus Dreyer	28/06/2006	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Residential Developments at the Farm Hartnolls 458, Kathu, Northern Cape
4381	AIA Phase 1	Julius CC Pistorius	01/08/2006	A Phase 1 Heritage Impact Assessment (HIA) Study for the Proposed New United Manganese of Kalahari (Umk) Mine on the Farms Botha 313, Smartt 314 and Rissik 330 near Hotazhel in the Northern Cape Province of South Africa
4383	AIA Phase 1	Peter Beaumont	17/01/2007	Supplementary Archaeological Impact Assessment Report on Sites near or on the Farm Hartnolls 458, Kgalagadi District Municipality, Northern Cape Province
4384	AIA Phase 1	Peter Beaumont	06/03/2007	Phase 1 Heritage Impact Assessment Report on Six Borrow Pits on Communal Ground Along the D320 Road from Batlharos to Tsineng, near Kuruman, in the Northern Cape Province
4387	AIA Phase 1	Peter Beaumont	12/06/2008	Phase 1 Archaeological Impact Assessment Report on Portion 459/49 of the Farm Bestwood 459 at Kathu, Kgalagadi District Municipality, Northern Cape Province

4390	AIA Phase 1	Jonathan Kaplan	01/08/2008	An Archaeological Assessment of Three Borrow Pits Alongside D300 Mothibistad, Northern Cape Province
4391	AIA Phase 1	Cobus Dreyer	11/08/2008	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Residential Developments at a Portion of the Remainder of the Farm Bestwood 459 Rd, Kathu, Northern Cape
4393	HIA Phase 1	Lita Webley, Dave Halkett	01/10/2008	Phase 1 Heritage Impact Assessment: Proposed Prospecting on the Farms Adams 328 and Erin 316, Kuruman, Ga-Segonyana Municipality in the Northern Cape
4596	AIA Phase 1	Peter Beaumont	01/05/2004	Heritage EIA of Two Areas at Sishen Iron Ore Mine
4597	AIA Phase 1	Peter Beaumont	01/10/2005	Heritage Impact Assessment of an Area of the Sishen Iron Ore Mine that may be Covered by the Vliegveldt Waste Dump
4598	HIA Letter of Exemption	Peter Beaumont	15/10/2005	Heritage Impact Assessment for EMPR Amendment for Crusher at Sishen Iron Ore Mine
4603	AIA Phase 1	David Morris	01/09/2008	Archaeological and Heritage Phase 1 Impact Assessment for Proposed Upgrading of Sishen Mine Diesel Depot Storage Capacity at Kathu, Northern Cape
6355	AIA Phase 1	Cobus Dreyer	10/12/2008	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Bourke Project, Ballast Site and Crushing Plant at Bruce Mine, Dingleton, near Kathu, Northern Cape
6639	AIA Phase 1	Jonathan Kaplan	01/09/2008	Phase 1 Archaeological Impact Assessment: Proposed Housing Development, Erf 5168, Kathu, Northern Cape Province
6720	HIA Letter of Exemption	Julius CC Pistorius	01/04/2008	A Phase I Heritage Impact Assessment (HIA) Study for a Proposed New Power Line for the United Manganese of Kalahari (UMK) Mine near Hotazel in the Northern Cape Province of South Africa
6804	AIA Phase 1	Peter Beaumont	01/04/2000	Archaeological Impact Assessment: Archaeological Scoping Survey for the Purpose of an EMPR for the Sishen Iron Ore Mine
7038	AIA Phase 1	David Morris	07/11/2010	PROPOSED KATHU-SISHEN SOLAR ENERGY FACILITIES. SPECIALIST INPUT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE AND ENVIRONMENTAL MANAGEMENT PLAN FOR THE PROPOSED KATHU SISHEN SOLAR ENERGY FACILITIES, NORTHERN CAPE
7930	AIA Phase 1	Thomas Huffman	01/04/2001	Draft Archaeological Survey of the Smartt/Rissik Mine, Northern Cape
8460	HIA Phase 1	H Steyn	25/03/2009	Heritage Impact Assessment: Ntsimbintle Mining (Pty) Ltd on Portions 1, 2, 3 and 8 of the Farm Mamatwan 331 and the Farm Moab 700 in the Kgalagadi District Municipality of the Northern Cape Province
8944	PIA Phase 1	John Pether	17/01/2011	BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT (Desktop Study) PROPOSED KATHU & SISHEN SOLAR ENERGY FACILITIES Portions 4 & 6 of the Farm WINCANTON 472 Kuruman District, Northern Cape
49754	Heritage Scoping	Tobias Coetzee	31/07/2012	ARCHAEOLOGICAL SCOPING REPORT FOR THE PROPOSED PROSPECTING FOR IRON ORE AND MANGANESE ORE FOR AMARI MANGANESE (PTY) LTD ON THE FARMS CONSTANTIA 309, SIMONDIUM 308 AND PORTIONS 1, 2, 3 AND 8 OF THE FARM GOOLD 329 IN THE

				VICINITY OF District Municipality:
83651	Archaeological Specialist Reports	Anton Pelser	01/04/2012	REPORT ON A HERITAGE IMPACT ASSESSMENT (AIA) FOR THE PROPOSED PHOTO-VOLTAIC SOLAR POWER GENERATION PLANT ON THE FARM ADAMS 328 NEAR HOTAZEL IN THE NORTHERN CAPE
93163	HIA Phase 1	Stephan Gaigher	09/05/2012	Heritage Impact Assessment Report Environmental Impact Assessment Phase: Proposed Establishment of the San Solar Energy Facility, Located North of Kathu on a Portion of Farm Wincanton 472, Northern Cape Province
104467	HIA Phase 1	Udo Kusel	02/06/2011	CULTURAL HERITAGE RESOURCES IMPACT ASSESSMENT OF ERF 5041 (PORTION OF ERF 1) KURUMAN MUNICIPALITY GA-SEGONYANA ADMINISTRATIVE DISTRICT NORTHERN CAPE PROVINCE
108346	AIA Phase 1	Christine Vivier	12/11/2009	Phase 1 archaelogical impact assessment report on a portion of the farm Lylyveld 545 near Kathu, Kagalagadi District Municipality, Northern Cape province.
108351	AIA Phase 1	Neels Kruger	01/04/2012	Archaeological impact assessment (AIA) of demarcated surface areas on the farms Fritz 540, Gamagara 541, Sishen 543 and Parsons 564, Sishen Iron Ore Mine Complex, Kgalagadi District Municipality, Northen Cape province.
110652	HIA Phase 1	Stephan Gaigher	01/02/2013	HERITAGE IMPACT ASSESSMENT REPORT ENVIRONMENTAL IMPACT ASSESSMENT PHASE Proposed establishment of the San Solar Energy Facility located south of Kathu on a Portion of the Farm Wincanton 472, Northern Cape Province
108970	AIA Phase 1	Nelius Kruger	01/09/2012	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DERMACAED SURFACE AREAS ON THE FARMS GAMAGARA 541, ONVERWACHT 540 (FRITZ 540 PORTION 1) AND NOOITGEDACHT 469 (WOON 469), SISHEN IRON ORE MINE, KGALAGADI DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE.
109330	AIA Phase 1	Jaco van der Walt	12/12/2012	AIA REPORT FOR THE PROPOSED EXTENSION OF AN ABANDONED GRAVEL PIT ON THE FARM HARVARD 171 IN THE KUDUMANE MAGISTERIAL DISTRICT 13KM EAST OF KURUMAN
109484	Heritage Statement	Stephan Gaigher	09/05/2012	HERITAGE IMPACT ASSESSMENT REPORT ENVIRONMENTAL IMPACT ASSESSMENT PHASE Proposed establishment of the San Solar Energy Facility located south of Kathu on a Portion of the Farm Wincanton 472, Northern Cape Province.
110765	HIA Phase 1	Stephan Gaigher	26/02/2013	HERITAGE IMPACT ASSESSMENT REPORT ENVIRONMENTAL IMPACT ASSESSMENT PHASE Proposed establishment of the San Solar Energy Facility located north of Kathu on a Portion of the Farm Wincanton 472, Northern Cape Province
114648	PIA Desktop	John E Almond	01/09/2012	Palaeontological specialist assessment: desktop study PROPOSED 16 MTPA EXPANSION OF TRANSNET'S EXISTING MANGANESE ORE EXPORT RAILWAY LINE & ASSOCIATED INFRASTRUCTURE BETWEEN HOTAZEL AND THE PORT OF NGQURA, NORTHERN & EASTERN CAPE. Part 1: Hotazel to K
116859	AIA Phase 1	Munyadziwa Magoma	08/04/2013	PHASE 1 ARCHAEOLOGICAL IMPACT ASSESSMENT SPECIALIST STUDY REPORT FOR THE PROPOSED PROSPECTING FOR MINING OF MINERALS ON PORTIONS 1, 2 REMAINDER EXTENT OF THE FARM 219 AND LOWER KURUMAN 219 IN KURUMAN AREA WITHIN GA-SEGONYANA LOCAL

				MUNICIPALITY, JOHN GAET
123399	AIA Phase 2	Peter Beaumont	15/05/2013	PHASE 2 ARCHAEOLOGICAL PERMIT MITIGATION REPORT ON A ~0.7 HA PORTION OF THE FARM BESTWOOD 549, SITUATED ON THE EASTERN OUTSKIRTS OF KATHU, JOHN TAOLO GAETSEWE DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE.
128171	AIA Phase 1	Jaco van der Walt	08/08/2013	Archaeological Impact Assessment For The Proposed Prospecting Right of a Quarry On The Farm Gamohaan 438 Portion 1 In The Kuruman Magisterial District
129751	HIA Phase 1	Elize Becker	20/02/2013	Phase 1 Heritage Impact Assessment Hotazel to Kimberley and De Aar to Port of Ngqura
145005	AIA Phase 1	Munyadzi wa Magoma	01/07/2013	Phase 1 Archaeological Impact Assessment specialist study report for the proposed development of prospecting rights of iron ore and manganese on remaining extent of Mashwening 557 in Khathu, within the Local Municipality of Gamagara, John Taolo Gaetsewe
152157	HIA Phase 1	Johnny Van Schalkwyk	15/05/2012	Heritage impact assessment for the proposed estate development on the farm Kalahari Golf and Jag Landgoed 775, KATHU, NORTHERN CAPE PROVINCE
152170	Heritage Impact Assessment Specialist Reports	Robert de Jong	03/09/2008	HERITAGE IMPACT ASSESSMENT REPORT: PROPOSED RESIDENTIAL DEVELOPMENT AND ASSOCIATED INFRASTRUCTURE ON A 200 HA PORTION OF THE FARM BESTWOOD 429 RD AT KATHU, NORTHERN CAPE PROVINCE
152171	AIA Phase 1	Cobus Dreyer	11/08/2008	FIRST PHASE ARCHAEOLOGICAL AND CULTURAL HERITAGE ASSESSMENT OF THE PROPOSED RESIDENTIAL DEVELOPMENTS AT A PORTION OF THE REMAINDER OF THE FARM BESTWOOD 459RD, KATHU, NORTHERN CAPE
153307	Heritage Impact Assessment Specialist Reports	Robert de Jong	22/02/2011	Kalahari Solar Power Project Heritage Impact Assessment Report and Heritage Management Plan developed by Robert De Jong and Associates
156525	AIA Phase 1		02/09/2013	Archaeological Impact Assessment for Assmang Ltd - Black Rock Mine Operations on a demarcated section of Erf 01 Kuruman
156617	AIA Phase 1	David Morris	01/02/2014	Rectification and/or regularistion of activities relating to the Bestwood Township development near Kathu, Northern Cape: Phase 1 Archaeological Impact Assessment
157923	Heritage Scoping	R. C. De Jong	10/12/2010	Heritage Scoping Report for the Proposed Kalahari Solar Project on Portions of the Farm Kathu 465, Kuruman Registration Division, Gamagara Local Municipality, Northern Cape Province
159473	AIA Phase 1	Johnny Van Schalkwyk		Archaeological impact survey report for THE PROPOSED DEVELOPMENT OF A SOLAR POWER PLANT ON THE FARM BESTWOOD 459, KATHU REGION, NORTHERN CAPE PROVINCE
160089	AIA Phase 1	Johnny Van Schalkwyk		Archaeological impact survey report for THE PROPOSED KALAHARI SOLAR PARK DEVELOPMENT ON THE FARM KATHU 465, NORTHERN CAPE PROVINCE

160188	AIA Phase 1	Tobias Coetzee	02/09/2013	Archaeological Impact Assessment for the proposed Mamatwan Manganese Mine
161427	HIA Phase 1	Stephan Gaigher	15/04/2014	Proposed Establishment of Several Electricity Distribution Lines within the Northern Cape Province
162320	HIA Letter of Exemption		19/04/2014	Request: Exemption from having to conduct an archaeological assessment, the proposed reuse of an existing borrow pit at Mothibistad near Kuruman, Northern Cape
165295	AIA Phase 1	Neels Kruger	18/05/2014	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF A DEMARCATED SURFACE PORTION ON THE FARM SHIRLEY 367 FOR THE PROPOSED SHIRLEY PHOTOVOLTAIC POWER PLANT AND POWER LINE DEVELOPMENT, GAMAGARA LOCAL MUNICIPALITY, JOHN TAOLO GAETSEWE DISTRICT MUNICIPALITY, NORTHERN
167779	Heritage Impact Assessment Specialist Reports	Jonathan Kaplan	30/06/2014	HERITAGE IMPACT ASSESSMENT PROPOSED MIXED USE DEVELOPMENT IN KATHU, NORTHERN CAPE PROVINCE Remainder & Portion 1 of the Farm Sims 462, Kuruman RD
170455	AIA Phase 1	Neels Kruger	31/03/2014	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DEMARCATED SURFACE PORTIONS ON THE FARMS SACHA 468, SIMS 462 AND SEKGAME 461 FOR THE PROPOSED STORMWATER INFRASTRUCTURE (CLEAN WATER CUT-OFF BERM & GROUNDWATER DAM) FOR THE SISHEN MINE, KATHU, NORTHERN CAPE PROVI
170460	AIA Phase 1	Neels Kruger	31/01/2014	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DEMARCATED SURFACE PORTIONS ON THE FARMS SACHA 468 AND WOON 469 FOR THE PROPOSED HIGH ENERGY FUEL PLANT AND RAILWAY SIDING, SISHEN IRON ORE MINE, JOHN TAOLO GAETSEWE DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE
174359	AIA Phase 1	Neels Kruger	25/08/2014	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DEMARCATED SURFACE PORTIONS ON THE FARMS SACHA 468 AND WOON 469 FOR THE PROPOSED HIGH ENERGY FUEL PLANT AND RAILWAY SIDING, SISHEN IRON ORE MINE, JOHN TAOLO GAETSEWE DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE
251329	Heritage Impact Assessment Specialist Reports	Jayson Orton	20/02/2015	Heritage Impact Assessment for a Proposed 132 kV Power Line, Kuruman Magisterail District, Northern Cape
252975	Heritage Impact Assessment Specialist Reports	Marko Hutten, Polke Birkholtz	18/07/2014	Heritage Impact Assessment for the Proposed Kathu Supplier Park on parts of the Remainder and on Portion 9 of the Farm Sekgame 461 on the southern side of the town of Kathu in the Gamagara Local Municipality, Northern Cape.
272118	Archaeologica l Specialist Reports	Jayson Orton, Steven Walker	20/04/2015	Archaeological Survey for the Proposed Kalahari Solar Project, Kuruman Magisterial District, NC Province

273602	Heritage Impact Assessment Specialist Reports	Polke Birkholtz	20/04/2015	Heritage Impact Assessment for the Proposed Establishment of a Grazing Project on a Portion of the Farm Marsh 467, Dingleton, Gamagara Local Municipality, Northern Cape.
279906	AIA Phase 1	Neels Kruger	02/12/2014	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DEMARCATED SURFACE PORTIONS ON THE FARM SEKGAME 461 FOR THE PROPOSED SEKGAME ELECTRICITY INFRASTRUCTURE EXPANSION PROJECT, SISHEN MINE, NORTHERN CAPE PROVINCE
294454	AIA Phase 1	Neels Kruger	05/04/2015	ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF AREAS DEMARACTED FOR THE PROPOSED LYLEVELD NORTH WASTE ROCK DUMP EXPANSION AND LYLEVELD SOUTH HAUL ROAD EXTENSION PROJECT, SISHEN MINE, NORTHERN CAPE PROVINCE

6.2 Potential Impact 1 (Construction Phase)

Nature of impact:

- Destruction of archaeological artefacts.
- Destruction of pastoralist cultural landscape of heritage and historical significance.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites).
- Destruction of burial grounds and graves, and sacred spaces

Significance of impact without mitigation measures: Moderate - significant heritage resources are located within the Phase 1 development area and are in close proximity to the development footprint.

Proposed mitigation measures:

- Implementing a buffer zone around the significant sites identified (see Table 1 and the Recommendations section)
- The development of a Heritage Conservation Management Plan for the Rock Art, significant archaeological sites, palaeontological sites, burial grounds and historic farm werfs identified to ensure that heritage resources are continuously managed throughout the construction, operational and decommissioning phases.

Significance of impact with mitigation measures: Low

6.3 Potential Impact 2 (Operational Phase)

Nature of impact:

- Destruction of archaeological artefacts during operational activities, maintenance or upgrades.
- Destruction of pastoralist cultural landscape of heritage and historical significance. A loss of ‘sense of place’ resulting from the wind turbine placement on the landscape
- Destruction of palaeontological material (mainly of Precambrian Stromatolites) during operational activities, maintenance or upgrades.
- Limitations regarding access to burial grounds and graves for friends and family

Significance of impact without mitigation measures: Moderate

Proposed mitigation measures:

- The implementation of a Heritage Conservation Management Plan for the Rock Art, significant archaeological sites, palaeontological sites, burial grounds and historic farm werfs identified to

ensure that heritage resources are continuously managed throughout the construction, operational and decommissioning phases.
- Implementing a buffer zone around significant sites identified
- Allow access to burial grounds for relatives and friends of deceased

Significance of impact with mitigation measures: Low

6.4 Decommissioning Phase

Nature of impact:
- Destruction of heritage resources during decommissioning (archaeological and palaeontological resources)

Significance of impact without mitigation measures: Moderate

Proposed mitigation measures:
- Careful mapping and avoidance of identified heritage resources
- The implementation of a Heritage Conservation Management Plan for the Rock Art, significant archaeological sites, palaeontological sites, burial grounds and historic farm werfs identified to ensure that heritage resources are continuously managed throughout the construction, operational and decommissioning phases.

Significance of impact with mitigation measures: Low

6.5 Cumulative Impacts

Nature of impact:
- Changes in the aesthetics of the cultural landscape.
- Destruction of heritage resources

Significance of impact without mitigation measures: Low

Proposed mitigation measures:
- Careful mapping and avoidance of identified heritage resources

Significance of impact with mitigation measures: Low

7. IMPACT ASSESSMENT SUMMARY

Overall, the proposed activity will not directly impact on significant archaeological heritage, however significant heritage resources are located within the Phase 1 development area and are in close proximity to the development footprint resulting in high significance of impact prior to mitigation. The heritage impact significance is rated as being low after mitigation.

A number of rock art sites were identified during this field assessment. Rock art in this area is rare and as such, these are significant findings. These rock art sites are all located in small caves or rock overhangs. As such, it is very unlikely that the proposed development will directly impact on these sites. In addition, as indicated in Figures 8a to 8e, none of the sites are located within the proposed footprint of the development. In general, however, it is recommended that a 20m buffer area be kept around known rock art sites.

In addition, often increased human activity in proximity to known rock art sites results in negative impact to the rock art sites as a result of inappropriate behaviour at these sites.

> **DON'T:**
> Dig into the sediment, remove any archaeological material from the site, graffiti the cave walls, wet or add any substance to the rock surface to make the paintings more visible, kick up dust in the cave, touch the paintings, try to chip the paint off or light fires in the caves/overhangs.

> **DO:**
> Take photographs, report any disturbance to the site, report any evidence of graffiti, respect the rarity and heritage value of rock paintings in the area, be aware that they were made at least a thousand years ago, be reminded that the paintings are part of the irreplaceable heritage of the San and Khoekhoe and their descendants, and if they are damaged by careless behaviour, they cannot be repaired.

Palaeontology

Given the overall low palaeosensitivity of the proposed footprint it is concluded that, in terms of palaeontological heritage resources, the impact significance of the Kuruman WEF Phase 1 is *low* (negative), both before and after mitigation. This assessment applies to the construction phase and to all relevant components of the WEF infrastructure (*e.g.* wind turbines, internal and external access roads, underground cabling, on-site substation and construction yards). No significant impacts during the operational and de-commissioning phases are anticipated. Confidence levels for this assessment are *medium*, given the low levels of bedrock exposure.

Table 4-1 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction of roads and infrastructure related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources and burial grounds and graves, and sacred spaces	Negative	Site	Long-Term	Substantial	Very likely	Low	High	Implement a buffer zone around significant resources identified Implement Fossil Chance Finds Procedure The development of a Heritage Conservation Management Plan for the WEF to ensure that heritage resources are continuously managed throughout the construction phase.	MODERATE	Low	3	HIgh

Table 4-2 Impact assessment summary table for the Operational Phase

Operational Phase													
Indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Activities related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources and burial grounds and graves, and sacred spaces	Negative	Site	Long-Term	Substantial	Likely	Low	High	The implementation of a Heritage Conservation Management Plan for the WEF to ensure that heritage resources are continuously managed throughout the operational phase. Implementing a buffer zone around significant sites identified Allow access to burial grounds for relatives and friends of deceased	MODERATE	Low	3	High

Table 4-3 Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Activities related to the Decommissioning of the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources and burial grounds and graves, and sacred spaces	Negative	Site	Long-Term	Substantial	Likely	Low	High	The implementation of a Heritage Conservation Management Plan for the WEF to ensure that heritage resources are continuously managed throughout the decommissioning phase.	MODERATE	Low	3	High

Table 4-4 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Construction of roads and infrastructure related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources and and burial grounds and graves, and sacred spaces	Negative	Site	Long-Term	Substantial	Low	Low	High	Careful mapping and avoidance of identified heritage resources.	LOW	Low	4	Medium

8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

It is recommended that a Heritage Conservation Management Plan be developed for the WEF to ensure that heritage resources are continuously managed throughout the construction and operational phases of the development. This CMP must be required as a condition of Environmental Authorisation.

Rock Art

- All rock art sites (Sites KUR28, KUR36, KUR37, KUR44, KUR45, KUR46), must be avoided and should not be visited. Location of rock art sites should not be made public. The location of these sites can be identified in site development plans and in the CMP.
- A no-go buffer zone of 20m must be kept around each rock art site

Burial Grounds and Graves

- These sites must not be impacted by the proposed development
- a 50m buffer area also be kept around these sites, and that access to these sites be permitted to relatives and friends of the deceased wishing to pay their respects.
- Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during preparation of the lands for cultivation, these must immediately be reported to the South African Heritage Resources Agency (Ms Natasha Higgit 021 462 4502), or the McGregor Museum (Att Dr David Morris 053 8392707 / 082 2224777). Burials, etc. must not be removed or disturbed until inspected by the archaeologist.

Palaeontology

All of the palaeontologically significant fossil sites identified are associated with small outcrop areas of Campbell Rand Subgroup carbonate bedrocks that lie *outside* and east of the WEF development footprint. These areas should be designated as no-go areas and protected from any disturbance or development during the construction phase.

Should substantial fossil remains be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency as soon as possible (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone : +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.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 proponent's expense. A procedure for Chance Fossil Finds is tabulated in Appendix 2. These recommendations must be incorporated in the Environmental Management Programme for the WEF project.

The above recommendations must be incorporated into the Environmental Management Programme (EMPr) for the proposed development.

9. CONCLUSION AND RECOMMENDATIONS

Mulilo is proposing to build the Kuruman Wind Energy Facility (WEF) in two phases (1&2) and supporting electrical infrastructure close to Kuruman, Northern Cape Province.

This assessment is for Phase 1 of the Kuruman WEF Project. The number of turbines to be completed in Phase 1 is 47. Each turbine has a maximum output of 4.5MW, blade height of 140m and blade length of 80m. Foundations will be excavated to a depth of 3m. Additional infrastructure assessed for the EIA will include 5m wide connecting roads and widening of existing roads to 8m.

The study site for the proposed Phase 1 Kuruman WEF (i.e. turbine location sites, access roads, substations, laydown areas) is not a sensitive archaeological landscape. A limited number of stone implements (isolated and dispersed scatters of Later Stone Age tools including retouched and utilized flakes, chunks, and a few cores in locally available banded ironstone), occur on some of the high hill top sites and access roads. Archaeological artefacts are located among extensive scatters of ironstone gravels which are ubiquitous in the surrounding area. No settlement sites, quarry sites, or evidence of human occupation were identified. Banded ironstone is a ready source of raw material across the entire study area. The hilltop sites are not conducive to pre-colonial settlement due to their high elevation, lack of caves as well as their isolated, exposed, cold and windy nature.

Given the overall low palaeosensitivity of the proposed footprint, it is concluded that in terms of palaeontological heritage resources the impact significance of the Kuruman WEF Phase 1 is *low* (*negative*), both before and after mitigation. This assessment applies to the construction phase and to all relevant components of the WEF infrastructure (*e.g.* wind turbines, internal and external access roads, underground cabling, on-site substation and construction yards). Significant impacts during the operational and de-commissioning phases are not anticipated. None of the fossil sites identified fall inside the WEF development footprint and no specialist palaeontological mitigation is therefore proposed here. Small stromatolite-rich outcrop areas of Campbell Rand carbonates to the east of the WEF footprint (areas outlined in red in Figures 8a, b and c) should be designated as no-go Areas and protected from any disturbance or development.

There is no heritage objection to the proposed development proceeding on condition that the proposed recommendations and mitigation measures are implemented.

10. REFERENCES

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
123045	AIA	Cobus Dreyer	26/06/2013	Report Eskom Garona Ferrum Mercury
152170	HIA	Robert de Jong	03/09/2008	Heritage Impact Assessment Report: Proposed Residential Development And Associated Infrastructure On A 200 Ha Portion Of The Farm Bestwood 429 Rd At Kathu, Northern Cape Province
152171	AIA	Cobus Dreyer	11/08/2008	First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Residential Developments At A Portion Of The Remainder Of The Farm Bestwood 459rd, Kathu, Northern Cape
156617	AIA	David Morris	01/02/2014	Rectification and/or regularisation of activities relating to the Bestwood Township development near Kathu, Northern Cape: Phase 1 Archaeological Impact Assessment
163959	HIA	Anton van Vollenhoven	17/03/2014	HIA Eskom Manganore to Ferrum Scoping Phase
170455	AIA	Neels Kruger	31/03/2014	Archaeological Impact Assessment Of Demarcated Surface Portions On The Farms Sacha 468, Sims 462 And Sekgame 461 For The Proposed Stormwater Infrastructure (clean Water Cut-off Berm & Groundwater Dam) For The Sishen Mine, Kathu, Northern Cape Province.
170660	AIA	Cobus Dreyer	31/01/2014	First Phase Archaeological & Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170664	AIA	Cobus Dreyer	28/09/2012	First Phase Archaeological And Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170666	AIA	Cobus Dreyer	31/12/2013	First Phase Archaeological And Heritage Assessment Of The Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
279906	AIA	Neels Kruger	02/12/2014	Archaeological Impact Assessment Of Demarcated Surface Portions On The Farm Sekgame 461 For The Proposed Sekgame Electricity Infrastructure Expansion Project, Sishen Mine, Northern Cape Province
294454	AIA	Neels Kruger	05/04/2015	Archaeological Impact Assessment Of Areas Demaracted For The Proposed Lyleveld North Waste Rock Dump Expansion And Lyleveld South Haul Road Extension Project, Sishen Mine, Northern Cape Province
324952	HIA	Lloyd Rossouw	07/07/2015	Phase 1 Heritage Impact Assessment of the 2.3 km long 40478 Vaal-Gamagara water pipeline alternative route around Kathu Pan, Northern Cape Province
329708	HIA	Anton van Vollenhoven	01/11/2014	HIA Eskom Manganore-Ferrum for EIA Phase
6339	**AIA**	**David Halkett**	**24/08/2009**	**An archaeological scoping assessment of the remainder and portion 1 (Tierkop) of farm Bramcote 446, Northern Cape Priovince.**

Palaeontological Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
114648	PIA	John E Almond	01/09/2012	Palaeontological Specialist Assessment: Desktop Study Proposed 16 Mtpa Expansion Of Transnet's Existing Manganese Ore Export Railway Line &

				Associated Infrastructure Between Hotazel And The Port Of Ngqura, Northern & Eastern Cape.

Web References
http://pza.sanbi.org/vegetation/nama-karoo-biom http://pza.sanbi.org/vachellia-erioloba http://pza.sanbi.org/sites/default/files/info_library/camelthorns_khathu_pdf.pdf http://www.museumsnc.co.za/aboutus/depts/education/GuidePlants.pdf https://www.sciencedirect.com/science/article/pii/S0195925509000857

11. APPENDICES

NOISE IMPACT ASSESSMENT:

Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch, 7599

South Africa

Report prepared by:

Mr Morné de Jager – Enviro Acoustic Research cc

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South Africa

September 2018

SPECIALIST EXPERTISE

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

He has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

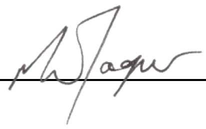
He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 12 years and has completed:

- more than 80 environmental noise impact assessments for various wind energy facilities;
- more than 50 environmental noise impact assessments for various mining and industrial projects;
- more than 50 environmental noise impact assessments for urban, rail and road development projects;
- various review reports for a variety of project;
- noise audits and measurement reports for mines, industry, urban mining and wind energy facilities.

SPECIALIST DECLARATION

I, Morné de Jager, 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 Specialist: Morné de Jager

Date: 2018 – 09 – 12

EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research (EARES) was contracted to determine the potential noise impact on the surrounding environment due to the proposed development of the Kuruman Phase 1 Wind Energy Facility (WEF). This facility with its associated infrastructure will be located on various farms south west of Kuruman in the Northern Cape Province.

This report describes ambient sound levels in the area, potential worst-case noise rating levels and the potential noise impacts that the facility and its associated infrastructure may have on the surrounding environment, highlighting the methods used, potential issues identified, findings and recommendations.

This study considered local regulations and both local and international guidelines, using the terms of reference (ToR) as proposed by SANS 10328:2008 to allow for a comprehensive Environmental Noise Impact Assessment report.

PROJECT DESCRIPTION

Mulilo Renewable Project Developments (Pty) Ltd (hereafter referred to as "Mulilo) propose the development of a commercial wind energy facility near Kuruman, Northern Cape. Mulilo proposes to develop two WEFs, namely:

- Kuruman Phase 1 WEF, with up to 47 wind turbines;
- Kuruman Phase 2 WEF, with up to 52 wind turbines.

This report specifically considers the potential noise impact of the Kuruman Phase 1 WEF.

The wind energy market is fast changing and adapting to new technologies and site specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. The developer has been evaluating several turbine models, however the selection will only be finalised at a later stage once the most optimal wind turbine is identified (pending factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc.). As the noise propagation modelling requires the specifications of a wind turbine, the Acciona AW125/3000 was selected as a reference turbine. It is widely used and known to have a high noise emission level and thus serves as a worse-case scenario for impact assessment.

BASELINE ASSESSMENT

Ambient sound levels were measured over a period of a few nights during February 2018 at four locations (two night-time periods at two locations and four night-time periods at the other two locations) in the vicinity of the project site. This constituted more than 1,600 10-minute measurements of which approximately 500 measurements were collected during the night-time period.

Considering the data collected at all four locations, the sound levels were elevated and higher than the sound levels typical for a rural noise district. The elevated sound levels were mainly due to natural sounds (birds, insects and wind-induced), typical of spring and summer seasons, except for one location. The elevated sound levels at the latter location were due to constant noises from the chicken coops that significantly raised the ambient sound levels. There is a high confidence in the information gained from the sound levels measured during the site visit.

Considering the developmental character of the area, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008.

NEED AND DESIRABILITY OF PROJECT

The proposed wind farm (worst-case scenario evaluated) will slightly raise the noise levels at a number of Noise-Sensitive Developments (NSDs) close to the proposed WEF. There is no alternative location where the wind farm can be developed as the presence of a viable wind resource determines the viability of a commercial WEF. While the location of the proposed WEF cannot be moved, the wind turbines within the WEF can be moved around, although this layout is the result of numerous evaluations and modelling to identify the most economically feasible and environmentally friendly layout.

The proposed layout will result in a slight increase in ambient sound levels in the area, but the change will be low and is unlikely to impact on the quality of living for the surrounding receptors. In terms of acoustics, there is no benefit to the surrounding environment (closest receptors). The significance of the potential noise impacts associated with the operation of the wind turbines was rated as 3 (low) after mitigation.

The project however, will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa and locally. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa and locally. People in the area that are not directly affected by increased noise will have a positive perception of the project and will see the need and desirability of the project.

With its promise for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when wind farms are near to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time, wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamic effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances, this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source. Rather, that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.

FINDINGS OF NOISE IMPACT ASSESSMENT

This study uses the noise emission characteristics of the Acciona AW125 3000 wind turbine, resulting in a worst-case scenario in terms of noise emissions from the wind turbines being evaluated (this is one of the noisiest wind turbines available in the market and on the database of the author). With the input data as used, this assessment indicated that:

- The significance of the noise impact relating to daytime construction of the wind turbine generators will be very low before mitigation.
- The significance of the noise impact relating to the operation of the WTGs at night will be very low before mitigation (will also be very low for daytime operational activities).
- The significance of the noise impact relating to daytime decommissioning activities will be very low before mitigation.
- The significance of the noise impact due to cumulative noise impacts will be low before mitigation.

MANAGEMENT AND MITIGATION OF NOISE IMPACT

Because of the low significance of a potential noise impact during all phases of this development, no specific monitoring or management measures are required for inclusion into the Environmental Management Programme (EMPr) or the Environmental Authorisation. General conditions that should be included are:

- Ensure that construction equipment is well maintained and fitted with the correct and appropriate noise abatement measures if available. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised.

- The developer must investigate and respond to any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the location where construction activities are taking place or from an operational wind turbine. A complaints register must be kept on site. All the noise complaints received must be included in the complaints register;
- The developer must ensure that no NSD is subjected to total noise levels exceeding 45 dBA (at night) due to the development of the wind energy facility and the operation of the WTG.

CONCLUSIONS AND RECOMMENDATIONS

This study assessed the significance of the potential noise impact from the construction and operation of the Kuruman Phase 1 wind farm., The significance of the noise impacts during the construction, operational and decommissioning activities was assessed to be **low (before mitigation and additional mitigation will not be required)**. No management or mitigation is required and no additional work or assessment is required or recommended.

The developer should investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the location where construction or operational activities are taking place. A complaints register must be kept on site. All the noise complaints received must be included in the complaints register.

The potential noise impact for the WF must again be evaluated should the layout be changed where any wind turbines are located closer than 1,000 m from a confirmed NSD or if the developer decides to use a different wind turbine that has a sound power emission level higher than the Acciona WTG used in this report (sound power emission level exceeding 108.4 dBA re 1 pW).

Considering the findings of this assessment, various activities associated with the development of the WF may have an impact on ambient sound levels. This increase however is of low significance and it is recommended that the development of Phase 1 of the Kuruman WF be authorised from a noise perspective.

LIST OF ABBREVIATIONS

ADT	Articulated Dump Trucks
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
ENIA	Environmental Noise Impact Assessment
ENPAT	Environmental Potential Atlas for South Africa
EPs	Equator Principles
EPFIs	Equator Principles Financial Institutions
FEL	Front-end Loader
GN	Government Notice
I&APs	Interested and Affected Parties
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
METI	Ministry of Economy, Trade, and Industry
NASA	National Aeronautical and Space Administration
NEMA	National Environmental Management Act
NCR	Noise Control Regulations
NSD	Noise-sensitive Development
PPP	Public Participation Process
PWL	Sound Power Level
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Level
SR	Significance Rating
UTM	Universal Transverse Mercator
WHO	World Health Organization
WF	Wind Farm

GLOSSARY OF UNITS

dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)
km	kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)

^{o}C	Degrees Celsius (measurement of temperature)
μPa	Micro pascal (measurement of pressure – in air in this document)

GLOSSARY OF ACOUSTIC TERMS

Definitions	
1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or

	(ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 µ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting

	display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} *and* L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species

	diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers

	to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 2
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.3
g) an identification of any areas to be avoided, including buffers;	Noise contours developed, section 1.6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 1.6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 1.7
k) any mitigation measures for inclusion in the EMPr;	Section 1.8
l) any conditions for inclusion in the environmental authorisation;	Section 1.8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8

n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 1.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Public Participation Process managed by EAP
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	No comments received
q) any other information requested by the competent authority.	No other information requested
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

1.1 INTRODUCTION AND METHODOLOGY

1.1.1 Scope and Objectives

Enviro-Acoustic Research CC was contracted by Mulilo Renewable Project Developments (Pty) Ltd ("Mulilo") to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the proposed development of the Kuruman Wind Energy Facility (WEF) near Kuruman in the Northern Cape Province. Mulilo intends to develop two WEFs, namely Kuruman Phase 1 and Kuruman Phase 2 WEF. This study assesses the potential impacts associated with the Kuruman Phase 1 WEF.

This report describes ambient sound levels in the area, potential worst-case noise rating levels and the potential noise impact that the facility, may have on the surrounding environment, highlighting the methods used, potential issues identified, findings and recommendations. This report did not investigate vibrations and only briefly considers blasting.

This study considered local regulations and both local and international guidelines, using the terms of reference (ToR) as proposed by SANS 10328:2008 to allow for a comprehensive Noise Report.

1.1.2 Terms of Reference

A noise impact assessment must be completed for the following reasons:

- If there are potential noise-sensitive receptors (noise sensitive developments or NSD) staying within 1,000 m from industrial activities (SANS 10328:2008);
- If there are potential noise-sensitive receptors staying within 2,000 m from any wind turbine (SANS 10328:2008);
- It is a controlled activity in terms of the NEMA regulations and an ENIA is required, because:
    - It may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice 579 of 2010; and
- It is generally required by the local or district authority as part of the environmental authorization or planning approval in terms of Regulation 2(d) of GN R154 of 1992.

In addition, Appendix 6 of GN 982 of December 2014 (as amended in Gov. Gaz. 40772, 7 April 2017), issued in terms of the National Environmental Management Act, No. 107 of 1998 also defines minimum information requirements for specialist reports. As such this report was drafted considering the requirements of this Appendix as well as the guidelines set by SANS 10103:2008 and SANS 10328:2008.

SANS 10328 recommend the following minimum requirements for a comprehensive ENIA:

1. A statement regarding the purpose of the investigation;
2. A brief description of the planned development or the changes that are being considered;
3. A brief description of the existing environment;
4. The identification of the noise sources that may affect the particular development, together with their respective estimated sound pressure levels or sound power levels (or both);
5. The identified noise sources that were not taken into account and the reasons why they were not investigated;
6. The identified noise-sensitive developments (NSD) and the estimated impact on them;
7. Any assumptions made with regard to the estimated values used;
8. An explanation, either by a brief description or by reference, of the methods that were used to estimate the existing and predicted noise rating levels;
9. The location of the measurement or calculation points, i.e. a description, sketch or map;
10. Estimation of the environmental noise impact;
11. Alternatives that were considered and the results of those that were investigated;
12. A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation;
13. A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them;
14. Conclusions that were reached;
15. Recommendations, i.e. if there could be a significant impact, or if more information is needed, a recommendation that an environmental noise impact assessment be conducted, and;
16. If remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority.

The Environmental Assessment Practitioner (CSIR) on this project also required compliance to their Terms of Reference, which included:

- Undertake a preliminary (scoping) study mainly in accordance with Section 7 of the South African National Standard (SANS) 10328:2008 ("Methods for environmental noise impact assessments"). This will include:

- Identification and description of the noise sources associated with the proposed development;
  - Identification of potential noise sensitive areas or receptors that could be impacted upon by noise emanating from the proposed development;
  - Estimation of the acceptable rating level of noise on identified noise sensitive areas;
  - Estimation of the noise emissions from the identified noise sources and estimation of the expected rating level of noise at the identified noise sensitive areas;
  - Estimation and assessment of the noise impacts on identified noise sensitive areas or receptors in accordance with SANS 10103:2008 and the National Noise Control Regulations;
  - Consideration of possible alternative noise mitigation procedures;
  - Determine whether the proposed development has significant acoustical implications;
  - Recommend whether a full noise impact assessment be conducted.
- A description of the current environmental conditions from a noise perspective in sufficient detail so that there is a baseline description/status quo against which impacts can be identified and measured i.e. sensitive noise receptors, etc.;
- A review of detailed information relating to the project description in order to precisely define the environmental risks in terms of noise emissions;
- Identification of issues and potential impacts related to noise emissions, which are to be considered in combination with any additional relevant issues that may be raised through the Public Participation Process;
- Identification of relevant legislation and legal requirements;
- A description of the regional and local features;
- Conduct baseline noise measurements (i.e. of the existing ambient noise (day and night time));
- Modelling of the future potential noise impacts during all phases of the proposed development taking into consideration sensitive receptors;
- Identification of buffer zones and no-go areas to inform the turbine layout (if relevant);
- Identify and assess all potential impacts (direct, indirect) of the construction, operational and decommissioning phases of the proposed development. Use the CSIR methodology to determine the significance of potential impacts;
- Assess all alternatives, including the no-go alternative;
- Assessment cumulative impacts by identifying other Renewable Energy Facilities such as WEFs in the local area (i.e. within 50 km of the proposed WEF). These include projects that have been approved (i.e. positive Environmental Authorization has been issued), have been constructed or projects for which an Application for Environmental Authorisation has been lodged with the Competent Authority;
- Provide recommended mitigation measures, management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts to be included in the EMPr;

- Provide a description of any assumptions, uncertainties, limitations and gaps in knowledge; and
- Incorporate and address issues and concerns raised during the Scoping and EIA phases where they are relevant to the specialist's area of expertise.

1.1.3 Approach and Methodology

The procedure followed in compiling this ENIA is roughly based on the SANS 10328 guideline and involved:

- Using aerial images (Google Earth ®) to identify the location of potential noise-sensitive receptors;
- A site visit was undertaken in February 2018 to confirm the status of the identified noise-sensitive receptors as well as to measure ambient sound levels to gauge the soundscape of the area;
- Processing of the measurement data for reporting in the Scoping Noise Report (De Jager, 2018);
- Development of a digital terrain model of the area using the topographical contours of the area. This report use the topographical contours as provided by Mulilo;
- Development of a noise propagation model using sound power emission levels of the Acciona AW125/3000 Wind Turbine Generator (WTG) and the layout as received from the developer to estimate the potential noise rating level from the WEF. The noise rating levels were illustrated in graph format (construction phase) and isopleths (contours of equal sound level) on aerial images;
- The potential significance of the noise impact was evaluated in terms of the noise rating level that the NSDs may experience, considering the ambient sound levels as measured in the area to estimate the probability of a noise impact occurring;
- The development of an Environmental Management Plan (if required) and a proposal of potential mitigation measures (if required).

Ambient sound levels were measured over a few nights during February 2018 at four locations (two night-time periods at two locations and four night-time periods at the other two locations) in the vicinity of the project site. Due to the fact that WEFs will only be operational during periods that the wind is blowing, ambient sound level measurements should reflect expected sound levels at various wind speeds, only possible when sound levels are collected over a longer-time period. Due to the complexity of these measurements the following methodology is followed:

- Compliance with the latest version of SANS 10103;
- The sound measuring equipment was calibrated directly before, and directly after the measurements were collected. In all cases drift[1] was less than 0.2 dBA between these two measurements.

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[1] Changes in instrument readings due to a change in altitude (air pressure), temperature and humidity

- The measurement equipment made use of a windshield specifically designed for outdoor use during increased wind speeds;
- The areas where measurements were recorded were selected so as to minimize the risks of direct impacts by the wind on the microphone;
- Measurements took place in 10-minute bins for at least two full night-time periods;
- Noise data was synchronised with the wind data measured onsite using an anemometer at a 1.5 m height.

While measurements collected in winter are generally slightly quieter, due to less faunal communication, data collected during February provide adequate information to be used to assess the ambient sound levels in the area.

1.1.4 Assumptions and Limitations

1.1.4.1 <u>Measurements of Ambient Sound Levels</u>

- Ambient sound levels are the cumulative effects of innumerable sounds generated from a variety of noise sources at various instances both far and near from the listener. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement, especially when at a community or house. It is assumed that the measurement locations represent ambient sound levels in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
    - the distance to the closest trees, number and type of trees as well as the height of the trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwellings, type of equipment used at dwelling (compressors, air-cons, etc.) and people in the area;
    - general maintenance condition of houses (especially during windy conditions), as well as
    - numbers and types of animals kept in the vicinity of the measurement locations.

- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels.
- Ambient sound levels are dependant not only on the time of day and meteorological conditions, but also changes due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location.

1.1.4.2 <u>Calculating noise emissions – Adequacy of predictive methods</u>

It is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor, but to calculate a noise rating level that is used to identify potential issues of concern. The noise emissions (noise rating level) into the environment from the various sources as defined were calculated using the algorithms described in ISO 9613-2 (operational phase) and SANS 10357[2] (construction phase).

The following was considered in the Noise Model:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout, as well as
- Acoustical characteristics of the ground. Seventy-five percent (75%) hard ground conditions were modelled considering the recommendation of a number of studies.

1.1.4.3 <u>Uncertainties of Information Provided</u>

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment.

[2] SANS 10357:2004 The calculation of sound propagation by the Concave method'

The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;

- Sound power emission levels from processes and equipment changes depending on the load the process and equipment is subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;
- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would be likely over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify, and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Seventy-five percent (75%) hard ground conditions will be modeled that should allow slightly precautionary values.

1.1.5 Source of Information

Aerial images were sourced from Google Earth ®, with the sound power levels for the Acciona WTG obtained from the manufacturer.

1.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO NOISE IMPACTS

Mulilo propose to develop a WEF comprising of up to 47 WTGs. Mulilo is also proposing to develop the Kuruman Phase 2 WEF (subject of a separate ENIA) which will comprise a maximum of 52 WTGs. Noise generating activities are different for the various phases of the project, with the noise generating activities of the construction and decommissioning phases similar, with the noise generated during the operational phase different. This will be addressed separately in the following sections.

1.2.1 Construction Phase Noises

The construction process will consist of the following principal activities:

- Site survey and preparation;
- Establishment of site entrance, internal access roads, contractors compound and passing places;
- Civil works to sections of the public roads to facilitate with turbine delivery;
- Site preparation activities will include clearance of vegetation at the footprint of each turbine as well as crane hard-standing areas. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construct foundations – due to the volume of concrete that will be required, an on-site batching plant will be required to ensure a continuous concreting operation. The source of aggregate is yet undefined but is expected to be derived from an offsite source or brought in as ready-mix. If the stones removed during the digging of foundations are suitable as an aggregate this can be used as the aggregate in the concrete mix;
- Transport of components & equipment to site – all components will be brought to site in sections by means of flatbed trucks. Additionally, components of various specialized construction and lifting equipment are required on site to erect the wind turbines and will need to be transported to site. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.). The transportation of ready-mix concrete to site or the materials for onsite concrete batching will result in temporary increase in heavy traffic (one turbine foundation up to 100 concrete trucks, and is undertaken as a continuous pour);
- Establishment of laydown & hard standing areas - laydown areas will need to be established at each turbine position for the placement of wind turbine components. Laydown and storage areas will also be required to be established for the civil engineering construction equipment which will be required on site. Hard standing areas will need to be established for operation of the cranes. Cranes of the size required to erect turbines are sensitive to differential movement during lifting operations and require a hard standing area;
- Erect turbines - a crane will be used to lift the tower sections into place and then the nacelle will be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor on the ground; it will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while the large crane will be needed to put it in place;
- Construct substation - the underground cables carrying the generated power from the individual turbines will connect at the substation. The construction of the substation would require a site survey; site clearing and levelling (including the removal / cutting of rock outcrops) and construction of access road/s (where required); construction of a substation

terrace and foundation; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas;

- Establishment of ancillary infrastructure - A workshop as well as a contractor’s equipment camp may be required. The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required; and
- Site rehabilitation - once construction is completed and all construction equipment are removed; the site will be rehabilitated where practical and reasonable.

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dB the noise can increase annoyance levels and may ultimately result in noise complaints.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. This is normally the noise descriptor that is used to calculate noise rating levels and to assess the potential for a noise impact.

As it is unknown where the different activities may take place it was selected to model the noise level from the potential noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact – various equipment operating simultaneously) at all locations where wind turbines may be erected, calculating how this may impact on noise levels at potential noise-sensitive developments.

1.2.2 Operational Phase

The wind energy market is fast changing and adapting to new technologies and site specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. As such the developer has been evaluating several turbine models, however the selection will only be finalized at a later stage once a most optimal wind turbine is identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered).

As the noise propagation modelling requires the details of a wind turbine, it was selected to use the sound power emission levels of the Acciona AW125 3000 WTG.

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources which are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc.

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

1. Self-noise due to the interaction of the turbulent boundary layer with the blade trailing edge.
2. Noise due to inflow turbulence (turbulence in the wind interacting with the blades).
3. Discrete frequency noise due to trailing edge thickness.
4. Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade).
5. Noise generated by the rotor tips.

Mechanical noise is normally perceived within the emitted noise from wind turbines as an audible tone(s) which is subjectively more intrusive than a broad band noise of the same sound pressure level. Sources for this noise are normally associated with:

- the gearbox and the tooth mesh frequencies of the step up stages;
- generator noise caused by coil flexure of the generator windings which is associated with power regulation and control;
- generator noise caused by cooling fans; and
- control equipment noise caused by hydraulic compressors for pitch regulation and yaw control.

As the wind speed increases, noises created by the wind turbine also increases. At a low wind speed the noise created by the wind turbine is generally (relatively) low, and increases to a maximum at a certain wind speed when it either remains constant, increase very slightly or even drops as illustrated in Figure 1. The developer is proposing to use the Acciona AW125 3000 WTG.

The propagation model also makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions providing a higher accuracy than models that only use the total sound power level. The octave sound power levels for various wind turbines are presented on Figure 2.

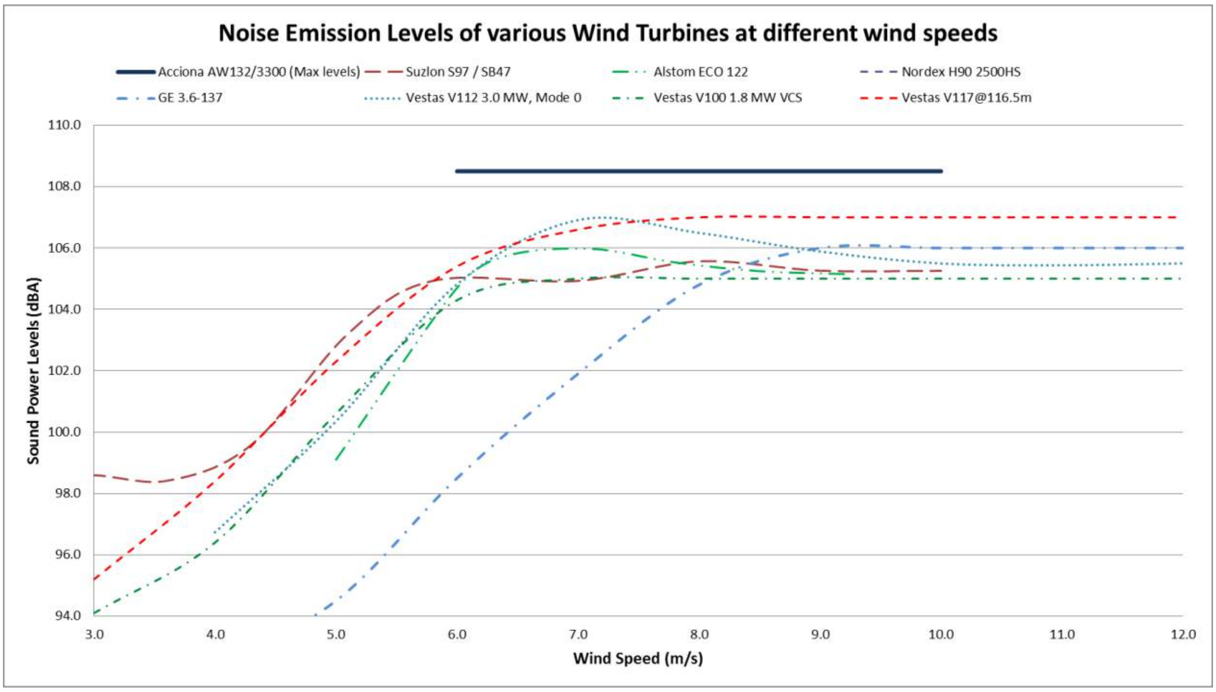

Figure 1: Noise Emissions Curve of a number of different wind turbines (figure for illustration purposes only)

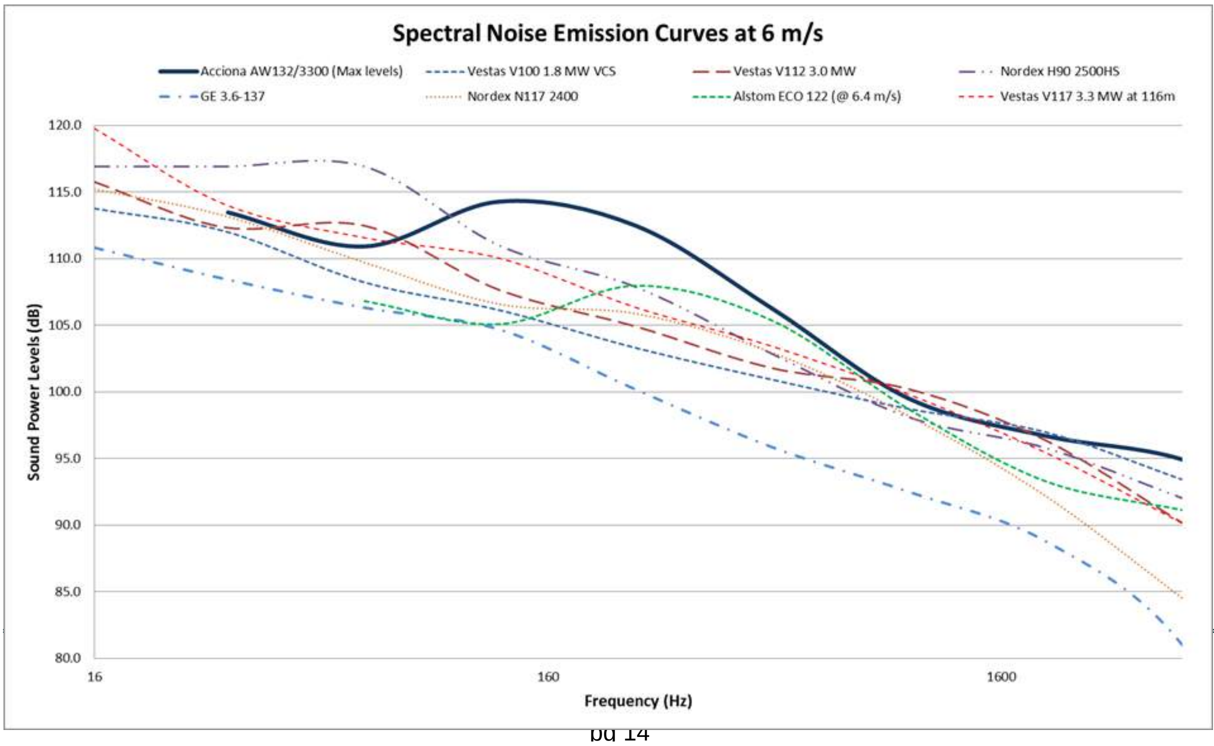

Figure 2: Spectral character of the noise from various wind turbines

1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

Ambient sound levels were measured over a period of a few nights during February 2018 at four locations (two night-time periods at two locations and four night-time periods at the other two locations) in the vicinity of the project site. This constituted more than 1,600 10-minute measurements of which approximately 500 measurements were collected during the night-time period. A detailed overview of the ambient sound level measurements as collected during the site visit is discussed in the Noise Report (de Jager, 2018) with the data summarized in Figure 3 (both night and day data). Figure 3 also illustrate ambient sound levels measured at other, similar locations, as well as best fit graphs (of the other measurements) that was used in this report to estimate the probability of a noise impact occurring.

Considering the data collected at all four locations, the sound levels were elevated and higher than the sound levels typical for a rural noise district. Excluding one location, this was mainly due to natural sounds (birds, insects and wind-induced), typical of spring and summer seasons. The elevated sound levels at the one measurement location were due to constant noises from the chicken coops that significantly raised the ambient sound levels. There is a high confidence in the information gained from the sound levels measured during the site visit.

However, considering the developmental character of the area, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008. The proposed development will cumulatively add to the existing ambient sound levels.

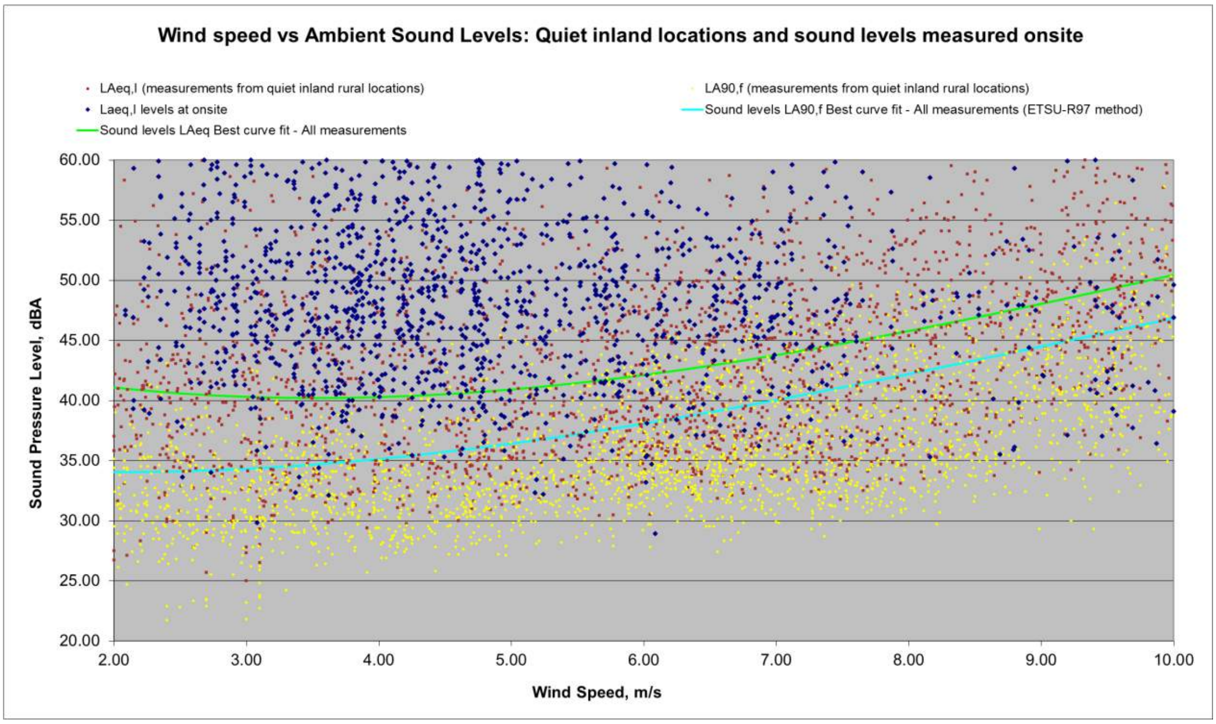

Figure 3: Summary of 10-minute impulse-weighted sound levels versus data from other areas

1.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

1.4.1 The Environment Conservation Act (Act 73 of 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns.

1.4.1.1 <u>National Noise Control Regulations: GN R154 of 1992 (NCR)</u>

In terms of section 25 of the ECA, the national noise-control regulations (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the NCR was devolved to provincial and local authorities. The 0

Cape Province has not promulgated their own noise control regulations and the national regulations will be in effect.

The National Noise Control Regulations (GN R154 1992) define:

"**controlled area**" as:

a piece of land designated by a local authority where, in the case of--

c) industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or

ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA;

"**disturbing noise**" as:

noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

"**zone sound level**" as:

a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. *This is the same as the Rating Level as defined in SANS 10103.*

In addition:

In terms of Regulation 2 -

"A local authority may –

(c): if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the level of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;

(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or (c), reports or certificates in relation to the noise impact to the satisfaction of that local authority are submitted by the owner, developer, tenant or occupant to the local authority on written demand";

In terms of Regulation 4 of the Noise Control Regulations:
"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

1.4.2 Noise Impact Assessment Criteria

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (DEAT, 2002) in terms of the NEMA, SANS 10103 as well as guidelines from the World Health Organization (WHO). This was assessed and aligned with criteria specific to acoustics. Fortunately, noise propagation modelling allow for the accurate calculation of noise levels at a particular point and this can be used to determine the probability of a noise impact occurring.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations, an increase of more than 7 dBA is considered a disturbing noise.
- *Zone Sound Levels:* Previously referred as the acceptable rating levels, it sets acceptable noise levels for various areas.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. However, anything above this level is considered unacceptable.

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103. It provides the maximum average ambient noise levels, $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed. For rural areas the Zone Sound Levels (Rating Levels) are:

- Day (06:00 to 22:00) - $L_{Req,d}$ = 45 dBA, and
- Night (22:00 to 06:00) - $L_{Req,n}$ = 35 dBA.

SANS 10103 unfortunately does not cater for instances when background noise levels change due to the impact of external forces. Locations close to the sea for instance always have a background noise level exceeding 35 dBA, and, in cases where the sea is rather turbulent, it can easily exceed 45 dBA. Similarly, noise induced by high winds is not considered.

Setting noise limits relative to the background noise level is relatively straightforward when the prevailing background noise level and source level are constant. However, wind turbines emit noise that is related to wind speed, and the environment within which they are heard will probably also be dependent upon the strength of the wind and the noise associated with its effects. It is therefore necessary to derive a background noise level that is indicative of the noise environment at the receiving property for different wind speeds so that the turbine noise level at any particular wind speed can be compared with the background noise level in the same wind conditions. Two options are available to derive acceptable noise limits, further discussed in the following sub-sections.

1.4.2.1 Using local regulations to set noise limits

Noise limits as set by the National Noise Control Regulations (GN R154 of 1992) defines a "**disturbing noise**" as the Noise Level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

While each measurement location had a different sound character, the lowest average fast-weighted night-time $L_{A90,f}$ value was 33 dBA90 and the lowest average fast-weighted $L_{Aeq,f}$ sound level value was 40 dBA (De Jager, 2018). Based on the developmental character, a night-time residual noise level of 35 dBA (typical of a rural noise district) was assumed at low wind speeds, which will increase as wind speeds increase.

As can be observed from Figure 3 if ambient sound levels were measured at increased wind speeds, ambient sound levels will be higher as wind-induced noises increase (**cyan** line, Figure 3). The estimated sound levels (see second column, Table 1) will be used to determine the probability for a noise impact to occur. The proposed night acceptable rating levels (see last column, Table 1) will be used to identify a potential noise impact.

For assessing the potential noise impact the values as proposed in Table 1 will be considered.

Table 1: Estimated ambient sound levels and proposed rating levels

10 meter Wind Speed (m/s)	Estimated ambient sound levels (night-time) (cyan line, Figure 3) (dBA)	Potential disturbing noise level (green line, Figure 3) (dBA)	MoE Sound Level Limits of Class 3 areas (dBA)	ETSU-R97 limit for project participants (dBA)	Night-time Zone Sound Level (SANS 10103:2008) (dBA)	Proposed Night Acceptable Rating Level (dBA)
4	35.1	40.2	40	45	35 (at low wind speeds, this will definitely increase as wind speeds increase)	40
5	36.4	40.9	40	45		40
6	38.1	42.1	40	45		40
7	40.0	43.8	43	45		43
8	42.2	45.8	45	45		45
9	44.5	48.0	45	45		45
10	46.8	50.4	45	45		45

The report will in addition also consider the potential ambient sound levels as measured at this site to estimate the likelihood (probability) of a noise impact occurring.

1.4.2.2 Using International Guidelines to set Noise Limits

When assessing the overall noise levels emitted by a wind farm, it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5 m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35 m/s measured at the hub height of a wind turbine. However, ETSU-R97 (1996) proposes that noise limits only be placed up to a wind speed of 12 m/s for the following reasons:

1. Wind speeds are not often measured at wind speeds greater than 12 m/s at 10 m height;
2. Reliable measurements of background ambient sound levels and turbine noise will be difficult to make in high winds due to the effects of wind noise on the microphone and the fact that one could have to wait several months before such winds were experienced;
3. Turbine manufacturers are unlikely to be able to provide information on sound power levels at such high wind speeds for similar reasons; and
4. If a wind farm meets noise limits at wind speeds lower than 12m/s, it is most unlikely to cause any greater loss of amenity at higher wind speeds. Turbine noise levels increase only slightly as wind speeds increase; however, background ambient sound levels increase significantly with increasing wind speeds due to the force of the wind.

Available data indicates that wind-induced noises start to increase at wind speeds 3 – 4 m/s, becoming a significant (and frequently the dominant noise source in rural areas) at wind speeds higher than 10 – 12 m/s/. Most wind turbines reach their maximum noise emission level at a wind speed of 8 – 10 m/s. At these wind speeds increased wind-induced noises (wind howling around building, rustling of leaves in trees, rattling noises, etc) could start to drown other noises, including that being generated by wind turbines[3].

Considering this data as well as the international guidelines, noise limits starting at 40 dB that increases to more than 45 dB (as wind speeds increase) could be acceptable (see also Table 1). Project participants could be exposed to noise levels up to 45 dBA (ETSU-R97).

1.5 IDENTIFICATION OF KEY ISSUES

1.5.1 Key Issues Identified During the Scoping Phase

The following potential noise impacts have been identified during the scoping phase:

- Construction Phase

[3] It should be noted that this does not mean that the wind turbines are inaudible.

- Increase in ambient sound levels as a result of construction activities during the day.
- Operational Phase
    - Increase in ambient sound levels as result of operational wind turbines at night.
- Decommissioning Phase
    - Increase in ambient sound levels as a result of decommissioning activities during the day; and
    - Ambient sound levels to return to pre-construction levels as a result of turbines which ceased operations.

To the knowledge of the author, no comments were registered or raised to date during the Public Participation Process (PPP) from stakeholders or Interested and Affected Parties (IAPs) with regards to acoustics.

1.5.2 Identification of Potential Impacts

It was reported that the construction and decommissioning activities will only take place during the day-time period and the night-time scenario will not be considered for this report.

This will raise the noise levels, especially close to these construction activities. The potential impacts identified during the EIA assessment are:

1.5.2.1 Construction Phase

Construction will introduce a number of activities and mobile equipment in the project area. Construction activities can take place at one or more locations, and, as it is unknown where the different activities may take place, it was selected to estimate the impact of a very noisy activity (laying of foundation totalling 113.6 dBA cumulative noise impact – various equipment operating simultaneously) at all locations where wind turbines (or power pylons) may be erected.

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Construction activities that may occur during night time include:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day; and
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion

date. Therefore, it is hard to judge beforehand if a construction team would be required to work late at night.

As can be noted from Figure 4, the closest NSD are located further than 1,000m from potential construction activities. The expected noise levels due to the construction activities will be less than 35 dBA, likely significantly less than the typical ambient sound levels of the study area (see also Figure 3).

Considering the location of the NSD, the projected noise levels (see Figure 4) as well as the ambient sound levels measured onsite (see Figure 3), there is very low probability that the construction activities will raise the existing ambient sound levels or exceed the acceptable noise rating levels for a typical rural noise district.

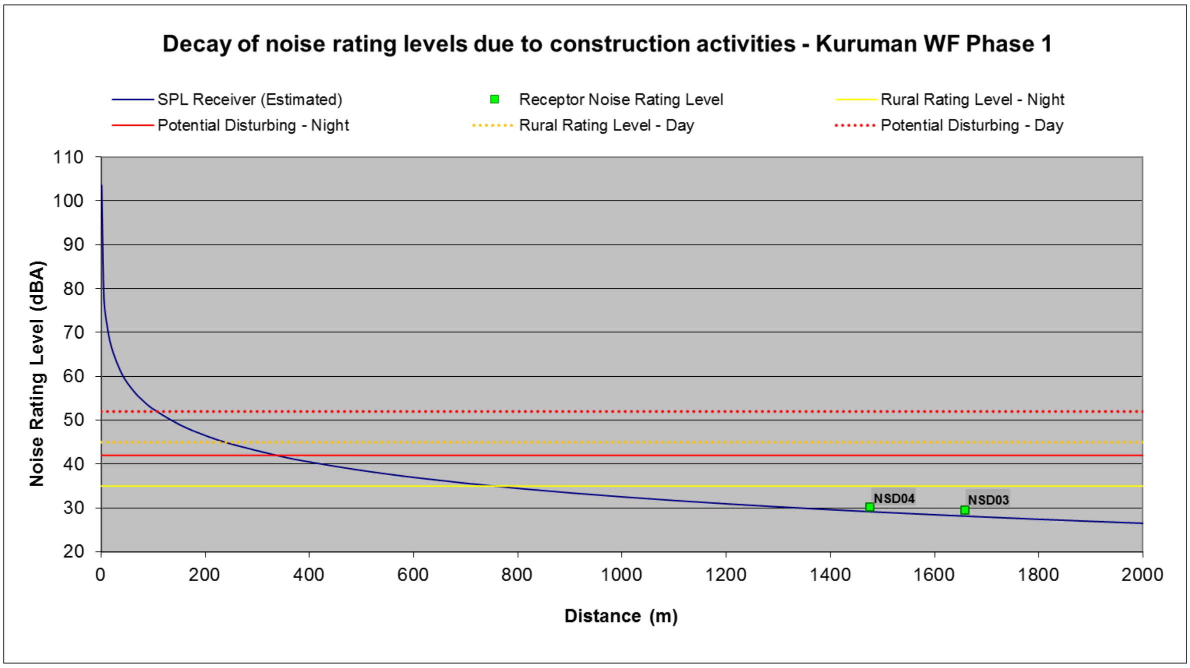

Figure 4: Projected conceptual construction noise levels[4] – Decay of noise from construction activities

1.5.2.2 Operational Phase

The operating wind turbines will increase the noise levels for the reasons as discussed in section 1.2.2. Typical daytime activities that can generate noise would include:

- The operation of the various Wind Turbines,

[4] The SPL Receiver graph can also be used for the construction of the overhead power line to allow connection to the ESKOM grid. Any activities further than 500 m from any receiver will have a noise impact of low significance (daytime construction activities).

- Maintenance activities (relatively insignificant noise source).

Noise generated from the operation of the wind turbines during the daytime period was not considered for the EIA. This is as the noise generated by the operating WTG is generally masked by other noise from a variety of sources surrounding a potentially noise-sensitive development. However, times when a quiet environment is desired (at night for sleeping, weekends etc.) ambient sound levels are more critical. The time period investigated therefore would be a quieter period, normally associated with the 22:00 – 06:00 timeslot. Maintenance activities would therefore not be considered, concentrating on the ambient sound levels created due to the operation of the various Wind Turbine Generators (WTGs) at night.

The layout presented by the developer was evaluated using the sound power emission levels for the Acciona AW125/3000 (see Table 2). Being a “loud” wind turbine, this will represent the worst case scenario as the author is not aware of another wind turbine with higher sound power emission levels.

The calculated octave sound power levels of the Acciona AW125/3000 wind turbine as used for modelling are presented in Table 2, considering the 7 m/s wind speed for the noise contours (maximum sound power level). The difference between the proposed height of the nacelle (up to 150 m) and height used for modelling (87.5 m) will have a negligible impact on the results because changes in hub-height generally do not change the sound power emission level (for the same wind turbine), or the change is insignificantly small.

Table 2: Octave Sound Power Emission Levels used for modelling: Acciona AW125/3000

Wind Turbine: Acciona AW125/3000 at hh87.5									
Source Reference: Acciona Windpower. General Document DG200383, Rev D dated 04/04/14									
Maximum expected A-weighted Octave Sound Power Levels									
Frequency	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Lpa (dB)	117.3	111.5	110.9	109.9	107.0	103.3	97.0	86.6	81.3
L_{WA} (dBA)	77.4	85.3	94.7	101.2	103.8	103.3	98.2	87.6	81.3

A-Weighted Sound Power Levels	
Wind speed at 10m height	Sound power level (dBA)
4	*101.4 **
5	*105.3 **
6	107.3
7	108.4
8	108.3
9	107.8
10	107.8

* Noise emission levels not available at the lower wind speeds and this report estimated sound emission levels considering the emission curves of other turbines. It is for illustration only.

Total noise rating levels (contours of constant sound levels) are illustrated in Figure 5 with Table 3 defining the noise rating levels at the closest potential noise-sensitive receptors for different wind speeds.

Table 3: Noise rating levels at the closest NSD at different wind speeds

Receptor	Noise rating level at different wind speeds						
	5 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s
NSD03	27.5	31.4	33.4	34.5	34.4	33.9	33.9
NSD04	27.8	31.7	33.7	34.8	34.7	34.2	34.2

Considering ambient sound levels measured onsite (see Figure 3) as well as the best fit curves on this figure, ambient sound levels may range between 40 – 44 dBA (at a 7 m/s wind). The projected noise levels (see Figure 5 and Table 3) are therefore significantly less than the ambient sound levels and there will be a very low probability that operational noises will raise the existing ambient sound levels.

1.5.2.3 Decommissioning Phase

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and operational phases. This is due to the lower urgency to complete this phase with less equipment and decommissioning activities being active simultaneously. The projected noise levels will be similar or less than the noise levels estimated in section 1.5.2.1.

1.5.2.4 Cumulative impacts

The potential cumulative impact was considered of all the other proposed renewable energy facilities within 30 km from the proposed project. However, to cumulatively contribute acoustic energy, the noise sources (such as the WTGs) of such a facility will have to be within 2,000 m from this project. As such only the Kuruman Phase 2 WEF was considered. The Kuruman Phase 2 WEF is proposed to the south of the Kuruman Phase 1 WEF. The development of the Kuruman Phase 2 will raise the noise levels at NSD03, but most of the acoustic energy would be due to the sound from the WTG of the Phase 2 development. The potential noise impacts from Phase 2 are discussed in a separate ENIA.

Table 4: Cumulative noise rating levels at the closest NSD at different wind speeds

Receptor	Noise rating level at different wind speeds						
	5 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s
NSD03	34.8	38.7	40.7	41.8	41.7	41.2	41.2
NSD04	27.8	31.7	33.7	34.8	34.7	34.2	34.2

Considering ambient sound levels measured onsite (see Figure 3) as well as the best fit curves on this figure, ambient sound levels may range between 40 – 44 dBA (at a 7 m/s wind). The projected noise level (see Figure 6 and Table 4) may be slightly higher at NSD03 than the ambient sound levels (quiet periods) and there will be a slight probability that operational noises will raise the existing ambient sound levels.

Figure 5: Contours of constant sound levels - projected maximum operational noise rating levels for Phase 1, Kuruman WF

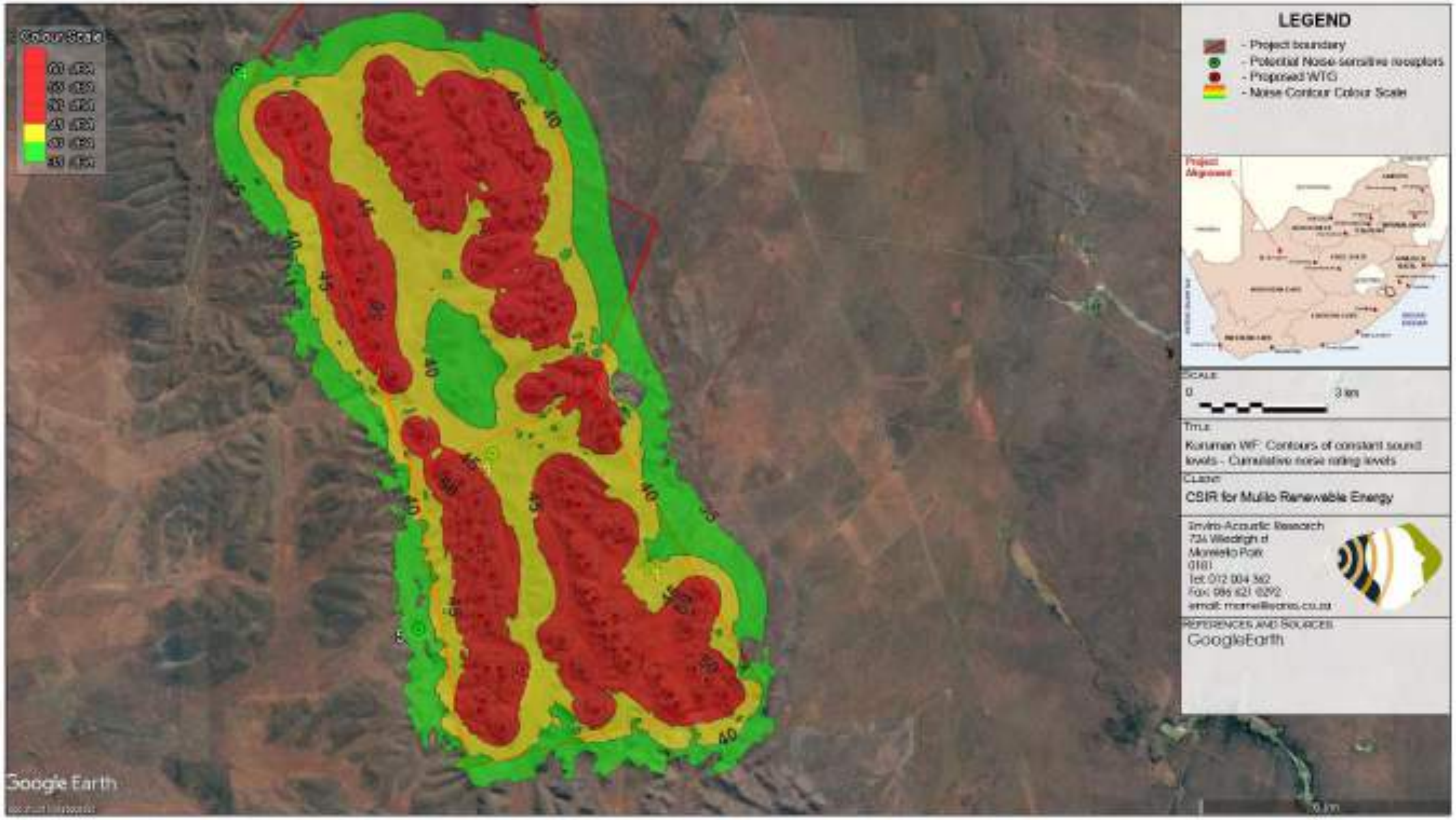

Figure 6: Contours of constant sound levels - projected cumulative noise rating levels for the Kuruman WF

1.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

There is a slight potential of increased noise levels at the identified NSD, with the other NSDs (identified in the Scoping Report, De Jager, 2018) located too far from the potential noise sources. The following sections summarize the potential noise levels and the associated noise impact.

1.6.1 Results of the Field Study

Ambient sound levels were measured over a period of a few nights during February 2018 at four locations. Longer-term measurements were conducted as it provides sufficient data to have a high confidence in the resultant data and allow the plotting of the data, together with the wind speeds, on one graph (see Figure 3) to assess the potential ambient sound levels that may be typical for the area.

Considering the data collected at all four locations, the sound levels were elevated and higher than the sound levels typical for a rural noise district. Excluding one location, this was mainly due to natural sounds (birds, insects and wind-induced), typical of spring and summer seasons. The elevated sound levels at the one measurement location were due to constant noises from the chicken coops that significantly raised the ambient sound levels.

Based on this data, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008 during periods with low winds. Based on other studies that specifically focused on the measurement of ambient sound levels as wind speeds increased, ambient sound levels would increase as wind speeds increase. These increased wind speeds also increase wind-induced noises that may mask the noises from the noise generating activities. This will be considered in the impact assessments.

1.6.2 Potential Impact - Construction Phase

The potential magnitude of the noise levels due to daytime construction activities were calculated in section 1.5.2.1. The projected noise levels are low due to the NSD located far from the potential construction locations. It can be summarised that:

- The nature of the impact – Increase in ambient sound levels;
- Magnitude of the noise impact – Very low noise levels expected;
- Consequence of noise impact - Slight (negligible alteration of natural systems, patterns or processes);
- Probability of noise impact occurring – Very low probability;
- Significance of impact without mitigation measures – Very low;

- Proposed mitigation measures – Mitigation not required due to low significance of noise impact.

1.6.3 Potential Impact - Operational Phase

The potential magnitude of the noise levels due to night-time operation of the WTG were calculated in section 1.5.2.2. The projected noise levels are low due to the NSD located far from the operating WTG. It can be summarised that:

- The nature of the impact – Increase in night-time ambient sound levels;
- Magnitude of the noise impact – Very low noise levels expected;
- Consequence of noise impact - Slight (negligible alteration of natural systems, patterns or processes);
- Probability of noise impact occurring – Very low probability;
- Significance of impact without mitigation measures – Very low;
- Proposed mitigation measures – Mitigation not required due to low significance of noise impact.

1.6.4 Potential Impact – Decommissioning

The potential magnitude of the noise levels due to daytime decommissioning activities were calculated in section 1.5.2.3. Noise levels would be similar or less than the construction phase noise levels and the potential noise impact can be summarised as follows:

- The nature of the impact – Increase in daytime ambient sound levels;
- Magnitude of the noise impact – Very low noise levels expected;
- Consequence of noise impact - Slight (negligible alteration of natural systems, patterns or processes);
- Probability of noise impact occurring – Very low probability;
- Significance of impact without mitigation measures – Very low;
- Proposed mitigation measures – Mitigation not required due to low significance of noise impact.

1.6.5 Potential Impact – Cumulative Effects

The potential magnitude of the noise levels due to potential cumulative noise levels were calculated in section 1.5.2.4. Considering ambient sound levels measured onsite (see Figure 3) as well as the best fit curves on this figure, ambient sound levels may range between 40 – 44 dBA (at a 7 m/s wind). The projected noise level may be slightly higher at NSD03 (± 42 dBA) than the ambient sound levels (during quiet periods) and there will be a slight probability that operational noises will raise the existing ambient sound levels. The potential noise impact can be summarised as follows:

- The nature of the impact – Increase in night-time ambient sound levels;

- Magnitude of the noise impact – Noise levels similar to ambient sound levels. WTG may be audible during quiet periods;
- Consequence of noise impact - Moderate (notable alteration of natural systems, patterns or processes);
- Probability of noise impact occurring – Likely probability;
- Significance of impact without mitigation measures – Low risk;
- Proposed mitigation measures – Mitigation not required due to low significance of noise impact.

1.7 IMPACT ASSESSMENT SUMMARY

1.7.1 Potential Significance of Noise Impact - Construction Phase

The potential magnitude of the noise levels due to daytime construction activities were calculated in section 1.5.2.1 and discussed in section 1.6.2. The assessment of impacts and recommendation of mitigation measures as discussed in section 1.6.2 is collated in Table 5.

1.7.2 Potential Significance of Noise Impact - Operational Phase

The potential magnitude of the noise levels due to night-time operational activities were calculated in section 1.5.2.2 and discussed in section 1.6.3. The assessment of impacts and recommendation of mitigation measures as discussed in section 1.6.3 is collated in Table 6.

1.7.3 Potential Significance of Noise Impact – Decommissioning

The potential magnitude of the noise levels due to daytime decommissioning activities were calculated in section 1.5.2.3 and discussed in section 1.6.4. The assessment of impacts and recommendation of mitigation measures as discussed in section 1.6.4 is collated in Table 7.

1.7.4 Potential Significance of Noise Impact – Cumulative Noise Levels

The potential magnitude of the noise levels due to cumulative noise levels were calculated in section 1.5.2.4 and discussed in section 1.6.5. The assessment of impacts and recommendation of mitigation measures as discussed in section 1.6.5 is collated in Table 8.

Table 5: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Equipment operating in area	Increase in ambient sound levels	Negative	Local	Short term	Slight	Extremely unlikely	Highly reversible	Moderate	No mitigation required	Very Low	Not Applicable	Very low (5)	High

Table 6: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
WTG noise operating at night	Increase in ambient sound levels	Negative	Local	Long term	Slight	Extremely unlikely	Highly reversible	Moderate	No mitigation required	Very Low	Not Applicable	Very low (5)	High

Table 7: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Equipment operating in area	Increase in ambient sound levels	Negative	Local	Short term	Slight	Extremely unlikely	Highly reversible	Moderate	No mitigation required	Very Low	Not Applicable	Very low (5)	High

Table 8: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
WTG noise due to cumulative noises from the Kuruman Phase 1 and 2 WEFs	Increase in ambient sound levels	Negative	Local	Long term	Moderate	Unlikely	Highly reversible	Moderate	No mitigation required	Low	Not Applicable	Very low (5)	High

1.8 INPUT INTO THE ENVIRONMENTAL MANAGEMENT PROGRAM

1.8.1 Environmental Management – Construction Phase

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

Projected noise levels during construction of the Kuruman Phase 1 WEF were modelled using the methods as proposed by SANS 10357:2004. The resulting future noise projections indicated that the construction activities, as modelled for the worst case scenario will comply with the South African Noise Control Regulations for typical construction activities.

Because of the very low significance of a noise impact, no specific monitoring or management measures are required for inclusion into the Environmental Management Program (EMPr) report or Environmental Authorization conditions. General conditions that should be included are:

- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures if available. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised.

1.8.2 Environmental Management – Operational Phase

Projected noise levels during operation of the WEF were modelled using the methodology as proposed by ISO 9613-2.

The resulting future noise projections indicated that the operation of the facility would comply with the proposed night-time rating levels at all wind speeds.

Because of the very low significance of a noise impact, no specific monitoring or management measures are required for inclusion into the EMPr or conditions of the Environmental Authorization. General conditions that should be included are:

- The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the location where construction activities are taking place or from an operational wind turbine;

- The developer must ensure that no NSD is subjected to total noise levels exceeding 45 dBA (at night) due to the development of the wind energy facility and the operation of the WTG.
- The potential noise impact for the WF must again be evaluated should the layout be changed where any wind turbines are located closer than 1,000 m from a confirmed NSD or if the developer decides to use a different wind turbine that has a sound power emission level higher than the Acciona WTG used in this report (sound power emission level exceeding 108.4 dBA re 1 pW).

1.8.3 Environmental Management – Decommissioning Phase

Because of the very low significance of a noise impact, no specific monitoring or management measures are required for inclusion into the EMPr or conditions of the Environmental Authorization for the decommissioning phase.

1.8.4 Environmental Management – Cumulative Impact

Projected noise levels during operation of the WF were modelled using the methodology as proposed by ISO 9613-2. The resulting future noise projections indicated that the noises from operating WTG will be audible during quiet periods. The noise level may be similar to the existing ambient sound levels but will not be disturbing. It is expected that wind-induced noises will mask the noise from the wind turbines for most of the time.

Because of the low significance of a noise impact (due to cumulative effects), no specific monitoring or management measures are required for inclusion into the EMPr or conditions of the Environmental Authorization.

1.9 CONCLUSION AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the predicted noise environment due to the development of the proposed Kuruman Phase 1 WEF on various farms near Kuruman in the Northern Cape. It is based on a predictive noise propagation model to estimate potential noise levels due to the various activities and to assist in the identification of potential issues of concern.

It is concluded that:

- The significance of the noise impact relating to daytime construction of the wind turbine generators will be Very Low (prior to mitigation)

- The significance of the noise impact relating to the operation of the WTG during the day will be Very Low (prior to mitigation).
- The significance of the noise impact relating to the operation of the WTG at night will be Very Low (prior to mitigation).
- The significance of the noise impact relating to daytime decommissioning activities will be Very Low (prior to mitigation).
- The significance of the noise impact due to cumulative noise impacts will be Low (prior to mitigation)

Because of the low significance of a potential noise impact during all phases of this development, no specific monitoring or management measures are required for inclusion into the EMPr. General conditions that should be included are:

- Ensure that construction equipment is well maintained and fitted with the correct and appropriate noise abatement measures if available. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised.
- The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the location where construction activities are taking place or from an operational wind turbine;
- The developer must ensure that no NSD is subjected to total noise levels exceeding 45 dBA (at night) due to the development of the WEF and the operation of the WTGs.

Considering the findings of this assessment, various activities associated with the development of the WEF may have a slight impact on ambient sound levels. This increase is of low significance and it is recommended that the development of the Kuruman Phase 1 WEF be authorised from a noise perspective.

1.10 REFERENCES

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1.11 APPENDICES

Socio-Economic Impact Study:

Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape:
EIA REPORT

Report prepared for:

CSIR – Environmental Management Services

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Congella, Durban, 4013

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10 September 2018

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Experience: 14 years

Nationality: Russian/South African

Professional Registration: SAPOA Urban-Econ Development Economists

Key Skills: Socio-Economic Impact Assessments; Economic Impact Assessments; Economic Modelling; Project Management

Brief Profile: Elena Broughton is a senior professional and the manager of the Innovation & Sustainable Development Unit at Urban-Econ. She has extensive knowledge in various fields of economic development that includes 14 years of experience in undertaking socio-economic impact assessment studies for a variety of private clients spanning the mining, manufacturing, energy, infrastructure, and retail sectors. She also acted as a peer reviewer in several socio-economic impact assessment studies and completed a few strategic socio-economic impact assessments. Her involvement in the field allowed her to develop a sound understanding of the South African environmental legislation and developmental policies and equipped her with a widespread knowledge of socio-economic implications and benefits of various new developments.

Education:

University of Pretoria - 2011	MSc (Technology Management)
University of Pretoria - 2007	BScHons (Technology Management) (*cum laude*)
Nizhny Novgorod University, Russia - 2002	BComHons (Economics)

SPECIALIST EXPERTISE

Ndivhuwo Malemagoba

Profession: Development Economist

Experience: 3 years

Nationality: South African

Professional Registration: SAPOA Urban-Econ Development Economists

Key Skills: Socio-Economic Impact Assessments; Economic Impact Assessments; Qualitative and Quantitative Research

Brief Profile: Ndivhuwo Malemagoba completed her MSc in Development Planning at the University of the Witwatersrand in 2016. In addition, she acquired her BSc and BSc (Hons) in Urban and Regional Planning at the same university in 2013 and 2014 respectively. She completed her BSc (Hons) degree with distinction. During her post-graduate studies, she attained Post-Graduate Merit Awards as a recognition of her outstanding academic record.

Ndivhuwo is a Development Economist with a sturdy background in development planning. Her endeavours include project management in built environment solution provision. Her robust experience in qualitative and quantitative research has equipped her with data collection, analysis and interpretation skills. This has led to her contribution to numerous development research studies in the academic and private sector arena.

Education:

University of the Witwatersrand- 2016	MSc (Development Planning)
University of the Witwatersrand - 2014	BSc Hons (Urban and Regional Planning)
University of the Witwatersrand - 2013	BSc (Urban and Regional Planning)

SPECIALIST DECLARATION

I, Elena Broughton, 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 favorable 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 Specialist: Elena Broughton

Date: 15 June 2018

SPECIALIST DECLARATION

I, Ndivhuwo Malemagoba, 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 favorable 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: N.J. Malemagoba

Name of Specialist: Ndivhuwo Malemagoba

Date: 15 June 2018

EXECUTIVE SUMMARY

Mulilo Renewable Project Developments proposes to develop the Kuruman Phase 1 Wind Energy Facility. The project is planned to be located in the Ga-Segonyana Local Municipality of the Northern Cape, near Kuruman. The project footprint will affect six farm portions and will involve erection of 47 wind turbines each producing 4.5-5.5 MW of power.

The review of key national, provincial and local policy documents and strategies indicates that the development of a wind farm is supported across all scales. The Northern Cape Provincial Spatial Development Framework further posits that the province holds a potential comparative advantage because of the regular occurrence of strong winds which could be a source of renewable energy, more specifically for sustainable electricity production. After considering the reviewed documentation, one red flag was raised with regard to the asbestos prevalence in the region and that a portion of the proposed site is located in the no-go asbestos area. Other than that, no fatal flaws or contraventions from a socio-economic policy perspective exist for the implementation of the proposed project.

The Ga-Segonyana Local Municipality has had stagnant population growth in the past five years which is largely attributed to push factors such as the closure of mines and limited economic opportunities. The municipality has a 35% unemployment rate and is largely comprised of low-income earners. Furthermore, it contributes a quarter to the John Taolo Gaetsewe District Municipality's GDP and has experienced a positive growth rate in recent years.

The proposed Kuruman Phase 1 wind energy facility will usher in notable positive impacts and contribute to the improvement in some of the main challenges experienced in the region. This includes the injection of expenditure which will stimulate production, create business opportunity and boost the economy. Furthermore, 75% local employment creation will alter the unemployment issue, lead to household income and enhance skills development. Numerous stakeholders will evidently benefit, such as business, the community and government. Government revenue will be accrued and will most likely aid socio-economic development.

On the contrary, negative impacts are also expected to ensue. The employment opportunities serve as a pull factor and will most likely attract job seekers. Further to this migrant labour will need to be accommodated in the area. This culmination will result in an increased demand for services, housing and social facilities. This is exacerbated by the additional 20 solar PV projects authorised and proposed in the region. The increased number of vehicular and pedestrian traffic on the proposed project site may potentially lead to stock theft.

Nonetheless, the net effect of the proposed project is positive as it ultimately leads to improved energy supply, increased energy security and indicates a path towards clean energy generation, which the country is in need of to curb climate change. This subsequently contributes to improved service delivery and socio-economic development. To improve the positive impact particularly for the local municipality, it is highly recommended that local procurement and employment is concentrated herein, as far as is feasible. <u>From a socio-economic perspective therefore, no objections are made with regard to the proposed project.</u>

The following table summarises the reviewed socio-economic impacts and provides an indication of the significance before and after mitigation.

Table A: Summary of socio-economic impacts

Socio-economic impact		Impact significance without mitigation	Impact significance with mitigation
Construction Phase			
Direct	Increase in production and GDP	High (+)	High (+)
	Temporary employment creation	Low (+)	Low (+)
	Skills development	Low (+)	Moderate (+)
Indirect	Attainment of household income	Low (+)	Low (+)
	Increased demand for services	Low (-)	Very Low (-)
	Potential increase in criminal activity	Moderate (-)	Low (-)
	Potential asbestos related health risks	Very low (-)	Very low (-)
	Government revenue	Low (+)	Low (+)
Operations phase			
Direct	Increased production and GDP	Moderate (+)	Moderate (+)
	Long-term employment creation	Very low (+)	Very low (+)
	Skills development	Very low (+)	Very low (+)
	Improved energy supply	Low (+)	Low (+)
Indirect	Sustainable household income	Very Low (+)	Very low (+)
Decommissioning Phase			
Local economy stimulation		Very low (+)	Very low (+)
Cumulative Impacts			
Increased production and GDP		Moderate (+)	Low (+)
Employment creation		High (+)	High (+)
Influx of migrant labour and job seekers		High (-)	High (-)

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
DM	District Municipality
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
HV	High Voltage
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
LM	Local Municipality
MV	Medium Voltage
MW	Megawatt
NDP	National Development Plan
NGPF	New Growth Path Framework
OPEX	Operating Expenditure
PV	Photovoltaic
SDF	Spatial Development Framework

GLOSSARY

Definitions	
Not Economically Active	The portion of the population who are neither employed nor unemployed but include discouraged job seekers.
Gross Domestic Product	The sum of value added created by all residents within a certain period, which is commonly a year.
Working Age Population	The portion of the population aged between 15 and 64.
Compounded Annual Growth Rate	A measure of growth over multiple time periods.
Capital Expenditure	The cost of developing or providing non-consumable parts for the product or system.
Operating Expenditure	Ongoing costs for running a product, business or system.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Specialist expertise
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Specialist declaration
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1 and 1.1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.4 and 1.1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.4 and section 1.5
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.4
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.7
g) an identification of any areas to be avoided, including buffers;	Not applicable
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Not applicable
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section. 1.6
k) any mitigation measures for inclusion in the EMPr;	Section 1.8
l) any conditions for inclusion in the environmental authorisation;	None
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 1.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 1.3 and 1.1.5
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not received
q) any other information requested by the competent authority.	Not applicable
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Yes

TABLE OF CONTENTS

1. Socio-Economic Impact Study

1.1 INTRODUCTION AND METHODOLOGY

1.1.1 Scope and Objectives

This document is prepared by **Urban-Econ Development Economists** (**Urban-Econ**) in response to a request by the **Council for Scientific and Industrial Research** (**CSIR**) to undertake a Socio-Economic Impact Assessment for the proposed Kuruman Phase 1 Wind Farm Facility (WEF), hereafter referred to as the Kuruman WEF, near Kuruman in the Northern Cape.

The socio-economic impact assessment contains information that together with other specialists allows assessment of the project from a sustainable development perspective and assists in identifying “the most practicable environmental option” that provides the “most benefit and causes the least damage to the environment, at a cost acceptable to society”, in the long-term and the short-term. Considering the above and in line with the Environmental Impact Assessment (EIA) Regulations of 2014, the purpose of the socio-economic impact assessment is to assess the need and desirability of the project. It specifically aims to ensure that the project, if approved, provides for justifiable social and economic development outcomes.

1.1.2 Terms of Reference

The scope of work for the socio-economic specialist involves:

- identify, predict, and evaluate geographical, social, economic, and cultural aspects of the environment that may be affected by the project activities and associated infrastructure; and
- advise on the alternatives to best avoid negative impacts or allow to manage and minimise them to acceptable levels, while optimising positive effects.

The specific objectives of the study include:

- Engage with the environmental practitioner, other specialists on the team and the client to gain necessary background on the project;
- Delineate the zone of influence in consultation with other specialists on the team;
- Determine the affected communities and economies located in the zone of influence and identify sensitive receptors within the delineated study area, i.e. communities, land uses and economic activities that could be directly or indirectly negatively affected by the proposed project or benefit from it;
- Review secondary data and assess data gaps;
- Collect primary social and economic data of the parties that may be directly or indirectly affected (positively or negatively) by the proposed project to address data gaps;
- Create profiles for the communities and economies representing the study areas and the environmentally affected zone;
- Identify, predict, and evaluate the potential positive and negative impacts associated with the project following the environmental specialist’s methodology;
- Assess the cumulative impacts; and
- Develop a mitigation plan by proposing mitigation measures for negative effects and enhancement measures for positive impacts.

1.1.3 Approach and Methodology

The following methodology was followed in completing the study:

- **Orientation:** The study started with gaining an understanding of the proposed project during various stages of its lifecycle and the potentially affected environment. A review of various data and maps provided for the project, as well as discussions with the project's environmental consultant, informed the delineation of the potential zone of influence associated with each component of the project. The delineated zone of influence defined the spatial boundaries of the area to be included in the assessment and assisted in identifying likely impacted and beneficiary communities and economic activities, as well as other stakeholders of the project.
- **Policy alignment review:** Relevant government policies and other strategic documents were gathered and reviewed to determine the alignment of the proposed project with the strategic plans of various government spheres and highlight any potential red flags, if such exist.
- **Baseline profiling:** Following policy review, primary and secondary data were gathered to create the socio-economic profile of the delineated zone of influence. The baseline profile assisted in gaining an understanding of the communities and economic activities likely to be affected or benefit from the proposed project. This included the description of the study area's composition and locational factors, economic and labour profiles, way of life of communities located within the zone of influence, their demographic trends and cultural references, their health and wellbeing, and their living environment. Specific attention was paid to the socio-economic composition of the area affected by the project's footprint and its potential environmental effects, i.e. visual, noise, and air pollution.
- **Impact analysis and evaluation**: Derived from the review of the project and its need and desirability is the list of various negative and positive socio-economic impacts that can ensue because of the proposed activity during various stages of its life cycle. All identified socio-economic impacts were assessed and categorised in line with the rating provided by the environmental specialist (refer to Annexure A).
- **Formulation of mitigation and enhancement measures:** Following the analysis and ranking of impact, mitigation, and enhancement measures, where applicable, were formulated whereby recommendations to reduce or eliminate the potential negative effects on the affected parties and enhance positive impacts were provided.

The season of the site investigation does not have an effect on the outcomes of the study as data gained from the interviews is representative of all seasons throughout the year (i.e. economic activity during different seasons is obtained). Furthermore, the socio-economic specialist did not conduct any tests on site that could have been affected by the season of investigation.

1.1.4 Assumptions and Limitations

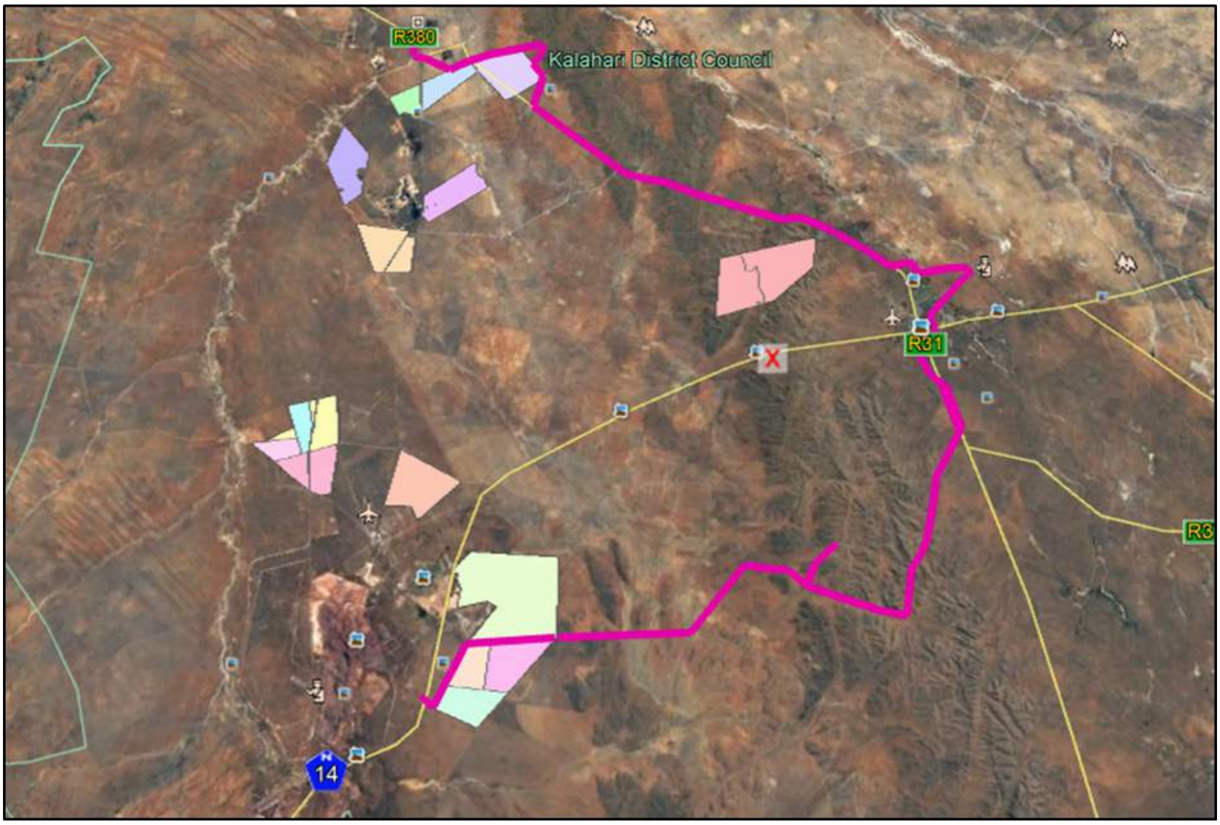
- The secondary data sources used to compile the socio-economic baseline (demographics, dynamics of the economy), although not exhaustive, can be viewed as being indicative of broad trends within the study area.
- Possible impacts and stakeholder responses to these impacts cannot be predicted with complete accuracy, even when circumstances are similar, and these predictions are based on research and years of experience, taking the specific set of circumstances into account.
- It is assumed that the motivation and ensuing planning and feasibility studies for the project were done with integrity and that all information provided to the specialist by the project proponent and its consultants to date is accurate.
- With regard to the telephonic and email interviews undertaken, the following assumptions are made:
    - Questions asked during the interviews were answered accurately.
    - No comments from Interested and Affected Parties (I&APs) outside the interviews were received to date during the conduct of this study. Therefore, all impacts

assessed are premised from primary and secondary data collected as well as previous experience of wind farm development.

The prospecting approved and proposed developments within a 50km radius will be taken into consideration as they have the potential to create supplementary positive or negative socio-economic impacts identified in this study or vice versa. The **projects considered for the cumulative assessment** include:

- The 75MW AEP Legoko PV Solar Facility
- The 75MW AEP Mogobe Photovoltaic Solar Facility
- Kathu Solar Energy Facility
- Kathu Solar Energy Facility 25MW 2
- Sishen Solar Farm
- Solar farm for Bestwood
- Kalahari Solar Power Project
- A 19MW PV Solar Power Generation Plant
- 150mw Adams PV Solar Energy Facility
- Roma Energy Mount Roper Solar Plant
- Keren Energy Whitebank Solar Plant
- San Solar Energy Facility and associated infrastructure
- Renewable energy generation project – Shirley Solar Park
- 75MW Perth-Kuruman Solar Farm
- 75MW Perth-Hotazel Solar Farm and associated infrastructure
- 75MW AEP Kathu Solar PV Energy Facility
- Kagiso Solar Power Plant near
- 115MW Boitshoko Solar Power Plant
- Tshepo Solar Power Plant
- Kuruman WEF Phase 2

The above-mentioned projects, except for Kuruman WEF Phase 2, are illustrate don the map below:



Map 1-1: Proposed and authorised energy projects in 50 km radius from proposed project site

1.1.5 Source of Information

The project made use of both primary and secondary data in order to assess the impacts and desirability of the project.

Indirect data analysed was mainly derived from the following sources and programmes:

- Stats SA Census, 2011
- Quantec Research Standardised Regional Data, 1995-2017
- John Taolo Gaetsewe District Municipality Integrated Development Plan 2012-2017
- John Taolo Gaetsewe District Municipality Spatial Development Framework 2017
- Ga-Segonyana Local Municpality Integrated Development Plan 2015/16 Review
- National Development Plan (NDP) 2030
- Mapable 2018
- Project data and maps obtained from client
- EIA and scoping documents for surrounding projects

The primary data gathering for this project was done via telephonic interviews and email questionnaires as these means were indicated to be preferred methods of communication by the key respondents. The interviews took place from the 08th to the 09th of March 2018 and included engagements with the owners of the following farm portions:

- Portion 2 and 4 of Farm Carrington 440
- Portion 1 and 2 of Farm Hartland 381
- Remainder of Farm Woodstock 441
- Remainder of Farm Rossdale 382

- Portion 1 of Farm Bramcot 446

1.2 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

A policy review plays an integral role in the early stages of a project. The review provides a high-level indication of whether a project is aligned with the goals and aspirations of the developmental policy within a country through to the local level. Furthermore, the analysis indicates any red-flag or developmental concerns that could jeopardise the development of the project. This assists in amending and preventing costly and unnecessary delays. Table 1 below outlines the objectives and main relevant ideas stipulated per policy, as well as the alignment of the proposed project with these.

Table 1-1: Project alignment with policy objectives

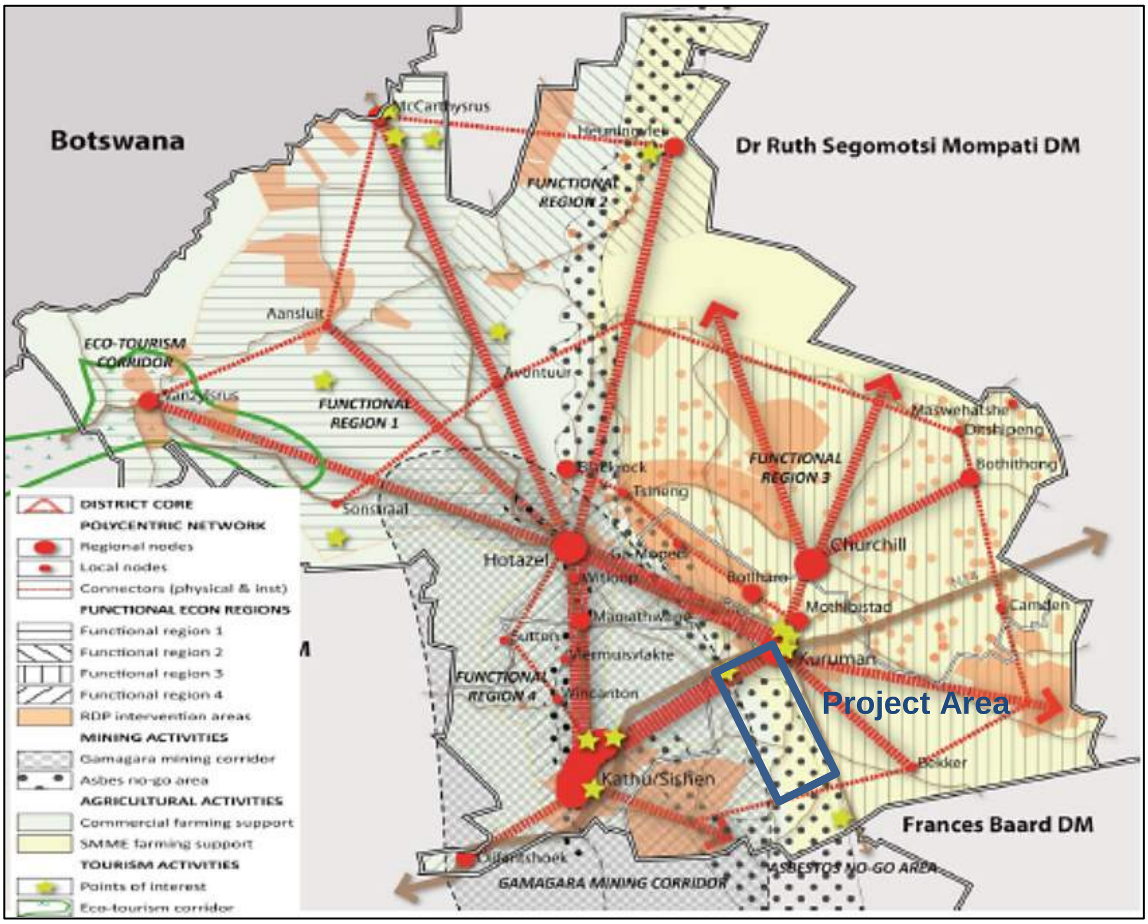
Policy	Key Policy Objectives	Source
	National Policy: South Africa	
National Development Plan 2030	✓ Creating jobs and livelihoods ✓ Expanding infrastructure ✓ Transitioning to a low-carbon economy ✓ Transforming urban and rural spaces • Improving education and training • Providing quality health care • Building a capable state • Transforming society and uniting the nation • Fighting corruption and enhancing accountability	(NPC, 2011)
New Growth Path Framework 2011	✓ Infrastructure investment • Main economic sectors as employment sectors ✓ Seizing the potential of new economies ✓ Investing in social capital and public services ✓ Fostering rural development and regional integration	(Department of Economic Development, 2011)
Renewable Energy Vision 2030 South Africa	✓ Renewable energy as an exceptional source of flexible supply within the context of uncertain energy demand ✓ Comprehensive renewable energy base will support a resilient South African future ✓ A sustainable energy mix that excludes undue risks for the environment of society	(World Wildlife Fund, 2014)
Integrated Energy Plan 2016	✓ South Africa should continue to track a diversified energy mix which lessens reliance on a few primary energy sources ✓ In addition to solar energy facilities, wind energy should continue to contribute in the generation of electricity • Allocations to safeguard the development of wind energy projects aligned with the Integrated Resource Plan 2010 should continue to be pursued ✓ Ensure energy security and supply ✓ Reduce environmental impacts • Endorse job creation and localisation ✓ Lessen cost of energy • Reduce water consumption ✓ Diversify supply sources • Promote energy efficiency • Promote energy access	(Department of Energy, 2016)
The Constitution of South Africa 1996	✓ "Everyone has the right to an environment that is not harmful to their health or well-being" (S24) • The environment should be protected for the benefit of present and future generations, through reasonable legislative and other measures that:	(Republic of South Africa, 1996)

Policy	Key Policy Objectives	Source
	✓ Prevent pollution and ecological degradation ✓ Promote conservation ✓ Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development	
White Paper on Energy Policy of the Republic of South Africa 1998	✓ Seeks to ensure that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options ✓ Aims to create energy security by diversifying the energy supply and energy carriers	(Department of Minerals and Energy, 1998)
White Paper on the Renewable Energy Policy of RSA 2003	✓ Pledges government support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications	(Department of Minerals and Energy, 2003)
Provincial Policy: Northern Cape		
Northern Cape Provincial Development and Resource Management Plan 2012	✓ Seeks to create a prosperous, sustainable and expanding provincial economy to eradicate poverty and improve social development • Aims to create a continuous network of natural resource areas throughout the province that maintain ecological processes and provide ecosystem services ✓ Aims to endorse and institute innovative energy technologies to improve access to reliable, sustainable and affordable energy services with the objective to realise sustainable economic growth and development	(Office of the Premier of the Northern Cape, 2012)
Municipal Policy: John Taolo Gaetsewe District Municipality		
John Taolo Gaetsewe District Municipality Integrated Development Plan 2016	Strategic objectives for the municipality are: • Water and sanitation • Roads and transport ✓ Local Economic Development ✓ Land development and reform • Integrated human settlements ✓ Sustainable development-oriented municipality • Promotion of health • Disaster management ✓ Environmental management, conservation and climate change management	(John Taolo Gaetsewe District Municipality, 2016)
Local Municipality: Ga-Segonyana Local Municipality		
Ga-Segonyana Local Municipality Integrated Development Plan 2015/16 Review	✓ An integrated municipality that is committed to the creation of a better life through sustainable development for the people of Ga-Segonyana • Aims to provide democratic and accountable government for local communities ✓ Aims to ensure the provision of services to communities in a sustainable manner ✓ Aims to promote social and economic development • Aims to promote a safe and healthy environment • Aims to encourage the involvement of communities and community organisations in the matters of local government • Aims to structure and manage its administration, budgeting and planning processes to give priority to the basic needs of the community and to promote the social and economic development of the community ✓ Aims to participate in national and provincial development programmes • Aims to create an enabling environment for economic	(Ga-Segonyana Local Municpality, 2015)

Policy	Key Policy Objectives	Source
	growth and to reduce unemployment and alleviate poverty	
Ga-Segonyana Service Delivery and Budget Implementation Plan 2017	✓ Progressive sustainable development • Skills development ✓ Aims to develop and maintain infrastructure and community services • Aims to enhance revenue and financial management	(Ga-Segonyana Local Municipality, 2017)

A correlation between the proposed wind farm and the goals of strategic documents is evident. National policy echoes renewable energy sentiments dating from pre-2000. Provincial policy seeks to create an enabling environment for economic growth and environmental preservation. Lastly, local policy places emphasis on service delivery improvement and enhancing the socio-economic conditions for residents some of which can be achieved due to the proposed project.

From a spatial perspective, it should be noted that historically, asbestos has been mined, mainly in a strip to the east and parallel to the Gamagara corridor (refer to Map 1-2). These mines have been decommissioned due to the prevalence of a hazardous substance in asbestos (John Taolo Gaetsewe DM, 2017). An area in circumference to these mines has been identified by the John Taolo Gaetsewe District Municipality in its spatial Development Framework of 2017, where development is prohibited. This is therefore a potential red flag as the proposed project site is within this prohibited zone as outlined in the map below.



Map 1-2: John Taolo Gaetsewe DM Spatial Development Framework (John Taolo Gaetsewe DM, 2017)

Due to the distress resulting from mine closures, job creation in this region is imperative. A guideline for any project planned to be developed in the no-go area includes a screening process which is specifically designated to identify high risk areas. Furthermore, a recommendation to allow minimal land use activities on rehabilitated areas is permitted but excludes the extensive development of these areas that would be associated with a presence of a large number of people during both construction and operation. The need for rehabilitation of asbestos pollution through the quantification of risks associated with a specific pollution site is a pre-requisite for development in any asbestos polluted areas (John Taolo Gaetsewe DM, 2017). This recommendation has also been included in this study.

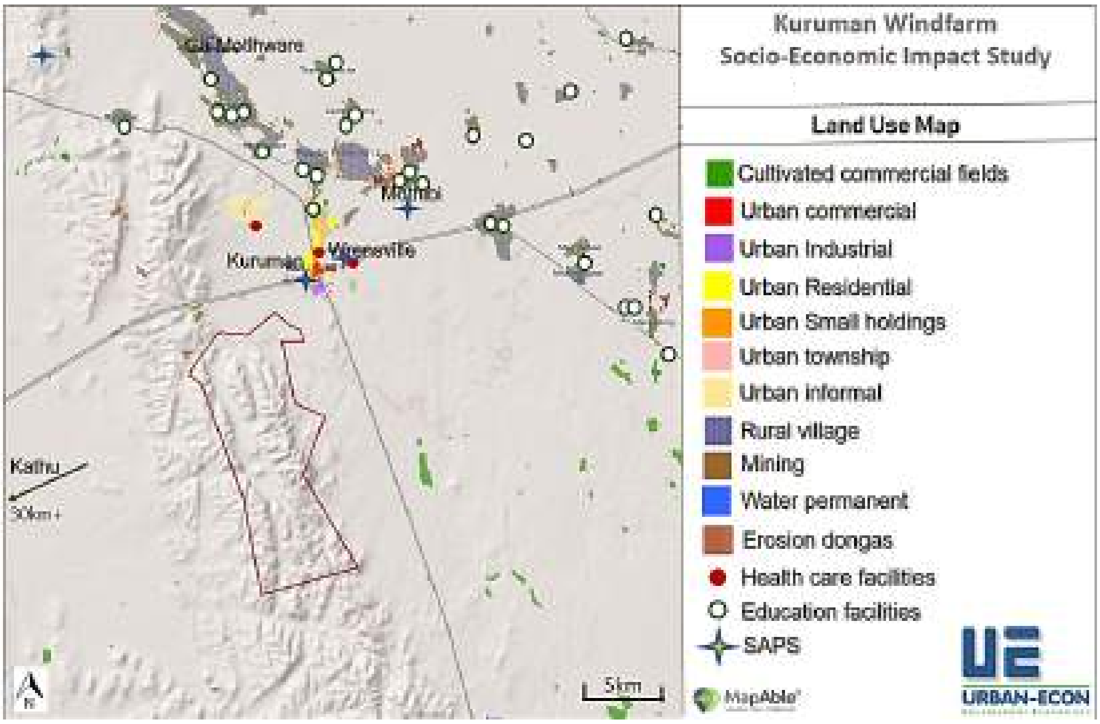
Furthermore, at a local municipality level, the Ga-Segonyana LM SDF seeks to develop a regional node comprising of social facilities, a diversified housing provision, a minimum of one shopping centre and light industry (Ga-Segonyana Local Municpality, 2015). Moreover, the SDF aims to retain and strengthen the game farming and tourism-based economies, which is relevant for some of the directly affected farm portions.

1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1 Land Use Profile in Surrounding Area

The site-related information section will investigate the various dynamics of the proposed project location. Map 1-3 below serves to demonstrate the land uses on the proposed project site and the surrounding area. In addition, the map serves to illustrate the terrain and the locations of social facilities. The deductions made are firstly that limited activity is taking place from a regional perspective. Furthermore, activities are concentrated to the north-east of the proposed project site, wherein the town of Kuruman and the villages Mothibi and Ga-Motlhware are located. Kuruman is less than 5km away from the proposed project site, and the closest residential communities of Bodulong and Wrenchville are 8km and 9km away, respectively. Economic activity, including commercial and retail, is featured in the residential and business district. The north-west section of the project site hosts pockets of mining activity.

With regard to social facilities, there are numerous primary, secondary, and intermediate schools serving the communities located to the north-east of the project site. Furthermore, one private hospital is located near Kathu, over 30km south-west from the project site. Additional health facilities such as clinics and public hospitals are concentrated in Kuruman. Lastly, three police stations are within 15km from the proposed project site.



Map 1-3: Land Use Map of Proposed Kuruman Windfarm Site and surrounding areas (Geo-terraimage, 2014)

The geo-fabric terrain demonstrates the mountainous and steep characteristic of the proposed project site. In terms of accessibility, the project site is accessible from the N14 which connects to Springbok to the south-west and Pretoria to the north-east.

1.3.1.1 Land Use Profile and economic activities of Proposed Project Site

The proposed project will directly affect the following five farm portions in Phase 1:

- Portion 2 and 4 of Farm Carrington 440
- Portion 1 and 2 of Farm Hartland 381

The economic activities hosted on the envisaged project area are agriculture and tourism related.

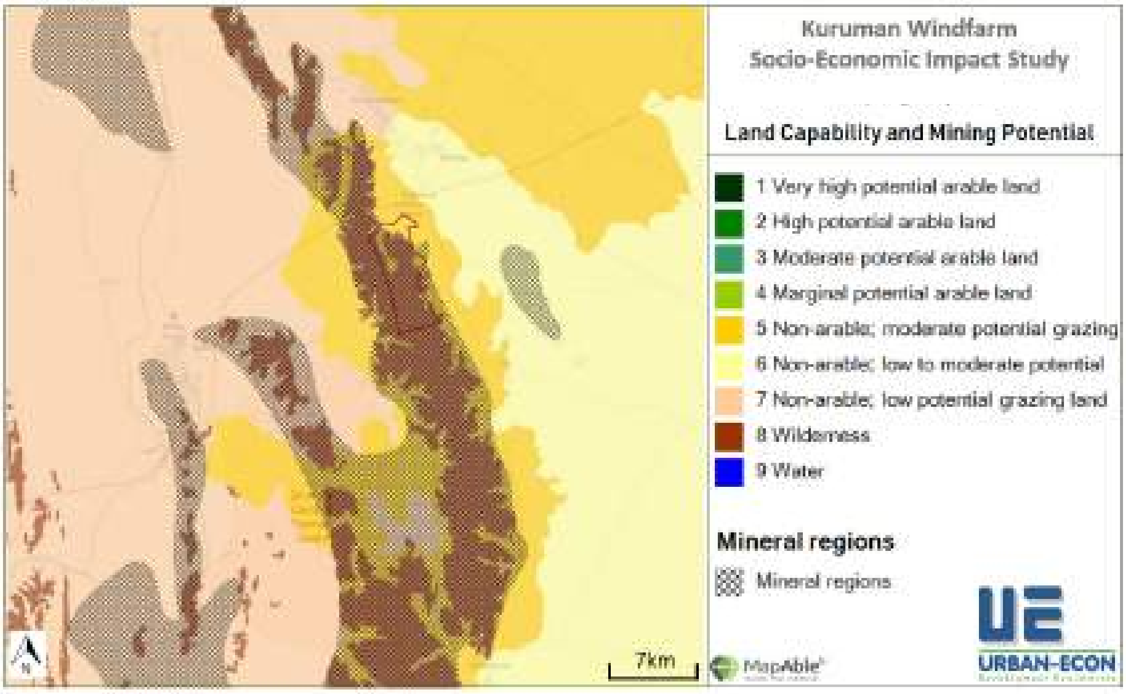
- **Mr Albutt** owns and utilises all the farm portions sought for Phase 1 of the Kuruman Wind farm. Mr Albutt derives his main source of income from game hunting and the accommodation offering lodge. With regard to visitation for game hunting, he receives about 20 international and 50 domestic visitors who each stay for an average of five days. The game hunting is not limited to specific seasons and is constant throughout the year.
- The additional economic activity observed on the potentially directly affected farm portions is the lodge, which caters for accommodation purposes and is active throughout the year. In addition, provision for weddings and events and conferences is made. On a minimal scale, there is dry land and irrigated crop production; a shared 4 ha is dedicated to this. The total staff permanently employed on these farm portions is 15, none of which reside on the premises. They currently earn R150 per day. Four family members permanently reside on the premises.
- **Mr Du Plessis** owns the farm portions envisioned for Phase 2 of the Kuruman Wind farm development, which will also be an indirectly affected farm portion for Phase 1. The economic activity taking place herein is livestock farming. This takes place on 22 000 ha of land, and the livestock is cattle. There are no additional economic activities taking place on this land. Three of the family members reside on the premises.

1.3.1.2 Perspective of landowners on proposed project

According to both land owners interviewed, the proposed projects will not prohibit nor disturb the current economic activities observed on their land portions. No concerns have been raised by either of the directly affected land owners. Additionally, no loss in employment is expected. Mr Albutt considers his farm portions to be scenic but does not foresee the wind turbines detracting from the natural aesthetic. He perceives the proposed project as one that is symbolic of a less polluted future. The proposed Kuruman Wind farm is essentially noted as a positive project.

1.3.2 Land potential and capability

Map 1-4 below demonstrates that the project site is located in a region with non-arable land, with moderate to low potential grazing land. The proposed project site specifically is characteristic of wilderness and on a minute scale, non-arable land with moderate grazing potential. In addition, it is located within a mineral region.



Map 1-4: Land Capability and Mining Potential in Zone of Influence (Council of Geo-Sciences)

In a quest to further understand the zone of influence, the larger regional dynamics ought to be understood. The following section serves to provide the socio-economic profile of the larger region in which this site is located.

1.3.3 Population Demographics

The Ga-Segonyana Local Municipality (LM) has a population of approximately 96 297, with a total of 93 651 households (Stats SA, 2017). This is indicative of an average household size of 3.5 in the municipality. The Ga-Segonyana LM is the largest administrative area in the district contributing two-fifths towards the John Taolo Gaetsewe District Municipality (DM) population. Furthermore, 44% of the total households in the John Taolo Gaetsewe DM are located in the Ga-Segonyana LM. The average population growth rate over the past five years has been just over 1%, indicative of stagnant to slow population growth. This could be attributed to the closure of mines and limited job opportunities thus resulting in limited in-migration of job seekers and migrant labour. The closest town, Kuruman had 3 188 households with 13 057 residents in 2011 (Quantec Easy Data, 2017).

Figure 1-1: Demographic profile of Ga-Segonyana LM (Stats SA, 2017)

A large portion (85%) of the population within the LM reside in tribal areas, followed by 14% located in urban areas, and the remaining 1% reside on farm land (Stats SA, 2017) . In the direct zone of influence, which extends to the settlements located in close proximity to the project site, the population density is concentrated in Kuruman town and Mothibi village. The majority of the residents in the Ga-Segonyana LM (87%) are Black, 8% are Coloured and 4% are White. Setswana is the most commonly used language in the municipality followed by Afrikaans (Stats SA, 2017).

Across all scales, a greater proportion of the population is comprised of females. Figure 1 below further indicates that the majority of the population are aged between 15 and 34, and the minority of the population are aged over 65 years (Quantec Easy Data, 2017). This is similar at a provincial and national scale. The working age population (15-64) constitutes just over 63% of the population. Close to a third of the population are aged below the age of 15, as can be derived from Figure 1-2 below.

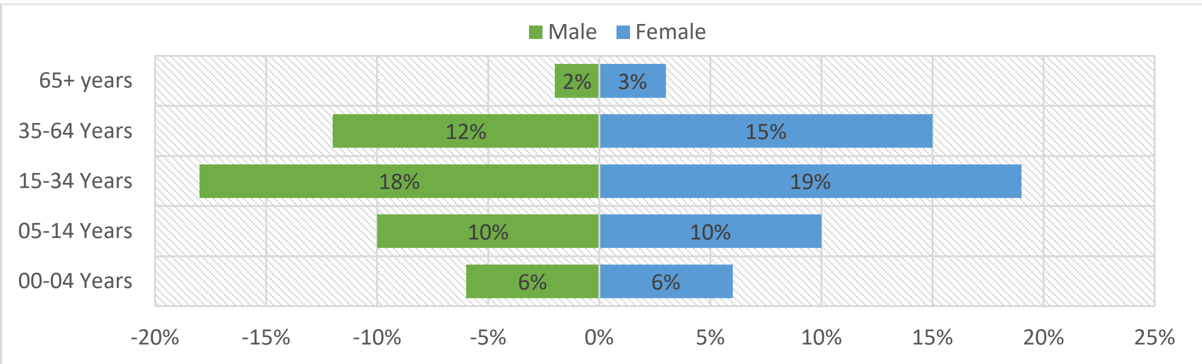


Figure 1-2: Population pyramid for the Ga-Segonyana Local Municipality (Stats SA, 2017)

1.3.4 Education and Skills

In the John Taolo Gaetsewe DM, Ga-Segonyana LM and the towns of Kuruman, the adult population with no schooling constitutes 14%, 9% and 5%, respectively (Quantec, 2017). Kuruman has the highest population of residents who have completed matric and have higher qualifications, with just over a third of its adult population possessing a matric certificate (Stats SA, 2017). The education levels are therefore moderate but have great room for improvement.

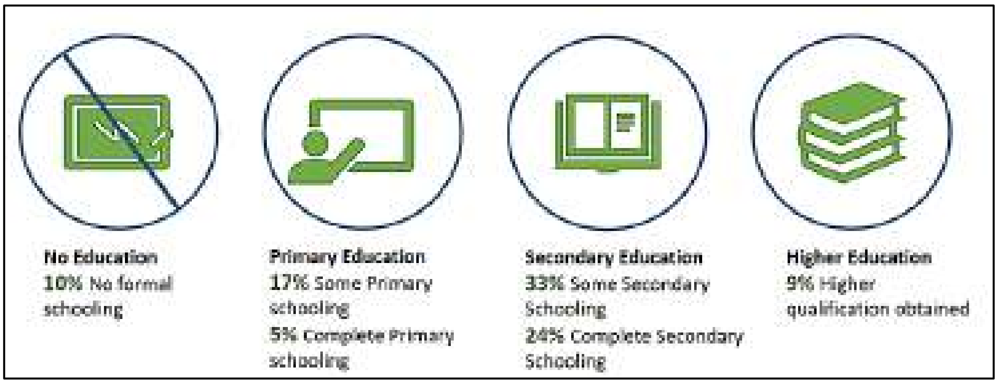


Figure 1-3: Education completion statistics for Ga-Segonyana LM (Stats SA, 2017)

1.3.5 Income Levels

Overall, 45% of the households within the LM earned up to R3 200 per month. In Kuruman, 7% of the households had no income and 29% earned up to R3 200 (Stats SA, 2017). The largest range of income earned in the Northern Cape is between R1 and R3 200. The household income in this area signals the stringent manner in which residents meet their needs and the dependence on government. In contrast, a minority of the population can be classified as middle-income earners and high-income earners, who thus have relatively increased purchasing power, which implies a comfortable livelihood.

Table 1-2: Monthly Income levels on Provincial, District and Local Scale

Income Level	Northern Cape	Ga-Segonyana LM	Kuruman
No income	7,6%	8,1%	7,3%
R1-R3200	53,5%	44,6%	28,5%
R3201-R6400	14,1%	18,2%	18,2%
R6401-R12800	13,3%	17,2%	20,1%
R12801-R25600	8,2%	8,7%	16,6%
R25601-R51200	2,3%	2,3%	7,0%
R51201-R102400	0,5%	0,5%	1,5%
R102401-R204800	0,3%	0,2%	0,5%
R204801 +	0,2%	0,1%	0,3%

(Urban-Econ calculations based on Quantec data, 2018)

1.3.6 The Economy

In 2016, The Ga-Segonyana LM economy was valued at R7 101 million in constant prices. The LM contributes a quarter to the economy of the John Taolo District Municipality and 6% to the economy of the Northern Cape (Quantec, 2017). Over a period of six years (2010-2016), the municipality's economy grew at a positive compounded annual growth rate (CAGR) of 3% per year. This is similar to the district and provincial growth of 2% and 3%, respectively.

Table 1-3: Northern Cape and Ga-Segonyana LM structure of economies

Economic Sector	Northern Cape (GDP in 2010 prices)			Ga-Segonyana LM (GDP in 2010 prices)		
	GDP (R'mil)	% of GDP	CAGR (2010-2016)	GDP (R'mil)	% of GDP	CAGR (2010-2016)
Agriculture, forestry and fishing	R10 908	9%	0%	R371	5%	3%
Mining and quarrying	R30 141	25%	2%	R1 880	26%	3%
Manufacturing	R7 479	6%	0%	R500	7%	1%
Electricity, gas and water	R3 973	3%	2%	R215	3%	1%
Construction	R5 260	4%	2%	R390	5%	3%
Trade	R12 892	11%	2%	R905	13%	3%
Transport and communication	R12 688	11%	3%	R730	10%	5%

Economic Sector	Northern Cape (GDP in 2010 prices)			Ga-Segonyana LM (GDP in 2010 prices)		
	GDP (R'mil)	% of GDP	CAGR (2010-2016)	GDP (R'mil)	% of GDP	CAGR (2010-2016)
Finance and business services	R16 760	14%	3%	R988	14%	5%
General government	R14 369	12%	2%	R726	10%	1%
Personal services	R6 003	5%	3%	R397	6%	3%
TOTAL	R120 473	100%	2%	R7 101	100%	3%

Urban-Econ calculations based on Quantec data

The economic sector with the greatest contribution to the GDP-R of the Northern Cape is mining and quarrying. Similarly, mining is the highest contributing economic sector in the Ga-Segonyana LM (Quantec, 2017). This indicates the vulnerability of the municipal economy in the case of a crisis in the mining sector. Electricity, gas and water is the economic sector with the least contribution to the GDP-R of the municipality (Quantec, 2017). Between 2008 and 2010, most economic sectors experienced a decrease in GDP-R as a result of the economic crisis. However, construction, trade, finance and business services and general government did not have a decline in GDP-R during that period.

1.3.7 Labour Force Composition

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of perspectives, including the employment rate and sectoral employment patterns.

According to Census 2011 data, the working age population of Ga-Segonyana LM was about 59 943. Amongst these, 29 202 were economically active (i.e. labour force) and the balance (29 741) were not economically active (NEA) persons (i.e. those who were neither employed nor unemployed, including discouraged job seekers). The employed labour in the municipality was estimated at 18 945. Close to three-quarters of the employed individuals in the Ga-Segonyana LM were employed in the formal sector and just over a quarter were employed in the informal sector (Quantec Easy Data, 2017). The unemployment rate in the LM was considerably higher than that observed in the district – 355% versus 9%, respectively.

Table 1-4: Labour Profile in John Taolo Gaetsewe DM and Ga-Segonyana LM

Indicators	John Taolo Gaetsewe DM	Ga-Segonyana LM
Total population	237 529	94 498
Working age	144 710	58 943
Formal and informal - Total	49 031	18 945
Employed - Formal	38 130	14 048
Employed - Informal	10 901	4 897
Unemployed	18 765	10 257
Not economically active	76 914	29 741
Unemployment rate	28%	35%

(Stats SA, 2017)

1.3.8 Employment Structure

In both, the John Taolo DM and the Ga-Segonyana LM, the wholesale and retail trade, catering and accommodation economic sector employs the largest number of people, whereas the electricity, gas and water economic sector has the lowest number of employed people. The secondary sector has been the sole sector with gradual growth of employment figures in the past five years. On the contrary, the sector that generates the largest GDP for the LM – mining – has experienced a minute decline in employment for three consecutive years from 2013 to 2015 (Quantec Easy Data, 2017). As indicated in the diagram below, between 2011 and 2016, all economic sectors in the LM, except for mining, have managed to create new employment opportunities and increase their employment absorption capacity.

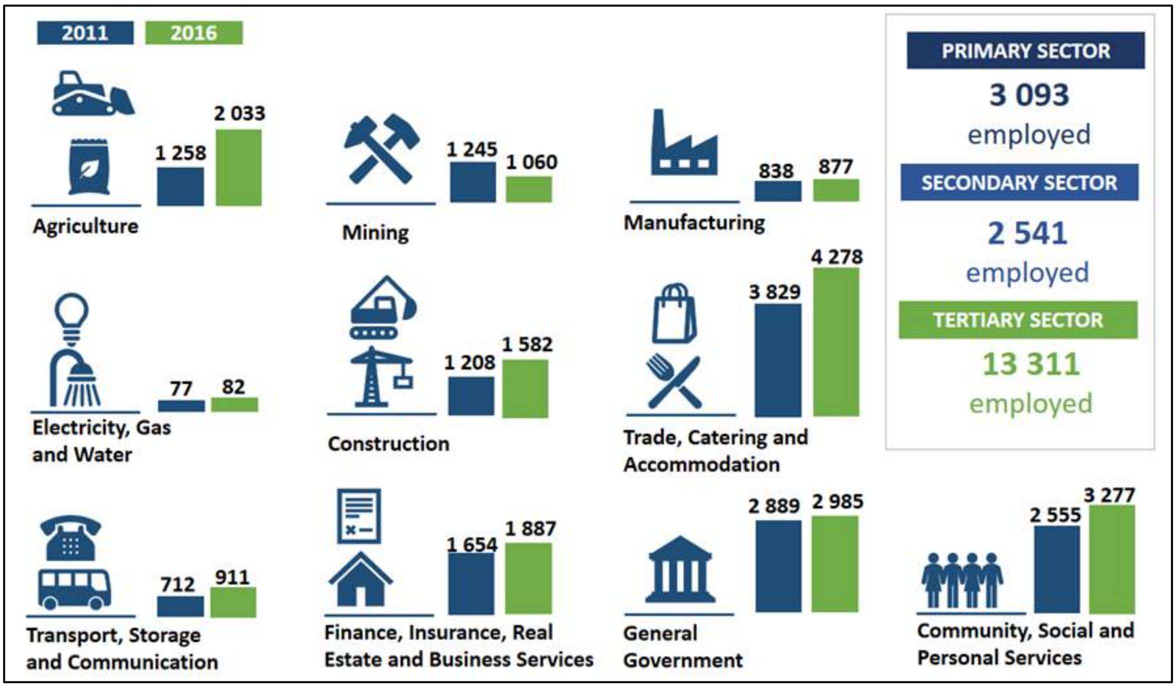


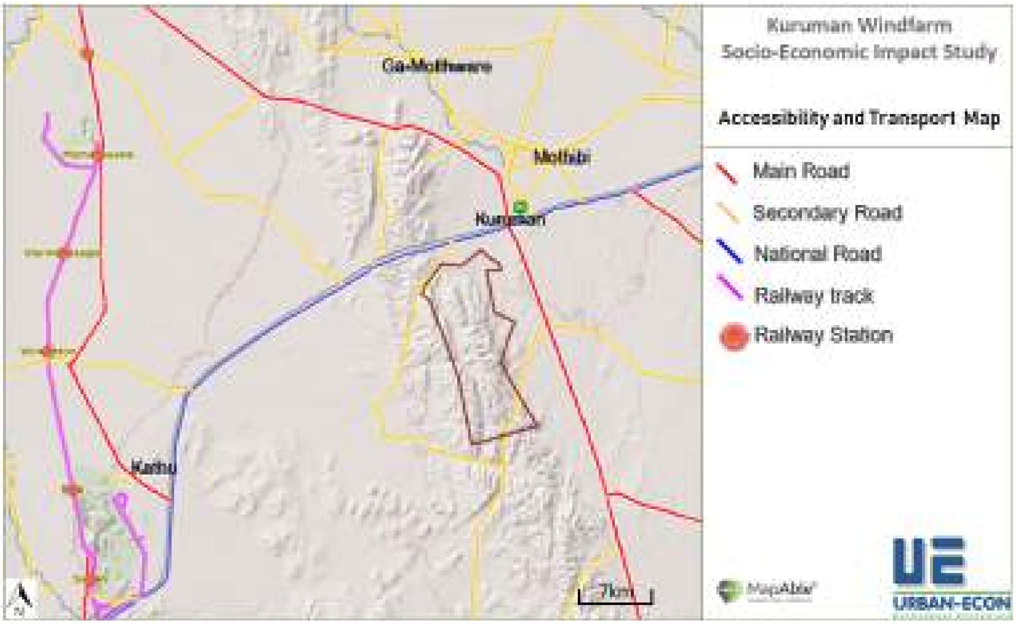
Figure 1-4: Employment figures comparison for the Ga-Segonyana LM between 2011 and 2016 per economic sector (Urban-Econ infographics based on Quantec data, 2017)

1.3.9 Services and Infrastructure

The Ga-Segonyana LM has backlogs in all basic services, as illustrated in the figure below, with refuse removal having the largest backlog of 37%. Nonetheless, the overall service delivery is moderate.

Figure 1-5: Status of service delivery in Ga-Segonyana LM (Ga-Segonyana Local Municpality, 2015)

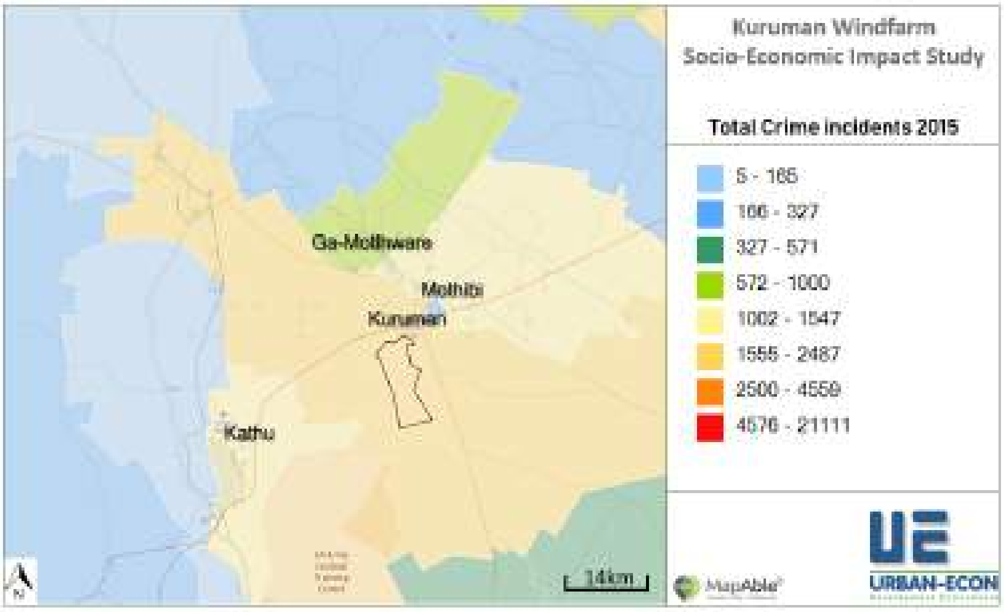
Map 1-5 illustrates the main, secondary and national roads in the area under analysis. It shows that the site has a relatively good accessibility considering its location in close proximity to the national route. The LM's IDP also indicates that main roads are in good condition; however, gravel roads serving as access routes to the rural areas are in poor condition. The roads, electricity infrastructure and water infrastructure are poorly managed. Moreover, illegal electricity connections have been rife. Furthermore, there are areas such as the village of Gantantelang located in Ward 1 that have no electricity connection for over 17 years. New electricity connections are planned as well as maintenance and upgrading (Ga-Segonyana Local Municpality, 2015).



Map 1-5: Accessibility and Transport of larger Kuruman region (MapAble, 2018)

1.3.10 Crime Statistics in study area

Map 1-6 below demonstrates the total number of total crime incidents reported per police precinct in 2015.



Map 1-6: A spatial representation of the Total Crime incidents reported in 2015 (Institute for Security Studies, 2015)

As mentioned, there are thee (3) police stations within 15km from the proposed project site. Evidently, the precinct where the proposed project site is located had had 1 002 to 1 547 reported crime incidents in 2015. The most pertinent crimes in the precinct, in which the proposed project is located, were (Institute for Security Studies, 2015):

- Theft out of motor vehicle (307 – 441 incidents)
- Burglary at business premises (136 – 587 incidents)
- Stock theft (49 – 240 incidents)

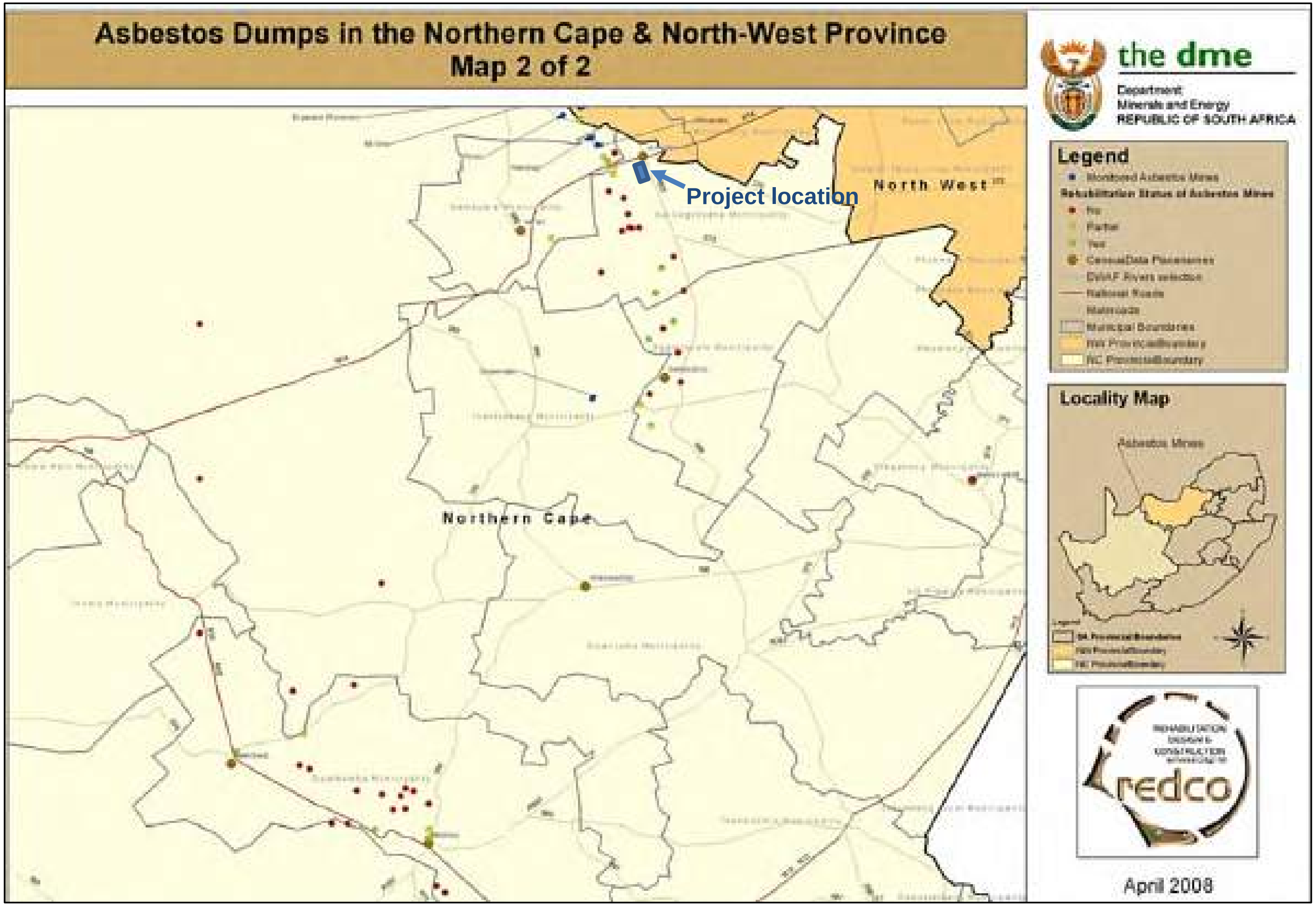
1.3.11 Environmental Sensitivity Map

The quantification of the risk associated with a specific pollution site is a prerequisite for development in any asbestos polluted region (John Taolo Gaetsewe DM, 2017). As indicated in Map 1-7 on the next page, the proposed project site is located in close proximity to some of the previosuely-active asbestos mining activities; however, it is worth noting that (Liebenberg-Weyers, 2010):

- There is no active asbestos mines located on the envisaged project area
- The proposed project is located in close proximity to seven un-rehabilitated asbestos mines
- The proposed project is located near three partially rehabilitated asbestos mines
- The proposed project is situated near three rehabilitated asbestos mines

However, the poor state of rehabilitation of the asbestos industry continues to render previously contaminated areas a serious constraint for development due to the remaining associated health risks (John Taolo Gaetsewe DM, 2017). Un-rehabilitated dumps continue to have the potential to pollute the environment and cause fatal diseases such as mesothelioma.

As stated previously in the report, local government allows minimal land use activities on rehabilitated areas is permitted and does not allow extensive development; the proposed project though is not considered to be an extensive development as it will not be associated with a large number of people present on site for a prolonged duration. Having said this, the risks associated with the proposed development will need to be quantified prior the commencement of the project, as per government requirements.



Map 1-7: Asbestos dumps in the Northern Cape (Liebenberg-Weyers, 2010)

1.4 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO SOCIO-ECONOMIC IMPACTS

The socio-economic impacts are triggered by aspects emanating from the proposed project. These include the following:

- During construction:
  - Procurement of goods and services required for the construction and development of the project
  - Transportation of machinery, equipment and other components from various locations in south Africa to the project site
  - Site clearance
  - Heavy machinery movement on site
  - Wind turbines assembly and installation
  - Road construction
  - Construction of temporary and permanent supporting facilities
  - Hiring of labour - locally and outside the local area
- During operation:
  - Procurement of goods and services required to maintain and operate the wind farm
  - Hiring of labour to support operations and maintenance
  - Visual effect on aesthetics of the place

1.5 IDENTIFICATION OF KEY ISSUES

1.5.1 Key Issues Identified During the Scoping Phase

The following issues were identified during the scoping study and were examined during the EIA phase:

- ***Construction Phase***
  - Increase in economic production due to capital expenditure
  - Temporary employment creation due to construction activities
  - Skills development and enhancement due to construction activities
  - Household income attainment due to employment opportunities
  - Increased demand for housing and social facilities due to influx of migrant labour and job seekers
  - Potential increase in theft related crimes due to high unemployment rate, and increased movement of people in area
- ***Operational Phase***
  - Increase in economic production due to operating expenditure
  - Long-term employment creation due to operation and maintenance activities
  - Skills development and enhancement due to operation activities
  - Household income attainment due to employment opportunities
  - Increase in local government revenue due to rates and taxes
- ***Decommissioning Phase***
  - Local economy stimulation and employment due to decommissioning activities
- ***Cumulative impacts***
  - Increase in production and GDP
  - Employment creation
  - Demographic changes due to influx of job seekers

In order inform the assessment of the potential impacts primary and secondary data were utilised. The primary data gathering for this project was done via telephonic interviews and email questionnaires as these means were indicated to be preferred methods of communication by the key respondents. The interviews took place from the 08th to the 09th of March 2018 and included interviews with the following directly affected land owners:

- Clive Albutt, the owner of the following potentially directly affected farm portions:
    - Portion 2 and 4 of Farm Carrington 440
    - Portion 1 and 2 of Farm Hartland 381
    - Remainder of Farm Woodstock 441
    - Remainder of Farm Rossdale 382
- Sarel Du Plessis, the owner of the following potentially directly affected farm portions:
    - Portion 1 of Farm Bramcot 446

No comments from the Interested and Affected Parties were received during the conduct of this study. Therefore, all impacts identified are based on primary and secondary data as well as previous experience of wind farm impact assessments.

1.5.2 Identification of Potential Impacts

1.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1 Construction Phase Impacts

1.6.1.1 Increase in production and GDP-R due to capital expenditure and investment

The Ga-Segonyana LM economy was valued at R7 101 million in constant prices and has been growing at an average of 3% per year. The municipality is highly dependent on the mining sector; therefore, the proposed project will to some extent offer a diversification and strengthen other sectors including the construction sector which declined by 2.8% in 2016, albeit for a temporary period.

The economic impact arising from the capital investment of R2.4 billion will be felt throughout the economy with windfall effects benefitting related sectors in the economy. The effect is allocated according to direct, indirect and induced impacts, together forming the “multiplier effect”. These spill-over effects spread throughout the economy, contributing to heightened production levels. The initial investment will give rise to a production effect where manufacturers and suppliers of goods and services would experience the need to expand current production levels by ramping up employee numbers and operations. Opportunities for relevant business are thus evident.

Down-the-line effects will produce a consumption-induced effect on the wider economy – as total salaries paid-out rise, consumer expenditure will lift, thereby raising the sales of goods and services in the surrounding economy.

The investment of R2.4 billion will have a considerable effect on production and GDP prior to enhancement measures. The enhancement measures include the procurement of goods and services at the local level to increase the benefit to the host municipality. With the implementation of enhancement measures, the impact will remain high.

1.6.1.2 Temporary employment creation due to construction activities

The unemployment rate is 35% in the Ga-Segonyana LM, which is much higher than that of the district and national level. The overall employment, however, has increased by 16% in the past six years. The proposed project will thus aid this progressive trend as construction phase activities require human capital and it is envisaged that 70% of labour involved in construction will be procured from the local communities.

It is envisaged that about 210 jobs will be created on-site for the duration of the construction activities, which translates to about 315 full-time-equivalent person-years. Since 70% of the above-mentioned jobs is envisaged to be filled by employing local labour, the local municipality's unemployment is expected to be temporarily reduced by 147 people, which equates to 1.4% of the current unemployed population in the municipality.

The creation of 210 temporary jobs will benefit employees in terms of enhanced skills, increased experience and an improved standard of living. To enhance this impact, individuals with relevant skills should be encouraged to apply for construction work associated with the Kuruman WEF and the developers should ensure that the systems and processes enable skilled individuals to access the employment opportunities presented. In addition, a skills desk at the local municipal office and in the nearby communities can be set up to identify skills available in the community and assist in recruiting local labour. Furthermore, a training programme is recommended in order to develop the local skill levels that are largely semi-skilled. This will enable the 70% employability in the local area and additionally decrease the 35% unemployment rate, albeit temporarily. With this enhancement measure applied, the significance of job creation will be intensified.

1.6.1.3 Skills development and enhancement due to construction activities

The Kuruman WEF project represents an important opportunity for locals to increase their participation in the labour market and to acquire critical skills and technical qualifications. A variation of skill sets is required ranging from semi-skilled construction workers to highly skilled engineers. The municipality has close to a fifth of skilled residents and a majority of semi-skilled residents. The semi-skilled level duties are, to an extent, attainable from the local municipality; however, skilled labour will not be fully attainable from the local municipality.

To successfully employ 70% local labour, it is recommended that a focused training programme and skills transfer occur. This will adequately equip employed individuals to effectively conduct required tasks and develop a local skilled construction labour force. All those employed will either develop new skills or enhance current skills. This insinuates that inexperienced workers will have the opportunity to attain and develop new skills, whilst experienced workers will further enhance their current skills.

As production and consumption effects filter through the economy creating a demand for more labour, human resources will be trained and skilled within aligned industries. Ultimately, the wind farm's construction will lead to enhanced skills through training and experience in the wider national economy.

In the case wherein skills development programmes and training take place, the significance of skills development will be high, whereas without focused training, the significance will be moderate.

1.6.1.4 Household income attainment due to employment opportunities

Close to half of the population of the Ga-Segonyana LM are classified as low-income earners. The proposed project provides an opportunity to improve the standard of living for benefitting households, albeit temporary. As indicated above, about 147 jobs will be made available for the local population. Considering that the average household size in the Ga-Segonyana LM is 3.59, it can be deduced that up to 530 people will directly benefit from the proposed activity during construction. The directly benefitting individuals and their respective households will incur an improvement in their standard of living due to the income earned. The income earned also results in increased purchasing power in the local community, given that 70% of the employed will come from the municipality. Therefore, the local business owners and individuals employed at these businesses will also likely to experience some improvement in their income and pass this benefit onto their households.

In order to augment the impact, the employment of 70% local labour is imperative to meet, so as to improve the dire income levels situation in the municipality.

1.6.1.5 Increased demand for housing, services and social facilities due to influx of migrant labour and job seekers

In a country with an unemployment rate of 26.7%, job seekers are continuously in search of employment prospects. Consequently, the knowledge of the proposed project will attract job seekers into the region. In addition, 30% of migrant labour will temporarily locate in the area. This influx, depending on its magnitude, can place pressure on local government to provide housing, services and social facilities. Additionally, in the case where employment expectations are not met, the possibility of informal settlement proliferation is high. Therefore, it is recommended that the recruitment process is well communicated and managed. Furthermore, accommodation options for migrant labour should be given due consideration, in order to avoid the imposition of additional pressure on the local housing market

The transport of equipment, material and commuting personnel to and from the project site will increase vehicle movements on local roads. This movement Is likely to place a strain on road infrastructure – potentially causing roads to deteriorate. Secondary data indicates that inadequate maintenance of roads is already one of the challenges faced by the local residents and businesses. Should the roads not receive the required maintenance, the increased traffic will exacerbate the situation and lead to accelerated degradation of local road infrastructure. The developer will need to engage with the local municipality to discuss various options to mitigate against the potential degradation of roads.

A male-dominated influx tends to exacerbate social ills such as prostitution and alcohol abuse which tarnish the social fabric. This may place a strain on public social facilities such as health care facilities and education facilities, as well as may lead to long-term negative effects such as unwanted pregnancies and addictions. Adequate education for workers on the dangers of substance abuse will be required. A consideration could also be given to support employment of a social worker in the area to reach a wider community. In addition, consultation during the planning phase should be undertaken with the local government to effectively plan for the provision of housing, services and social facilities to meet the potential change in demographics.

1.6.1.6 Potential increase in theft related crimes due to high unemployment rate and increased movement of people in area

As established, the most common incidents in the project area include stock theft, burglary, and theft out of motor vehicle. The influx of labour may exacerbate this status if job expectations are not met. Furthermore, inequality, social ills and insufficient job opportunities have a positive correlation with increase in incidents of various crimes.

The construction phase will create additional movement of people and vehicles to the site, which can also increase the chances of theft in the surrounding properties. This negative impact is moderate and can cause the loss of livestock or valuables. As a counter-action, access to the project site should be controlled wherein only authorised staff are permitted entry. Moreover, movement to and from the project site should be controlled wherein construction workers are transported to and from the pick-up area and project site.

Potential affected parties have indicated their concerns over their safety and the safety of their property. Therefore, it would also be advisable to set up regular engagements with the surrounding community and land owners on issues of safety and crime in the area. It is proposed that the developer considers forming a local safety forum, which will develop solutions suitable to immediate community members with regard to safety and address any concerns related to possible crime escalation. A community watch could also be set up.

1.6.1.7 Potential health risks for employees due to asbestos prevalence in region

The proposed project is located in close proximity to several rehabilitated, partially rehabilitated and un-rehabilitated asbestos mines, all of which continue to pose health risks to surrounding communities and land uses (Liebenberg-Weyers, 2010). Due to the carcinogenic nature of asbestos, numerous diseases can result due to exposure to the asbestos fibres for prolonged periods. Asbestosis is an occupational disease confined to the workplace wherein continuous inhalation of asbestos fibres weakens the lungs. An additional disease linked to asbestos is mesothelioma, which occurs as a result of trivial exposure to asbestos fibres (Journeyman.tv, 2002).

No health statistics in terms of the number of asbestos-related illnesses are available from the local and regional health facilities. Nonetheless, asbestosis was the third killer disease in the region after HIV and TB, which serves an indication of the possibly high prevalence of the disease (Journeyman.tv, 2002). Moreover, secondary impacts emanating from asbestos pollution in the Northern Cape include materials contaminated with asbestos for a variety of purposes such as school playgrounds, sports fields, roads and buildings. Therefore, exposure has been and continues to be rampant for residents.

For the proposed project, therefore, this is a potential negative impact particularly with respect to the exposure of workers during the construction phase of the wind energy facility. From data gathered, it is deduced that prolonged exposure in the area for the workers increases their likelihood of acquiring asbestos-related illnesses but reduces their risks developing asbestosis as they will not be working within the asbestos mines. A portion of the proposed project site is within the asbestos no-go area due to the likelihood of exposure to asbestos. To circumvent the potential health risk posed, it is recommended that an air quality specialist and a health specialist are employed and tasked to determine potential risk levels of exposure and devise an adequate safety and health plan for the employees working on site.

1.6.1.8 Increase in government revenue due to rates and taxes

In 2017/18, government revenue experienced a considerable shortfall with the revenue gap growing from R30.7 experienced in 2016/17 to R48.2 billion (NT, 2018). The shortfall was largely attributed to lower income tax, VAT and customs duties collected as a result of slowing wage increases, weaker consumer spending, and lower import growth (NT, 2018). The situation therefore is considerably grimmer than that observed during the 2008 financial crisis with the gross debt-to-GDP ratio increasing from 26.0% in 2008/09 to unprecedented 53.3% (NT, 2018).

Although, collection of tax is also dependent on tax morality in the country, a vibrant growth stimulated by investment into the economy contributes to the growth of the tax base and leads to increase in gross tax revenue. The project will see an investment of R2.4 billion, some of which will be spent on imported goods and services, and some will be spent on goods and services procured in the country. As a result, the project is likely to lead the increase in import tax collections, VAT collections, and personal and company tax collection.

Although the spending of the money earned by government through tax collection is difficult to associate with a specific budget item, any revenue received by national government is allocated towards certain budget items, provinces or local municipalities to support and assist with the improvement of their service delivery. Thus, without a doubt this revenue will assist government in the improvement of socio-economic conditions for residents.

1.6.2 Operation Phase Impacts

1.6.2.1 Increase in production and GDP-R due to operation expenditure

The operations and maintenance of the proposed wind farm will cost about R80 million per annum. These costs will be spent on procurement of spares, maintaining the facilities, security, and other line items. Additional and new business sales will be created as a result of the indirect multiplier effect stimulated by the operating activities of the wind farm. The long-term number of business sales and production will have moderate significance as an increase in business sales will take place. To enhance the positive impact on the local area, procurement of selected goods and services from local businesses will serve to boost the local economy. Nonetheless, the enhancement measure will not alter the significance rating but rather concentrate benefits to the local area, which is in need of the consistent injection of expenditure.

1.6.2.2 Long-term employment creation due to operation and maintenance activities

Operations and maintenance of the wind farm will lead to the creation of 17 permanent employment opportunities, majority of which will be of technical nature. It is advisable that as many of these jobs as possible are filled by individuals from the local communities. This may require identifying prospective candidates at the construction phase and up-skilling them in time for the project to start operations. Sending them for on-job training or internships at other wind farms owned by the developer could be considered. Alternatively, skills transfer programmes should be put in place to ensure that all jobs created on site during operations are eventually passed onto the individuals from the local communities.

1.6.2.3 Skills development and enhancement due to operation activities

Skills are imperative for satisfying job requirements and adequately performing tasks that ultimately boost the economy. It is envisaged that about 17 jobs will be created. Employees who are new to the market will develop and attain new skills, whilst workers adept in particular skills will sharpen their abilities. In addition, the employees will improve their marketability for future employment and will be perceived positively by future employers. Successful training and development programmes will develop labour capability in wind farm skills within the region.

The employment opportunities are for a long-term period of 20 years and are thus sustainable and will have a positive impact on skills for benefitting employees, although the quantity is minor.

1.6.2.4 Household income attainment due to employment opportunities

Household earnings are linked closely with trends in employment and, as such, will be affected positively by the envisaged small increase in employment. The creation of employment during the 20-year operation period will provide sustainable earnings for 17 benefitting households. Resultantly, an improvement in the standard of living based on the additional income will accrue. A portion of this income will be earned by households residing in the local communities, thus positively impacting the local economy. This will improve the current income profile of the Ga-

Segonyana LM, which is dominated by low-income earners and could lessen the dependence of selected local households on social grants.

1.6.3 Decommissioning Phase Impacts

1.6.3.1 Local economy stimulation and job creation due to decommissioning costs

The lifespan of the wind farm is 20 years; thereafter the termination of the project will take place. A certain amount will be allocated towards the dismantling and uninstallation of the wind farm. This expenditure on closure activities will generate positive impacts on production, GDP, employment and household income, albeit relatively small and for a temporary period. Decommissioning activities will stimulate demand for services of transport and construction companies, amongst others. Resultantly, the local economy will be stimulated for the duration of the decommissioning phase. Decommissioning expenditure such as the disassembly of components will increase the demand for construction services and services offered by other industries.

Some of the project components will be of recyclable value and therefore will also bring some income to the owner. Importantly, the recovery of valuable metallic and non-metallic materials will lead to the generation of revenue for the owner and allow for savings in production costs of companies that will use the recovered materials in their processes.

In addition to the stimulus of the economy, a number of employment opportunities will be created on site of workers who will need to be involved in decommissioning and de-construction activities.

1.6.4 Cumulative Impacts

The extent to which a proposed project will influence the zone of influence is based on the baseline conditions of that environment, which includes other constructed and proposed projects in the zone. Such projects, depending on their timing in relation to the project which is the subject of this impact study, may influence the manifestation and significance of socio-economic impacts that could result from the current project. As such, knowledge of such projects is required in order to accurately predict and rate socio-economic impacts.

The Department of Environmental Affairs and Tourism’s guidelines (DEAT, 2004) suggest that the identification of cumulative effects should focus on important and meaningful issues as “it is not practical to analyse the cumulative effects of an action on every environmental receptor”. Furthermore, it is advised that the analysis should focus on “what is needed to ensure long-term productivity or sustainability of the resource” (DEAT, 2004).

Considering the above, the expected cumulative impacts assessed are:

- Negative:
  - Influx of migrant labour and job seekers placing pressure on services and social facilities
- Positive:
  - Job creation
  - Economic stimulus and GDP growth
  - Change in sense of place

1.6.4.1 Influx of migrant labour and job seekers placing pressure on government to provide housing, services and social facilities

There is a total of 21 renewable energy projects that are proposed (and some already approved), which are located within a 50 km radius from the site of the proposed wind farm. In the case that the proposed projects are constructed and operate at a similar time period, a large number of migrant labour will have to be accommodated in the area. Further to this, job seekers will be drawn to the area due to the numerous job opportunities anticipated from the many developments. This influx of people could lead to a notable shift in demographics in the region. As a result, additional housing, services and the use of social facilities will be required. Given the current backlog in the municipality, it can be said that a significant pressure will be placed on local government to adequately provide for the increased demand. The situation could be exacerbated if the municipality continues experienced challenges with the collection of revenue.

1.6.4.2 Employment creation due to numerous developments

To conduct and fulfil objectives of all proposed and authorised development, labour will be required. This requirement denotes that employment will be created. The exact number of employment opportunities to be made available by the 20 projects is not known, but it can be stated with confidence that the combined figure would contribute to a notable increase in employment figures. This positive impact can be augmented in the case that the majority of labour is sourced locally, which will then considerably reduce the 35% unemployment rate in the Ga-Segonyana LM.

1.6.4.3 Stimulation of economy due to capital and operating expenditure from projects

The injection of investment from all proposed projects will have a multiplier effect on the economy, wherein numerous economic sectors such as the transport and manufacturing will benefit. The combined expenditure will be colossal and will have a notable impact on GDP and production. Local business will not have the capacity to supply all required services and materials; therefore, the local economy will only benefit to a limited extent. Nonetheless, the GDP of the Ga-Segonyana will increase as a result of these projects.

1.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in the tables below.

Table 1-5: Impact assessment summary table for the Construction Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk: Without Mitigation/ Management	Significance of Impact and Risk: With Mitigation/ Management (Residual Impact/ Risk)	Ranking of Residual Impact/ Risk	Confidence Level
Construction Phase													
Direct Impacts													
Increase in production and GDP-R	Economy will be stimulated due to capital investment and resultant increased production	Positive	National	Medium-term	Severe	Very likely	High reversibility	Replaceable	Procure goods and services, as far as practically possible, from the local municipality.	High	High	2	High
Temporary employment creation	Unemployment figures will slightly decrease due to jobs created	Positive	National	Medium-term	Moderate	Very likely	High reversibility	Replaceable	Advise on the set-up of a skills desk and where it will be situated. Offer training to increase employability.	Low	Low	5	High
Skills development and enhancement	Skills levels in municipality and for benefitting individuals will improve due to employment created.	Positive	National	Long term	Moderate	Likely	Low reversibility	Low irreplaceability	Devise and implement skills training and skills transfer.	Low	Moderate	2	High
Indirect Impacts													

Construction Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Household income attainment	Employment due to wind farm construction work will result in household income earnings for benefitting households.	Positive	National	Medium term	Moderate	Very likely	High reversibility	Replaceable	Hire majority of local residents who will boost local economy through expenditure that empowers local businesses and economy.	Low	Low	5	High
Increased demand for housing, services and social facilities	The in-migration of migrant labour and job seekers will place pressure on local government to adequately provide housing, services and social facilities.	Negative	Regional	Medium term	Moderate	Likely	Moderately reversible	Moderate irreplaceability	Manage recruitment process to control expectations and unnecessary in-migration. Ongoing consultation should be undertaken with the local government to effectively plan for the influx. Adequate education for workers on the dangers of substance abuse.	Low	Very Low	4	Medium

Construction Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Increase in theft related crimes	The increased number of people on site creates potential for theft, particularly livestock theft.	Negative	Local	Medium term	Substantial	Likely	Low reversibility	High irreplaceability	Implement controlled access to project site and monitor activity in immediate surrounding sites. Set up local community safety forum.	Moderate	Low	5	High
Potential health risks for employees due to asbestos prevalence	Hazardous emissions from inactive asbestos mines pose a health risk for personnel that will be working on site.	Negative	Regiona l	Medium term	Slight	Unlikely	Low reversibility	Moderate irreplaceability	Undertake a health risks assessment to quantify the potential risks associated with the possible pollution of the site by asbestos; Formulation of an adequate safety and health plan for the employees working on site..	Very low	Very low	4	Medium

Construction Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Increase in government revenue	The rates, payroll taxes and Value Added Tax paid to local government will increase government revenue	Positive	National	Short-term	Moderate	Very likely	Highly reversible	Replaceable	No enhancement measures applicable.	Low	Low	5	Medium

Table 1-6: Impact assessment summary table for the Operational Phase

Operational Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Direct Impacts													
Increase in production and GDP-R	Expenditure associated with the operation of the wind farm will impact on production in the economy.	Positive	National	Long-term	Substantial	Very likely	High reversibility	Replaceable	Maximise benefit for local economy through local procurement.	Moderate	Moderate	3	High

Operational Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Long term employment creation	Operation and maintenance activities will create long term job opportunities.	Positive	Regional	Long-term	Slight	Very likely	High reversibility	Replaceable	Offer skills development programme to serve energy market in region and create local employability.	Very Low	Very Low	5	High
Skills development and enhancement	Skills levels in municipality and for benefitting individuals will improve due to employment created	Positive	Regional	Long-term	Slight	Likely	Low reversibility	High irreplaceability	Offer skills development programme to serve energy market in region and create local employability	Very low	Very low	3	High
Indirect Impacts													
Household income attainment	Employment in operations and maintenance of the windfarm will result in household income earnings for benefitting households.	Positive	Regional	Long-term	Slight	Very likely	High reversibility	Replaceable	Employing locally will increase benefit to local households and inadvertently the local economy.	Very low	Very low	5	High

Table 1-7: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Direct Impacts													
Local Economy stimulation and job creation	The cost of the removal and disconnection of the wind turbines will stimulate economic activity.	Positive	Regional	Short term	Slight	Very Likely	High reversibility	Replaceable	Develop and implement a material recovery strategy to optimise use of valuable material.	Very low	Very low	4	High

Table 1-8: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Influx of job seekers and migrant labour causing pressure	The influx into the region will possibly be immense due to the numerous projects in the area	Negative	Regional	Medium term	Substantial	Very Likely	Moderate reversibility	Low irreplaceability	Manage recruitment process to control expectations. Engage with local government	Moderate	Low	4	Medium

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
on local government service provision	attracting migrant job seekers. This will increase the demand for services.								during planning stages for adequate preparation to took place.				
Employment creation	The numerous projects will create a notable number of jobs	Positive	National	Long-term	Severe	Likely	Moderate reversibility	Replaceable	Offer skills development programme to serve energy market in region and create local employability.	High	High	2	High
Stimulation of Economy	Capital and operating expenditure of numerous projects will increase production in the economy.	Positive	National	Long-term	Extreme	Likely	High reversibility	Replaceable	Procure goods and services, as far as practically possible, from the local municipality.	High	High	2	High

1.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

Mitigation Measure	Key monitoring recommendations	Applicable phases
Procure goods and services, as far as practically possible, from the local municipality.	• Run a supplier day in Kuruman and identify prospective companies to engage with during construction and operation • Keep record of companies and businesses supplying goods and services • Calculate split percentage of local and national/international companies	• Construction • Operation • Decommissioning
Manage recruitment process to control expectations and unnecessary in-migration and increase local labour hire	• Skills desk set up in the Kuruman • Advertisement published • Skills review and prospective candidates contacted • Candidates interviewed and decision on employment made • Keep record of employee details including addresses as part of HR administration processes • Calculate split percentage of local and migrant labour at the beginning of each phase	• Construction
Provide focused training and skills transfer	• Create a skills requirement for both construction and operation • Identify potential candidates and their gaps in skills required • Develop necessary training programmes • Engage in training • Assess quality of work of trained individuals before and after training	• Construction • Operation
Engage with local government to advise on the potential demand for local infrastructure	• Ongoing consultation with key government officials to inform trends in service delivery • Track service delivery backlog figures bi-annually to determine the growth or decline of backlogs	• Construction
Curb potential increase in social ills	• Devise an awareness campaigns aimed at educating workers on the dangers of substance abuse will be required • Regularly conduct campaigns and keep track of attendance by workers • Review the effectiveness of the campaigns by undertaking independent evaluations • Set up a local safety forum • Devise a schedule for forum meetings and appoint a administrator • Keep attendance register, issues raised, and issues resolved	• Construction
To circumvent the potential health risk posed, it is recommended that an air quality specialist and a health specialist are employed and tasked to determine potential risk levels of exposure and devise an adequate safety and health plan for the employees working on site.	• Employment of a health and air quality specialists • Undertaking a health risks assessment • Devise a health and safety plan •	• Construction
	• Continuous monitoring of implementation of the health and safety plan	• Construction • Operation • Decommissioning

1.9 CONCLUSION AND RECOMMENDATIONS

Mulilo Renewable Project Developments proposes to develop the Kuruman Phase 1 Wind Energy Facility. The project is planned to be located in the Ga-Segonyana Local Municipality of the Northern Cape, near Kuruman. The project footprint will affect six farm portions and erect 47 wind turbines each producing 4.5 MW – 5.5 MW of power.

The review of key national, provincial and local policy documents and strategies indicates that the development of a wind farm is supported across all scales. The Northern Cape Provincial Spatial Development Framework further posits that the province holds a potential comparative advantage because of the regular occurrence of strong winds which could be a source of renewable energy, more specifically for sustainable electricity production. After considering the reviewed documentation, one red flag was raised with regard to the asbestos prevalence in the region and that a portion of the proposed site is located in the no-go asbestos area. Other than that, no fatal flaws or contraventions from a socio-economic policy perspective exist for the implementation of the proposed project.

The Ga-Segonyana Local Municipality has had stagnant population growth in the past five years which is largely attributed to push factors such as the closure of mines and limited economic opportunities. The municipality has a 35% unemployment rate and is largely comprised of low-income earners. Furthermore, it contributes a quarter to the John Taolo Gaetsewe District Municipality’s GDP and has experienced a positive growth rate in recent years.

The proposed Kuruman wind energy facility, will usher in notable positive impacts and contribute to the improvement in some of the main challenges experienced in the region. This includes the injection of expenditure which will stimulate production, create business opportunity and boost the economy. Furthermore, 70% of jobs created during construction will be made available to local labour which will alter the unemployment issue, lead to household income and enhance skills development. Numerous stakeholders will evidently benefit, such as business, the community and government. Government revenue will be accrued and will most likely aid socio-economic development.

On the contrary, negative impacts are also expected to ensue. The employment opportunities serve as a pull factor and will most likely attract job seekers. Further to this migrant labour will need to be accommodated in the area. This culmination will result in an increased demand for services, housing and social facilities. This is exacerbated by the additional 20 similar projects authorised and proposed in the region. The increased number of vehicular and pedestrian traffic on the proposed project site may potentially lead to stock theft.

Nonetheless, the net effect of the proposed project is positive as it ultimately leads to improved energy supply, increased energy security and indicates a path towards clean energy generation, which the country is in need of to curb climate change. This subsequently contributes to improved service delivery and socio-economic development. To improve the positive impact particularly for the local municipality, it is highly recommended that local procurement and employment is concentrated herein, as far as is feasible. From a socio-economic perspective therefore, no objections are made with regard to the proposed project.

The following table summarises the reviewed socio-economic impacts and provides an indication of the significance before and after mitigation.

Table 1-9: Summary of socio-economic impacts

Socio-economic impact		Impact significance without mitigation	Impact significance with mitigation
Construction Phase			
Direct	Increase in production and GDP	High (+)	High (+)
	Temporary employment creation	Low (+)	Low (+)
	Skills development	Low (+)	Moderate (+)
Indirect	Attainment of household income	Low (+)	Low (+)
	Increased demand for services	Low (-)	Very Low (-)
	Potential increase in criminal activity	Moderate (-)	Low (-)
	Potential asbestos related health risks	Very low (-)	Very low (-)
	Government revenue	Low (+)	Low (+)
Operations phase			
Direct	Increased production and GDP	Moderate (+)	Moderate (+)
	Long-term employment creation	Very low (+)	Very low (+)
	Skills development	Very low (+)	Very low (+)
	Improved energy supply	Low (+)	Low (+)
Indirect	Sustainable household income	Very Low (+)	Very low (+)
Decommissioning Phase			
Local economy stimulation		Very low (+)	Very low (+)
Cumulative Impacts			
Increased production and GDP		Moderate (+)	Low (+)
Employment creation		High (+)	High (+)
Influx of migrant labour and job seekers		High (-)	High (-)

1.10 REFERENCES

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1.11 APPENDICES

SOILS AND AGRICULTURAL POTENTIAL ASSESSMENT:

Scoping and Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

EIA REPORT

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services	Johann Lanz – Soil Scientist
PO Box 320	P.O. Box 6209
Stellenbosch	Stellenbosch, 7599
7600	South Africa

9 July 2018

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1999
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: Aurecon; CSIR; SiVEST; SRK Consulting; Juwi Renewable Energies; Mainstream Renewable Power; Subsolar; Tiptrans; Planscape; Afrimat; Savannah Environmental; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Haw & Inglis.

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; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; Goedgedacht Olives;, Lourensford Fruit Company; Kaarsten Boerdery; Wedderwill Estate; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

I have conducted several research projects focused on conservation farming, soil health and carbon sequestration.

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.

Name of Specialist: Johann Lanz

Signature of the specialist: 

Date: 9 July 2018

Executive summary

The proposed Kuruman Phase 1 Wind Farm Facility will be 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 land that may be valuable for cultivation. This assessment has found that the proposed development is on land which is of low agricultural potential and is unsuitable for cultivation.

The key findings of this study are:

- Soils of the proposed wind farm site are dominated by rock outcrops and shallow, sandy, red soils on underlying rock, which are of the Hutton soil form.
- The major limitations to agriculture are the shallow, rocky soils and the limited climatic moisture availability.
- As a result of these limitations, the study area is totally unsuitable for cultivation and agricultural land use is limited to grazing.
- The wind farm footprint impacts predominantly on land capability evaluation values of between 1 and 4, which are very low to low.
- 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 of the wind farm constitutes only a very small proportion of the available grazing land. The second is the fact that the proposed site is on land of limited agricultural potential that is only viable for grazing.
- Five potential negative impacts of the development on agricultural resources and productivity were identified as:
    - Loss of agricultural land use caused by direct occupation of land by the development footprint;
    - Loss of topsoil in disturbed areas, causing a decline in soil fertility;
    - Soil erosion caused by alteration of the surface characteristics;
    - Degradation of veld vegetation beyond the direct development footprint; and
    - Cumulative regional loss of agricultural land use and potential.
- One potential positive impact of the development on agricultural resources and productivity was identified as:
    - Generation of alternative / additional land use income through the wind farm, which will improve cash flow and financial sustainability of farming enterprises on site.
- All impacts were assessed as having **low or very low significance**.
- Cumulative impact is also assessed as low. Furthermore it is far more preferable to incur a 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.

- Recommended mitigation measures include implementation of an effective system of storm water run-off control and the maintenance of vegetation cover to mitigate erosion; topsoil stripping and re-spreading to mitigate loss of topsoil; restricted vehicle access; and dust control.
- Due to the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.
- There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation, should this be granted.
- The overall significance of the impact on agriculture for the construction, operation and decommissioning phase is assessed as **very low**.

Table of Contents

List of figures

List of Tables

Table 1: Compliance with the Appendix 6 of the 2014 EIA Regulations (as Amended)

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 Title page CV in the beginning of report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 3
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1 & 1.1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.3.6 & 1.6.4
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.3.4, 1.3.8 & Figure 3
g) an identification of any areas to be avoided, including buffers;	Section 1.3.8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3, Section 1.3.4
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 1.6
k) any mitigation measures for inclusion in the EMPr;	Section 1.8
l) any conditions for inclusion in the environmental authorisation;	Section 1.9.2
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 1.9 Section 1.8
2. a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable

1.1 Introduction and methodology

1.1.1 Scope and objectives

This report presents the Soil and Agricultural Potential Assessment undertaken by Mr. Johann Lanz (an independent consultant), appointment by the CSIR, as part of the Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Farm near Kuruman, Northern Cape Province (see Figure 1.)

The objectives of the 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 potential impacts.

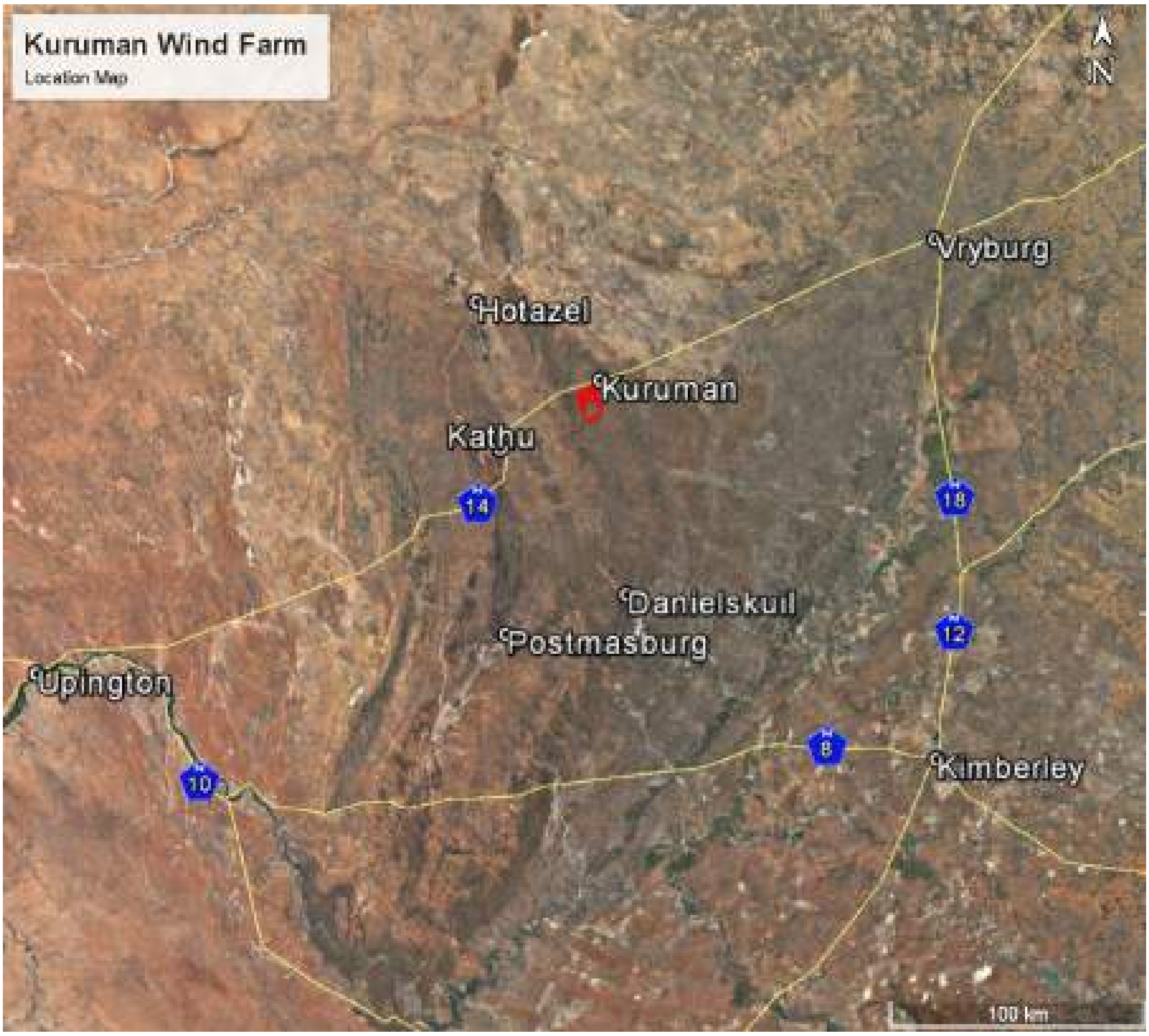

Figure 1: Location of the proposed Kuruman Wind Farm Facility, south west of Kuruman in the Northern Cape.

1.1.2 Terms of Reference

The following Terms of Reference (ToR) apply to this study:

The report fulfils the ToR for an agricultural study as set out 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. DEA's requirements for an agricultural study are taken directly from this document, but use an older version of the document and not the most recent version, which was updated in 2011.

The study applies an appropriate level of detail for the agricultural suitability on site and for the level of impact of the proposed development on agricultural land. A detailed soil survey, as per the requirement in the above document, is appropriate for a significant footprint of impact on arable land. It is not appropriate for this site, where soil and climate constraints make cultivation completely non-viable. Conducting a soil survey at the required level of detail would be very time consuming but would also be unnecessary as it would add no value to the impact 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.

The above requirements together with requirements for an EIA specialist report may be summarised as follow:

- Based on existing data as well as a field soil survey, 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 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 and map the agricultural potential across the site.
- Determine and map the agricultural sensitivity to development across the site, including "no-go" areas, setbacks/buffers, as well as any red flags or risks associated with soil and agricultural impacts.
- Identify relevant legislation and legal requirements relating to soil and agricultural potential impacts.
- Identify and assess all potential impacts (direct, indirect and cumulative) of the construction, operational and decommissioning phases of the proposed development on soils and agricultural potential, and note the economic consequences of the proposed development on soils and agricultural potential.
- Provide recommended mitigation measures, management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts.

1.1.3 Approach and Methodology

The pre-fieldwork assessment was based on the existing Agricultural Geo-Referenced Information System (AGIS) data, as well as Google Earth satellite imagery for the site. 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 exposures. The field assessment was done on 20 February 2018, during summer. 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 the timing of the assessment therefore has no bearing on its results. Soils were classified according to Soil Classification Working

Group (1991).

The field investigation also included a visual assessment of erosion and erosion potential on site, taking into account a probable development layout. The level of field investigation for this assessment is considered more than adequate for the purposes of this study (see section 1.1.2).

The potential impacts identified in this specialist study have been assessed based on the criteria and methodology outlined in Chapter 6 of the Draft EIA Report. The ratings of impacts are based on the specialist's knowledge and experience of the field conditions and the impact of disturbances on those.

1.1.4 Assumptions, knowledge gaps and Limitations

The following assumptions were used in this specialist study:

- The study assumes that 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.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Appendix B.

The following limitation was identified in this study:

- 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 limitations or knowledge gaps relevant to this study.

1.1.5 Source of information

All data on land types, land capability, grazing capacity etc. was sourced from the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, 2007). Current and historical satellite imagery was all sourced from Google Earth. Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal (2015).

Soil data on AGIS originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.

Land capability data was sourced from DAFF (2017).

1.2 Applicable legislation and permit 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 (Act 70 of 1970) (SALA). This is required for long term lease, even if no subdivision is required. Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). No application is required in terms of CARA. The EIA process covers the required aspects of this. The Department of Agriculture, Forestry and Fisheries (DAFF) 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.

1.3 Description of the affected environment: Soils and agricultural capability

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 1.1.2 of this report.

A satellite image map of the study site is given in Figure 3 and photographs of site conditions are given in Figures 4 to 7.

1.3.1 Climate and water availability

The site has a low rainfall of 400 mm per annum (The World Bank Climate Change Knowledge Portal, 2015). The average monthly rainfall distribution is shown in Figure 2. The low rainfall is a significant agricultural constraint that limits the level of agricultural production (including grazing) which is possible.

There are wind pumps with stock watering points across the area, but no other water or water storage infrastructure.

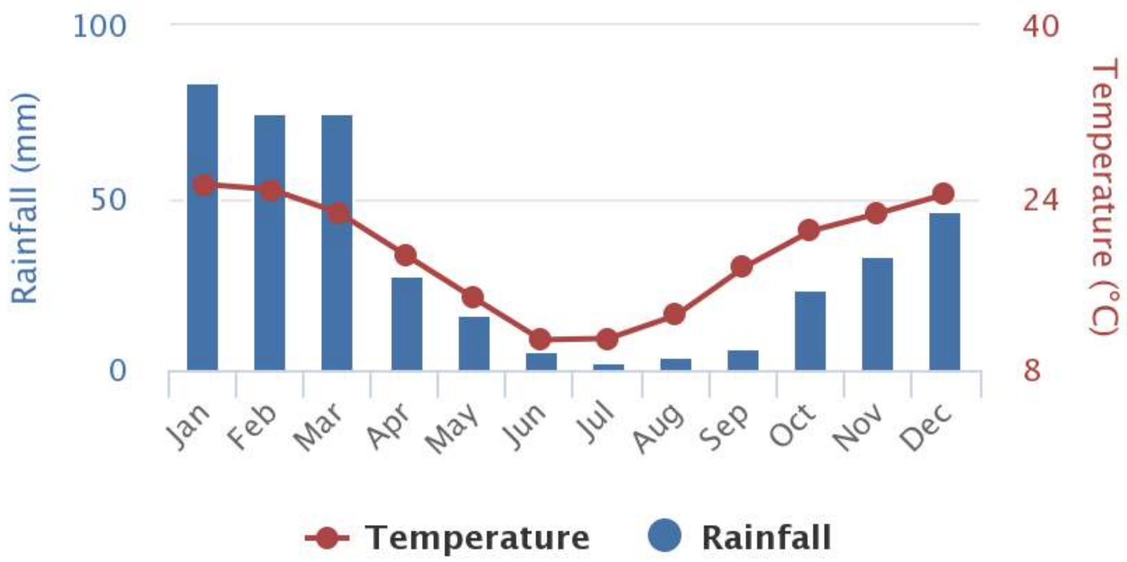

Figure 2: Figure 2. Average monthly temperature and rainfall for location (-27.59, 23.40) from 1991 – 2015 (The World Bank Climate Change Knowledge Portal. 2015).

1.3.2 Terrain, topography and drainage

The turbines of the proposed development are located on a series of hilly, north-south running ridges which rise from the plateau, at an altitude of approximately 1,400 metres, to a maximum altitude of over 1,700 meters. Slopes vary across the area, with maximum slopes of 35% down the sides of the ridges where they are steepest. The maximum slopes that would be impacted by any project footprint are however much less and are not likely to exceed 15%.

The underlying geology of the area is yellow-brown banded or massive jaspilite with crocidolite, and banded ironstone with subordinate amphibolite, crocidolite and ferruginous brecciated banded ironstone.

No perennial drainage features occur on the site, but there are non-perennial drainage lines in the valley bottoms.

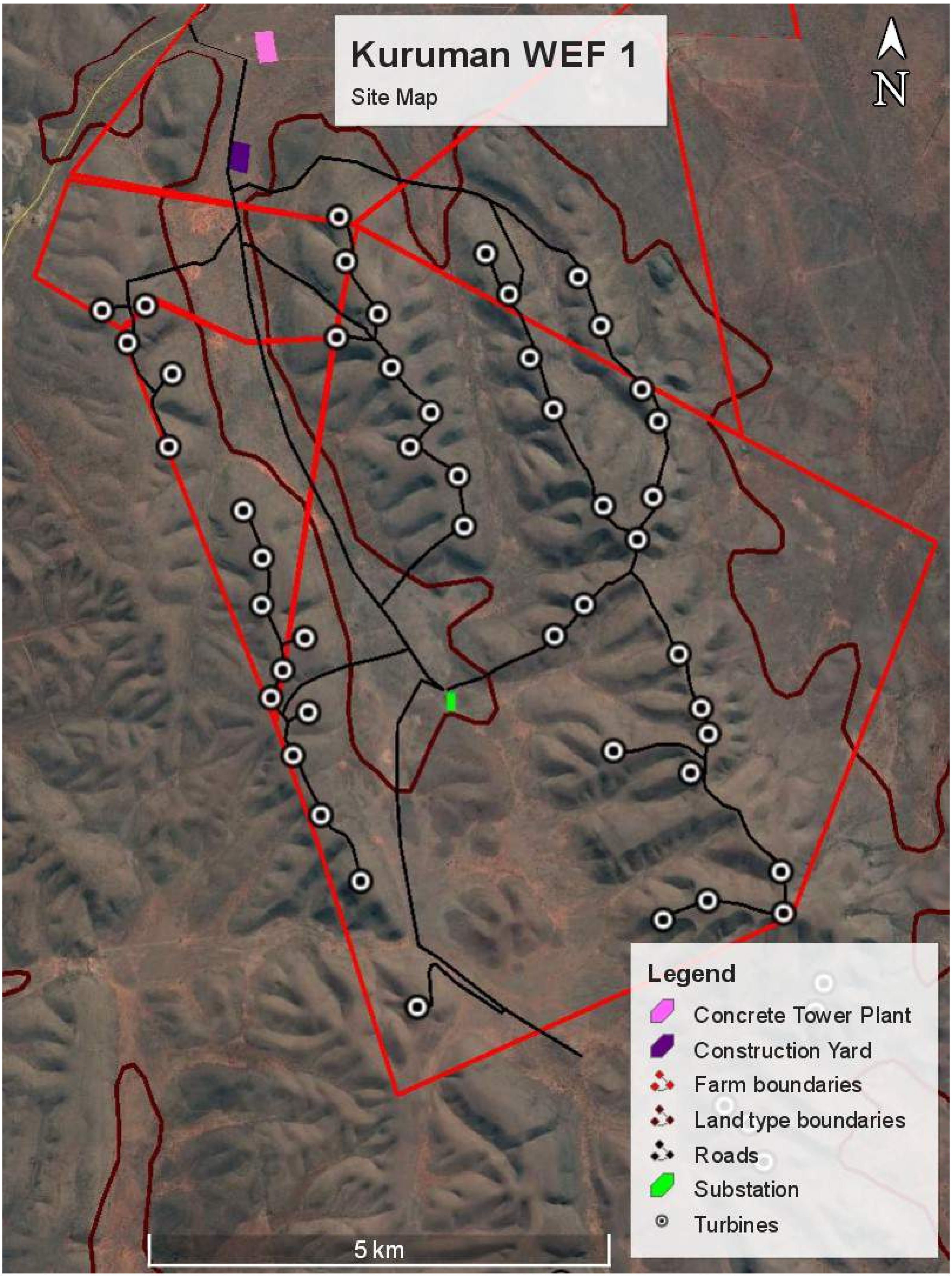

Figure 3: Satellite image site map of the proposed Kuruman Wind Farm showing land type distribution.

Figure 4: Photograph showing typical landscape and veld conditions of the proposed wind farm site. Turbines will be restricted to the tops of the higher lying hills and ridges.

Figure 5: Photograph showing typical landscape and veld conditions of the proposed wind farm site. The commonly occurring rock outcrops are clearly visible in the foreground.

Figure 7: Photograph showing the typical red, sandy soils that occur between rock outcrops on the proposed wind farm site.

not only on the higher ground. Some wind farm support infrastructure will be located in the valleys, but most infrastructure will be located on the hills and ridges.

1.3.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There is predominantly only one land type, Ib236, across the hilly terrain of the site, with a second, Ae2, extending a small distance into the site, up some of the largest valleys.

Land type Ib236 is dominated (71% of the surface) by rock outcrop. The soils between the rock outcrops are red, sandy soils on underlying hard rock, of the Hutton soil form. They are predominantly shallow, but patches of deeper sands occur. The soils of Ae2 are shallow to deep, red, sandy soils on underlying rock or hardpan carbonate and are of the Hutton or Plooysburg soil forms. The soils would fall into the Oxidic and Calcic (underlying hardpan carbonate) soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in Appendix B, Table B1. The field investigation confirmed that the dominant soil types are as described in the land type data.

The environment does not pose a particularly high erosion risk. Mitigating factors are the rock outcrops, permeability of the sandy soils and adequate vegetation cover. However, any surface disturbance always poses an erosion risk. Because the soils have a sandy texture, they are susceptible to wind erosion.

1.3.4 Agricultural capability

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land, or at the lowest extreme, not even suitable for grazing. In 2017 DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Values of below 8 are generally not suitable for production of cultivated crops. Detail of this land capability scale is shown in Table 2.

The proposed project area is classified with a range of land capability evaluation values of between 1 and 6. Values of 5 and 6 are confined to the bottom of the valleys where not much of the wind farm infrastructure is located. The wind farm footprint therefore impacts largely on land capability evaluation values of between 1 and 4 only. The land capability of the project area is therefore classified as being entirely unsuitable for the rain fed production of cultivated crops. The land capability is limited by the shallow, rocky soils, but even in the patches of deeper soils, land capability is still very limited by the climatic moisture availability.

The grazing capacity of the area is classified at approximately 20 hectares per large stock unit.

Table 2: Details of the 2017 Land Capability classification for South Africa.

Land capability evaluation value	Description
1	Very Low
2	
3	Very Low to Low
4	
5	Low
6	Low to Moderate
7	
8	Moderate
9	Moderate to High
10	
11	High
12	High to Very High
13	
14	Very High
15	

1.3.5 Land use and development on and surrounding the site

The area is a cattle farming area. The climate does not support any cultivation and grazing is the only viable agricultural activity. The only agricultural infrastructure present on site is wind pumps, stock watering points and fencing surrounding grazing camps. The only farmstead within the study area exists on the plains to the north of the proposed wind farm infrastructure.

Access to the site is by way of farm access roads off the nearest public road to the northwest.

1.3.6 Status of the land

The vegetation has been grazed but there is no significant erosion or other land degradation on the site.

1.3.7 Possible land use options for the site

The low climatic moisture availability and shallow, rocky soils mean that grazing is the only possible agricultural land use for the site.

1.3.8 Agricultural sensitivity

Agricultural potential and conditions are very uniform across the site 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 sensitive agricultural areas occur within the study area. From an agricultural point of view, no parts of the site need to be avoided by the proposed development and no buffers are required.

1.4 Description of project aspects relevant to agricultural impacts

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

- Occupation of the land by the total physical footprint of the proposed project including all turbines, hard stands, roads and electrical infrastructure.
- Construction activities that may disturb the soil profile and vegetation, for example for levelling, excavations, etc.

The facility will comprise the following infrastructure:

- Turbines with foundations;
- Hard standing areas for crane usage per turbine;
- Internal gravel roads linking turbine locations.
- On-site substation;
- Operation and maintenance building;
- Concrete tower plant;
- Temporary site offices, construction camp area, and lay down areas;
- Cabling between turbines to be laid underground wherever practical; and
- Stormwater channels and culverts.

1.5 Identification of key issues

1.5.1 Identification of potential impacts

The potential impacts identified during the assessment are:

1.5.1.1 Construction phase

- Loss of agricultural land use;
- Soil erosion;
- Loss of topsoil; and
- Degradation of veld vegetation.

1.5.1.2 Operational phase

- Loss of agricultural land use;
- Generation of alternative land use income; and
- Soil erosion.

1.5.1.3 Decommissioning phase

- Loss of agricultural land use;
- Soil erosion;
- Loss of topsoil; and
- Degradation of veld vegetation.

1.5.1.4 Cumulative impact

- Regional loss of agricultural land.

1.6 Assessment of impacts and identification of management actions

The significance of all potential agricultural impacts is low due to two important factors.

1. The actual footprint of disturbance of the wind farm (including associated infrastructure and roads) is very small in relation to the land available for grazing on the affected farm portions (<2% of the surface area). All agricultural activities will be able to continue unaffectedly on all parts of the farm other than the small development footprint for the duration of and after the project.
2. The proposed site is on land of limited agricultural potential that is only viable for grazing. These factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

All identified impacts are considered to be direct impacts. No indirect impacts were identified.

1.6.1 Construction phase

1.6.1.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of the land by all development infrastructure. It results in affected portions of land being taken out of agricultural production. This applies to the direct footprint of the development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area. During the construction phase there will be slightly more disturbance, due to temporary lay down areas and construction camps.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable

1.6.1.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.
Mitigation Required	Implement an effective system of storm water run-off control. Maintain, where possible, all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.1.3 Loss of topsoil

Aspect / Activity	Activities that disturb the soil profile.
Type of impact	Direct
Potential Impact	Loss of topsoil can result from poor topsoil management (burial, erosion, etc) during construction related soil profile disturbance (levelling, excavations, road surfacing etc.). It will result in a decrease in the soil's capability for supporting vegetation.
Mitigation Required	Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.1.4 Degradation of veld vegetation

Aspect / Activity	Vehicle traffic and dust generation
Type of impact	Direct
Potential Impact	Degradation of veld vegetation can occur beyond the direct footprint of the development due to vehicle trampling and dust deposition.
Mitigation Required	Control vehicle passage and control dust
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.2 Operational phase

1.6.2.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of the land by all development infrastructure. It results in affected portions of land being taken out of agricultural production. This applies to the direct footprint of the

	development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Not applicable

1.6.2.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.
Mitigation Required	Implement an effective system of storm water run-off control. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.2.3 Additional land use income

Aspect / Activity	Project land rental
Type of impact	Direct
Potential Impact	This is a positive impact for agriculture. Alternative / additional land use income will be generated by the farming enterprise through the lease of the land for the WEF. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability.
Mitigation Required	None

Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not Applicable

1.6.3 Decommissioning phase

1.6.3.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of the land by all development infrastructure. It results in affected portions of land being taken out of agricultural production. This applies to the direct footprint of the development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area. During the decommissioning phase there is more disturbance.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable

1.6.3.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.
Mitigation Required	Implement an effective system of storm water run-off control. Maintain where possible all vegetation cover and facilitate re-vegetation of

	denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.3.3 Loss of topsoil

Aspect / Activity	Activities that disturb the soil profile.
Type of impact	Direct
Potential Impact	Loss of topsoil can result from poor topsoil management (burial, erosion, etc) during construction related soil profile disturbance (levelling, excavations, road surfacing etc.). It will result in a decrease in the soil's capability for supporting vegetation.
Mitigation Required	Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.3.4 Degradation of veld vegetation

Aspect / Activity	Vehicle traffic and dust generation
Type of impact	Direct
Potential Impact	Degradation of veld vegetation can occur beyond the direct footprint of the development due to vehicle trampling and dust deposition.
Mitigation Required	Control vehicle passage and control dust
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.4 Cumulative impacts

Cumulative impact has been assessed by consideration of all renewable energy developments within 50 km of this development (see Appendix B). The cumulative impact is a regional loss of agricultural land. The impact is low because of the limited agricultural potential of all land in the area, predominantly as a result of climatic limitations. There is no particular scarcity of such land in South Africa. Furthermore the footprint of disturbance of wind farms is very small in relation to available land (<2% of surface area). Therefore even if all farm portions in an area contained wind farms, the total cumulative footprint would never exceed 2%. In reality the cumulative impact across the landscape is much lower because only a small percentage of farms is actually occupied by wind farms.

In addition, 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.

The cumulative impact is assessed in table form below.

Aspect / Activity	Occupation of the land by the project infrastructure of multiple developments
Type of impact	Direct
Potential Impact	Cumulative impacts are likely to occur as a result of the regional loss of agricultural land and production because of other developments on agricultural land in the region. Because the proportion of the land surface that is lost is so small, and because the land is of low agricultural potential, the cumulative loss of agricultural resources is of low significance.
Mitigation Required	None
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.7 Impact assessment summary

Table 3: Impact assessment summary table - Construction phase direct impacts

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Constructioactivities that disturb the soil profile.	Loss of topsoil	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	5	High
Vehicle traffic and dust generation	Degradation of veld vegetation	Negative	Site	Short term	Slight	Unlikely	Low	Low	Very Low	No	Yes	Control vehicle passage and	Very Low	5	High

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
												control dust			

Table 4: Impact assessment summary table - Operational phase direct impacts

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Slight	Very Likely	Low	Low	Very low	No	No	None	Not applicable	5	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Project land rental	Additional land use income	Positive	Site	Long term	Moderate	Very Likely	High	Low	Low	No	No	None	Not applicable	4	High

Table 5: Impact assessment summary table - Decommissioning phase direct impacts

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Constructional activities that disturb the soil profile.	Loss of topsoil	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	5	High
Vehicle traffic and dust generation	Degradation of veld vegetation	Negative	Site	Short term	Slight	Unlikely	Low	Low	Very Low	No	Yes	Control vehicle passage and	Very Low	5	High

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
												control dust			

Table 6: Impact assessment summary table - Cumulative impacts

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure of multiple developments	Regional loss of agricultural land	Negative	Regional	Long term	Slight	Very Likely	High	Low	Very low	No	No	None	Not applicable	5	High

1.8 Input to the Environmental Management Programme (EMPr)

The following mitigation measures are proposed for inclusion in the EMPr:

- Implement an effective system of storm water run-off control using bunds 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.
- Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
- If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.
- Restrict vehicle access to approved roads and areas only.
- Control dust generation during construction activities by implementing standard construction site dust control measures of damping down with water where dust generation occurs.

The following monitoring requirements are proposed for inclusion in the EMPr:

- Undertake a periodic site inspection (monthly during construction and once every 6 months during operation) to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.
- Establish an effective record keeping system for each area where soil is disturbed for construction and decommissioning purposes. Recommendations for the recording system are included in the EMPr.
- Undertake a periodic site inspection (monthly during construction to check for vehicle tracks beyond the approved vehicle areas.

1.9 Conclusions and recommendations

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 proposed development will only impact agricultural land which is of low agricultural potential and only suitable for grazing.

The significance of all agricultural impacts is low due to two important factors. Firstly, the actual footprint of disturbance of the wind farm (including associated infrastructure and roads) is very small in relation to the available grazing land on the effected farm portions (<2% of the surface area). All agricultural activities will be able to continue unaffectedly on all parts of the farm other than the small development footprint for the duration of and after the project. Secondly, the proposed site is on land of limited agricultural potential that is only viable for grazing. These two factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

There are no agriculturally sensitive areas that need to be avoided by the development.

1.9.1 Final statement by the specialist - should the proposed activities be authorised?

Due to the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.

1.9.2 Recommended conditions to be included in the environmental authorisation

There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation should this be granted.

2 References

Agricultural Research Council. 2007. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Department of Agriculture, Forestry and Fisheries, 2017. National land capability evaluation raster data layer, 2017. Pretoria.

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 A: Soil data

Table 7: Land type soil data for site.

Land type	Land capability class	Soil series (forms)	Depth (mm)			Clay % A horizon			Clay % B horizon			Depth limiting layer	% of land type
Ib236	8	Rock outcrop											71
		Hutton	50	-	300	2	-	6	4	-	10	R	22
		Hutton	300	-	1200	2	-	6	4	-	10	R	6
Ae2	5	Hutton	600	>	1200	2	-	6	4	-	10	R	26
		Hutton	750	>	1200	2	-	6	4	-	9	R,ka	23
		Hutton	300	-	600	2	-	6	4	-	10	R	16
		Hutton	100	-	300	4	-	8	4	-	10	R	15
		Hutton	300	-	600	2	-	6	4	-	9	R,ka	10
		Rock outcrop											4
		Hutton	450	-	750	10	-	15	15	-	20	R,ka	2
		Clovelly	750	-	1200	2	-	6	4	-	10	ka	1
		Mispah	50	-	250	4	-	10				ka	1

Land capability classes: 5 = non-arable, moderate potential grazing land; 8 = non-utilisable wilderness land.

Depth limiting layers: R = hard rock; ka = hardpan carbonate.

Appendix B: Projects to be considered in terms of cumulative impacts

DEA_REF	PROJECTTITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT
14/12/16/3/3/2/819	The 75 MW AEP Legoko Photovoltaic Solar Facility on Portion 2 of the Farm Legoko 460, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Lekogo Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
14/12/16/3/3/2/820	The 75 MW AEP Mogobe Photovoltaic Solar Facility on portion 1 of the farm Legoko 460 and farm Sekgame 461, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Mogobe Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
12/12/20/1858/1	Kathu Solar Energy Facility	Renewable Energy Investments South Africa (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
12/12/20/1858/2	Kathu Solar Energy Facility 25MW 2	Lokian Trading and Investments	Savannah Environmental Consultants (Pty) Ltd	Solar PV	25
12/12/20/1860	Proposed establishment of the Sishen Solar Farm on Portion 6 of Wincanton 472, NC	VentuSA Energy Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	74
12/12/20/1906	Proposed construction of solar farm for Bestwood, Kgalagadi District Municipality, NC	Katu Property Developers Pty Ltd	Rock Environmental Consulting (Pty) Ltd	Solar PV	0
12/12/20/1994 12/12/20/1994/1 12/12/20/1994/2 12/12/20/1994/3	The Proposed Construction Of Kalahari Solar Power Project On The Farm Kathu 465, Northern Cape Province	Group Five (Pty) Ltd	WSP Environmental (Pty) Ltd	Solar PV	480
12/12/20/2566	A 19MW Photovoltaic Solar Power Generation Plant On The Farm Adams 328 Near Hotazel, Northern Cape Province	To review	To review	Solar PV	19
12/12/20/2567	The Proposed 150mw Adams Photo-Voltaic Solar Energy Facility On The Farm Adams 328 Near Hotazel Northern Cape Province	To review	To review	Solar PV	75
14/12/16/3/3/1/474	Construction of the Roma Energy Mount Roper Solar Plant on the Farm Moutn Roper 321, Kuruman, Ga-Segonyana Local	To review	EnviroAfrica Environmental	Solar PV	10

DEA_REF	PROJECTTITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT
	Municipality		Consultants (Pty) Ltd		
14/12/16/3/3/1/475	The Proposed Construction Of Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province	To review	EnviroAfrica Environmental Consultants (Pty) Ltd	Solar PV	10
14/12/16/3/3/2/273	The Proposed San Solar Energy Facility And Associated Infrastructure On A Site Near Kathu, Gamagara Local Municipality, Northern Cape Province	To review	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/616	Proposed renewable energy geneartion project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park	Danax Energy (Pty) Ltd	AGES Limpopo (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/761	Proposed 75 MW Perth-Kuruman Solar Farm on the remainder of the farm Perth 276 within the Joe Morolong Local Municipality, Northern Cape Province	Agulhas-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/762	The 75MW Perth-Hotazel Solar Farm and its associated infrastructure on the Remainder of the Farm Perth 276 within the Joe Morolong Local Municipality in Northern Cape Province	Agulhus-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus	Solar PV	75
14/12/16/3/3/2/911	Proposed 75MW AEP Kathu Solar PV Energy Facility on the Remainder of the Farm 460 Legoko near Kathu within the Gamagara local Municipality in the Northern Cape Province	AEP Kathu Solar (Pty) Ltd	Cape Eprac	Solar PV	75
14/12/16/3/3/2/934	Kagiso Solar Power Plant near Hotazel, Northern Cape Province	Kagiso Solar Power Plant (RF) (Pty) Ltd	Environamics	Solar PV	115
14/12/16/3/3/2/935	Proposed 115 Megawatt (MW) Boitshoko Solar Power Plant on the Remaining Extent of Portion 1 of The Farm Lime Bank no. 471 Near Kathu in the Gamagara Local Municipality	Boitshoko Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115
14/12/16/3/3/2/936	Tshepo Solar Power Plant near Hotazel, Northern Cape	Tshepo Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115

TRANSPORT STUDY:

Scoping and Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape: EIA REPORT

Report prepared for:

CSIR – Environmental Management Services

P O Box 17001

Congella, Durban, 4013

South Africa

Report prepared by:

JG AFRIKA (PTY) LTD

Branch: Cape Town

PO Box 38561

7430

30 August 2018

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	Rev 13

TITLE:

TRANSPORT STUDY: SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 WIND ENERGY FACILITY NEAR KURUMAN IN THE NORTHERN CAPE: EIA REPORT

JGA REF. NO.	DATE:	REPORT STATUS
4686	30/08/2018	Final Issue

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD **Cape Town** PO Box 38651 Pinelands 7430 Tel.: 021 530 1800 Email: wink@jgafrika.com	**CSIR** **Environmental Management Services** PO Box 3201747 Stellenbosch, 7600 Tel: 021 888 2561 Email: slaurie@csir.co.za
AUTHOR	**CLIENT CONTACT PERSON**
Adrian Johnson *PrTechEng*	Surina Laurie

SYNOPSIS

Preparation of a Transport Study for the proposed development of the Phase 1 Kuruman Wind Energy Facility near Kuruman in the Northern Cape, pertaining to all relevant traffic and transportation engineering aspects.

KEY WORDS:

Wind Energy Facility, Transport Study

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2008 which has been independently certified by DEKRA Certification under certificate number 90906882

Verification	Capacity	Name	Signature	Date
By Author	Senior Technologist	Adrian Johnson		
Checked by:	Associate	Iris Wink		
Authorised by:	Technical Director	Chris Wise		

Filename:	4686/Reports/Phase 1

IRIS SIGRID WINK

Profession	Civil Engineer (Traffic & Transportation)
Position in Firm	Associate
Area of Specialisation	Manager: Traffic & Transportation Engineering
Qualifications	PrEng, MSc Eng (Civil & Transportation)
Years of Experience	15 Years
Years with Firm	5 Years

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156). She joined JG Afrika (Pty) Ltd. in 2012. Iris obtained a Master of Science degree in Civil Engineering in Germany and has more than 15 years of experience in a wide field of traffic and transport engineering projects. Iris left Germany in 2003 and has worked as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial and industrial projects and providing conceptual designs for the abovementioned. She has also been involved with transport assessments for renewable energy projects and traffic safety audits.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng - Registered with the Engineering Council of South Africa No. 20110156
Registered Mentor with ECSA for the Cape Town Office of JG Afrika
MSAICE - Member of the South African Institution of Civil Engineers
ITSSA - Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA - Member of the South African Wind Energy Association
SARF - South African Road Federation: Committee Member of Council

EDUCATION

1996 - Matric – Matric (Abitur) – Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma as Draughtsperson – Lower Saxonian State Office for Road and Bridge Engineering
2003 - MSc Eng (Civil and Transportation) – Leibniz Technical University of Hanover, Germany

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)
2016 – Date
Position – Associate

- **Coega West Windfarm** – Transportation and Traffic Management Plan for the Coega Windfarm in Coega, Port Elizabeth – Client: Electrawinds Coega

- **Traffic and Parking Audits** for the Suburb of Groenvallei in Cape Town – Client: City of Cape Town Department of Property Management.
- **Road Safety Audit** for the Upgrade of N1 Section 4 Monument River – Client: Aurecon on behalf of SANRAL
- **Sonop Windfarm** – Traffic Impact Assessment for the Sonop Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Univeral Windfarm -** Traffic Impact Assessment for the Universal Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Road Safety Audit** for the Upgrade of N2 Section 8 Knysna to Wittedrift – Client: SMEC on behalf of SANRAL
- **Road Safety Audit** for the Upgrade of N1 Section 16 Zandkraal to Winburg South – Client: SMEC on behalf of SANRAL
- **Traffic and Road Safety Studies** for the Improvement of N7 Section 2 and Section 3 (Rooidraai and Piekenierskloof pass) – Client: SANRAL
- **Road Safety Appraisal**s for Northern Region of Cape Town – Client: Aurecon on behalf of City of Cape Town (TCT)
- **Traffic Engineering Services** for the Enkanini Informal Settlement, Kayamandi - Client: Stellenbosch Municipality
- **Lead Traffic Engineer** for the Upgrade of a 150km Section of the National Route N2 from Kangela to Pongola in KwaZulu-Natal, Client: SANRAL
- **Traffic Engineering Services** for the Kosovo Informal Settlement (which is part of the Southern Corridor Upgrade Programme), Client: Western Cape Government
- **Traffic and Road Safety Studies** for the proposed Kosovo Informal Housing Development (part of the Southern Corridor Upgrade Program), Client: Western Cape Government.
- **Road Safety Audit** Stage 3 – Upgrade of the R573 Section 2 between Mpumalanga/Gauteng and Mpumalanga/Limpopo, Client: AECOM on behalf of SANRAL
- **Road Safety Audit** Stage 1 and 3 – Upgrade of the N2 Section 5 between Lizmore and Heidelberg, Client: Aurecon on behalf of SANRAL
- **Traffic Safety Studies** for Roads Upgrades in Cofimvaba, Eastern Cape – Client: Cofimvaba Municipality
- **Road Safety Audit** Stage 1 and 3 – Improvement of Intersections between Olifantshoek and Kathu, Northern Cape, Client: Nadeson/Gibb on behalf of SANRAL
- **Road Safety Audit** Stage 3 – Upgrade of the Beacon Way Intersection on the N2 at Plettenberg Bay, Client: AECOM on behalf of SANRAL
- **Traffic Impact Assessment** for a proposed Primary School at Die Bos in Strand, Somerset West, Client: Edifice Consulting Engineers
- **Road Safety Audit** Stage 1 and 3 – Improvement of R75 between Port Elizabeth and Uitenhage, Eastern Cape, Client: SMEC on behalf of SANRAL

SPECIALIST DECLARATION

I, **IRIS WINK** 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 favorable 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 realize 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 Specialist: IRIS WINK

Date: 30 August 2018

EXECUTIVE SUMMARY

This transport study was commissioned to assess the potential impact of activities related to the delivery of turbine components and traffic movement for the construction, operation and maintenance of the proposed Phase 1 Kuruman Wind Energy Facility (WEF).

The main transport impacts will be during the construction and decommissioning phases of a WEF where the delivery of the turbine components, construction and decommissioning of the WEF infrastructure will generate significant traffic. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network.

Traffic generated by the construction of the WEF will have a significant, albeit short term, impact on the surrounding road network. Proposed mitigation measures include:

- The delivery of wind turbine components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- Reduce the construction period
- Stagger the construction of the turbines
- The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods.

As it is not known whether turbine components will be imported or manufactured locally, the port of entry and delivery route to the proposed site cannot be finalized. It is assumed that the wind turbine components will be imported to South Africa via the Port of Ngqura.
Consequently, the potential mitigation measures mentioned in the construction and decommissioning phases are general measures that would normally be recommended to mitigate the impact on the road network. When the manufacturing location of the turbine components has been established, the delivery route can be finalized and more detailed potential mitigation measures can be provided.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Yes. See attached CV
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Yes. See attached declaration
c) an indication of the scope of, and the purpose for which, the report was prepared;	Yes. See section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	N/A
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Yes. See section 1.6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Yes. See section 1.1
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Yes. Section 1.3
g) an identification of any areas to be avoided, including buffers;	Yes. Section 1.3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Yes. Section 1.1
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Yes. Section 1.5
k) any mitigation measures for inclusion in the EMPr;	Yes. Section 1.6
l) any conditions for inclusion in the environmental authorisation;	N/A
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	n/a
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Yes. Section 1.6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
q) any other information requested by the competent authority.	n/a
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

TABLE OF CONTENTS

TABLES AND FIGURES

TRANSPORT STUDY

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd is proposing to develop the Kuruman Wind Energy Facility just south of Kuruman and approximately 34km east of Kathu in the Northern Cape. The WEF will be developed in two phases – Phase 1 with 47 turbines and Phase 2 with 52 turbines. The wind energy facilities are subject to a EIA process and the supporting electrical infrastructure (including a distribution line) is subject to a separate BA process. As part of the Environmental Impact Assessment (EIA) and Basic Assessment (BA) stages, the services of a Transportation Specialist are required to conduct respective Transportation Studies.

The main objective of this report is to prepare a transport study (traffic and transport risk assessment and route investigation) for the proposed Phase 1 Kuruman WEF site.

The following two main transportation activities will be investigated:

- Abnormal load vehicles transporting wind turbine components to the site.
- The transportation of construction materials, equipment and people to and from the site/facility.

The transport study plan will aim to provide the following objectives:

- Activities related to traffic movement for the construction, operation and maintenance of the wind energy facility.
- Provide a main route for the transportation of the wind turbine components from the entry point to the proposed site.
- Provide a preliminary transportation route for the transportation of materials, equipment and people to site.

1.1.2. Terms of Reference

The Terms of Reference for this Transport Study include the following:

- Extent of the transport study and study area;
- The proposed development;
- Assumptions concerning candidate turbines;
- Trip generation for the wind farm during construction, operation and decommissioning;
- Traffic impact on external road network;
- Accessibility and circulation requirements;
- National and local haulage routes between port of entry/manufacturer and site;
- Assessment of internal roads and site access;
- Assessment of freight requirements and permitting needed for abnormal loads; and
- Traffic accommodation during construction.

1.1.3. Approach and Methodology

The report deals with the traffic impact on the surrounding road network in the vicinity of the site during the construction of the access roads, construction and installation of the turbines, during maintenance and decommissioning.

This transport study includes the following tasks:

Site Visit and Project Assessment

- Site visit and initial meeting with the client to gain sound understanding of the project
- Overview of project background information including location maps, component specs and any resulting abnormal loads to be transported
- Research of all available documentation and information relevant to the proposed windfarm and substations

Correspondence with Authorities

- Correspondence with the relevant Authorities dealing with the external road network, such as SANRAL and Province

Traffic and Route Assessment

- Trip generation and potential traffic impact
- Possible haul routes between port of entry / manufacturing location and sites in regards of
  - National route
  - Local route
  - Site access route (internal roads)
  - Road limitations due to abnormal loads
- Construction and maintenance (operational) vehicle trips
  - Generated vehicles trips
  - Abnormal load trips
  - Access requirements
  - Possible damaging effects on road surface
  - Scheduling of transport (i.e. during night)
- Station data will be obtained as far as available from SANRAL for the closest national roads.
- Investigation of the impact of the development traffic generated during construction and operation.

Access and Internal Roads Assessment

- Assessment of the proposed access points including:
  - Feasible location of access points
  - Motorised and non-motorised access requirements
  - Queuing analysis and stacking requirements if required
  - Access geometry
  - Sight distances and required access spacing
- Assessment of the proposed internal roads on site
- Assessment of internal circulation of trucks and proposed roads layout in regard to turbine positions and turbine laydown areas

Report (Documentation and Figures)

- Reporting on all findings and preparation of the report.

1.1.4. Assumptions and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by Mulilo/CSIR and the subsequent site visit.
- Due to access constraints during the site visit and the topography of the area, certain sections of the proposed WEF development could not be assessed and reasonable assumptions have been made.
- It is not known whether wind turbine component will be imported or manufactured locally.
- It is assumed that the Port of Entry will be the Port of Ngqura. According to the Eskom Specifications for Power Transformers, the following dimensional limitations need to be kept

when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300mm and total maximum length 10 500mm.

- Maximum vertical height clearances along the haulage route is 5.2m for abnormal loads.
- The imported elements will be transported from the most feasible port of entry, which is deemed to be Port of Ngqura. It is expected that the inverter will be imported and shipped.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.

1.1.5. Source of Information

Information used in a transport study includes:

- Project Information and report template provided by the Client
- Google Earth.kmz provided by the Client
- Google Earth Satellite Imagery

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE TRANSPORT STUDY

1.2.1. Port of Entry

It is assumed that the wind turbine components will be imported to South Africa via the Port of Ngqura. The Port of Ngqura is a world class deep water transhipment hub offering an integrated, efficient and competitive port service for containers on transit. The Port forms part of the Coega Industrial Development Zone and is operated by Transnet National Ports Authority.

The Port also services the industrial bulk commodity requirements of the regional and national hinterland. Containers handled include imports and exports from across the globe as well as trans-shipment cargoes serving primarily East and West coast traffic as well as inter-line traffic from South America to Asia.

1.2.2. Selected Candidate Turbine

The possible range of wind turbines varies largely with various wind turbine manufacturers operating worldwide. The project information states that a turbine with a hub height of 140m and a blade length of 80m is to be considered.

In general, each turbine unit consists of a tower, a Nacelle (final weight dependent on the supplier and whether the nacelle has gears or not) and rotor blades.

It is assumed that all turbine parts will be imported and shipped via the Ngqura Port.

1.2.3. Transportation requirements

1.2.3.1. Abnormal Load Considerations

Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Safety Act (Act No. 93 of 1996):

- Length: 22m for an interlink, 18.5m for truck and trailer and 13.5m for a single unit truck
- Width: 2.6m
- Height: 4.3m measured from the ground. Possible height of load – 2.7m.
- Weight: Gross vehicle mass of 56t resulting in a payload of approximately 30t
- Axle unit limitations: 18t for dual and 24t for triple-axle units

- Axle load limitation: 7.7t on front axle and 9t on single or rear axles

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses. A detailed Transport Plan is required for the permit application process.

1.2.3.1.1. Further Guideline Documentation

The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outlines the rules and conditions that apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges and culverts.

The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the Road Traffic Act and the relevant regulations.

1.2.3.1.2. Permitting – General Rules

The limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing or permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

1.2.3.1.3. Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer;
- the load which may be carried by the tyres;
- the damaging effect on pavements;
- the structural capacity on bridges and culverts;
- the power of the prime mover(s);
- the load imposed by the driving axles and
- the load imposed by the steering axles.

1.2.3.1.4. Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e. loads that cannot, without disproportionate effort, expense or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit.

- Width

- Height
- Length
- Front Overhang
- Rear Overhang
- Front Load Projection
- Rear Load Projection
- Wheelbase
- Turning Radius
- Stability of Loaded Vehicles

1.2.3.2. Transporting Wind Turbine Components

Wind turbine components can be transported in a number of ways with different truck / trailer combinations and configurations, which will need to be investigated at a later stage when the transporting contractor and the plant hire companies apply for the necessary permits from the Permit Issuing Authorities.

1.2.3.2.1. Nacelle

The heaviest component of a wind turbine is the Nacelle (approximately 100 tons depending on manufacturer and design of the unit). Combined with road based transport, it has a total vehicle mass of approximately 145 000kg for a 100-ton unit. Thus, route clearances and permits will be required for transporting the Nacelle by road based transport (see example of a road based transport below). The unit will require a minimum height clearance of 5.1metres.

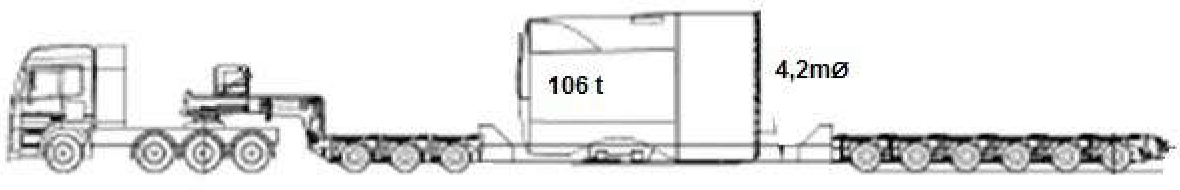


Figure 1: Transporting the Nacelle

1.2.3.2.2. Blades

These are the longest and possibly most vulnerable components of a wind turbine and hence needs to be transported with upmost care. The set of three blades are 80m in length each and they need to be transported on an extendible blade transport trailer or in a rigid container with rear steerable dollies. The blades can be transported individually, in pairs or in three's; although different manufacturers have different methods of packaging and transporting the blades. The transport vehicle exceeds the dimensional limitation (length) of 22m and will only be allowed under permit, provided the trailer is fitted with steerable rear axles or dollies.

Figure 2:Example: 3 x 45m Blades on extendible trailers

Figure 3: Example of Blade Transport

Turbine blades of 80m in length have been proposed. Due to this abnormal length, special attention needs to be given to the route planning, especially to suitable turning radii and adequate sweep clearance. Therefore, vegetation or road signage may have to be removed before transport.
Once transported to site, the blades need to be carefully stored in their respective laydown areas before being installed onto the rotary hub.

1.2.3.2.3. Tower Sections

Tower sections generally consist of sections of around 20 metres in length and hence the number of tower sections required depends on the selected hub height. For a hub height of 140 metres, it is assumed that seven tower sections are required. Each section is transported separately on a low-bed trailer. Depending on the trailer configuration and height when loaded, some of these components may not meet the dimensional limitations (height and width), but will be permitted under certain permit conditions (see examples below).

Figure 4: Transporting the Tower Sections

1.2.3.2.4. Turbine Hub and Rotary Units

These components need to be transported separately, due to their significant weights - a hub unit weighs around 45 tons and the rotary unit weighs over 90 tons.

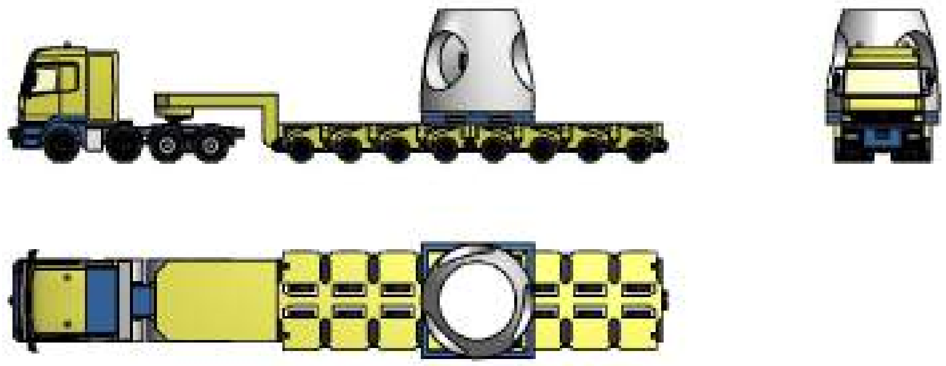


Figure 5: Transporting the Hub and Rotary Units

1.2.3.3. Transporting Cranes, Mobile Crane and other Components

This technology has developed rapidly, and a number of different heavy lifting options are available on the market. Costs involved to hire cranes vary and hence should be compared beforehand. For this assessment, some possible crane options are outlined as follows.

1.2.3.3.1. Cranes for Assembly and Erection on Site

Option 1: Crawler Crane & Assembly Crane

One possible option is that the main lift crane that would be capable of performing the required lifts, i.e. lifting the tower sections into position, lifting the Nacelle to the hub height and lifting the Rotor and Blades into place, needs to be similar to the Liebherr Crawler Crane LR1750 with a SL8HS (Main Boom and Auxiliary Jib) configuration. A smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the crawler crane at each turbine location.

- **Crawler Crane LR1750 with the SL8HS boom system (Main Lifting Crane):**

The Crawler Crane will be transported to site in components and the heaviest load will be the superstructure and crawler centre section (83 tons). The gross combination mass (truck, trailer and load) will be approximately 133 000 kg. The boom sections, counterweights and other equipment will be transported on conventional tri-axle trailers and then assembled on site. It will require a number of truckloads of components to be delivered for assembly of the Crawler Crane before it can be mobilised to perform the heavy lifts.

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

The Liebherr LTM 1200-5.1 crane is a 5-axle vehicle with rubber tyres, which will travel to site on its own. However, the counterweights will be transported on conventional tri-axle trailers and then assembled on site. The assembly crane is required to assemble the main lift crane as well as assist in the installation of the wind turbine components.

Option 2: GTK 1100 Crane & Assembly Crane

For the single wind turbine at Coega, the GTK 1100 hydraulic crane was used (see example in picture below). The GTK 1100 was designed to lift ultra-heavy loads to extreme heights and its potential lies in being deployed on facilities such as wind turbine farms.


Figure 6: Cranes at work

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

As above - a smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the hydraulic crane at each turbine location.

1.2.3.3.2. Cranes at Port of Entry

Most shipping vessels importing the turbine components will be equipped with on-board cranes to do all the safe off-loading of WTG components to the abnormal transport vehicles, parked adjacent to the shipping vessels.


Figure 7: Cranes at Port of Entry

The imported turbine components may be transported from the Port of Entry to the nearby turbine laydown area. Mobile cranes will be required at these turbine laydown areas to position the respective components at their temporary storage location.

1.2.3.4. Transporting Other Plant, Material and Equipment

In addition to transporting the specialised lifting equipment, the normal Civil Engineering construction materials, plant and equipment will need to be brought to the site (e.g. sand, stone, cement, concrete batching plant, gravel for road building purposes, excavators, trucks, graders, compaction equipment, cement mixers, transformers in the sub-station, cabling, transmission pylons etc.). Other components, such as electrical cables, pylons and substation transformers, will also be transported to site during construction. The transport of these items will generally be conducted with normal heavy loads vehicles.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Description of the site

The proposed Phase 1 Kuruman WEF will be located south-west of Kuruman, approximately 34km east of Kathu in the Northern Cape and comprises six farms, as shown below.

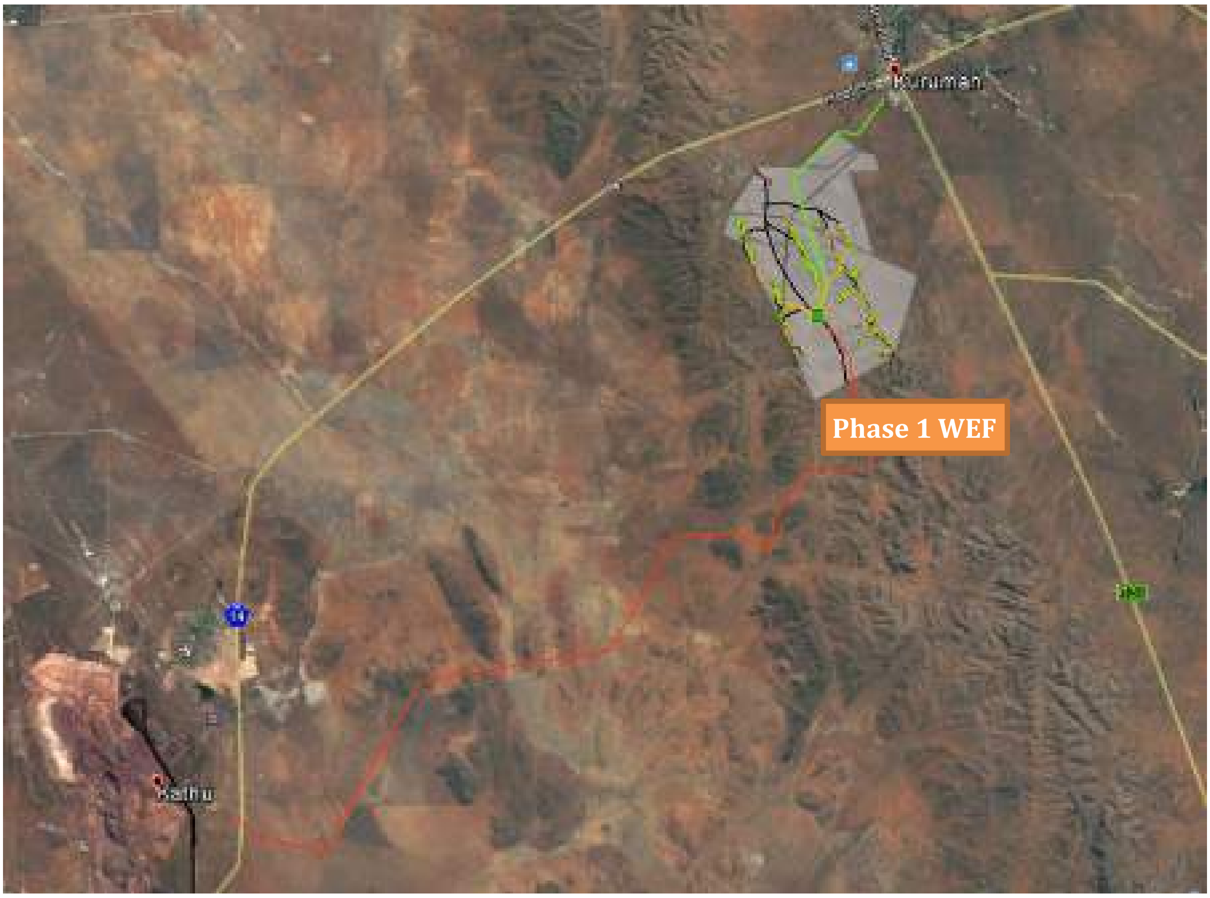


Figure 8: Aerial View of Proposed Phase 1 Kuruman WEF

The proposed WEF will accommodate 47 wind turbines with a generation capacity of 4.5 megawatts (MW) per turbine. Turbine corridors have been provided as an indication of the proposed locations of the turbines.

The infrastructure associated with this facility includes:

- A total of 47 wind turbines with a generating capacity of 4.5MW-5.5MW per turbine;
- 3 construction yards of 200m x 100m = 2 ha;
- Roads connecting turbines will be constructed at 8m wide and existing roads will be widened to 8m;
- Collector substation;
- 33kV underground lines; and
- Supporting electrical infrastructure, subject to a separate BA process (Eskom metering station, transmission lines and Eskom Substation)

1.3.2. National Route to Site

The most suitable port is the Port of Ngqura, which is located 1057 km travel distance from the site. This Port is a deep-water port geared for handling large container ships and has large laydown area available for storage of wind turbine components.

The preferred route for abnormal load vehicles will be from the port, heading north on the N10 to Britstown (passing Middelburg) and onto the N12 towards Kimberley. At Kimberly, the abnormal load vehicle will travel on the R31 to Barkly West. Due to geometric constraints at Barkly West, the abnormal load vehicle will take the R374, R371 and R370 gravel roads as a detour, which will connect the abnormal load vehicle to the R31. At Danielskuil, the abnormal vehicle will head north to Kuruman.

Figure 9: Preferred route from Port of Entry to the proposed WEF

1.3.3. Main Route for the Transportation of the Wind Turbine Components

The investigation showed that it will be possible to transport the imported wind turbine components by road to the proposed sites. The proposed main route will be along the R31 (Voortrekker Road) and the N14 (Hoof Street). The proposed WEF site can be accessed via the gravel road D3420, located south of the site and accessed via the R31 to the east of the site and the partially surfaced road D3441, located to the east of the site and accessed via the N14. The access roads are shown in **Figure 2** below.

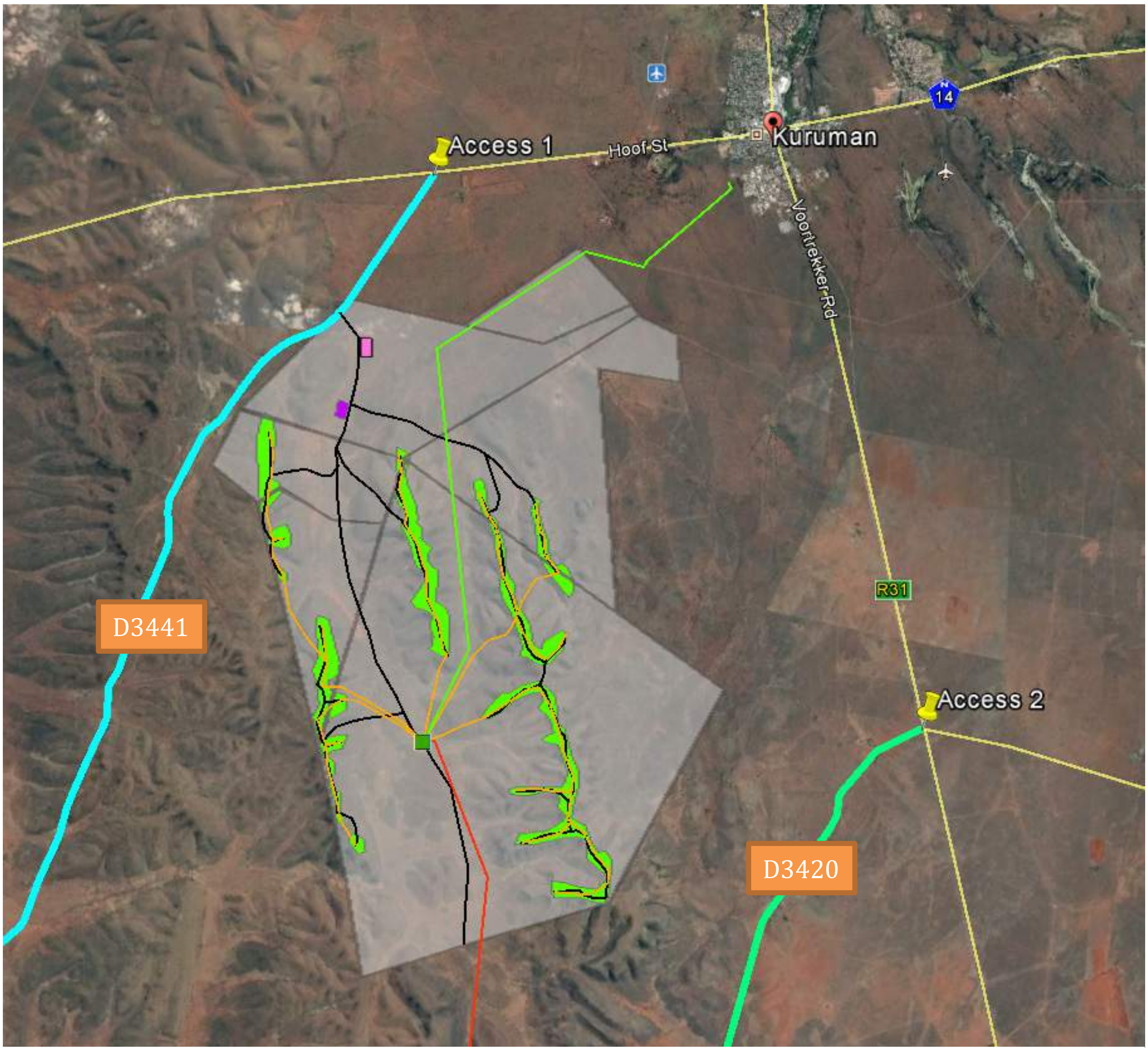


Figure 10: Access Roads

1.3.4. Proposed main access road to the proposed WEF

For Phase 1 of the proposed Kuruman WEF, access will be provided via the D3441. No existing access road currently exists along D3441 to the proposed WEF site. The proposed turbine and internal road layout indicates that the main access road to the WEF will be constructed on D3441, approximately 3km from the N14. The layout also indicates that a concrete tower plant and a construction yard will be constructed on the main access road to the WEF.

Figure 11: D3441

During the site visit, the proposed WEF site could not be accessed from D3441 as no gravel roads exist. The internal roads of the proposed WEF will predominately be new gravel roads as there are few existing gravel roads.

It should be noted that there are additional existing gravel roads located further south on D3441. These existing gravel roads could be further investigated as alternative accesses to the proposed Phase 1 site should the proposed main access (located 3km from the N14) not be a feasible option.

An additional option for access to the Phase 1 area would be via gravel road D3420. For Phase 2 of the Kuruman WEF, the proposed main access road is located on D3420. This main access road connects to the main access road of Phase 1 on the boundary of the two phases. Turbines could therefore be delivered to the Phase 1 area via the proposed main access road of Phase 2. This option, however, is dependent on the approval of Phase 2 in conjunction with Phase 1 and that the main access road of Phase 2 be constructed in advance.

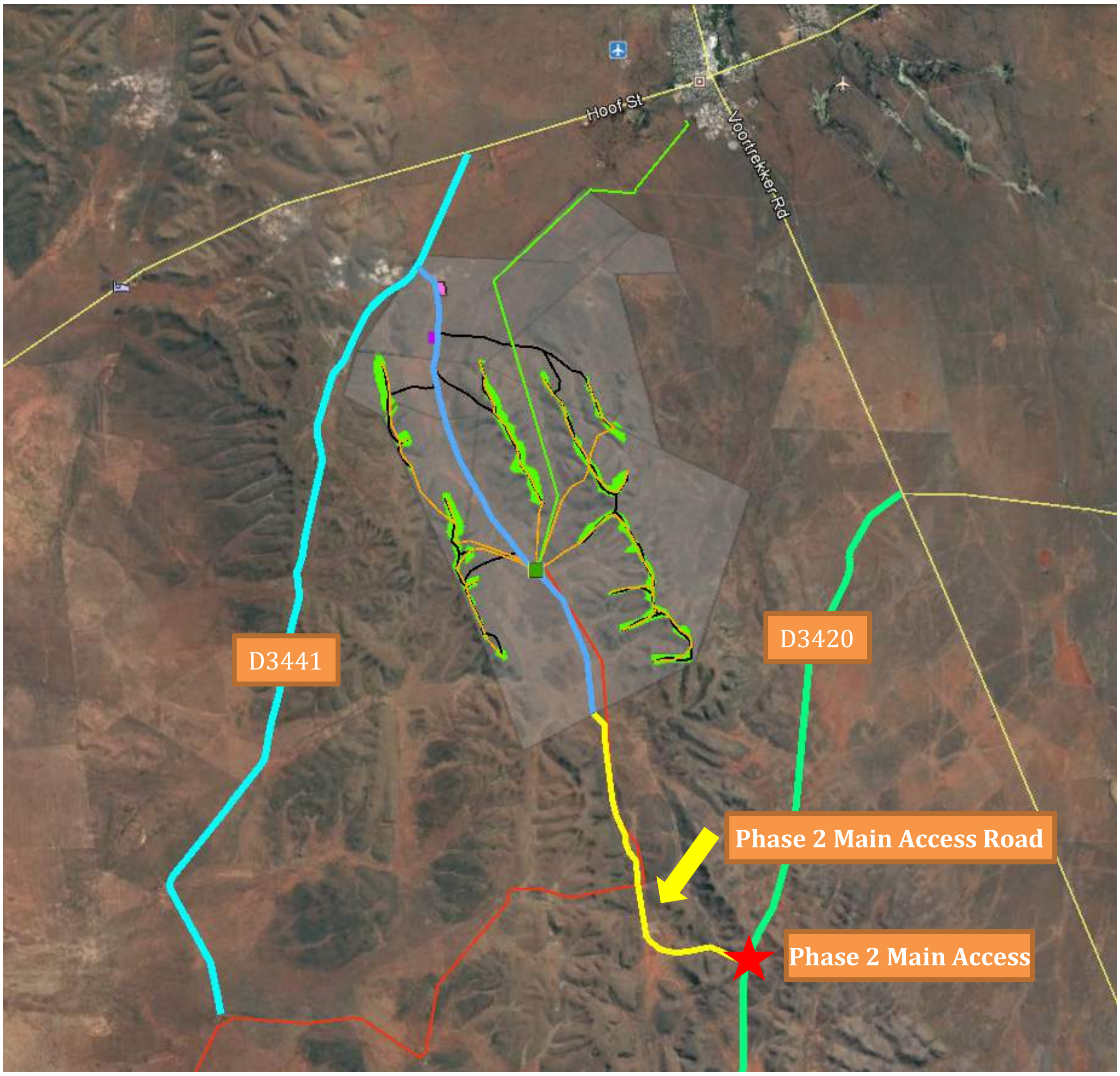


Figure 12: Access via Phase 2 - proposed main access

A minimum required road width of 4 meters needs to be kept and all turning radii must conform with the specifications needed for the abnormal load vehicles and haulage vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed. The gravel roads will require grading with a road grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. Geometric design constraints might be encountered due to the rolling, hilly topography of the area, as shown in the photographs below. The road designer should take cognizance that the turbines are to be positioned at the top of the hills, therefore roads need to be designed with smooth, relatively flat gradients to allow an abnormal load vehicle to ascend to the top of the hill.

Figure 13: Hills at Phase 1 site

Figure 14: Hills at Phase 1 site

1.3.5. Main Route for the Transportation of Materials, Plant and People to the proposed WEF

The nearest towns in relation to the proposed WEF sites are Kuruman and Kathu. Kuruman is situated within 5km from the WEF and Kathu at 40km. The main route linking Kuruman and Kathu to the proposed WEF is the N14. It is envisaged that the majority of materials, plant and labour will be sourced from these towns and transport to the WEF will be via the N14.

Existing concrete batch plants and quarries are situated in Kuruman and Kathu. If these businesses were contracted to supply materials and concrete, the impact on the traffic would be reduced due to their proximity to the proposed WEF site. Alternatively, mobile concrete batch plants and temporary construction material stockpile yards could be commissioned on vacant land near the proposed WEF site. Delivery of materials to the mobile batch plant and the stockpile yard could be staggered to minimise traffic disruptions.

It is envisaged that most materials, water, plant, services and people will be procured within a 60km radius from the proposed WEF.

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the transport requirements for the proposed WEF development are:

- Abnormal load permits,
- Port permit,
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1. Identification of Potential Impacts

The potential transport related impacts are described below.

1.5.2. Construction Phase

- *Potential impact 1*
  Construction related traffic including transportation of people, construction materials, water and equipment to the site (Abnormal trucks delivering turbine components to the site).
  This phase also includes the construction of roads, excavations of turbine footings, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

1.5.3. Operational Phase

During operation, it is expected that staff and security will periodically visit the turbines. It is assumed that approximately five full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

1.5.4. Decommissioning Phase

- *Potential Impact 2*
  Construction related traffic including transportation of people, construction materials, water and equipment (Abnormal trucks transporting turbine components).

1.5.5. Cumulative impacts

- Traffic congestion/delays on the surrounding road network.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1. Potential Impact 1 (Construction Phase)

- *Nature of the impact*
  Potential traffic congestion and delays on the surrounding road network.

- *Significance of impact without mitigation measures*
  Traffic generated by the construction of the WEF will have a significant impact on the surrounding road network. The exact number of trips generated during construction will be determined by the haulage company transporting the components to site.

  For the transportation of the turbines to the WEF site, it was assumed that the turbine blades will be transported separately to site. Consequently, for each wind turbine three abnormal loads will be required for the blades, seven abnormal loads for the tower sections and another abnormal load for the nacelle. All further components will be transported with normal limitations haulage vehicles. With approximately 11 abnormal loads trips, the total trips to deliver the components of 47 turbines to the WEF site will be around 517 trips. This would amount to less than 1 vehicle trip per day for a construction period of 18-24months.

  The constructions of roads and concrete footings will also have a significant impact on the surrounding road network as vehicles deliver materials to the site. A concrete footing (approximately 500m^3) adds over 80 trips by concrete trucks to the surrounding road network.

  The significance of the transport impact without mitigation measures during the construction phase can be rated as substantial.

- *Proposed mitigation measures*
  - The delivery of wind turbine components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
  - Reduce the construction period by accelerating tasks that do not generate traffic.
  - Stagger the construction of the turbines.
  - The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network.
  - Staff and general trips should occur outside of peak traffic periods.
  - Maintenance of haulage routes. It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred routes. The preferred route should be surveyed to identify problem areas e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, prior to the transportation of any turbine components, to ensure that the delivery of the turbines will occur without disruptions. This process is to be undertaken by the haulage company transporting the components and the contractor, who will modify the road and intersections to accommodate abnormal vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.
  - Design and maintenance of internal roads. The internal gravel roads will require grading with a road grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional. Geometric design constraints might be encountered due to the rolling,

hilly topography of the area, as shown in the photographs below. The road designer should take cognizance that the turbines are to be positioned at the top of the hills, therefore roads need to be designed with smooth, relatively flat gradients to allow an abnormal load vehicle to ascend to the top of the hill.
  - It should be noted that Eskom lines along the gravel road will have to be moved to accommodate the abnormal load vehicles.

- *Significance of impact with mitigation measures*
  The proposed mitigation measures will result in a minor reduction of the impact on the surrounding road network, but the impact on the local traffic will remain moderate.

1.6.2. Potential Impact 2 (Decommissioning Phase)

- This phase will result in the same impact as the Construction Phase as similar trips are expected.

1.6.3. Cumulative Impacts

The impact of proposed renewable energy projects within a 30km radius of the proposed Phase 1 Kuruman WEF have been assessed. The following list of 19 proposed projects were provided:

- The 75MW AEP Legoko PV Solar Facility
- The 75MW AEP Mogobe Photovoltaic Solar Facility
- Kathu Solar Energy Facility
- Kathu Solar Energy Facility 25MW 2
- Sishen Solar Farm
- Solar farm for Bestwood
- Kalahari Solar Power Project
- A 19MW PV Solar Power Generation Plant
- 150MW Adams PV Solar Energy Facility
- Roma Energy Mount Roper Solar Plant
- Keren Energy Whitebank Solar Plant
- San Solar Energy Facility and associated infrastructure
- Renewable energy generation project - Shirley Solar Park
- 75MW Perth-Kuruman Solar Farm
- 75MW Perth-Hotazel Solar Farm and associated infrastructure
- 75MW AEP Kathu Solar PV Energy Facility
- Kagiso Solar Power Plant near
- 115MW Boitshoko Solar Power Plant
- Tshepo Solar Power Plant

All the above projects are solar energy projects. From experience on other projects of a similar nature, the number of heavy vehicles per 7MW installation is estimated to range between 300 and 400 trips depending on the site conditions and requirements. For the 75MW, the total trips can therefore be estimated to be between 3 000 and 4 000 heavy vehicle trips, which will generally be made over a 12-month construction period (depending on size of facility). Choosing the worst-case scenario of 4 000 heavy vehicles over a 12-month period travelling on an average of 22 working days per month, the resulting daily number of vehicle trips is 15. Taking into account that the number of vehicle trips during peak hour traffic in a rural environment can roughly be estimated at around 20-40% of the average daily traffic (assumed at 4000 vehicles/day), the resulting vehicle trips for the construction phase are approximately 3-6 trips.

It is very unlikely that the 19 projects will be constructed at the same time. A more realistic scenario would be the construction of five solar facilities that will utilize the same road network as proposed by the Kuruman WEF. The impact on the road network will be around 30 vehicle trips during the peak hour traffic if five 75MW solar energy facilities are developed at the same time. The additional traffic is considered negligible.

The construction and decommissioning phases of a WEF are the only significant traffic generators. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network.

1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in the Tables below.

Table 1-1 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component delivery to site - Reduce the construction period - Stagger the construction of the turbines - The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network. - Staff and general trips should occur outside of peak traffic periods. - Maintenance of haulage routes. - Design and maintenance of internal roads.	Moderate	Moderate	3	Medium

Table 1-2 Impact assessment summary table for the Operational Phase

<table>
<tr><th colspan="14">Operational Phase</th></tr>
<tr><th colspan="14">Direct Impacts</th></tr>
<tr><th rowspan="2">Aspect/ Impact Pathway</th><th rowspan="2">Nature of Potential Impact/ Risk</th><th rowspan="2">Status</th><th rowspan="2">Spatial Extent</th><th rowspan="2">Duration</th><th rowspan="2">Consequence</th><th rowspan="2">Probability</th><th rowspan="2">Reversibility of Impact</th><th rowspan="2">Irreplaceability</th><th rowspan="2">Potential Mitigation Measures</th><th colspan="2">Significance of Impact and Risk</th><th rowspan="2">Ranking of Residual Impact/ Risk</th><th rowspan="2">Confidence Level</th></tr>
<tr><th>Without Mitigation/ Management</th><th>With Mitigation/ Management (Residual Impact/ Risk)</th></tr>
<tr><td colspan="14">The traffic generated during this phase will be minimal and will have a nominal impact on the surrounding road network.</td></tr>
</table>

Table 1-3 Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Decommissioning Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component transportation - Reduce the construction period - Stagger the construction of the turbines - Staff and general trips should occur outside of peak traffic periods. - Maintenance of haulage routes and internal roads.	Moderate	Moderate	3	Medium

Table 1-4 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component transportation - Reduce the construction period - Stagger the construction of the turbines - Staff and general trips should occur outside of peak traffic periods	Moderate	Moderate	3	Medium

1.8. CONCLUSION AND RECOMMENDATIONS

The potential transport related impacts for the construction, operation and decommissioning phases were assessed. The construction and decommissioning phases of a WEF are the only significant traffic generators. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network.

At present it is unknown whether turbine components will be manufactured locally or imported. It is assumed that the wind turbine components will be imported to South Africa via the Port of Ngqura. This has a significant impact in the identification of mitigation measures as the port of entry and delivery route to the proposed site cannot be finalized.

The potential mitigation measures mentioned in the construction and decommissioning phases are general measures that would normally be recommended to mitigate the impact on the road network. When the manufacturing location of the turbine components has been established, the delivery route can be finalized and more detailed potential mitigation measures can be provided.

1.9. REFERENCES

- Google Earth Pro
- SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
- Road Safety Act (Act No. 93 of 1996)
- The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads

VISUAL IMPACT ASSESSMENT:

Scoping and Environmental Impact Assessment for the Proposed Development of the Kuruman Phase 1 Wind Farm Facility, Kuruman, Northern Cape Province:
EIA REPORT

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

Report prepared by:

SiVEST

51 Wessels Road

Rivonia

2128

17 August 2018

SPECIALIST EXPERTISE

Curriculum Vitae of Visual Specialist – Andrea Gibb

Name	Andrea Gibb
Profession	Environmental Practitioner / Visual Specialist
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Senior Manager Environmental Division
Years with Firm	7 Years
Date of Birth	29 January 1985
Place of Birth	South Africa
ID Number	8501290020089
Nationality	South African

Education

Matriculated 2003, Full Academic Colours, Northcliff High School, Johannesburg, South Africa

Professional Qualifications

BSc (Hons) Environmental Management (University of South Africa 2008-2010)
Coursework**:** Project Management, Environmental Risk Assessment and Management, Ecological and Social Impact Assessment, Fundamentals of Environmental Science, Impact Mitigation and Management, Integrated Environmental Management Systems & Auditing, Integrated Environmental Management, Research Methodology.
Research Proposal**:** Golf Courses and the Environment

BSc Landscape Architecture (with distinction) (University of Pretoria 2004-2007)
Coursework: Core modules focused on; design, construction, environmental science, applied sustainability, shifts in world paradigms and ideologies, soil and plant science, environmental history, business law and project management.
Awards: Cave Klapwijk prize for highest average in all modules in the Landscape Architecture programme, ILASA book prize for the best Landscape Architecture student in third year design, Johan Barnard planting design prize for the highest distinction average in any module of plant science.

Employment Record

Aug 2010 – to date	SiVEST SA (Pty) Ltd: Environmental Practitioner
Jan 2008 – July 2010	Cave Klapwijk and Associates: Environmental Assistant and Landscape Architectural Technologist
Feb 2006 – Dec 2006	Cave Klapwijk and Associates: Part time student

Key Experience

Specialising in the field of Environmental Management and Visual Assessment.

Andrea has 10 years' work experience and is employed by SiVEST Environmental as the Senior Manager heading up the Johannesburg office. She is primarily involved with managing large scale multifaceted Environmental Impact Assessments (EIAs) and Basic Assessments (BAs) (incl. Amendment Applications), undertaken according to International Finance Corporation (IFC) standards and Equator Principles, within the renewable energy generation and electrical distribution sectors. Andrea has extensive experience in overseeing public participation and stakeholder engagement processes and has also been involved in environmental feasibility and sensitivity analyses. She further specialises in undertaking and overseeing visual impact and landscape character assessments.

Key Visual Impact Assessment Experience

<u>Aug 2010 – to date</u>

- VIAs for the proposed construction of the Grasskoppies, Hartebeest Leegte, Ithemba and !Xha Boom Wind Farms near Loeriesfontein, Northern Cape Province.
- VIAs for the proposed Phezukomoya and San Kraal Wind Energy Facilities near Noupoort, Northern Cape Province.
- VIAs for the proposed Assagay Valley and Kassier Road North Mixed Use Developments, KwaZulu-Natal Province.
- VIA for the proposed construction of the Aletta 140MW Wind Energy Facility near Copperton, Northern Cape Province.
- VIAs (Scoping and Impact Phase) for the proposed construction of the Sendawo 1, 2 and 3 solar PV energy facilities near Vryburg, North West Province.
- VIA (Scoping and Impact Phase) for the proposed construction of the Sendawo substation and associated power line near Vryburg, North West Province.
- VIAs (Scoping and Impact Phase) for the proposed construction of the Tlisitseng 1 and 2 solar PV energy facilities near Lichtenburg, North West Province.
- VIA for the proposed construction of the Tlisitseng substation and associated 132kV power line near Lichtenburg, North West Province.
- VIA for the proposed Tinley Manor South Banks Development, KwaZulu-Natal Province.
- VIAs (Scoping and Impact Phase) for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- Visual Status Quo and Due Diligence Report for the possible rapid rail extensions to the Gauteng network, Gauteng Province.
- VIA for the proposed Tweespruit to Welroux power lines and substation, Free State Province.
- VIA for the proposed construction of the Nokukhanya 75MW Solar PV Power Plant near Dennilton, Limpopo Province.
- VIA (Scoping and Impact Phase) for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province.
- VIAs for the Spoornet Coallink Powerline Projects in KZN and Mpumalanga.
- VIA for the (Scoping and Impact Phase) proposed Construction of the Renosterberg Wind Farm near De Aar, Northern Cape Province.
- VIA for the (Scoping and Impact Phase) proposed Construction of the Renosterberg Solar PV Power Plant near De Aar, Northern Cape Province.
- VIA for the proposed Mookodi Integration phase 2 132kV power lines and Ganyesa substation near Vryburg, North West Province.
- VIA for the proposed construction of a substation and 88kV power line between Heilbron (via Frankfort) and Villiers, Free State Province.
- Visual Status Quo Assessment for the Moloto Development Corridor Feasibility Study in the Gauteng Province, Limpopo Province and Mpumalanga Province.

SPECIALIST DECLARATION

I, **Andrea Gibb**, 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 Specialist: Andrea Gibb

Date: 11 June 2018

EXECUTIVE SUMMARY

Although the majority of the study area has a largely natural, untransformed visual character, it is characterised by the presence of typical rural / pastoral infrastructure and is not typically valued or utilised for its tourism significance. In addition, the study area is characterised by the presence of human transformation / disturbance in the vicinity of the town of Kuruman, the suburb of Wrenchville and the rural settlement of Budolong. These areas will not be significantly impacted by the visual impacts associated with the proposed WEF. The rest of the study area / visual assessment zone has seen limited transformation / disturbance and is considered to be largely natural / scenic. These undisturbed / natural areas will therefore be impacted significantly from a visual perspective as a result of the development of the proposed WEF.

Due to the presence of urban built-up areas and low levels of leisure-based or nature based tourism activities in the assessment area, only three (3) visually sensitive receptors with tourism significance have been identified within the study area. Potentially sensitive receptor roads include the N14 national route. A total number of thirty-seven (37) potentially sensitive visual receptors were also identified. Overall it can be concluded that the visual impact of the proposed WEF would be reduced due to the lack of sensitive visual receptors present. The proposed development is however expected to alter the largely natural / scenic character of majority of the study area and contrast highly with the typical land use and/or pattern and form of human elements present in the undisturbed / natural areas of the study area.

The visual impact of the proposed development on most of the potentially sensitive visual receptors identified within the study area was rated as being medium (15 in total). The proposed development would however result in a high visual impact on VR 19 and VR 20. In addition, the proposed development would result in a low visual impact on six (6) of the potentially sensitive receptor locations, while the proposed development would result in negligible visual impacts on fourteen (14) of the potentially sensitive receptor locations. In terms of the sensitive receptors, the proposed development would result in a medium visual impact on SR2 – Red Sands Country Lodge and SR3 – Oryx Trail Game Lodge, as well as the N14 National Route. In addition, the proposed development would result in a low visual impact on SR1 – Chapman Safaris Game Lodge.

The impact rating revealed that overall the proposed WEF is expected to have a moderate negative visual impact rating during both construction and operation, with relatively few mitigation measures available. Cumulative impacts associated with the proposed WEF would have a moderate negative visual impact rating during both construction and operation, with relatively few mitigation measures available. These impacts would however remain moderate after the implementation of the relevant mitigation measures, due to the nature of the impacts.

Several renewable energy developments (one wind and the rest solar) are being proposed within a 50km radius of the proposed WEF application site. These renewable energy developments would reduce the overall natural / scenic character of the study area, although they would increase the cumulative visual impacts if some or all of these developments are constructed. As mentioned however, the cumulative impact assessment has been based solely on the information made available at the time by the EAP, namely the CSIR. As such, the cumulative impact assessment is based on broad assumptions as to the likely impacts of these developments. The relatively large number of renewable energy facilities within the surrounding area and their potential for large scale visual impacts could however significantly alter the sense of place and visual character in the study area, as well as exacerbate the visual impacts on surrounding visual receptors.

LIST OF ABBREVIATIONS

BA	Basic Assessment
DEA	Department of Environmental Affairs
DEM	Digital Elevation Model
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GIS	Geographic Information System
kV	Kilo Volt
MW	Megawatt
NEMA	National Environmental Management Act No. 107 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NGI	National Geospatial Information
OHL	Overhead Line
PPP	Public Participation Process
PV	Photovoltaic
SANBI	South African National Biodiversity Institute
VIA	Visual Impact Assessment
WEF	Wind Energy Facility

GLOSSARY

Definitions	
Anthropogenic feature	An unnatural feature as a result of human activity.
Aspect	Direction in which a hill or mountain slope faces.
Cultural landscape	A representation of the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (World Heritage Committee, 1992).
Sense of Place	The unique quality or character of a place, whether natural, rural or urban. It relates to uniqueness, distinctiveness or strong identity.
Scenic Route	A linear movement route, usually in the form of a scenic drive, but which could also be a railway, hiking trail, horse-riding trail or 4x4 trail.
Sensitive visual receptors	An individual, group or community that is subject to the visual influence of the proposed development and is adversely impacted by it. They will typically include locations of human habitation and tourism activities.
Study area	The study area / visual assessment zone is assumed to encompass a zone of 8km from the outer boundary of the proposed wind farm application site.
Vantage point	A point in the landscape from where a particular project or feature can be viewed.
Viewpoint	A point in the landscape from where a particular project or feature can be viewed.
Viewshed	The outer boundary defining a visual envelope, usually along crests and ridgelines.
Visual assessment zone	The visual assessment zone / study area is assumed to encompass a zone of 8km from the outer boundary of the proposed wind farm application site.
Visual character	The physical elements and forms and land use related characteristics that make up a landscape and elicit a specific visual quality or nature. Visual character can be defined based on the level of change or transformation from a completely natural setting.

Visual contrast	The degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would conform with the land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape.
Visual envelope	A geographic area, usually defined by topography, within which a particular project or other feature would generally be visible.
Visual exposure	The relative visibility of a project or feature in the landscape.
Visual impact	The effect of an aspect of the proposed development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.
Visual receptors	An individual, group or community that is subject to the visual influence of the proposed development but is not necessarily adversely impacted by it. They will typically include commercial activities and motorists travelling along routes that are not regarded as scenic.
Visual sensitivity	The inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (visual character), spatial distribution of potential receptors, and the likely value judgements of these receptors towards the new development, which are usually based on the perceived aesthetic appeal of the area.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	**Page 1** and **Page 2**. A copy of the Specialist's curriculum vitae (CV) is included in **Appendix D**.
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Page 3**
c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 1.1.1**
(cA) an indication of the quality and age of base data used for the specialist report;	**Section 1.1.4** and **Section 1.1.5**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Section 1.3**, **Section 1.5**, **Section 1.6** and **Section 1.7**.
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Section 1.1.3** and **Section 1.1.4**.
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Section 1.1.3**, **Section 1.1.4** and **Section 1.1.5**.
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**Section 1.3**, **Section 1.5**, **Section 1.6** and **Section 1.7**.
g) an identification of any areas to be avoided, including buffers;	**Section 1.3.6**, **Section 1.6.1** and **Section 1.6.2**.
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	The Visual Sensitivity Map has been provided in **Appendix C**.
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 1.1.4**
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	**Section 1.3**, **Section 1.5**, **Section 1.6** and **Section 1.7**.
k) any mitigation measures for inclusion in the EMPr;	**Section 1.6** and **Section 1.7**
l) any conditions for inclusion in the environmental authorisation;	**N/A.** No specific conditions relating to the visual environment need to be included in the environmental authorisation
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Section 1.7** and **Section 1.8**
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	**Section 1.9**

o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	**Section 1.1.3**. A Visual Impact Questionnaire has been included in **Appendix B**.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	The only comments received during the consultation process included a Visual Impact Questionnaire which was completed by the affected landowner. This questionnaire has been included in **Appendix B**.
q) any other information requested by the competent authority.	**N/A**. No information regarding the visual study has been requested from the competent authority to date.
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	**N/A**

TABLE OF CONTENTS

TABLES AND FIGURES

APPENDICES

VISUAL IMPACT ASSESSENT: EIA PHASE

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd (hereafter referred to as 'Mulilo') is proposing to construct a wind energy facility (WEF) near Kuruman in the Northern Cape Province. The proposed WEF together with associated infrastructure is referred to as Kuruman Phase 1 Wind Energy Facility (WEF).

This proposed development is currently the subject of an Environmental Authorisation (EA) application being submitted under the Environmental Impact Assessment (EIA) Regulations 2014 (as amended in 2017) and a Visual Impact Assessment (VIA) is required in order to inform the Environmental Impact Report (EIR) and Application for EA under NEMA.

The aim of the VIA is to identify potential visual issues associated with the development of the proposed WEF and its associated infrastructure, as well as to determine the potential extent of visual impact. This is done by characterising the visual environment of the area and identifying areas of potential visual sensitivity that may be subject to visual impacts.

1.1.2. Terms of Reference

The Terms of Reference for this VIA include the following:

- A description of the regional and local features;
- Identification of the visual character of the receiving environment;
- Desktop and field investigation to identify sensitive and potentially sensitive receptor locations;
- Mapping of the sensitive landscape features and/or receptor locations;
- Assessing (identifying and rating) the potential impacts on the environment,
- Description of the potential cumulative impacts;
- Identification of relevant legislation and legal requirements; and
- Providing recommendations on possible mitigation measures and rehabilitation procedures/ management guidelines.

1.1.3. Approach and Methodology

As mentioned above, this EIA level VIA is based on a combination of desktop-level assessment as well as field-based observation.

- <u>Physical landscape characteristics</u>

Physical landscape characteristics such as topography, vegetation and land use are important factors influencing the visual character and visual sensitivity of the study area. Baseline information about the physical characteristics of the study area was initially sourced from spatial databases provided by National Geospatial Information (NGI), the South African National Biodiversity Institute (SANBI) and the South African National Land Cover Dataset (Geoterraimage – 2014). The characteristics identified via desktop means were later verified during the site visit.

- <u>Identification of sensitive and potentially sensitive receptor locations</u>

Receptor locations and routes that are sensitive and/or potentially sensitive to the visual intrusion of the proposed development were also identified and assessed in order to determine the impact of the proposed development on each of the identified receptor locations.

- Fieldwork and photographic review

A three (3) day site visit was undertaken between the 19^{th} and the 21^{st} of February 2018 (summer). The study area was visited in order to:

- verify the landscape characteristics identified via desktop means;
- capture photos of the proposed study area;
- verify the sensitivity of visual receptor locations identified via desktop means;
- eliminate receptor locations that are unlikely to be influenced by the proposed development;
- identify any additional visually sensitive receptor locations within the study area; and
- assist with the impact rating assessment from visually sensitive receptor locations.

- Impact Assessment

A rating matrix was used to objectively evaluate the significance of the visual impacts associated with the proposed development, both before and after implementing mitigation measures. Mitigation measures were identified (where possible) in an attempt to minimise the visual impact of the proposed development. The rating matrix made use of a number of different factors including geographical extent, probability, reversibility, irreplaceable loss of resources, duration and cumulative effect in order to assign a level of significance to the visual impact of the project.

A separate rating matrix was used to assess the visual impact of the proposed development on each visual receptor location (both sensitive and potentially sensitive), as identified. This matrix is based on three (3) parameters, namely the distance of an identified visual receptor from the proposed development, the presence of screening factors and the degree to which the proposed development would contrast with the surrounding environment.

- Visualisation Modelling

Visual simulations were produced from specific viewpoints in order to support the findings of the visual assessment. The proposed WEF development was modelled at the correct scale and superimposed onto the landscape photographs which were taken during the site visit. These were used to demonstrate the visibility of the proposed turbines from various locations within the visual assessment zone and to assist with rating the visual impact.

- Consultation with I&APs

Continuous consultation with Interested and Affected Parties (I&APs) undertaken as part of the public participation process for the EIA will be used to help establish how the proposed development will be perceived by the various receptor locations and the degree to which the impact will be regarded as negative. It should be noted that only one (1) comment regarding the visual environment has been received from the public participation process to date, namely Mr. Poolman from the adjoining Farm Spitzberg. This feedback has subsequently been incorporated into this report. Should any further feedback be provided by I&APs in this regard, the report will be updated to include relevant information as and when it becomes available.

In addition, the landowners of the properties within which the proposed WEF development would be constructed were asked to complete a visual impact questionnaire in order to determine whether they would view the proposed development in a negative light and whether the farmsteads / homesteads located on these properties could ultimately be eliminated from the list of identified sensitive and potentially sensitive visual receptors locations. These questionnaires were also used to inform the VIA and have been included in **Appendix B**.

1.1.4. Assumptions and Limitations

The following assumptions and limitations apply:

- This visual study has been undertaken based on the project description provided by Mulilo and the CSIR at the inception of the project, as well as the final layout information provided by Mulilo and the CSIR during the EIA phase of the project.

- Given the nature of the receiving environment and the height of the proposed wind turbines, the study area or visual assessment zone is assumed to encompass a zone of 8km from the proposed WEF – i.e. an area of 8km from the boundary of the application site. This 8km limit on the visual assessment zone relates to the importance of distance when assessing visual impacts. Although the wind farm may still be visible beyond 8km, the degree of visual impact would diminish considerably and as such the need to assess the impact on potential receptor locations beyond this distance would not be warranted.

- Despite the fact that the study area or visual assessment zone encompasses a zone of 8km from the boundary of the application site, the distance from the nearest proposed turbine position was used when determining the zones of visual impact for the identified visual receptor locations (both sensitive and potentially sensitive). As such, even though a receptor location will be located within a negligible visual impact zone, it was still taken into consideration for the purposes of this study.

- The identification of visual receptor locations has been based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential visual receptor locations within the study area. Thereafter a three (3) day site visit was undertaken between the 19th and 21st of February 2018 (summer) in order to verify the sensitive visual receptor locations within the study area and assess the visual impact of the development from these receptor locations. Due to the extent of the study area, it was not possible to visit every potentially sensitive receptor location and as such a number of broad assumptions have been made in terms of the sensitivity of the receptors to the proposed development. It should be noted that not all receptor locations would necessarily perceive the proposed development in a negative way. This is usually dependent on the use of the facility and the economic dependency on the scenic quality of views from the facility. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include tourism facilities and scenic locations within natural settings. The presence of a receptor location in an area potentially affected by the proposed development does not therefore necessarily mean that visual impacts will be experienced.

- Due to access limitations during the field investigation / site visit and the nature of the study area, the identified potentially sensitive visual receptor locations (such as farmsteads and dwellings) could not be visited and investigated from a visual perspective during the time of the field investigation / site visit. Although the use of these receptor locations could not be investigated further during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were assessed as part of the VIA.

- Due to the fact that ground-truthing was undertaken during the scoping phase of this study, the visual sensitivity of each receptor location was investigated and explored during the scoping phase of the study. The visual sensitivity of each visual receptor location was however investigated and explored further in this phase of the study.

- Impact rating assessments for the sensitive and potentially sensitive visual receptor locations have been undertaken in this EIA phase VIA report. A matrix has been developed to assist in the assessment of the potential visual impact at each visual receptor location. The limitations of quantitatively assessing a largely subjective or qualitative type of impact should be noted. The matrix is relatively simplistic in considering three (3) main parameters relating to visual impact, but provides a reasonably accurate indicative assessment of the degree of visual impact likely to be exerted on each visual receptor location by the proposed WEF development. The matrix should therefore be seen as a representation of the likely visual impact at a visual receptor location. The results of the matrix should be viewed in conjunction with the visualisation modelling exercise to gain a full understanding of the likely visual impacts associated with the proposed WEF development.

- It should be noted that only one (1) comment regarding the visual environment has been received from the public participation process to date, namely Mr. Poolman from the adjoining Farm Spitzberg. This feedback has subsequently been incorporated into this report. In addition, some feedback has emanated from the visual impact questionnaire completed by the landowner of the property being proposed for the WEF development. This questionnaire was used to determine whether the landowner would view the proposed development in a negative light and whether the farmsteads / homesteads located on this property could ultimately be eliminated from the list of identified potentially sensitive visual receptor locations. Any further feedback received from the public during the review period of the Draft Environmental Impact Assessment Report (DEIAr) will also be incorporated into further drafts of this report. Undertaking a perception survey falls outside of the scope of this VIA.

- The viewshed analysis does not take into account any existing vegetation cover or built infrastructure which may screen views of the proposed development. In addition, detailed topographic data was not available for the broader study area and as such the visibility analysis does not take into account any localised topographic variations which may constrain views. This analysis should therefore be seen as a conceptual representation or a worst case scenario.

- The visibility analysis is based purely on topographic data available for the broader study area and does not take into account any localised topographic variations or any existing infrastructure and / or vegetation which may constrain views. In addition, the analysis does not take into account differing perceptions of the viewer which largely determine the degree of visual impact being experienced. The visual sensitivity analysis should therefore be seen as a conceptual representation or a worst-case scenario which rates the visibility of the site in relation to sensitive and potentially sensitive receptor locations.

- Due to the varying scales and sources of information as well as the fact that the terrain data available for the study area (NGI 25m DEM) is fairly coarse and somewhat inconsistent; maps and visual models may have minor inaccuracies. As such, only large scale topographical variations have been taken into account and minor topographical features or small undulations in the landscape may not be depicted on the DEM.

- Operational and security lighting will be required for the proposed wind energy facility and the associated infrastructure proposed within the development footprint. At the time of undertaking the visual study no information was available regarding the type and intensity of lighting required and therefore the potential impact of lighting at night has not been assessed at a detailed level. As such, the night-time environment in the study area was not fully characterised. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have however been provided.

- The assessment of receptor-based impacts has been based on the turbine layout provided by Mulilo and the CSIR. It is however recognised that this layout is a preliminary one, and is subject to changes based on a number of potential factors, including the findings of the EIA studies. The turbine locations may thus move, which may result in greater or lesser visual impacts on identified receptor locations.

- The cumulative impact assessment in this EIA phase VIA has been based solely on the information made available by the Environmental Assessment Practitioner (EAP), namely the CSIR. As such, this EIA level cumulative impact assessment is based on broad assumptions as to the likely impacts of these developments. It should however be noted that the proposed Kuruman Phase 2 WEF development (part of a separate on-going EIA process) has been assessed in detail as SiVEST was also responsible for undertaking the VIA for this proposed development and thus this information was available at the time of writing the report.

- Visualisation modelling from all sensitive and potentially sensitive receptor locations has not been undertaken. An indicative range of locations were selected for modelling purposes to provide an indication of the possible impacts from different locations within the study area. It should be noted that this modelling is specific to the location, and that even sites in close proximity to one another may be affected in different ways by the proposed WEF development. The visual models represent a visual environment that assumes that all vegetation cleared during construction will be restored to its current state after the construction phase. This is however an improbable scenario as some trees and shrubs may be permanently removed which may reduce the accuracy of the models generated. At the time of this study the proposed project was still in its planning stages. Therefore, the turbine layouts, as provided by Mulilo and the CSIR, may change and the infrastructure associated with the facility has not be included in the models.

- It should be noted that the fieldwork was undertaken in mid-February 2018, during late summer when most rainfall occurs in the area. As such, it is likely that the visual impact of the proposed development would be less significant at this time of year than it would be during the winter months when the surrounding vegetation is expected to provide less potential screening than in the late summer months.

- The overall weather conditions in the study area also have certain visual implications and are expected to affect the visual impact of the proposed development to some degree. As mentioned above, the fieldwork was undertaken during the late summer months which are characterised by clear weather conditions. In these conditions, the wind turbines would present a greater contrast with the surrounding environment than they would on a cloudy overcast day. The weather conditions during the time of the study were therefore taken into consideration when undertaking this VIA. In addition, these weather conditions were taken into consideration when undertaking the impact rating for each identified sensitive and potentially sensitive receptor locations.

1.1.5. Source of Information

Main sources of information for the visual impact assessment included:

- Project description for the proposed Kuruman Phase 1 WEF provided by Mulilo;
- Elevation data from 25m DEM from the NGI;
- 1:50 000 topographical maps of South Africa from the NGI;
- Land cover and land use data extracted from the 2013-2014 South African National Land-Cover Dataset provided by GEOTERRAIMAGE;
- Vegetation classification data extracted from SANBI's VEGMAP 2012 dataset;
- Google Earth Satellite imagery 2016;
- South African Renewable Energy EIA Application Database from Department of Environmental Affairs (incremental release Quarter 4 2017).

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE VISUAL IMPACT ASSESSMENT

In this section, the typical visual issues and impacts related to the establishment of a WEF are discussed. It is important to note that over the past few years many WEFs have been constructed in South Africa. The development and associated environmental assessment of WEFs in South Africa is however relatively new, and thus it is valuable to draw on international experience. This section of the report therefore draws on international literature and web material (of which there is significant material available) to describe the generic impacts associated with WEFs.

At this stage it is proposed that the WEF, comprising wind turbines and associated infrastructure, will be constructed on several farms comprising the application site with a total area of approximately 7317ha. The total number of turbines proposed is 47, each with a generation capacity of 4.5MW. The generated electricity will be fed into the national grid via a 132kV power line at either the Ferrum Substation or the Segame Substation. It should however be noted that this 132kV power line will require a separate Environmental Authorisation (EA) in order to allow for handover to Eskom and is being assessed as a part of a separate Basic Assessment (BA) process.

Detailed below is a preliminary list of the key components of the project that have visual implications. Although the associated infrastructure has been included here, the visual impact of associated infrastructure is generally far less significant than the visual impact associated with wind turbines. The infrastructure would however, magnify the visual prominence of the development if located on ridge tops or flat sites in natural settings where there is limited tall wooded vegetation present to conceal the impact.

1.2.1. Turbines

Wind turbines proposed for the Kuruman Phase 1 WEF will have a hub height of 140m, a rotor diameter of 160m and a blade length of 80m (**Figure 1**). Each wind turbine will have a foundation as well as a hardstand area / platform which will be required for turbine crane usage. It is proposed that 47 turbines will be constructed within identified turbine corridors, each with a generation capacity of 4.5MW. The height of the turbines and their location on higher lying ridges and plateaus would result in the development typically being visible over a large area.

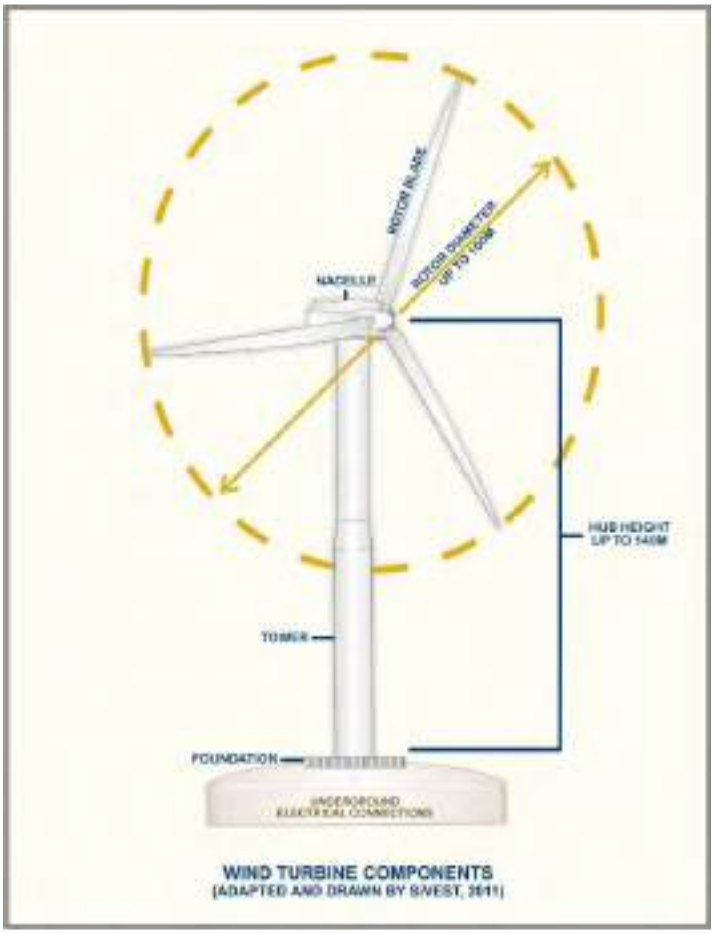
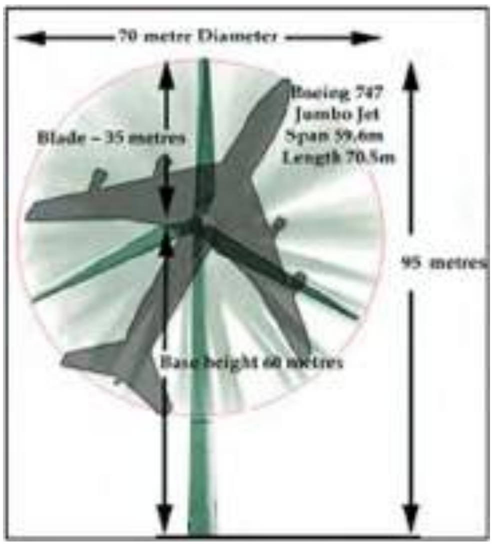


Figure 1: Typical components of a wind farm

Internationally, studies have demonstrated that there is a direct correlation between the number of turbines and the degree of objection to a WEF, with less opposition being encountered when fewer turbines are proposed (Devine-Wright, 2005). Certain objectors to wind energy developments also mention the “sky space” occupied by the rotors of a turbine. As well as height, "sky space" is an important issue. “Sky space” refers to the area in which the rotors would rotate. The diagram below indicates that the “sky space” occupied by rotors would be similar to that occupied by a jumbo jet (http://www.stopbickertonwindturbines.co.uk/ - page on visual impact).



The visual prominence of the development would be exacerbated within natural settings, in areas of flat terrain or if located on a ridge top. Even dense stands of wooded vegetation are likely to offer only partial visual screening, as the wind turbines are of such a height that they will rise above even mature large trees.

- **Shadow Flicker**

Shadow flicker is an effect which is caused when shadows repeatedly pass over the same point. It can be caused by wind turbines when the sun passes behind the hub of a wind turbine and casts a shadow that continually passes over the same point as the rotor blades of the wind turbine rotate (http://www.ecotricity.co.uk).

The effect of shadow flicker is only likely to be experienced by people situated directly within the shadow cast by the rotor blades of the wind turbine. As such, shadow flicker is only expected to have an impact on people residing in houses located within close proximity of a wind turbine (less than 500m) and at a specific orientation, particularly in areas where there is little screening present. Shadow flicker may also be experienced by and impact on motorists if a wind turbine is located in close proximity to an existing road. The impact of shadow flicker can be effectively mitigated by choosing the correct site and layout for the wind turbines, taking the orientation of the turbines relative to the nearby houses and the latitude of the site into consideration. Tall structures and trees will also obstruct shadows and prevent the effect of shadow flicker from impacting on surrounding residents (http://www.ecotricity.co.uk).

- **Motion-Based Visual Intrusion**

An important component of the visual impacts associated with wind turbines is the *movement* of the rotor blades. Labelled as motion-based visual intrusion, this refers to the inclination of the viewer to focus on discordant, moving features when scanning the landscape. Evidence from surveys of public attitudes towards WEFs suggest that the viewing of moving rotor blades is not necessarily perceived negatively (Bishop and Miller, 2006). The authors of the study suggest two (2) possible reasons for this; firstly when the turbines are moving they are seen as being ‘at work’, ‘doing good’ and producing energy. Conversely, when they are stationary they are regarded as a visual intrusion that has no evident purpose. More interestingly, the second theory that explains this perception is related to the intrinsic value of wind in certain areas and how turbines may be an expression or extension of an otherwise ‘invisible’ presence.

Famous winds across the world include the Mistral of the Camargue in France, the Föhn in the Alps, or the Bise in the Lavaux region of Switzerland. The wind, in these cases, is an intrinsic component of the landscape being expressed in the shape of trees or drifts of sands, but being otherwise invisible. The authors of the study argue that wind turbines in these environments give expression, when moving, to this quintessential landscape element. In a South African context, this phenomenon may well be experienced if wind farms are developed in areas where typical winds, like berg winds, or the south-easter in the Cape are an intrinsic part of the environment. In this way, it may even be possible that wind farms will, through time, form part of the cultural landscape of an area, and become a representation of the opportunities presented by the natural environment.

1.2.2. WEF Electrical Infrastructure

1.2.2.1 Underground Cabling

The proposed wind turbines will be connected to an on-site collector substation by way of internal reticulation power lines which will be buried underground. A 2ha assessment site has been identified for the collector substation, although the exact size of the development footprint is not known at this stage. It is however known that the substation structures will have a maximum height of 5m. **Figure 2** below shows the process typically associated with the generation of electricity from WEFs.

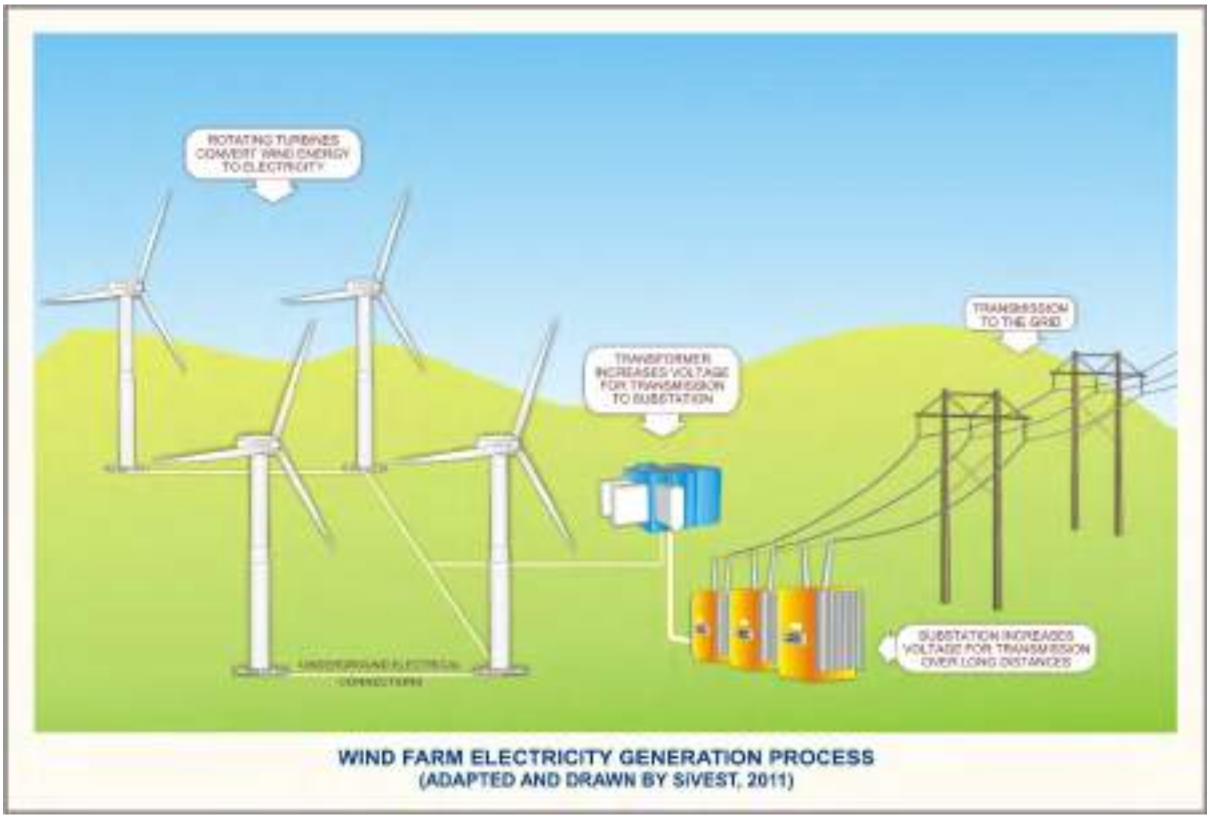


Figure 2: Conceptual wind farm electricity generation process showing electrical connections

The visual impact of this cabling would be very similar to access roads in that the 'scar' associated with the cable could create a visual contrast with the largely natural vegetation on the site. This is due to the fact that vegetation will need to be removed in order to install the underground cabling. It should also be noted that these cables may become a visual intrusion if placed in areas of the site that are visible to the surrounding areas, especially those areas that are located on ridges and associated sloping ground. The vegetation which has been removed from these areas is expected to take a significant amount of time to re-establish, thus leaving a 'scar' in the landscape for a period of time. it is recommended that where possible, all cables should avoid steeper slopes in order to preserve the natural visual integrity of the landscape. However, as all the turbines will be placed on high ridges / high points on the proposed wind farm site, this is not realistic. In light of this, it is expected that underground cabling will result in some form of a visual impact. It is thus strongly recommended that all reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid, in order to reduce the potential for creating unnatural linear features in the environment. Local nurseries may need to be commissioned to cultivate the vegetation removed. In addition, erosion control measures should be employed to prevent the scarring from worsening with time.

1.2.2.2 Power Lines

As mentioned above, the proposed wind turbines will be connected to an on-site collector substation by way of internal reticulation power lines which will be buried underground. However, above-ground power lines may also be used if deemed necessary. Power lines consist of a series of tall towers which make them highly visible. Power lines are not features of the natural environment, but are representative of anthropogenic transformation. Thus when placed in largely natural landscapes, they will be perceived to be highly incongruous in this setting. These power lines may become a visual intrusion if placed in areas of the site that are visible to the surrounding areas, especially those areas that are located on ridges and associated sloping ground. Excavations associated with the power lines may become prominent if they create a linear feature that contrasts with the surrounding vegetation.

Conversely, the presence of other anthropogenic elements associated with the built environment, especially other power lines, may result in the visual environment being considered to be ‘degraded’ and thus the introduction of a new power line into this setting may be less of a visual impact than if there was no existing built infrastructure visible. It is important to note that there are some existing medium voltage power lines which can be found within the study area (**Figure 14**). In addition, the newly constructed Ferrum-Mercury 400kV transmission power lines traverse the northern section of the study area in an east-west alignment (**Figure 22**). The presence of these medium and high voltage power lines are therefore expected to lessen the visual contrast associated with the introduction of a new power line.

It should be noted that the electricity generated from the proposed Kuruman Phase 1 WEF will be fed into the national grid at either the Ferrum or Segame Substations via a 132kV power line. This 132kV power line is however part of a separate on-going BA process and is this the subject of a separate EA assessment.

Power lines are anthropogenic elements that are typically found in the landscape, both in urban or industrial and in more natural rural settings. The visual impact of a power line would largely be related to the physical characteristics of the area, land use and the spatial distribution of potential receptors. These factors are also important factors used to determine whether a power line would be congruent within an environment as the degree of visual contrast is generally based on the land use, settlement density, visual character and presence of existing power lines. When combining this with the distribution and likely value judgements of visual receptors, the visual impact of the proposed power line can be determined. In areas, where the power line would contrast with the surrounding area it may change the visual character of the landscape and be perceived negatively by visual receptors.

As mentioned above, the presence of other linear structures such as roads, railways and especially other power lines would influence the perception of whether a power line is a visual impact. Where existing power lines are present the visual environment would already be visually ‘degraded’ and thus the introduction of a new power line in this setting may be considered to be less of a visual impact than if no existing built infrastructure were visible.

1.2.2.3 On-site Substations

A new on-site collector substation is being proposed which will supply the generated electricity to the Eskom grid. As previously mentioned, a 2ha assessment site has been identified for the collector substation, although the exact size of the development footprint is not known at this stage. It is however known that the substation structures will have a maximum height of 5m. In isolation, the substation may be considered to be visually intrusive, however, it must be assumed that the substation would be built to serve the needs of the power generated from the proposed WEF. Thus the substation would only be constructed if the proposed WEF was developed as well.

A substation is by nature a large object which will typically be visible for great distances. Thus in the context of a largely natural landscape, the new collector substation will be perceived to be highly incongruous. However, the substation would likely form part of the proposed WEF complex, as viewed from the surrounding farmsteads / homesteads. Views of the substation would therefore be dwarfed by the large number of turbines that would be visible. As such, the substation is not expected to be associated with a significant visual impact, or even a measurable cumulative impact. In addition, the presence of other anthropogenic objects associated with the built environment, especially other substations, may result in the visual environment being considered to be ‘degraded’ and thus the introduction of a new substation into this setting may be less of a visual impact than if there was no existing built infrastructure visible.

1.2.3. Access Roads

The WEF internal road network will provide access within the site and will connect all the turbines. This road network will comprise new roads and some existing roads, all constructed or widened to a width of 5m. These access roads could be considered a visual intrusion if they traverse sloping ground on an aspect that is visible to the surrounding area or if they are constructed in visible areas of the site. Roads are likely to be wider than cable trenches and thus could be even more greatly visible than the cable servitude. In addition, the cutting of ‘terraces’ into a steep sided slope would increase the visibility and contrast of the road against the surrounding vegetation.

Considering that the proposed access roads are located on sloping terrain, it is likely that there will be some form of visual impact associated with the construction of these access roads. Additionally, if these roads are not maintained correctly during the construction phase, construction vehicles travelling along the gravel access roads could expose surrounding farmsteads / homesteads to dust plumes.

1.2.4. Laydown Areas

In addition to the construction lay down areas next to each turbine, three (3) construction yards will be established on the application site, each with an area of 2ha. These construction yards will accommodate various welfare and storage facilities. From a visual perspective, construction yards could result in visual impacts if they are placed in prominent positions such as on ridge tops. In these locations, buildings may break the natural skyline, drawing the attention of the viewer.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Site Location

The proposed WEF is located approximately 5km south-west of Kuruman in the Northern Cape Province (Refer to ***Regional Context Map*** which has been provided as ***Map 1*** in **Appendix C**). The site lies within the boundaries of Ga-Segonyana Local Municipality, in the John Taolo Gaetsewe District Municipality. As shown in the ***Site Locality Map*** which has been provided as ***Map 2*** in **Appendix C**, the application site comprises six (6) farms and is approximately 7 300 hectares (ha) in extent, although the actual footprint of the proposed development is only expected to occupy some 8% of this area.

1.3.2. Topography

The study area is largely dominated by the Kuruman Hills, a range of high hills and ridges running in a roughly north-south alignment, parallel to the R31 Main Road (**Figure 3**).

Figure 3: Typical view of the Kuruman Hills which can be found within the application site

The surrounding area is however largely characterised by the relatively flat plains of the Ghaap Plateau with some relief in the form of isolated koppies and hills (**Figure 4**). In addition, the Kuruman River traverses the north-eastern sector of the study area while the rest of the area is characterised by a network of low lying dry water courses.

Figure 4: Typical view of the topography within the study area

Much of the application site lies in the Kuruman Hills and the terrain here is characterised by a mix of incised valleys and flatter, higher lying plateaux (**Figure 5**).

Figure 5: Typical view of the topography from within the application site

The topography and slope of the study area is illustrated in the respective ***Topography*** and ***Slope Classification Maps*** which have been provided as ***Map 3*** and ***Map 4*** in **Appendix C** respectively.

Visual Implications

Areas of flat relief, such as the flat plains and the higher-lying grassy plateaux, are characterised by wide ranging vistas. Vistas in the hillier and higher-lying terrain can be more open or more enclosed, depending on the position of the viewer. Within some of the more incised valleys for example, the vista would be limited, whereas a much wider view or vista would be available from the higher-lying ridge tops or slopes (**Figure 6**). Importantly in the context of this study the same is true of objects placed at different elevations and within different landscape settings, with objects placed on high-elevation slopes or ridge tops being highly visible, while those placed within valleys or enclosed plateaux would be far less visible.

Figure 6: Typical wide vista experienced from a high-lying area

GIS technology was used to undertake a preliminary visibility analysis for the turbine assessment corridors. A worst-case scenario was assumed when undertaking the analysis, where random points within the corridors were considered with a maximum height of 220m. Other infrastructure associated with the proposed WEF was not factored into the visibility analysis as the visual impact of the associated infrastructure is generally not regarded as a significant factor when compared to the visual impact associated with wind turbines. The resulting viewshed indicates the geographical area from where turbines located within the assessment corridors would be visible, i.e. the zone of visual influence. This analysis is based entirely on topography (relative elevation and aspect) which is an important factor that should be considered when determining the area of visual influence for a WEF development. The viewshed analysis does not take into account any existing vegetation cover or built infrastructure which may screen views of the proposed development. In addition, detailed topographic data was not available for the broader study area and as such the visibility analysis does not take into account any localised topographic variations which may constrain views. This analysis should therefore be seen as a conceptual representation or a worst case scenario.

The results of this analysis are shown in the ***Preliminary Visibility Analysis Map*** which has been provided as ***Map 5*** in **Appendix C**. From this it is evident that turbines placed within the assessment corridors would be highly visible from most parts of the study area.

1.3.3. Vegetation

According to Mucina and Rutherford (2006), the areas of the visual assessment zone which are characterised by flatter plains are largely covered by the Kuruman Thornveld vegetation type, which is generally characterized by a well-developed shrub layer and an open tree layer dominated by camel thorn trees (*Acacia erioloba*) (**Figure 7**).

Figure 7: Typical vegetation cover which can be found within the parts of the study area characterised by flatter plains

The hillier areas of the Kuruman Hills are classified as Kuruman Mountain Bushveld which is typically characterised by an open shrub layer and a well-developed grass layer (**Figure 8**).

Figure 8: Typical vegetation cover which can be found within the hillier parts of the study area such as the Kuruman Hills

In certain areas, man has had an impact on the natural vegetation, especially around farmsteads, where over many years tall exotic trees and other typical garden vegetation have been established

(**Figure 9**). Much of the study area however is still characterised by natural low shrubland with transformation limited to a few isolated areas of cultivation.

Figure 9: Example of the typical tall exotic trees and other garden vegetation which have been established around farmsteads within the study area

A site locality map showing the vegetation cover which can be found within the study area is shown in the ***Vegetation Classification Map*** which has been provided as ***Map 6*** in **Appendix C**.

<u>Visual Implications</u>

The predominant low shrub layer and open areas of grassland result in wide-open vistas across most of the study area (**Figure 7** and **Figure 8**). Vegetation would only provide significant screening in areas where artificial wooded vegetation has been established around farmhouses (**Figure 9**). The relatively low density of human habitation and natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (**Figure 10**).

Figure 10: Typical natural rural visual character of majority of the study area

1.3.4. Land Use

According to the South African National Land Cover dataset (2013-2014) from Geoterraimage (2014), much of the visual assessment area is characterised by natural unimproved vegetation which is dominated by low shrubland, grassland and woodland/open bush (Refer to ***Land Cover*** **C*lassification*** ***Map*** which has been provided as ***Map 7*** in **Appendix C**). The arid nature of the local climate has resulted in livestock rearing being the dominant activity within the area (**Figure 11**). Only very small, isolated areas have been cultivated and as such, the natural vegetation has been retained across much of the study area.

Figure 11: Evidence of livestock rearing taking place within the study area

The nature of the climate and corresponding land use has also resulted in low stocking densities and relatively large farm properties across the area. Thus the area has a very low density of rural settlement, with relatively few scattered farmsteads occurring across the area. Built form in the rural parts of the study area is limited to isolated farmsteads (**Figure 10**), gravel access roads (**Figure 12**), ancillary farm buildings, telephone lines (**Figure 13**), fences and farm workers' dwellings.

Figure 12: Typical view of the gravel access roads which can be found within the study area

Figure 13: Typical view of the telephone lines which can be found within the study area

It should also be noted that existing medium voltage power lines are also present within the area and can thus also be found within parts of the rural sections of the study area (**Figure 14**).

Figure 14: Typical view of the existing medium voltage power lines which can be found within parts of the study area

The closest built-up area is the town of Kuruman (**Figure 15**) which, along with the adjoining suburb of Wrenchville (**Figure 16**) is situated on the northern boundary of the proposed application site.

Figure 15: Typical urban built-up character of the town of Kuruman

Figure 16: Typical urban built-up character of the Wrenchville suburb

Also in the northern sector of the study area is the rural settlement of Bodulong (**Figure 17**), some 6kms north-west of Kuruman. It should be noted that the above-mentioned areas are characterised by significant amounts of urban transformation and/or disturbance and the impact of the proposed development would be less in these areas.

Figure 17: Typical urban built-up character of the Budolong rural settlement

Further human influence is visible in the area in the form of the N14 national route (**Figure 18**) which traverses the study area in an east-west direction and the R31 main road (**Figure 19**) which runs south through Kuruman, to Barkly West.

Figure 18: Typical view of the N14 national route

Figure 19: Typical view of the R31 main road

It should also be noted that the Billy Duvenhage Nature Reserve can also be found in the northern sector of the study area, adjacent to the town of Kuruman and the rural settlement of Budolong (**Figure 20**). This nature reserve was operated by the Kuruman Municipality, however, it is no longer operational, is severely degraded and has subsequently been closed down. This was confirmed during the site visit. Despite the fact that this reserve is severely degraded and is situated adjacent to transformed areas of Kuruman and Budolong, the area set aside for this nature reserve is still regarded as being largely natural and/or scenic (**Figure 21**), In addition, the reserve is still listed in the South African Protected Areas Database (SAPAD 2017).

Figure 20: Entrance of the Billy Duvenhage Nature Reserve which is no longer operational

Figure 21: Typical natural / scenic view of the area set aside for the Billy Duvenhage Nature Reserve

Electricity infrastructure in the area includes the newly constructed Ferrum-Mercury 400kV transmission power lines traversing the study area in an east-west alignment (**Figure 22**) as well as the Segame substation (**Figure 23**) on the southern boundary of Kuruman.

Figure 22: Typical view of the Ferrum-Mercury 400kV transmission power lines which traverse the study area

Figure 23: Typical view of the Segame Substation

In addition, there are some relatively small scale mining/quarrying activities scattered across the study area.

Visual Implications

As stated above, sparse human habitation and the predominance of natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (**Figure 10**).

High levels of human transformation and visual degradation only become evident in the northern sector of the study area with the urban/peri-urban development associated with the town of Kuruman, Wrenchville suburb and rural settlement at Bodulong (**Figure 15**, **Figure 16** and **Figure 17**).

The influence of the level of human transformation on the visual character of the area is described in more detail below.

1.3.5. Visual Character

The above physical and land use-related characteristics of the study area contribute to its overall visual character. Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as telephone or electrical infrastructure.

As mentioned above, much of the study area is characterised by rural areas with low densities of human settlement. Agriculture in the form of livestock grazing (**Figure 11**) is the dominant land use, which has transformed the natural vegetation in some areas.

However, a large portion of the study area has retained a natural appearance due to the presence of the low shrubs and taller trees dominated by camel thorn (*Acacia erioloba*). The most prominent anthropogenic elements in these areas include the N14 national route (**Figure 18**), the R31 main road (**Figure 19**), power lines (**Figure 14**) and other linear elements, such as telephone poles (**Figure 13**), communication poles and farm boundary fences. The presence of this infrastructure is an important factor in this context, as the introduction of the proposed wind energy facilities would result in less visual contrast where other anthropogenic elements are already present.

In contrast to the overall rural character is the town of Kuruman (**Figure 15**), the suburb of Wrenchville (**Figure 16)** and the nearby Bodulong settlement (**Figure 17**) which are distinctly urban and disturbed in character. Although it is a small town, Kuruman has a concentration of housing and other buildings such as schools, hospitals and churches, as well as relatively well established commercial centre to distinguish it from the surrounding rural landscape. It should be noted however that both of these areas have relatively small populations and occupy a limited spatial extent thus resulting in a clearly defined urban edge which contains the urban visual character.

As mentioned, the Billy Duvenhage Nature Reserve can also be found in the northern sector of the study area, adjacent to the rural settlement of Budolong (**Figure 20**). This nature reserve is however no longer operational and has subsequently been closed down. Despite the fact that this reserve is no longer operational and is situated adjacent to an area characterised by significant amounts of urban transformation and/or disturbance (i.e. the rural settlement of Budolong), the area set aside for this nature reserve is still regarded as being largely natural and/or scenic (**Figure 21**).

The scenic quality of the landscape is also an important factor contributing to the visual character of an area or the inherent sense of place. Visual appeal is often associated with unique natural features or distinct variations in landform. As such, the hilly / mountainous terrain which occurs on the application site and within the wider study area is considered to be an important feature that would potentially increase the scenic appeal and visual interest in the area.

The greater area surrounding the proposed development site is an important component when assessing visual character. The area can be considered to be typical of a Karoo or "platteland" landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa. Much of South Africa's dry Karoo interior consists of wide open, uninhabited spaces sparsely punctuated by widely scattered farmsteads and small towns. Traditionally the Karoo has been seen by many as a dull, lifeless part of the country that was to be crossed as quickly as possible on route between the major inland centres and the Cape coast, or between the Cape and Namibia. However, in the last couple of decades this perception has been changing, with the launching of tourism routes within the Karoo. In a context of increasing urbanisation in South Africa's major centres, the Karoo is being marketed as an undisturbed getaway, especially as a stop on a longer journey from the northern parts of South Africa to the Western and Eastern Cape coasts. Examples of this may be found in the relatively recently published "Getaway Guide to Karoo, Namaqualand and Kalahari" (Moseley and Naude-Moseley, 2008).

The typical Karoo landscape can also be considered a valuable 'cultural landscape' in the South African context. Although the cultural landscape concept is relatively new, it is becoming an increasingly important concept in terms of the preservation and management of rural and urban settings across the world (Breedlove, 2002).

Cultural Landscapes can fall into three categories (according to the Committee's Operational Guidelines):

i) "a landscape designed and created intentionally by man";
ii) an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The typical Karoo landscape consisting of wide open plains, and isolated relief, interspersed with isolated farmsteads, windmills and stock holding pens, is an important part of the cultural matrix of the South African environment. The Karoo farmstead is also a representation of how the harsh arid nature of the environment in this part of the country has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small towns, such as Kuruman, engulfed by an otherwise rural environment, form an integral part of the wider Karoo landscape. As such, the Karoo landscape as it exists today has value as a cultural landscape in the South African context. In the context of the types of cultural landscape listed above, the Karoo cultural landscape would fall into the second category, that of an organically evolved, "continuing" landscape.

Much of the study area, as visible to the viewer, represents a typical Karoo cultural landscape. This is important in the context of potential visual impacts associated with the development of a WEF as introducing this type of development could be considered to be a degrading factor in the context of the natural Karoo character of the study area, as discussed further below.

1.3.6. Sensitive Visual Receptor Locations

A sensitive receptor location is defined as a location from where receptors would potentially be adversely impacted by a proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described above, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the WEF into a 'view', which may affect the 'sense of place'.

The identification of sensitive receptor locations is typically undertaken based on a number of factors which include:

- the visual character of the area, especially taking into account visually scenic areas and areas of visual sensitivity;
- the presence of leisure-based (especially nature-based) tourism in an area;
- the presence of sites / routes that are valued for their scenic quality and sense of place;
- the presence of homesteads / farmsteads in a largely natural setting where the development may influence the typical character of their views; and
- feedback from interested and affected parties, as raised during the public participation process conducted as part of the EIA study.

A distinction must be made between a potentially sensitive receptor location and a sensitive receptor location. A potentially sensitive receptor location is a site from where the proposed wind farm may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Potentially sensitive receptor locations include locations such as residential dwellings, farmsteads / homesteads, as well as locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities, scenic sites and certain residential dwellings and/or farmsteads / homesteads in natural settings.

Distance bands were used to delineate zones of visual impact from the nearest proposed turbine position, as the visibility of the development would diminish exponentially over distance. As such, the proposed development would be more visible to receptor locations located within a short distance, and these receptor locations would therefore experience greater adverse visual impact than those located further away. Distance from the nearest proposed turbine position was therefore used to determine zones of visual impact. Based on the height and scale of the project, the radii chosen to assign these zones of visual impact are as follows:

- 0 < 2km (high impact zone);
- 2 < 5km (moderate impact zone);
- 5km < 8km (low impact zone); and
- > 8km (negligible impact zone)

Preliminary desktop assessment of the study area identified several potentially sensitive visual receptor locations, including existing residential areas, farm houses, accommodation and sport/recreation facilities. However, only three (3) sensitive visual receptor locations were identified within the rural parts of the study area. These include tourism facilities such as the Chapman's Safaris Game Lodge (SR1) (**Figure 24**), the Red Sands Country Lodge (SR2) (**Figure 25**) and the Oryx Trail Game Lodge (SR3) (**Figure 26**). This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area.

Figure 24: View of the entrance of the Chapman's Safaris Game Lodge (SR1)

Figure 25: View of the entrance of the Red Sands Country Lodge (SR2)


Figure 26: View of the Oryx Trail Game Lodge (SR3)

It should be noted that the Oryx Trail Game Lodge (SR3) is located within the application site and was previously operated as a lodge for hunters. However, according to the owner (i.e. Clive Albutt), it is currently used as a wedding and conference venue. Despite the fact that it is located within the site proposed for the WEF, the owner has plans to extend this lodge and keep it in operation and thus it has been included as a sensitive receptor location for the purpose of this visual study.

In addition, the only significant concentrations of human habitation in the study area occur on the northern boundary of the assessment area where the town of Kuruman, the suburb of Wrenchville and the Bodulong settlement encroach into the study area. Although there is a high concentration of receptor locations in this area, they are not regarded as sensitive to the visual impact of the proposed development due to the existing level of visual degradation within these areas.

In many cases, roads, along which people travel, are regarded as sensitive receptor locations. The primary thoroughfares in the study area include the N14 national road (**Figure 18**) and R31 main road (**Figure 19**). The N14 is the primary access road into Upington to the south-west and Vryburg to the north-east, and carries much of the local access traffic to and from these towns. In addition, the road connects Johannesburg/Gauteng with Springbok in the Northern Cape and forms part of a tourism route known as the Kokerboom Food & Wine Route. The Kokerboom Food & Wine Route takes tourists and travelers into one of the most interesting and beautiful areas of South Africa's Northern Cape Province and embraces the towns and settlements of Keimoes, Kanoneiland, Kenhardt, Augrabies, Upington and Marchand (http://www.openafrica.org/experiences/route/58-kokerboom-food-and-wine-route). This road is therefore valued or utilised for its scenic or tourism potential and as a result it is classed as a sensitive receptor road – i.e. a road along which motorists may object to the potential visual intrusion of the proposed WEF.

The R31 is a regional route in the Northern Cape Province that links Kuruman with Kimberley in the south east and carries much of the local access traffic to and from these towns. It is considered unlikely that this road would be widely used by tourists and as such it is not regarded as being visually sensitive.

Other thoroughfares in the study area are primarily used by local farmers travelling to and from Kuruman. They are therefore not regarded as visually sensitive as they do not form part of any scenic tourist routes, and are not specifically valued or utilised for their scenic or tourism potential.

Visual receptor locations are examined in more detail in **Section 1.6.1** and **Section 1.6.3**.

1.3.7. Existing and Proposed Renewable Energy Developments

Several renewable energy developments are being proposed within a 50 km radius of the proposed project. It should however be noted that only one of these is a wind energy development (namely the Kuruman Phase 2 WEF), while the remainder of the renewable energy developments in the surrounding area are solar energy facilities which are expected to have different impacts. These renewable energy developments are however relevant as they influence the cumulative visual impact of the proposed development and have been taken into consideration when identifying the cumulative impacts. The existing and proposed developments within a 50 km radius of the proposed project are listed in **Table 1** below and are indicated in the ***Renewable Energy Developments within 50kms of the Application Site Map*** which has been provided as ***Map 8*** in **Appendix C**.

Table 1: Existing and proposed renewable energy developments within 50kms of Kuruman Phase 1 WEF

DEA_REF	PROJ_TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT
14/12/16/3/3/2/819	The 75 MW AEP Legoko Photovoltaic Solar Facility on Portion 2 of the Farm Legoko 460, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Lekogo Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
14/12/16/3/3/2/820	The 75 MW AEP Mogobe Photovoltaic Solar Facility on portion 1 of the farm Legoko 460 and farm Sekgame 461, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Mogobe Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
12/12/20/1858/1	Kathu Solar Energy Facility	Renewable Energy Investments South Africa Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
12/12/20/1858/2	Kathu Solar Energy Facility 25MW 2	Lokian Trading and Investments	Savannah Environmental Consultants (Pty) Ltd	Solar PV	25
12/12/20/1860	Proposed establishment of the Sishen Solar Farm on Portion 6 of Wincanton 472, NC	VentuSA Energy Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	74
12/12/20/1906	Proposed construction of solar farm for Bestwood, Kgalagadi District Municipality, NC	Katu Property Developers Pty Ltd	Rock Environmental Consulting (Pty) Ltd	Solar PV	0
12/12/20/1994 12/12/20/1994/1 12/12/20/1994/2 12/12/20/1994/3	The Proposed Construction Of Kalahari Solar Power Project On The Farm Kathu 465, Northern Cape Province	Group Five Pty Ltd	WSP Environmental (Pty) Ltd	Solar PV	480
12/12/20/2566	A 19MW Photovoltaic Solar Power Generation Plant On The Farm Adams 328 Near Hotazel, Northern Cape Province	To review	To review	Solar PV	19
12/12/20/2567	The Proposed 150mw Adams Photo-Voltaic Solar Energy Facility On The Farm Adams 328 Near Hotazel Northern Cape Province	To review	To review	Solar PV	75
14/12/16/3/3/1/474	Construction of the Roma Energy Mount Roper Solar Plant on the Farm Moutn Roper 321, Kuruman, Ga-Segonyana Local Municipality	To review	EnviroAfrica Environmental Consultants (Pty) Ltd	Solar PV	10
14/12/16/3/3/1/475	The Proposed Construction Of Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province	To review	EnviroAfrica Environmental Consultants (Pty) Ltd	Solar PV	10

14/12/16/3/3/2/273	The Proposed San Solar Energy Facility And Associated Infrastructure On A Site Near Kathu, Gamagara Local Municipality, Northern Cape Province	To review	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/616	Proposed renewable energy geneartion project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park	Danax Energy (Pty) Ltd	AGES Limpopo (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/761	Proposed 75 MW Perth-Kuruman Solar Farm on the remainder of the farm Perth 276 within the Joe Morolong Local Municipality, Northern Cape Province	Agulhas-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/762	The 75MW Perth-Hotazel Solar Farm and its associated infrastructure on the Remainder of the Farm Perth 276 within the Joe Morolong Local Municipality in Northern Cape Province	Agulhus-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus	Solar PV	75
14/12/16/3/3/2/911	Proposed 75MW AEP Kathu Solar PV Energy Facility on the Remainder of the Farm 460 Legoko near Kathu within the Gamagara local Municipality in the Northern Cape Province	AEP Kathu Solar (Pty) Ltd	Cape Eprac	Solar PV	75
14/12/16/3/3/2/934	Kagiso Solar Power Plant near Hotazel, Northern Cape Province	Kagiso Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115
14/12/16/3/3/2/935	Proposed 115 Megawatt (MW) Boitshoko Solar Power Plant on the Remaining Extent of Portion 1 of The Farm Lime Bank no. 471 Near Kathu in the Gamagara Local Municipality	Boitshoko Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115
14/12/16/3/3/2/936	Tshepo Solar Power Plant near Hotazel, Northern Cape	Tshepo Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115
14/12/16/3/3/2/1066	Kuruman Phase 2 Wind Energy Facility (WEF) near Kuruman, Northern Cape Province	Mulilo Renewable Project Developments (Pty) Ltd	Council of Scientific and Industrial Research (CSIR)	Wind	4.5

Although it is important to assess the visual impacts of the proposed WEF development itself, it is equally important to assess the cumulative visual impact that would materialise in the area as a result of the construction of the proposed WEF development in addition to the other renewable energy developments in the surrounding area. Cumulative impacts are the combined impacts from different developments / facilities which, in combination, result in significant impacts that may be larger than the sum of all the impacts combined. The relatively large number of renewable energy facilities within the surrounding area and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, as well as exacerbate the visual impacts on surrounding visual receptors. As previously mentioned, the height of the proposed development in combination with distance are critical factors when assessing visual impacts. As mentioned above, renewable energy developments within a 50km radius of the proposed WEF development were identified and mapped.

As indicated in the ***Renewable Energy Developments within 50kms of the Application Site Map*** (***Map 8*** in **Appendix C**), there are no renewable energy facilities either under construction or currently operational within the 8km visual assessment zone. As such, the visual character of the study area has not been significantly altered and the visual impacts associated with renewable energy developments further afield are considered to be insignificant. There is however one (1) WEF being proposed within the 8km visual assessment zone, namely the Kuruman Phase 2 WEF development. This proposed WEF development however still requires EA and therefore it is unsure at this stage whether or not it will in fact be constructed. In light of this, the visual receptors (both sensitive and potentially sensitive) located within the 8km visual assessment zone would experience exacerbated visual impacts should both the proposed Kuruman Phase 1 WEF and Kuruman Phase 2 WEF developments receive EA and ultimately be constructed. In addition to the cumulative impact that would be experienced by visual receptors in the study area, the renewable energy facilities being proposed and/or constructed in the surrounding area are also expected to impact on the pastoral visual character of the larger area. The proposed Kuruman Phase 1 WEF development, in combination with the Kuruman Phase 2 WEF development being proposed within the study area, could therefore potentially be viewed as one (1) very large development which significantly alters the character of the study area and impacts on visual receptors.

The cumulative impacts anticipated as a result of the construction and operation of the proposed Kuruman Phase 1 WEF and Kuruman Phase 2 WEF developments include:

- visual impacts on users of arterial and secondary roads:
- the visual impacts on residents of farmsteads / homesteads and settlements;
- the visual impacts of shadow flicker on sensitive and potentially sensitive visual receptors;
- the visual impacts of lighting at night on sensitive and potentially sensitive visual receptors;
- the visual impacts of construction and operation on sensitive and potentially sensitive visual receptors, and
- the visual impacts on the visual quality of the landscape and sense of place.

In addition to the other renewable energy developments in the surrounding area, the Kuruman Phase 1 and Phase 2 WEF developments and their associated infrastructure could exert a greater visual impact within the surrounding area by further altering the visual character, thereby exposing a greater number of visual receptor locations to visual impacts. The operation of the Kuruman Phase 1 and Phase 2 WEF developments in addition to the other nearby renewable energy developments may also be perceived as unwelcome visual intrusions, particularly in more natural undisturbed settings. Large construction vehicles and equipment during the construction phases will contribute further to the alteration of the natural character of the study area and will also expose a greater number of visual receptors to visual impacts associated with the construction phases. The construction activities may thus also be perceived as further unwelcome visual intrusions, particularly in more natural undisturbed settings. Vehicles and trucks travelling to and from the proposed development sites on gravel access roads are also expected to result in an increase in dust emissions in the greater area. The increased traffic on these roads and the dust plumes could create a greater visual impact within the greater area and may evoke more negative sentiments from surrounding viewers.

It should however be noted that the existing roads which can be found around the project sites also appear to be gravel. As such, the gravel access roads are not expected to contribute significantly to the overall cumulative visual impact. Surface disturbance during construction would also result in a greater amount of bare soil being exposed which could result in a greater visual contrast with the surrounding environment. In addition, temporary stockpiling of soil during construction may alter the landscape further. Wind blowing over these disturbed areas could result in a greater amount of dust which would have a visual impact. It should however be noted that mitigation measures will be put in place during the construction and operation phases respectively in order to control dust and thus this is not expected to have a significant visual impact. Security and operational lighting at the proposed WEF developments and their associated infrastructure could also result in a greater amount of light pollution and glare within the surrounding area, which could be a significant annoyance to surrounding viewers. The significance of the above-mentioned visual impacts was however only found to range from moderate to low and thus the impact of the proposed Kuruman Phase 1 and Phase 2 WEF developments, in addition to the other renewable energy developments in the surrounding area, is not significant enough to result in the cumulative visual impact being considered unacceptable. Additionally, mitigation measures will be put in place during the construction and operations phases respectively in order to ensure that the proposed development will not result in significant visual impacts.

It should be noted that the proposed Keren Energy Whitebank Solar Plant is located just outside the 8km visual assessment and has received approval according to the DEA's South African Renewable Energy EIA Application Database (incremental release Quarter 4 2017). As mentioned above, renewable energy facilities, such as the Whitebank Solar Plant, being proposed and/or constructed in the surrounding area are expected to impact on the pastoral visual character of the larger area, in addition to the cumulative impact that would be experienced by visual receptors in the study area. Therefore, despite the fact that this renewable energy facility, is outside the 8km visual assessment zone, this facility along with several others which are proposed or under construction, could still potentially impact cumulatively on some of the visual receptors.

Ultimately, the cumulative impact assessment found that the cumulative impact of the proposed Kuruman Phase 1 WEF development would not significantly affect the surrounding area from a visual perspective. The anticipated cumulative impact could also be reduced to a moderate significance after the implementation of appropriate mitigation measures. As such, the addition of the proposed WEF is not expected to contribute to a greater visual impact than all of the other renewable energy developments combined and thus the construction of this WEF is not expected to result in an unacceptable overall visual impact.

It should be noted that this cumulative impact assessment has been based solely on the information available at the time of writing the report.

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the proposed WEF development are as follows:

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), (NEMA) and the EIA Regulations 2014 (as amended), the proposed development includes listed activities which require a full Environmental Impact Assessment (EIA) to be undertaken. As part of this EIA process, the need for a VIA to be undertaken has been identified in order to assess the visual impact of the proposed WEF.

There is currently no legislation within South Africa that explicitly pertains to the assessment of visual impacts, however in addition to NEMA the following legislation has relevance to the protection of scenic resources:

- National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)

- National Heritage Resources Act, 1999 (Act No. 25 of 1999)

Based on these Acts protected or conservation areas and sites or routes with cultural or symbolic value have been taken into consideration when identifying sensitive and potentially sensitive receptor locations and rating the sensitivity of the study area.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1. Key Issues Identified During the Scoping Phase

The potential visual issues / impacts identified during the EIA process for the proposed WEF development include:

- Potential visual intrusion resulting from construction vehicles and equipment during construction;
- Potential impacts of increased dust emissions from construction activities and related traffic during construction;
- Potential visual scarring of the landscape as a result of site clearance and earthworks during construction;
- Potential alteration of the visual character of the area during operation;
- Potential visual intrusion resulting from wind turbines located on ridge lines and higher plateaus during operation;
- Potential alteration of the night time visual environment as a result operational and security lighting as well as navigational lighting on top of the wind turbines during operation;
- Potential visual intrusion resulting from vehicles and equipment involved in the decommissioning process;
- Potential impacts of increased dust emissions from decommissioning activity activities and related traffic; and
- Potential visual intrusion of any remaining infrastructure on the site during decommissioning; and
- Combined visual impacts (i.e. cumulative visual impacts) from several renewable energy facilities in the broader area could potentially alter the sense of place and visual character of the area.

As previously mentioned, only one (1) comment regarding the visual environment has been received from the public participation process to date. This was from a nearby landowner (namely Mr. Poolman from the Farm Spitzberg) who stated that he had concerns over the visual impact associated with the proposed development and would like this to be given consideration. This VIA report has been compiled in order to address issues relating to the visual environment and has subsequently provided mitigation measures to reduce the visual impacts associated with the proposed development. As such, the visual environment has been taken into consideration by the developer (namely Mulilo) who will also implement the recommended mitigation measures as far as possible in order to reduce visual impacts.

Other feedback regarding the visual environment which has been received to date includes a visual impact questionnaire which was completed by the owner of the property within which the proposed WEF development would be constructed. The purpose of this was to determine whether they would view the proposed development in a negative light and whether the farmsteads / homesteads located on these properties could ultimately be eliminated from the list of identified sensitive and potentially sensitive visual receptors locations. The comment received from a surrounding landowner, as well as the questionnaire which was completed by the owner of the property within which the proposed WEF development would be constructed, have been included in **Appendix B**.

Should any further comments and/or any feedback be received this regard, the report will be updated to include relevant information as and when it becomes available.

1.5.2. Identification of Potential Impacts

Potential visual issues / impacts resulting from the proposed Kuruman Phase 1 WEF and associated infrastructure are outlined below.

1.5.2.1 Construction Phase

- Potential visual intrusion resulting from construction vehicles and equipment;
- Potential impacts of increased dust emissions from construction activities and related traffic; and
- Potential visual scarring of the landscape as a result of site clearance and earthworks.

1.5.2.2 Operational Phase

- Potential alteration of the visual character of the area;
- Potential visual intrusion resulting from wind turbines located on ridge lines and higher plateaus; and
- Potential alteration of the night time visual environment as a result operational and security lighting as well as navigational lighting on top of the wind turbines.

1.5.2.3 Decommissioning Phase

- Potential visual intrusion resulting from vehicles and equipment involved in the decommissioning process;
- Potential impacts of increased dust emissions from decommissioning activity activities and related traffic; and
- Potential visual intrusion of any remaining infrastructure on the site.

1.5.2.4 Cumulative impacts

- Combined visual impacts from several renewable energy facilities in the broader area could potentially alter the sense of place and visual character of the area; and
- Combined visual impacts from several renewable energy facilities in the broader area could potentially exacerbate visual impacts on visual receptors.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1. Results of the Field Study

As previously stated, the field investigation and photographic review was conducted between the 19th and 21st of February 2018. A summary of the findings of this investigation is provided below.

Visibility

The field investigation confirmed that the Kuruman Hills are a significant feature of the local landscape and as such, wind turbines placed on the ridges and higher lying plateaus of these hills would be highly visible to several identified potentially sensitive receptor locations, sensitive receptor locations and receptor roads as described below.

Sensitive Visual Receptors

The field investigation revealed a total number of three (3) sensitive receptor locations and thirty-seven (37) potentially sensitive receptor locations in the visual assessment zone. These receptor locations are shown in the ***Potentially Sensitive Visual Receptor Locations Map*** which has been provided as ***Map 9*** in **Appendix C**. As previously mentioned, the sensitive receptor locations were identified as:

- Chapman Safaris Game Lodge (SR1);
- Red Sands Country Lodge (SR2); and
- Oryx Trail Game Lodge (SR3).

Details of the visually sensitive receptor locations that were identified for the proposed WEF during the field investigation are provided below.

- **Chapman's Safaris Game Lodge (SR1)**

This receptor location is located approximately 7.3km from the nearest proposed turbine position and is thus in the 'Low' visual impact zone (**Figure 24**).

This facility consist of a few chalets which are used for overnight accommodation (**Figure 27**). The area surrounding this receptor location is largely natural and is characterised by limited amounts of visual transformation / disturbance. There are however anthropogenic linear elements present (such as power lines) although the surrounding area is generally characterised by relatively scenic views (**Figure 28**).

Figure 27: Example of the chalets at the Chapman's Safaris Game Lodge


Figure 28: Typical scenic character of the area surrounding the Chapman's Safaris Game Lodge (SR1)

- **Red Sands Country Lodge (SR2)**

This receptor location is located approximately 4.8km from the nearest proposed turbine positon and is thus in the 'Moderate' visual impact zone (**Figure 25**).

This facility consists of a number of accommodations facilities such as camping facilities (**Figure 29**), Rondawels (**Figure 30**) and chalets (**Figure 31**). In addition, there are also a number of other facilities such as a restaurant, a pool area, a pool bar and wedding and conference facilities.

Figure 29: View of some of the camping facilities at the Red Sands Country Lodge (SR2)

Figure 30: View of some of the Rondawel accommodation facilities at the Red Sands Country Lodge (SR2)

Figure 31: View of some of the chalets at the Red Sands Country Lodge (SR2)

This lodge is located in the middle of an 1800ha Private Nature Reserve which is home to numerous antelope and other wildlife (http://www.redsands.co.za). As such, this facility also provides various nature based activities such as self-guided game drives and bush / hiking trails. This is due to the largely natural setting of this facility and the low levels of visual transformation / disturbance which make it an appealing destination to undertake these activities. There are however certain linear elements present such as power lines, telephone lines and a tall tower which can be seen on one (1) of the surrounding hills (**Figure 32**). The surrounding area is however largely natural and is generally characterized by largely scenic views (**Figure 33**).

Figure 32: Typical view of some of the linear elements which are present at the Red Sands Country Lodge (SR2)

Figure 33: Typical natural scenic character of the area surrounding the Red Sands Country Lodge (SR2)

- **Oryx Trail Game Lodge (SR3)**

This receptor location is located approximately 3.1km from the nearest proposed turbine position and is thus in the 'Moderate' visual impact zone (**Figure 26**).

As mentioned, this facility was previously operated as a lodge for hunters. However, according to the owner, it is currently used as a wedding and conference venue. Despite the fact that it is located within the site proposed for the WEF, the owner has plans to extend this lodge and keep it in operation and thus it has been included as a sensitive receptor location for the purpose of this visual study.

The area surrounding this receptor location is largely natural and is characterized by limited amounts of visual transformation / disturbance. There are however a few linear elements present such as power lines As such, the surrounding area is generally characterized by relatively scenic views (**Figure 34**).

Figure 34: typical natural scenic character of the area surrounding the Oryx Trail Game Lodge (SR3)

It should be noted that, as previously mentioned, the field investigation showed that the Billy Duvenhage Nature Reserve (VR67), which is situated adjacent to the rural settlement of Budolong, no longer functions as a nature reserve and is severely degraded. The reserve is however still listed in the South African Protected Areas Database (SAPAD 2017) and as such is regarded as a potentially sensitive receptor location.

Many of the potentially sensitive receptor locations were identified as scattered farmsteads / homesteads which house the local farmers as well as their farm workers. These dwellings are regarded as potentially sensitive visual receptor locations as they are located within a mostly rural setting and the proposed development will likely alter natural vistas experienced from these dwellings, however their sentiments toward the development are unknown.

Details of the potentially sensitive receptor locations are provided in ***Table 2*** below.

Table 2: Potentially sensitive visual receptor locations in the study area

Name	Details	Approximate distance to nearest proposed turbine	Visual Impact Zone
VR1	Rural Settlement of Budolong	*10.7km (nearest part of settlement)	Negligible
VR2	Town of Kuruman (Smallholdings)	*9.2km (nearest part of smallholdings)	Negligible
VR3	Town of Kuruman (Northern Section)	*9.0km (nearest part of town)	Negligible
VR4	Town of Kuruman (Central Section)	7.2km (nearest part of town)	Low (nearest part of town)
VR5	Suburb of Wrenchville	*9.6km (nearest part of suburb)	Negligible
VR6	Town of Kuruman (Southern Section)	6.7km (nearest part of town)	Low (nearest part of town)
VR7	Kuruman Country Club	*8.8km	Negligible
VR8	Farmstead / Homestead	*8.2km	Negligible
VR9	Farmstead / Homestead	*8.8km	Negligible
VR10	Farmstead / Homestead	*8.9km	Negligible
VR11	Farmstead / Homestead	5.3km	Low
VR14	Farmstead / Homestead	4.8km	Moderate
VR18	Farmstead / Homestead	2.6km	Moderate
VR19	Farmstead / Homestead	1.5km	High
VR20	Farmstead / Homestead	1.7km	High
VR21	Farmstead / Homestead	5.6km	Low
VR22	Farmstead / Homestead	5.6km	Low
VR23	Farmstead / Homestead	*8.6km	Negligible
VR24	Farmstead / Homestead	*8.8km	Negligible
VR25	Farmstead / Homestead	7.2km	Low
VR26	Farmstead / Homestead	6.7km	Low
VR27	Farmstead / Homestead	6.6km	Low
VR28	Farmstead / Homestead	3.9km	Moderate
VR29	Farmstead / Homestead	5.0km	Moderate
VR30	Farmstead / Homestead	5.7km	Low
VR31	Farmstead / Homestead	3.3km	Moderate
VR32	Farmstead / Homestead	6.7km	Low
VR49	Farmstead / Homestead	*8.9km	Negligible
VR57	Farmstead / Homestead	4.6km	Moderate
VR58	Farmstead / Homestead	3.3km	Moderate
VR59	Farmstead / Homestead	7.4km	Low
VR60	Farmstead / Homestead	*8.2km	Negligible
VR61	Farmstead / Homestead	5.3km	Low
VR62	Farmstead / Homestead	*9.7km	Negligible
VR63	Farmstead / Homestead	5.4km	Low
VR64	Farmstead / Homestead	4.6km	Moderate

Name	Details	Approximate distance to nearest proposed turbine	Visual Impact Zone
VR67	Billy Duvenhage Nature Reserve	*8.7km (nearest part of reserve)	Negligible

*As previously mentioned, despite the fact that the study area or visual assessment zone encompasses a zone of 8km from the boundary of the application site, the distance to the nearest proposed turbine position was used when determining the zones of visual impact for the identified visual receptor locations. As such, even though a receptor location will be located within a negligible visual impact zone (i.e. further than 8km from the nearest turbine), it was still taken into consideration for the purposed of this study.

Field investigation also revealed that the section of N14 that traverses the study area is visually degraded in part due to urban development around Kuruman and Wrenchville (**Figure 35**), as well as the presence of a high voltage power line which is visible from sections of the road (**Figure 36**). Passing traffic on the N14 is therefore only expected to experience a low level of visual impact as a result of the proposed WEF. It should however be noted that certain parts of this road are characterised by low levels of visual transformation / degradation and therefore parts of this road regarded as being largely natural (**Figure 37**).

Figure 35: Example of visual degradation which is visible from parts of the N14 national route

Figure 36: Typical view of the high voltage power line which is visible from sections of the N14 national route

Figure 37: Typical view of a part of the N14 national route which is largely natural / untransformed

Several places of interest identified in the town of Kuruman were assessed during the field investigation and subsequently excluded from the list of potentially sensitive receptor locations. These locations were not regarded as potentially sensitive or sensitive to the visual impact of the proposed development due to the existing visual degradation within the built-up area.

The degree of visual impact experienced will vary from one receptor location to another, as it is largely based on the viewer's perception. Factors influencing the degree of visual impact experienced by the viewer include the following:

- Value placed by the viewer on the natural scenic characteristics of the area;
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression toward a less polluted future) or negative (foreign objects degrading the natural landscape); and
- Degree to which the viewer will accept a change in the typical Karoo character of the surrounding area.

1.6.2. Environmental Sensitivity Map

Visual Sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e. topography, landform and land cover), the spatial distribution of potential receptor locations, and the likely value judgements of these receptor locations towards a new development (Oberholzer: 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the area, SiVEST has developed a matrix based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer: 2005).

Based on the criteria in the matrix (***Table 3***), the visual sensitivity of the area is broken up into a number of categories, as described below:

- **High** - The introduction of a new development such as a wind farm would be likely to be perceived negatively by receptor locations in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptor locations
- **Moderate** - Presence of receptor locations, but due to the nature of the existing visual character of the area and likely value judgements of receptor locations, there would be limited negative perception towards the new development as a source of visual impact.
- **Low** - The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

The table below outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area.

Table 3: Environmental factors used to define visual sensitivity of the study area

FACTORS	**RATING**									
	1	2	3	4	5	6	7	8	9	10
Pristine / natural character of the environment										
Presence of sensitive visual receptor locations										
Aesthetic sense of place / scenic visual character										
Value to individuals / society										
Irreplaceability / uniqueness / scarcity value										
Cultural or symbolic meaning										
Scenic resources present in the study area										
Protected / conservation areas in the study area										

Sites of special interest present in the study area										
Economic dependency on scenic quality										
Local jobs created by scenic quality of the area										
International status of the environment										
Provincial / regional status of the environment										
Local status of the environment										
**Scenic quality under threat / at risk of change										

**Any rating above '5' will trigger the need to undertake an assessment of cumulative visual impacts.

Low							**Moderate**							**High**
10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**

Based on the above factors, the study area is rated as having a moderately-low visual sensitivity. This is mainly owing to the rural character of the area. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptor locations that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. As described above, relatively few sensitive and potentially sensitive receptor locations are present in the study area. There are however formally protected areas and leisure / nature-based tourism activities in the study area, and the area would still be valued as a typical Karoo cultural landscape.

Although the area is associated with a moderately low visual sensitivity, it should be stressed that the concept of visual sensitivity has been utilised indicatively to provide a broad-scale indication of whether the area is likely to be sensitive to visual impacts, and is based on the physical characteristics of the study area, economic activities and land use that predominates. This does not mean that high visual impacts could not potentially be experienced in areas of low visual sensitivity. The potential presence and perception of sensitive receptor locations as discussed above must also be taken into account.

During the EIA phase, all project specialists were also requested to indicate the environmentally-sensitive areas within the development site. This exercise was undertaken to inform the design of the development layout within the application site.

The aim of the assessment was to identify those parts of the application site where locating turbines and other associated infrastructure would result in the greatest probability of visual impacts on sensitive and potentially sensitive visual receptor locations, and should be precluded from the proposed development i.e. areas within the application site that should be avoided.

As previously mentioned, the visual prominence of a tall structure such as a wind turbine would be exacerbated if located on a ridge top or high lying plateau. Preliminary layout plans for the proposed development have largely utilised the higher lying plateaus within the application site for turbine placement and as such the development is likely to be highly visible from much of the surrounding area. This does not necessarily mean that these plateaus should be precluded from any development and as such a desktop analysis was conducted to determine likely visual sensitivity in relation to the sensitive and potentially sensitive receptor locations in the study area.

Using GIS-based visibility analysis, it was possible to determine which sectors of the site would be visible to the highest numbers of receptor locations in the study area. This analysis took into account all the sensitive and potentially sensitive receptor locations indicated in the ***Potentially Sensitive Visual Receptor Locations Map*** which has been provided as ***Map 9*** in **Appendix C**, as well as points along the N14 receptor road at 500m intervals. Based on this analysis, the areas visible to the highest number of receptor locations were initially rated as areas of 'High Sensitivity'. Given the importance of viewing distance in assessing visual impacts, the initial sensitivity ratings were weighted according to distance from the receptor locations. The resultant sensitivity map is shown in the ***Visual Sensitivity Map*** which has been provided as ***Map 10*** in **Appendix C**. Areas of high sensitivity should preferably be precluded from turbine development.

It should be noted that this sensitivity rating applies to turbine development only. The visual impacts resulting from the associated infrastructure are considered to have far less significance when viewed in the context of multiple wind turbines and as such the infrastructure has been excluded from the sensitivity analysis.

It should be further noted that the visibility analysis is based purely on topographic data available for the broader study area and does not take into account any localised topographic variations or any existing infrastructure and / or vegetation which may constrain views. In addition, the analysis does not take into account differing perceptions of the viewer which largely determine the degree of visual impact being experienced. The visual sensitivity analysis should therefore be seen as a conceptual representation or a worst-case scenario which rates the visibility of the site in relation to sensitive and potentially sensitive receptor locations.

In addition to the sensitivity ratings, the Sensitivity Map shows a 500m exclusion buffer around the Oryx Trail Game Lodge (SR3) sensitive receptor which is located within the application site. It is recommended that no wind turbines should be allowed to be developed within this buffer zone so as to prevent the impact of shadow flicker on this receptor location. This is due to the fact that this facility is still operated as a wedding and conference venue and will be expanded in the future. For more details regarding this impact refer to **Section 1.2.1**.

1.6.3. Receptor Impact Rating

In order to assess the impact of the proposed development on the identified sensitive and potentially sensitive receptor locations listed in **Section 1.6.1**, a matrix that takes into account a number of factors has been developed (***Table 5***), and is applied to each identified visual receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of a receptor location from the proposed development (zones of visual impact);
- Presence of screening factors (topography, vegetation etc.); and
- Visual contrast of the development with the landscape pattern and form.

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive and/or potentially sensitive receptor location in this context. It should be noted that this rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. Experiencing of visual impacts is however a complex and qualitative phenomenon, and is thus difficult to accurately quantify. The matrix should therefore be seen as a representation of the likely visual impact at a visual receptor location. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact.

As described above, distance of the viewer / receptor location from the development is an important factor in the context of experiencing of visual impacts which will have a strong bearing on mitigating the potential visual impact. A high impact rating has been assigned to receptor locations that are located within 2km of the proposed development. Beyond 8km, the visual impact would be virtually nil, as the development would appear to merge with the elements on the horizon. Any visual receptor locations beyond this distance have therefore not been assessed as they fall outside the study area and would not be visually influenced by the proposed development. Where a visual receptor is located within more than one (1) distance band, such as a receptor road, it is assigned a score according to the distance at its closest point to the proposed development (i.e. the highest visual impact experienced).

Based on the height and scale of the proposed WEF development, as well as the investigations undertaken during the fieldwork, the distance categories chosen to assign levels of visual impact are as follows:

- 0 <= 2km (high impact);
- 2km < 5km (moderate impact);
- 5km < 8km (low impact); and
- > 8km (Negligibly low impact).

The presence of screening factors is equally important in this context as the distance away from the development. Screening factors can be vegetation, buildings, as well as topography. For example, a grove of trees located between a visual receptor location and an object could completely shield the object from the receptor. Topography (relative elevation and aspect) plays a similar role as a visual receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is in close proximity, but not in its viewshed. As such, the complete screening of the development has been assigned an overriding negligible impact rating, as the development would not impose any impact on the visual receptor.

The visual contrast of a development refers to the degree to which the proposed WEF development would be congruent with the surrounding environment. This is based on whether or not the development would conform to the land use, settlement density, structural scale, form and pattern of natural elements that define the structure of the surrounding landscape. The visual compatibility is an important factor to be considered when assessing the impact of the development on visual receptors within a specific context. A development that is incongruent with the surrounding area could have a significant visual impact on visual receptors as it may change the visual character of the landscape.

Through the matrix a score for each receptor location (both sensitive and potentially sensitive) is calculated. The range in which the score falls, as listed in ***Table 4*** below, determines the visual impact rating for each visual receptor location.

Table 4: Ratings scores

Rating	Overall Score
High Visual Impact	8-9
Medium Visual Impact	5-7
Low Visual Impact	3-4
Negligible Visual Impact	(overriding factor)

An explanation of the matrix is provided in ***Table 5*** below.

Table 5: Visual assessment matrix used to rate the impact of the proposed development on sensitive and potentially sensitive receptors

	VISUAL IMPACT RATING			
VISUAL FACTOR	**HIGH**	**MEDIUM**	**LOW**	**OVERRIDING FACTOR: NEGLIGIBLE**
Distance of receptor away from proposed development	0 ≤= 2km **Score 3**	2km ≤ 5km **Score 2**	5km ≤ 8km **Score 1**	8km <
Presence of screening factors	No / almost no screening factors – development highly visible **Score 3**	Screening factors partially obscure the development **Score 2**	Screening factors obscure most of the development **Score 1**	Screening factors completely block any views towards the development, i.e. the development is not within the viewshed
Visual Contrast	**High contrast** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score 3**	**Moderate contrast** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score 2**	**Corresponds** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score 1**	

Table 6 below presents a summary of the overall visual impact of the proposed development on each of the sensitive and potentially sensitive visual receptor locations which were identified within the viewshed of the proposed WEF development. As previously mentioned, due to access limitations during the field investigation / site visit and the nature of the study area, the identified potentially sensitive visual receptor locations could not be visited and investigated from a visual perspective during the time of the field investigation / site visit. Although the use of these receptor locations could not be investigated further during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were assessed as part of the VIA.

Table 6: Summary - Sensitive and Potentially Sensitive Visual Receptor Rating

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
SR 1 – Chapman Safaris Game Lodge	Low (1)	Low (1)	Medium (2)	**LOW (4)**
SR 2 – Red Sands Country Lodge	Medium (2)	Low (1)	Medium (2)	**MEDIUM (5)**
SR 3 – Oryx Trail Game Lodge	Medium (2)	Medium (2)	High (3)	**MEDIUM (7)**
VR 1 – Rural Settlement of Budolong	Negligible			**NEGLIGIBLE**
VR 2 – Town of Kuruman (Smallholdings)	Negligible			**NEGLIGIBLE**
VR 3 - Town of Kuruman (Northern Section)	Negligible			**NEGLIGIBLE**
VR 4 - Town of Kuruman (Central Section)	Low (1)	Low (1)	Low (1)	**LOW (3)**
VR 5 - Suburb of Wrenchville	Negligible			**NEGLIGIBLE**
VR 6 - Town of Kuruman (Southern Section)	Low (1)	Low (1)	Low (1)	**LOW (3)**
VR 7 - Kuruman Country Club	Negligible			**NEGLIGIBLE**
VR 8 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 9 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 10 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 11 - Farmstead / Homestead	Low (1)	Medium (2)	High (3)	**MEDIUM (7)**

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 14 - Farmstead / Homestead	Medium (2)	Medium (2)	Medium (2)	**MEDIUM (6)**
VR 18 - Farmstead / Homestead	Medium (2)	Medium (2)	High (3)	**MEDIUM (7)**
VR 19 - Farmstead / Homestead	High (3)	Medium (2)	High (3)	**HIGH (8)**
VR 20 - Farmstead / Homestead	High (3)	Medium (2)	High (3)	**HIGH (8)**
VR 21 - Farmstead / Homestead	Low (1)	Low (1)	Medium (2)	**LOW (4)**
VR 22 - Farmstead / Homestead	Low (1)	Low (1)	Medium (2)	**LOW (4)**
VR 23 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 24 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 25 - Farmstead / Homestead	Low (1)	Low (1)	Medium (2)	**LOW (4)**
VR 26 - Farmstead / Homestead	Low (1)	Low (1)	Medium (2)	**LOW (4)**
VR 27 - Farmstead / Homestead	Low (1)	Low (1)	High (3)	**MEDIUM (5)**
VR 28 - Farmstead / Homestead	Medium (2)	Low (1)	High (3)	**MEDIUM (6)**
VR 29 - Farmstead / Homestead	Medium (2)	Low (1)	High (3)	**MEDIUM (6)**
VR 30 - Farmstead / Homestead	Low (1)	Low (1)	High (3)	**MEDIUM (5)**
VR 31 - Farmstead / Homestead	Medium (2)	Medium (2)	High (3)	**MEDIUM (7)**
VR 32 - Farmstead / Homestead	Low (1)	Low (1)	High (3)	**MEDIUM (5)**
VR 49 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 57 - Farmstead / Homestead	Medium (2)	Low (1)	High (3)	**MEDIUM (6)**
VR 58 - Farmstead / Homestead	Medium (2)	Low (1)	High (3)	**MEDIUM (6)**
VR 59 - Farmstead / Homestead	Low (1)	Medium (2)	Medium (2)	**MEDIUM (5)**
VR 60 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 61 - Farmstead / Homestead	Low (1)	Medium (2)	Medium (2)	**MEDIUM (5)**
VR 62 - Farmstead / Homestead	Negligible			**NEGLIGIBLE**
VR 63 - Farmstead / Homestead	Low (1)	Medium (2)	Medium (2)	**MEDIUM (5)**
VR 64 - Farmstead / Homestead	Medium (2)	Medium (2)	High (3)	**MEDIUM (7)**
VR 67 - Billy Duvenhage Nature Reserve	Negligible			**NEGLIGIBLE**
Receptor Road – N14 National Route	Low (1)	Medium (2)	Medium (2)	**MEDIUM (5)**

As indicated in the table above, the proposed WEF development would not result in a high visual impact on any of the identified sensitive visual receptors. The proposed development would however result in a medium visual impact on two (2) of the identified sensitive visual receptors (namely SR2 – Red Sands Country Lodge and SR3 – Oryx Trail Game Lodge), as well as the Receptor Road (namely the N14 National Route). In addition, the proposed development would result in a low visual impact on one (1) of the identified sensitive visual receptors, namely SR1 – Chapman Safaris Game Lodge.

In terms of the potentially sensitive visual receptor locations, the proposed development would result in a medium visual impact on majority of the receptor locations (15 in total). It should however be noted that the proposed development would result in a high visual impact on two (2) of the potentially sensitive receptor locations, namely VR 19 and VR 20 (both Farmsteads / Homesteads). In addition, it was found that the proposed development would result in a low visual impact on six (6) of the potentially sensitive receptor locations, while the proposed development would result in negligible visual impacts on fourteen (14) of the potentially sanative receptor locations.

1.6.4. Visual Modelling

In order to provide an indication of what the proposed WEF development would look like from various chosen viewpoints / vantage points, visual models were created to strengthen the findings of the receptor impact ratings (see **Section 1.6.3**). As mentioned, an indicative range of locations (referred to as "vantage points" or "viewpoints") were selected for modelling purposes to provide an indication of the possible impacts from different locations within the study area. The models illustrate how views from each selected vantage point will be transformed by the proposed WEF development if the wind turbines are erected on the site as proposed.

As mentioned above, the following assumptions and limitations are of relevance for the visual models:

- The visual models represent a visual environment that assumes all vegetative clearing undertaken during construction phase will be restored to its current state after the construction phase. This, however, is an improbable scenario as some trees and shrubs may be removed which may reduce the accuracy of the models generated.

- At the time of this study the proposed project was still in its planning stages. Therefore, the layout plans of the turbines, as provided by Mulilo and the CSIR, may change. In addition, all infrastructure associated with the WEF has been excluded from the models.

1.6.4.1 *Vantage Point 1 – View towards the proposed Kuruman Phase 1 WEF Application Site from the western section of the visual assessment zone, within 2km of the proposed application site*

Figure 38: Existing view (to the E) towards the proposed Kuruman Phase 1 WEF application site from the western section of the visual assessment zone, within 2km of the proposed application site.

Figure 39: Visually modelled post-construction view (to the E) towards the proposed Kuruman Phase 1 WEF application site from the western section of the visual assessment zone, within 2km of the proposed application site

As indicated in **Figure 39** above, the close proximity of the proposed turbines (i.e. within 2km) is expected to result in the proposed WEF development being highly visible. In addition, the vegetative screening factors are not significant enough to block out most views of the proposed WEF development and therefore the turbines are expected to be highly visible. The hills found to the east of this viewpoint are also not expected to aid significantly in screening as the wind turbines will be placed on the higher lying plateaus of hills located within the application site and are thus still expected to be largely visible. The visible wind turbines would contrast highly with the dominant natural landscape elements as there are no tall linear elements in view from this viewpoint except for telephone poles and fence poles.

1.6.4.2 Vantage Point 2 - View towards the proposed Kuruman Phase 1 WEF Application Site from the north-western section of the visual assessment zone (from SR2), within 5km of the proposed application site

Figure 40: Existing view (to the ESE) towards the proposed Kuruman Phase 1 WEF application site from the north-western section of the visual assessment zone (from SR2), within 5km of the proposed application site.

Figure 41: Visually modelled post-construction view (to the ESE) towards the proposed Kuruman Phase 1 WEF application site from the north-western section of the visual assessment zone (from SR2), within 5km of the proposed application site

As indicated in **Figure 41** above, the hills surrounding this viewpoint would provide a significant amount of screening and block out most views of the proposed WEF development. As can be seen from above, one would need to be situated on a point of elevation (such as on the top of a hill) in order for the turbines to become highly visible from this area. In addition, the vegetation surrounding this viewpoint is also expected to aid significantly in screening, especially from low-lying areas. As such, views of the turbines from this area are most likely to be significantly screened from lower lying points. The visible wind turbines would however only contrast moderately with the dominant natural landscape elements present as there are some tall linear elements such as telephone poles and a tall tower (**Figure 32**) present.

1.6.4.3 *Vantage Point 3 - View towards the proposed Kuruman Phase 1 WEF Application Site from the south-eastern section of the visual assessment zone (along the R31), within 8km of the proposed application site*

Figure 42: Existing view (to the WNW) towards the proposed Kuruman Phase 1 WEF application site from the south-eastern section of the visual assessment zone (along the R31), within 8km of the proposed application site.

Figure 43: Visually modelled post-construction view (to the WNW) towards the proposed Kuruman Phase 1 WEF application site from the south-eastern section of the visual assessment zone (along the R31), within 8km of the proposed application site

As indicated in **Figure 43** above, the lack of significant vegetative screening factors in the area surrounding this viewpoint are expected to result in the proposed WEF development being highly visible. In addition, the hills found to the north-west of this viewpoint are not expected to provide any form of screening as the wind turbines will be placed on the higher lying plateaus of these hills (as can be seen in the figure above). The wind turbines are thus expected to be highly visible from areas surrounding this viewpoint, as well as areas along the R31. Despite the high visibility, the distance of the proposed turbines diminished the visual impact. The visible wind turbines would however only contrast moderately with the dominant natural landscape elements as there are tall linear elements such as existing power lines and telephones poles in view from this viewpoint, as well as various areas along the R31.

1.6.5. Night-time Impacts

The visual impact of lighting on the nightscape is largely dependent on the existing lighting present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely have a significant impact on the nightscape. In contrast, introducing light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed WEF at night.

Much of the study area is characterised by rural areas with low densities of human settlement and as a result, relatively few light sources are present in the area surrounding the proposed development site. The town of Kuruman, the suburb of Wrenchville and the rural settlement of Bodulong are however situated in the northern section the study area, relatively close to the proposed application site. These built-up areas will therefore introduce an element of light pollution at night and this part of the study area will thus not be characterised by picturesque dark starry skies. The visual character of the night environment in this area is thus considered to be mostly ‘polluted’ and not pristine. Other prominent light sources within this part of the study area at night include the operational and security lighting at the Segame Substation which is situated on the southern boundary of Kuruman. Other sources of light are limited to, isolated lighting from the surrounding farmsteads / homesteads and transient light from the passing cars travelling along the N14, R31 and gravel access roads.

It should however be noted that the southern section of the study area is largely undisturbed / untransformed and therefore there are limited light sources present in this area. As such, these areas will be characterised by a picturesque dark starry sky at night and the visual character of the night environment is considered to be mostly ‘unpolluted’ and pristine. Prominent sources of light in this area are limited to isolated lighting from the surrounding farmsteads / homesteads and transient light from the passing cars travelling along the N14, R31 and gravel access roads.

Operational and security lighting at night will be required for the proposed WEF. In addition, a permanent aviation light or hazard light will be placed on the top of each wind turbine, which will create a network of red lights in the largely dark night-time sky. The type and intensity of lighting required was unknown at the time of writing this report and therefore the potential impact of the development at night has been discussed based on the general effect that additional light sources will have on the ambiance of the nightscape.

Although the area is not generally renowned as a tourist destination, the largely natural dark character of the nightscape will be sensitive to the impact of additional lighting at night. The operational and security lighting required for the proposed development is likely to intrude on the nightscape and create glare, which will contrast with the largely dark backdrop of the surrounding area. In addition, the red hazard lights may be particularly noticeable as their colour will differ from the lights typically found within the environment and the flashing will draw attention to them. These lights will however have a low intensity and will create less contrast than white lights typically would (Vissering, 2011). However, in the areas where other sources of light are present and the night environment is considered to be largely “polluted” by the effects of existing light sources, the nightscape will not be regarded to be sensitive to the impact of additional lighting at night.

1.6.6. Overall Visual Impact Rating

1.6.6.1 Potential Impact 1 (Construction Phase)

Nature of the impact

- Potential visual intrusion resulting from construction vehicles and equipment.
- Potential impacts of increased dust emissions from construction activities and related traffic.
- Potential visual scarring of the landscape as a result of site clearance and earthworks.

Significance of impact without mitigation measures

During the construction phase, large construction vehicles and equipment will alter the natural character of the study area and expose visual receptor locations to visual impacts associated with construction. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Vehicles and trucks travelling to and from the proposed site on gravel access roads are also expected to increase dust emissions. The increased traffic on gravel roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the landscape. Wind blowing over these disturbed areas could therefore result in dust which would have a visual impact.

The significance of visual impacts without mitigation measures during construction are rated as moderate.

Proposed mitigation measures

- Carefully plan to minimise the construction period and avoid construction delays.
- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.
- Make use of existing gravel access roads where possible.
- Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads, especially those leading up steep slopes.
- Maintain a neat construction site by removing rubble and waste materials regularly.

Significance of impact with mitigation measures

Mitigation measures will result in a reduction of visual impacts during construction from moderate to low.

1.6.6.2 Potential Impact 2 (Operational Phase)

Nature of the impact

- Potential alteration of the visual character of the area.
- Potential visual intrusion resulting from wind turbines located on ridge lines and higher plateaus.
- Potential alteration of the night time visual environment as a result operational and security lighting as well as navigational lighting on top of the wind turbines.

Significance of impact without mitigation measures

During the operation phase, the proposed Kuruman WEF (Phase 1) could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the WEF via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the proposed WEF could result in light pollution and glare, which could be an annoyance to surrounding viewers.

The significance of visual impacts without mitigation measures during operation are rated as moderate.

Proposed mitigation measures

Design Phase:

- Areas of 'High Sensitivity' should preferably be precluded from turbine development.
- No turbines should be placed within 500m of the N14 national road and R31 main road.
- Where possible, fewer but larger turbines with a greater output should be utilised rather than a larger number of smaller turbines with a lower capacity.
- Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011), unless another specialist recommends that one (1) or more of the turbine blades be painted an alternative colour in order to reduce an identified impact (for example as part of the Avifauna specialist's recommendations / mitigation measures). It is highly recommended that bright colours should not be permitted and that large, clear or obvious logos should preferably not be used or be kept to an absolute minimum.

Operational Phase:

- Turbines should be repaired promptly as they are considered more visually appealing when the blades are rotating (Vissering, 2011).
- If required, turbines should be replaced with the same model, or one of equal height and scale. Repeating elements of the same height, scale and form can result in unity and lessen the visual impact that would typically be experienced in a chaotic landscapes made up of diverse colours, textures and patterns (Vissering, 2011).
- Light fittings for security at night should reflect the light toward the ground and prevent light spill.
- Where practically possible, the operation and maintenance buildings should not be illuminated at night.
- Cables should be buried underground where possible.
- The operation and maintenance buildings should be painted with natural tones that fit with the surrounding environment. Non-reflective surfaces should be utilised where possible.
- Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads.
- Select the alternatives that will have the least impact on visual receptor locations.

Significance of impact with mitigation measures

Mitigation measures will result in a minor reduction of visual impacts during operation but the impact rating will remain moderate.

The significance of visual impacts without mitigation measures during construction are rated as moderate.

1.6.6.3 Cumulative Impacts

Nature of the impact

- Combined visual impacts from several renewable energy facilities in the broader area during the construction and operation phases could potentially alter the sense of place and visual character of the area; and
- Combined visual impacts from several renewable energy facilities in the broader area during construction and operations phases could potentially exacerbate visual impacts on visual receptors.

Significance of impact without mitigation measures

The cumulative impacts anticipated as a result of the construction and operation of the proposed WEF include visual impacts on users of arterial and secondary roads, visual impacts on residents of farmsteads / homesteads and settlements, visual impacts of shadow flicker on sensitive and potentially sensitive visual receptor locations, visual impacts of lighting at night on sensitive and potentially sensitive visual receptor locations, visual impacts of construction and operation on sensitive and potentially sensitive visual receptor locations and the visual impacts on the visual quality of the landscape and sense of place.

Large construction vehicles and equipment during the construction phase of the surrounding renewable energy facilities will contribute further to the alteration of the natural character of the study area and will also expose a greater number of visual receptor locations to visual impacts associated with the construction phase, especially in if some of the construction phases coincide. This is also true for the operational phase as the surrounding renewable energy facilities and their associated infrastructure would alter the visual character of the surrounding area further and expose a greater number of sensitive and potentially sensitive visual receptor locations to visual impacts. The construction and operational activities may be perceived as unwelcome visual intrusions, particularly in more natural undisturbed settings. Vehicles and trucks travelling to and from the proposed development sites during the construction phases on gravel access roads are also expected to result in an increase in dust emissions in the greater area. In addition, maintenance vehicles may need to access the surrounding renewable energy facilities and their associated infrastructure via gravel access roads and are also expected to increase dust emissions in the surrounding area in doing so. The increased traffic on these roads and the dust plumes could create a greater visual impact within the greater area and may evoke more negative sentiments from surrounding viewers. It should however be noted that the majority of the existing roads in the vicinity of the project site are also gravel. As such, the gravel access roads are not expected to contribute significantly to the overall cumulative visual impact. Surface disturbance during construction of the surrounding renewable energy facilities would also result in a greater amount of bare soil being exposed which could result in a greater visual contrast with the surrounding environment. In addition, temporary stockpiling of soil during construction may alter the landscape further. Wind blowing over these disturbed areas could result in a greater amount of dust which would have a visual impact. Security and operational lighting will be required for the operation of the surrounding renewable energy facilities and their associated infrastructure. This could therefore result in a greater amount of light pollution and glare within the surrounding area, which could be a significant annoyance to surrounding viewers.

The significance of the cumulative visual impacts without mitigation measures during construction and operation are rated as moderate.

Proposed mitigation measures

- Carefully plan to reduce the construction period.
- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.
- Vegetation clearing should take place in a phased manner.
- Maintain a neat construction site by removing rubble and waste materials regularly.
- Make use of existing gravel access roads, where possible.
- Limit the number of vehicles and trucks travelling to and from the proposed development site, where possible.
- Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads.
- Unless there are water shortages, ensure that dust suppression is implemented in all areas where vegetation clearing has taken place.
- Unless there are water shortages, ensure that dust suppression techniques are implemented on all soil stockpiles.
- Temporarily fence-off the construction sites (for the duration of the construction period).
- All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid, where possible.
- It is not realistic to attempt to screen wind farms visually. Providing a means whereby they can be absorbed into the landscape is more feasible. This can be approached by making use of certain materials and finishes, such as monochromatic dull colours.
- Buildings and similar structures must be in keeping with regional planning policy documents, especially the principles of critical regionalism (namely sense of place, sense of history, sense of nature, sense of craft and sense of limits).
- Where possible, fewer but larger turbines with a greater output should be utilised rather than a larger number of smaller turbines with a lower capacity.
- High visual impact zones should be viewed as zones where the number of turbines should be limited, or precluded where possible.
- Light fittings for security at night should reflect the light toward the ground (except for aviation lighting) and prevent light spill.
- The operations and maintenance buildings should not be illuminated at night, if possible.
- Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011), unless another specialist recommends that one (1) or more of the turbine blades be painted an alternative colour in order to reduce an identified impact (for example as part of the

Avifauna specialist's recommendations / mitigation measures). It is highly recommended that bright colours should not be permitted and that large, clear or obvious logos preferably not be used or be kept to an absolute minimum.

- Turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011).
- If possible and practically feasible, the operation and maintenance buildings should be painted with natural tones that fit with the surrounding environment[1]. In addition, non-reflective surfaces should be utilised where possible.
- If required, turbines should be replaced with the same model, or one of equal height and scale. Repeating elements of the same height, scale and form can result in unity and lessen the visual impact that would typically be experienced in a chaotic landscapes made up of diverse colours, textures and patterns (Vissering, 2011).
- As far as possible, limit the number of maintenance vehicles, which are allowed to access the sites.
- Bury cables under the ground where possible.
- Select the alternatives that will have the least impact on visual receptor locations.

Significance of impact with mitigation measures

Mitigation measures will not result in a reduction of cumulative visual impacts during construction and operation. Moderate cumulative visual impacts are still expected during the construction and operational phases.

1.7. IMPACT ASSESSMENT SUMMARY

The EIA process requires that an overall rating for visual impact be provided to allow the visual impact to be assessed alongside other environmental parameters. The CSIR has developed an impact rating matrix for this purpose. The assessment of impacts and recommendation of mitigation measures as discussed above are collated in ***Table 7 - Table 10*** below.

Please refer to **Appendix A** for an explanation of the impact rating methodology.

[1] Depending on the building design, the developer may find it preferable to paint the building white in order to reflect heat and keep the interior of the building cool

Table 7: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Construction Activities	Visual intrusion and dust emissions	Negative	Local	Short-Term	Substantial	Very likely	High	Low	- Carefully plan to minimise the construction period and avoid construction delays. - Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. - Make use of existing gravel access roads where possible. - Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads. - Maintain a neat construction site.	Moderate	Low	4	Medium

Table 8: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		

Operational Activities	Visual intrusion, dust emissions and light pollution and glare	Negative	Local	Long Term	Substantial	Very likely	High	Low	*Design Phase:* - High visual impact zones should be viewed as zones where the number of turbines should be limited, where possible. - No turbines should be placed within 500m of the N14 national road and R31 main road. - Where possible, fewer but larger turbines with a greater output should be utilised rather than a larger number of smaller turbines with a lower capacity. - Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011), unless another specialist recommends that one (1) or more of the turbine blades be painted an alternative colour in order to reduce an identified impact (for example as part of the Avifauna specialist's recommendations / mitigation measures). It is highly recommended that bright colours should not be permitted and that large, clear or obvious logos preferably not be used or be kept to an absolute minimum. *Operational Phase:* - Turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011). - If required, turbines should be replaced with the same model, or one of equal height and scale. Repeating elements of the same	Moderate	Moderate	3	Medium

									height, scale and form can result in unity and lessen the visual impact that would typically be experienced in a chaotic landscapes made up of diverse colours, textures and patterns (Vissering, 2011). - Light fittings for security at night should reflect the light toward the ground and prevent light spill. - Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads. - Where practically possible, the operations and maintenance buildings should not be illuminated at night. - Cables should be buried underground where possible. - If possible, the operation and maintenance buildings should be painted with natural tones that fit with the surrounding environment[2]. In addition, non-reflective surfaces should be utilised where possible. - Select the alternatives that will have the least impact on visual receptor locations.				

[2] Depending on the building design, the developer may find it preferable to paint the building white in order to reflect heat and keep the interior of the building cool.

Table 9: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Decommissioning Activities	Visual intrusion and dust emissions	Negative	Local	Short-Term	Substantial	Very likely	High	Low	- Carefully plan to minimise the construction period and avoid construction delays. - Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. - Make use of existing gravel access roads where possible. - Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads. - Maintain a neat construction site.	Moderate	Low	4	Medium

Table 10: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		

Construction Activities	Visual intrusion and dust emissions	Negative	Regional	Short Term	Substantial	Very likely	Moderate	Moderate	- Carefully plan to reduce the construction period. - Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. - Vegetation clearing should take place in a phased manner. - Maintain a neat construction site by removing rubble and waste materials regularly. - Make use of existing gravel access roads, where possible. - Limit the number of vehicles and trucks travelling to and from the proposed development site, where possible. - Unless there are water shortages, ensure that dust suppression techniques are implemented on all access roads. - Unless there are water shortages, ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. - Unless there are water shortages, ensure that dust suppression techniques are implemented on all soil stockpiles. - Temporarily fence-off the construction sites (for the duration of the construction period).	Moderate	Moderate	3	Medium

									- All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid, where possible. - It is not realistic to attempt to screen wind farms visually. Providing a means whereby they can be absorbed into the landscape is more feasible. This can be approached by making use of certain materials and finishes, such as monochromatic dull colours. - Buildings and similar structures must be in keeping with regional planning policy documents, especially the principles of critical regionalism (namely sense of place, sense of history, sense of nature, sense of craft and sense of limits).				

Operational Activities	Visual intrusion, dust emission and light pollution and glare	Negative	Regional	Long Term	Substantial	Very likely	Moderate	Moderate	- Where possible, fewer but larger turbines with a greater output should be utilised rather than a larger number of smaller turbines with a lower capacity. - High visual impact zones should be viewed as zones where the number of turbines should be limited, where possible. - Light fittings for security at night should reflect the light toward the ground (except for aviation lighting) and prevent light spill. - The operations and maintenance buildings should not be illuminated at night, if possible. - Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011), unless another specialist recommends that one (1) or more of the turbine blades be painted an alternative colour in order to reduce an identified impact (for example as part of the Avifauna specialist's recommendations / mitigation measures). It is highly recommended that bright colours should not be permitted and that large, clear or obvious logos preferably not be used or be kept to an absolute minimum.	Moderate	Moderate	3	Medium

									- Turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011). - If possible, the operation and maintenance buildings should be painted with natural tones that fit with the surrounding environment[3]. In addition, non-reflective surfaces should be utilised where possible. - If required, turbines should be replaced with the same model, or one of equal height and scale. Repeating elements of the same height, scale and form can result in unity and lessen the visual impact that would typically be experienced in a chaotic landscapes made up of diverse colours, textures and patterns (Vissering, 2011). - As far as possible, limit th number of maintenanc vehicles, which are allowed t access the sites. - Bury cables under the ground where possible. - Unless there are wate shortages, ensure that dus suppression techniques ar implemented on all acces roads.				

									- Select the alternatives that will have the least impact on visual receptor locations.				

[3] Depending on the building design, the developer may find it preferable to paint the building white in order to reflect heat and keep the interior of the building cool.

1.8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

Design Phase Monitoring:

Although no monitoring can be undertaken during the design phase, it must be ensured that the number of turbines within the high visual impact zone are limited, where possible. In addition, ensure that no turbines are placed within 500m of the N14 national road and R31 main road. Turbines should also be painted plain white, unless another specialist recommends that one (1) or more of the turbine blades be painted an alternative colour in order to reduce an identified impact (for example as part of the Avifauna specialist's recommendations / mitigation measures).

Construction Phase Monitoring:

Ensure that visual management measures are included as part of the EMPr and monitored by an Environmental Control Officer (ECO). This will include monitoring activities associated with visual impacts such as the siting of construction camp, management of soil stockpiles, screening and dust suppression. Regular reporting to an environmental management team must also take place during the construction phase.

Operation Phase Monitoring:

Ensure that visual mitigation measures are monitored by the management team on an on-going basis. This will include monitoring activities associated with visual impacts such as the control of signage, lighting and dust on the site.

Decommissioning Phase Monitoring:

Ensure that procedures for the removal of structures and stockpiles during decommissioning are implemented, including recycling of materials. In addition, it must be ensured that rehabilitation of the site to a visually acceptable standard is undertaken.

1.9. CONCLUSIONS AND RECOMMENDATIONS

An EIA level study has been conducted in order to identify the potential visual impact and issues related to the development of the proposed Kuruman Phase 1 WEF near Kuruman in the Northern Cape Province. Although the majority of the study area has a largely natural, untransformed visual character, it is characterised by the presence of typical rural / pastoral infrastructure and is not typically valued or utilised for its tourism significance. In addition, the study area is characterised by the presence of human transformation / disturbance in the vicinity of the town of Kuruman, the suburb of Wrenchville and the rural settlement of Budolong. These areas will not be significantly impacted by the visual impacts associated with the proposed WEF. The rest of the study area / visual assessment zone has seen limited transformation / disturbance and is considered to be largely natural / scenic. These undisturbed / natural areas will therefore be impacted significantly from a visual perspective as a result of the development of the proposed WEF. It should also be noted that there are several renewable energy developments (solar and wind) being proposed and/or constructed within 50kms of the proposed WEF. These facilities and their associated infrastructure, will significantly alter the visual character and baseline in the study area once constructed and make it appear to have a more industrial-type visual character. Due to the presence of urban built-up areas and low levels of leisure-based or nature based tourism activities in the assessment area, only three (3) sensitive visual receptors were identified within the study area, namely SR1 – Chapman's Safaris Game Lodge, SR2 – Red Sands Country Lodge and SR3 – Oryx Trail Game Lodge. It was however ascertained that the proposed WEF development is likely to visually impact thirty-seven (37) potentially sensitive receptors. In many cases, roads along which people travel, are regarded as sensitive receptors. Potentially sensitive receptor roads which were identified within the study area include the N14 national route. This road is valued or utilised for its scenic or tourism potential and as a result it is regarded as a sensitive receptor road. It is considered unlikely that the R31 road would be widely used by tourists and as such it is not regarded as being visually sensitive.

In order to assess the impact of the proposed development on the sensitive and potentially sensitive receptor locations identified within the study area, a receptor impact rating was undertaken. It was established that the proposed Kuruman Phase 1 WEF would result in a medium visual impact on SR2 – Red Sands Country Lodge and SR3 – Oryx Trail Game Lodge, as well as the N14 National Route. In addition, the proposed development would result in a low visual impact on SR1 – Chapman Safaris Game Lodge. In terms of the potentially sensitive visual receptor locations, the proposed development would result in a medium visual impact on majority of the receptor locations (15 in total). It should however be noted that it would result in a high visual impact on VR 19 and VR 20 (both Farmsteads / Homesteads). In addition, it was found that the proposed development would result in a low visual impact on six (6) of the potentially sensitive receptor locations, while the remaining fourteen (14) potentially sensitive receptor locations would only be exposed to negligible visual impacts.

An overall impact rating was also conducted in order to allow the visual impact to be assessed alongside other environmental parameters. The impact rating revealed that overall the proposed WEF (including associated infrastructure) is expected to have a moderate negative visual impact rating during both construction and operation, with relatively few mitigation measures available. The significance of the cumulative impacts associated with the proposed WEF in addition to the other renewable energy developments proposed nearby were also rated according to the significance rating methodology. The impact assessment revealed that the cumulative visual impacts of the proposed WEF in addition to the other renewable energy developments (including associated infrastructure) proposed nearby would have a moderate negative visual impact rating during both construction and operation, with relatively few mitigation measures available. These impacts would however remain moderate after the implementation of the relevant mitigation measures, due to the nature of the impacts.

Overall it can be concluded that the visual impact of the proposed WEF would be reduced due to the lack of sensitive visual receptors present. However, it is expected that the proposed development would alter the largely natural / scenic character of much of the study area and contrast with the typical land use and/or pattern and form of human elements present in the undisturbed / natural areas of the study area. As previously mentioned, several renewable energy developments (both wind and solar) are being proposed within a 50km radius of the proposed WEF application site. These renewable energy developments would reduce the overall natural / scenic character of the study area, however they would increase the cumulative visual impacts, should some or all of these developments be constructed. As mentioned, the cumulative impact assessment has been based on the information made available by the EAP, namely the CSIR. As such, the cumulative impact assessment is based on broad assumptions as to the likely impacts of these developments. The relatively large number of renewable energy facilities within the surrounding area and their potential for large scale visual impacts could however significantly alter the sense of place and visual character in the study area, as well as exacerbate the visual impacts on surrounding visual receptors.

1.9.1. Visual Impact Statement

It is SiVEST's opinion that the visual impacts identified in this VIA are not significant enough to prevent the project from proceeding and that an EA should be granted. From a visual impact perspective, only three (3) visually sensitive receptors with tourism significance have been identified within the study area. A total number of thirty-seven (37) potentially sensitive visual receptors were however identified. These included scattered farmsteads / homesteads which house the local farmers as well as their farm workers. These dwellings are regarded as potentially sensitive visual receptors as they are located within a mostly rural setting and the proposed development will likely alter natural vistas experienced from these dwellings. In addition, the proposed development is expected to alter the largely natural / scenic character of much of the study area and contrast highly with the typical land use and/or pattern and form of human elements present in the undisturbed / natural areas of the study area as these areas are largely natural / scenic and untransformed. The visual impact of the proposed development on most of the potentially sensitive visual receptors identified within the study area was rated as being medium (15 in total). The proposed development would however result in a high visual impact on VR 19 and VR 20. In addition, the proposed development would result in a low visual impact on six (6) of the potentially sensitive receptor locations, while the proposed development would result in negligible visual impacts on fourteen (14) of the potentially sanative receptor locations. In terms of the sensitive receptors, the proposed development would result in a medium visual impact on SR2 – Red Sands Country Lodge and SR3 – Oryx Trail Game Lodge, as well as the N14 National Route. In addition, the proposed development would result in a low visual impact on SR1 – Chapman Safaris Game Lodge. In light of the above, SiVEST is of the opinion that the impacts associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

1.10. REFERENCES

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Appendix A

IMPACT RATING METHODOLOGY PROVIDED BY CSIR

Specialist Impact Assessment Criteria

The identification of potential impacts and risks should include impacts that may occur during the construction, operational and decommissioning phases of the activity. The assessment of impacts is to include direct, indirect, as well as cumulative impacts.

In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed activity is well understood so that the impacts associated with the activity can be understood. The process of identification and assessment of impacts will include:

- Determine the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Determine future changes to the environment that will occur if the activity does not proceed;
- An understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts which are likely to occur if the activity is undertaken.

As per DEA *Guideline 5: Assessment of Alternatives and Impacts* the following methodology is to be applied to the prediction and assessment of impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

- **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

- **Nature of impact** - this reviews the type of effect that a proposed activity will have on the environment and should include "what will be affected and how?"

- **Status** - Whether the impact on the overall environment (social, biophysical and economic) will be:
  - Positive - environment overall will benefit from the impact;
  - Negative - environment overall will be adversely affected by the impact; or
  - Neutral - environment overall will not be affected.

- **Spatial extent** – The size of the area that will be affected by the risk/impact:
  - Site;
  - Local (<10 km from site);
  - Regional (<100 km of site);
  - National; or
  - International (e.g. Greenhouse Gas emissions or migrant birds).

- **Duration** – The timeframe during which the risk/impact will be experienced:

- Very short term (instantaneous);
- Short term (less than 1 year);
- Medium term (1 to 10 years);
- Long term (the impact will occur for the project duration); or
- Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).

- **Reversibility of impacts -**
  - High reversibility of impacts (impact is highly reversible at end of project life, i.e. this is the most favourable assessment for the environment. For example, the nuisance factor caused by noise impacts associated with the operational phase of an exporting terminal can be considered to be highly reversible at the end of the project life);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment. The impact is permanent. For example, the loss of a palaeontological resource on the site caused by building foundations could be non-reversible).

- **Irreplaceability of resource loss caused by impacts –**
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment. For example, if the project will destroy unique wetland systems, these may be irreplaceable);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Probability** – The probability of the impact occurring:
  - Extremely unlikely (little to no chance of occurring);
  - Very unlikely (<30% chance of occurring);
  - Unlikely (30-50% chance of occurring)
  - Likely (51 – 90% chance of occurring); or
  - Very Likely (>90% chance of occurring regardless of prevention measures).

- **Consequence**–The anticipated severity of the impact:
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
  - Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).

o

- **Significance** – To determine the significance of an identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 1 below). The approach incorporates internationally recognised methods from the Intergovernmental Panel on Climate Change (IPCC) (2014) assessment of the effects of climate change and is based on an interpretation of existing information in relation to the proposed activity, to generate an integrated picture of the risks related to a specified activity in a given location, with and without mitigation. Risk is assessed for each significant stressor (e.g. physical disturbance), on each different type of receiving entity (e.g. the municipal capacity, a sensitive wetland), qualitatively (very low, low, moderate, high, very high) against a predefined set of criteria (as shown in Figure 1 below).

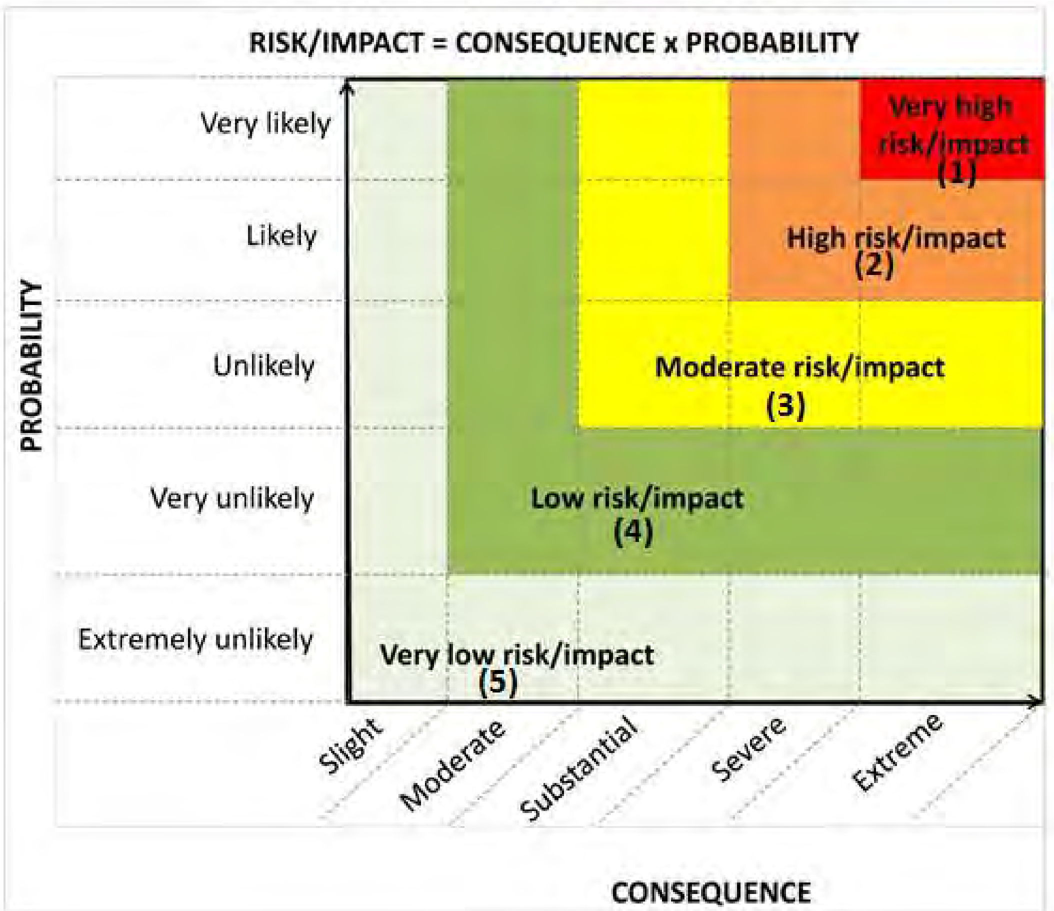


Figure 1: Guide to assessing risk/impact significance as a result of consequence and probability.

- **Significance** – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);

- Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated); or
- High (the risk/impacts will result in a considerable alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making).
- Very high (the risk/impacts will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

The above assessment must be described in the text (with clear explanation provided on the rationale for the allocation of significance ratings) and summarised in an impact assessment Table in a similar manner as shown in the example below (Table 1).

- **Ranking -** With the implementation of mitigation measures, the residual impacts/risks must be ranked as follow in terms of significance:

  - Very low = 5;
  - Low = 4;
  - Moderate = 3;
  - High = 2; and
  - Very high = 1.

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - Low;
  - Medium; or
  - High.

Impacts will then be collated into an EMPr and these will include the following:

- Management actions and monitoring of the impacts;
- Identifying negative impacts and prescribing mitigation measures to avoid or reduce negative impacts; and
- Positive impacts will be identified and enhanced where possible.

Other aspects to be taken into consideration in the assessment of impact significance are:

- Impacts will be evaluated for the construction, operational and decommissioning phases of the development. The assessment of impacts for the decommissioning phase will be brief, as there is limited understanding at this stage of what this might entail. The relevant rehabilitation guidelines and legal requirements applicable at the time will need to be applied;
- The impact evaluation will, where possible, take into consideration the cumulative effects associated with this and other facilities/projects which are either developed or in the process of being developed in the local area; and
- The impact assessment will attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact.

- Impacts should be assessed for all layouts and project components.
- **<u>IMPORTANT NOTE FROM THE CSIR</u>: IMPACTS SHOULD BE DESCRIBED BOTH BEFORE AND AFTER THE PROPOSED MITIGATION AND MANAGEMENT MEASURES HAVE BEEN IMPLEMENTED. THE ASSESSMENT OF THE POTENTIAL IMPACT "BEFORE MITIGATION" SHOULD TAKE INTO CONSIDERATION ALL MANAGEMENT ACTIONS THAT ARE ALREADY PART OF THE PROJECT DESIGN (WHICH ARE A GIVEN). THE ASSESSMENT OF THE POTENTIAL IMPACT "AFTER MITIGATION" SHOULD TAKE INTO CONSIDERATION ANY ADDITIONAL MANAGEMENT ACTIONS PROPOSED BY THE SPECIALIST, TO MINIMISE NEGATIVE OR ENHANCE POSITIVE IMPACTS.**

Appendix B

COMMENTS FROM PPP / VISUAL IMPACT QUESTIONNAIRE

I&AP COMMENT & REGISTRATION FORM

PROPOSED CONSTRUCTION OF THE KURUMAN PHASE 1 AND KURUMAN PHASE 2 WIND ENERGY FACILITIES AND ASSOCIATED INFRASTRUCTURE NEAR KURUMAN, NORTHERN CAPE PROVINCE

PLEASE SUBMIT ALL COMMENTS BY 21 JUNE 2018

Please provide your full contact details:	
First Name: Dana	Surname: Poolman
Organisation: Land Owner	Designation: Farmer
Postal Address: P.O.Box 542 Kuruman	Street Address: Farm Spitzberg Alphen Kuruman
Postal Code: 8460	Street Code: 8460
Phone: ( )	Fax: ( )
Cell: 0829206610	Email: spitzberg9@gmail.com

Please indicate if you want to be registered as an Interested and Affected Party (I&AP) for the proposed projects (please tick the appropriate box). **PLEASE NOTE:** Registration as an I&AP is required in order to receive further correspondence regarding the EIA Process			
YES	X	**NO**	
Please clearly state any interest (business, financial, personal or other) you may have in the projects and/or the applications for Environmental Authorisation:			
Financial and Personal			

Please describe any issues or concerns you may have which you think should be considered during the Scoping and Environmental Impact Assessment Processes:
View and Noise

Please provide details of any other individuals or organisations that should be registered as I&APs:

Please return all completed I&AP Comment & Registration Forms to Ms Lizande Kellerman at:

CSIR I PO Box 320 I Stellenbosch I I 7599
Tel: (021) 888 2489 **I Fax**: (021) 888 2693**I Email:** lkellerman@csir.co.za
Please visit the project website at:
https://www.csir.co.za/environmental-impact-assessment

PART 7: WIND TURBINES

7.1 Have you ever seen a wind turbine in real life / in a photograph?

YES

7.2 Do you consider your surrounding environment to be scenic or something of natural beauty to be valued?

YES

If yes-
Do you think the proposed development will detract from the beauty of the landscape?

NO

7.3 Would you consider the establishment of the proposed structures (i.e. wind turbines) to be elegant structures that symbolize progression toward a less polluted future, or foreign objects that will degrade and alter the natural landscape?

YES

7.4 Would it be problematic for you if wind turbines were visible from your farmhouse / dwelling?

NO

7.5 In general do you regard the proposed establishment of a wind farm in your direct surroundings as a positive or negative change and what is your overall opinion / perception toward the proposed development?

POSSITIVE

7.6 What are the main roads in the area primarily used for (e.g. farm access, day visitors etc.)?

FORM & LODGE

7.7 Are there any tourism activities / facilities in the area that you know of?

I HAVE A LODGE

If yes-
Please elaborate / provide general information related to tourism in the area

Wedding + Conferance Venue

7.8 Are there any future tourism activities / facilities planned in the area that you know of?

NO

If yes-
Please elaborate / provide general information related to future tourism in the area

7.9 Do any places in the area have any cultural or symbolic meaning?

NO

If yes-
Please elaborate / provide information

7.10 Are there any scenic resources present in the area (e.g. mountains, scenic rivers, water falls etc.)?

No

If yes-
Please elaborate / provide information

7.11 Are there any sites of special interest present in the area?

No

If yes-
Please elaborate / provide information

7.12 Are there any future residential developments planned in the area?

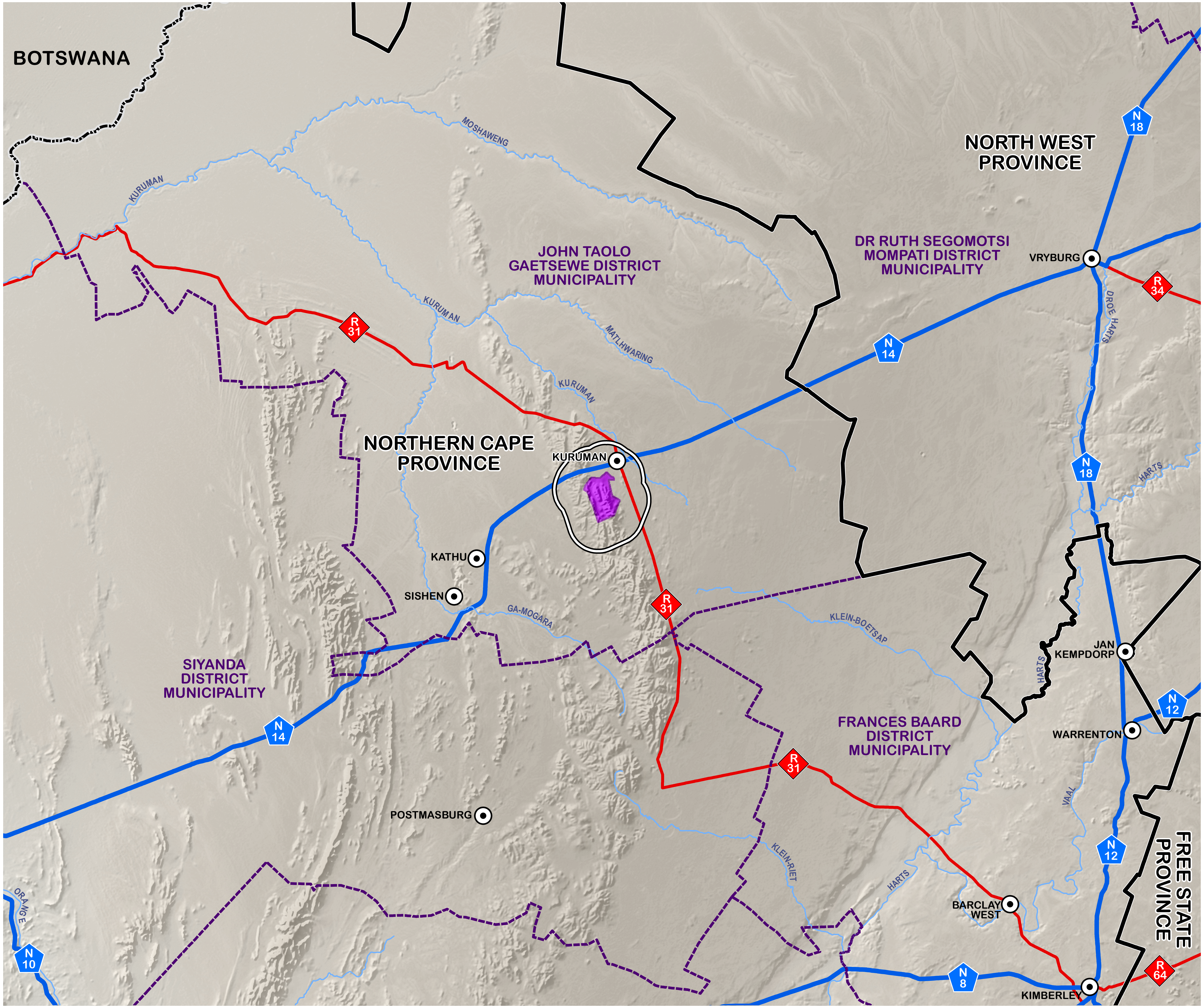
EXTENDING THE Lodge.

If yes-
Please elaborate / provide information

Appendix C

PROJECT MAPS

Map 1 – Regional Context Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: REGIONAL CONTEXT

Legend

- Main Towns
- National Boundary
- Provincial Boundaries
- District Municipal Boundaries
- National Routes
- Main Arterial Routes
- Main Rivers
- Kuruman WEF Phase 1 Application Site
- 8km Visual Assessment Zone

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N

0 10 20
Kilometers

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51 WESSELS ROAD
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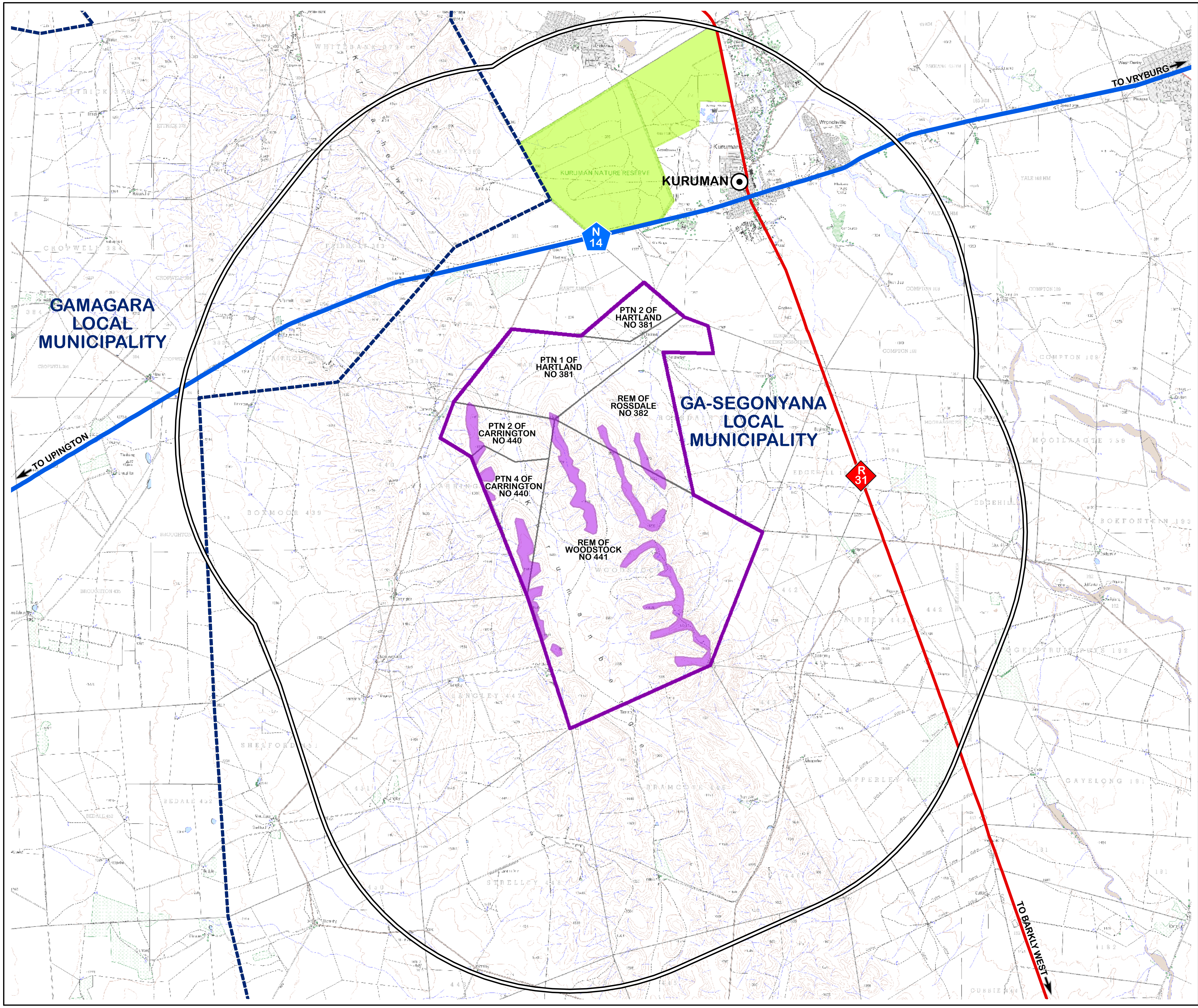
Project No	Prepared By	Date
14869	KLS	15/12/2017
Map Ref No	**Revision**	**Date**
14869/SC1_02	0	

Map 2 – Site Locality Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: SITE LOCALITY

Legend

- Main Towns
- Local Municipal Boundaries
- National Route (N14)
- Main Arterial Routes
- Rivers
- Nature Reserve
- Kuruman WEF Phase 1 Application Site
- Component Farm Portions
- Turbine Asessment Corridors
- 8km Visual Assessment Zone

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N
0 1 2
Kilometers

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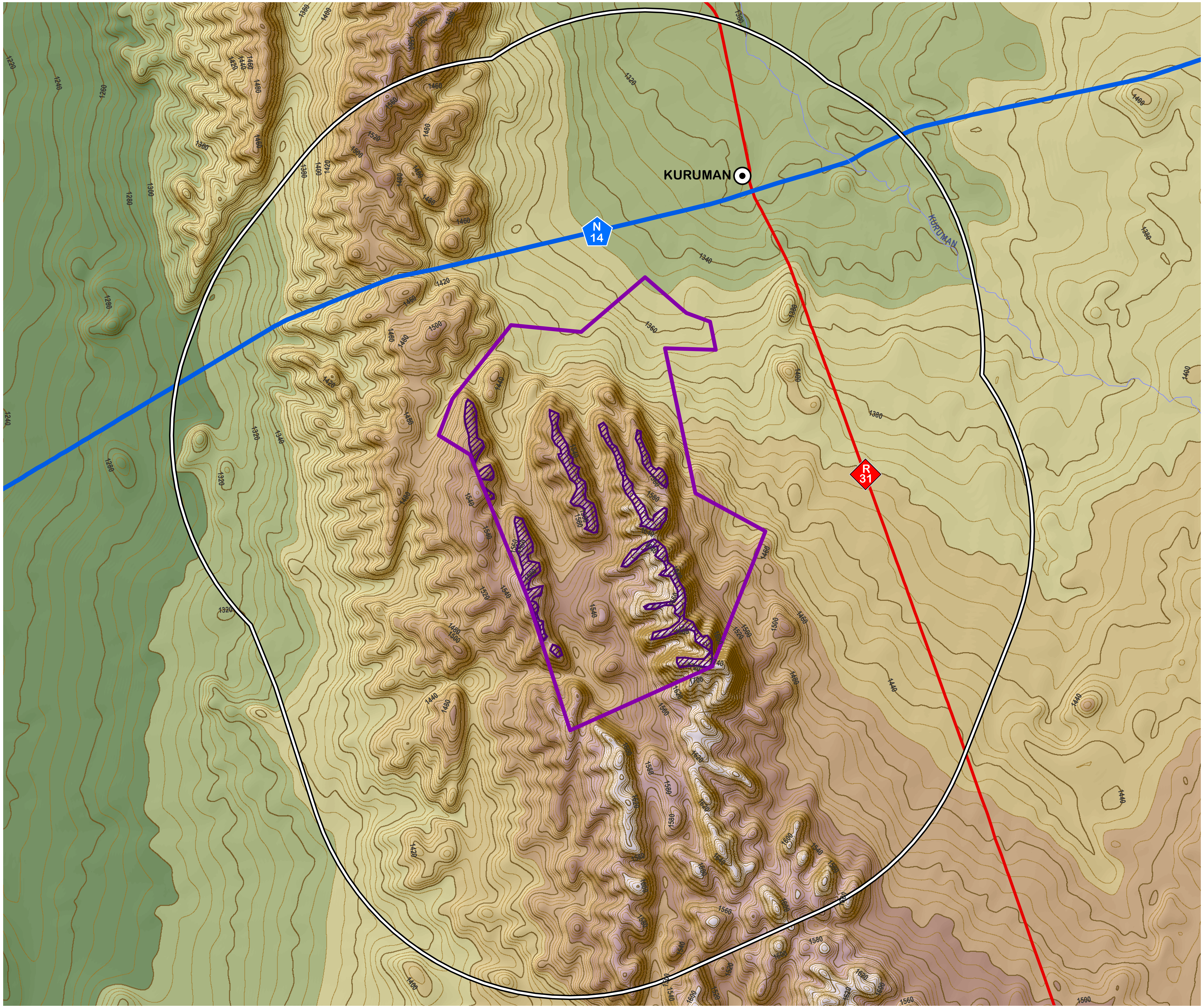
Fax: +27 11 803 7272
e-mail: info@sivest.co.za

Project No	Prepared By	Date
14869	KLS	15/12/2017
Map Ref No	**Revision**	**Date**
14869/SC1_01	0	

Map 3 – Topography Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: TOPOGRAPHY

Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Rivers
- Contours (20m Interval)
- Contours (5m Interval)
- Kuruman WEF Phase 1 Application Site
- Turbine Assessment Corridors
- 8km Visual Assessment Zone

Elevation (msl)

High: >1,600m

Low: <=1,300m

SOURCE:
NFEPA, 2011
NGI, 2014

N

0 1 2
Kilometers

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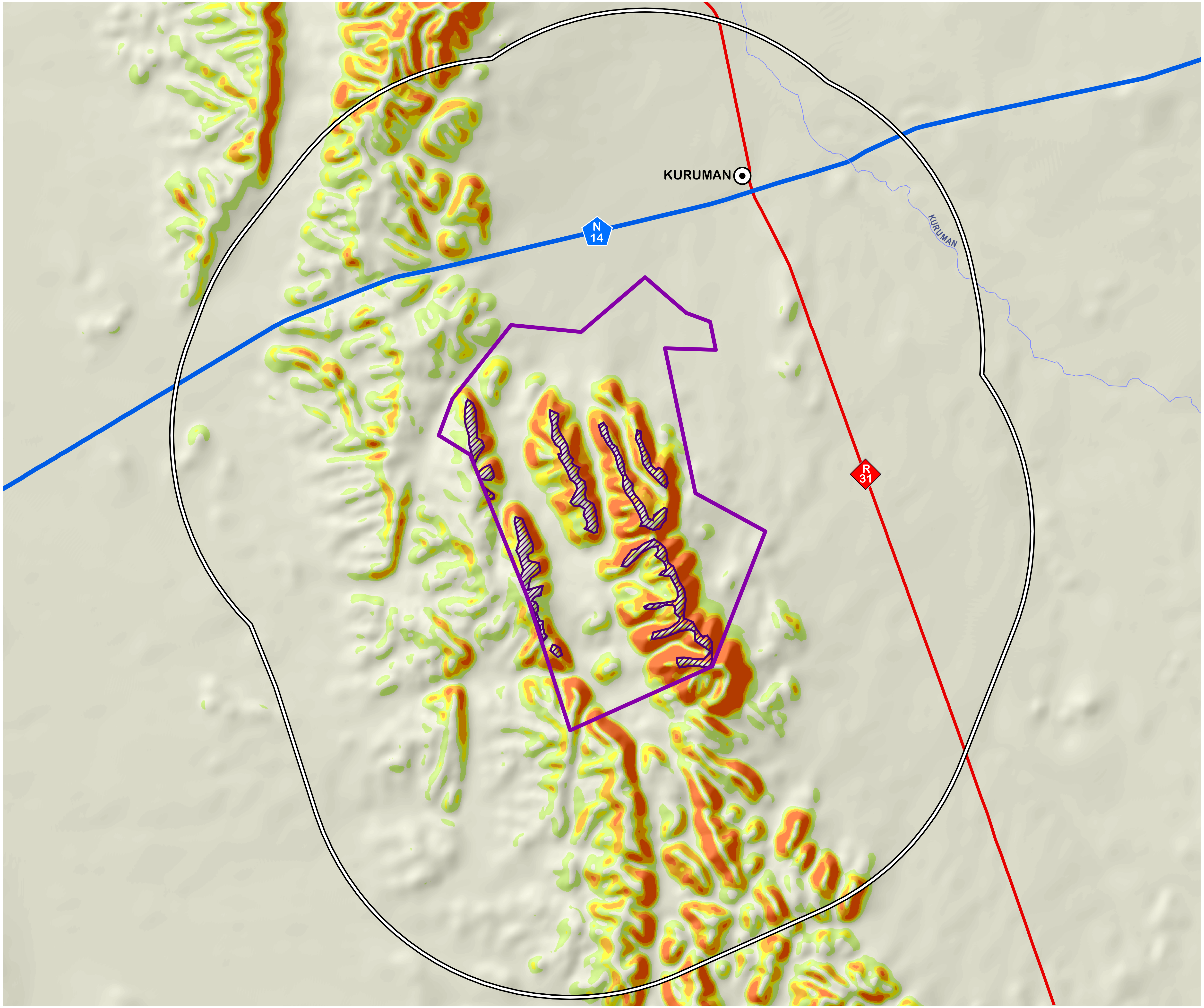
Project No	Prepared By	Date
14869	KLS	15/12/2017
Map Ref No	**Revision**	**Date**
14869/SC1_03	0	________

THIS MAP HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SiVEST QUALITY MANAGEMENT SYSTEM WHICH HAS BEEN CERTIFIED ISO 9001:2008 COMPLIANT

Map 4 – Slope Classification Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: SLOPE CLASSIFICATION

Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Rivers
- Kuruman WEF Phase 1 Application Site
- Turbine Asessment Corridors
- 8km Visual Assessment Zone

Slope Classification (Percent Rise)

- <=8%
- 8.01 - 12%
- 12.01 - 14%
- 14.01 - 18%
- >18%

SOURCE:
NFEPA, 2011
NGI, 2014

N

0 1 2
Kilometers

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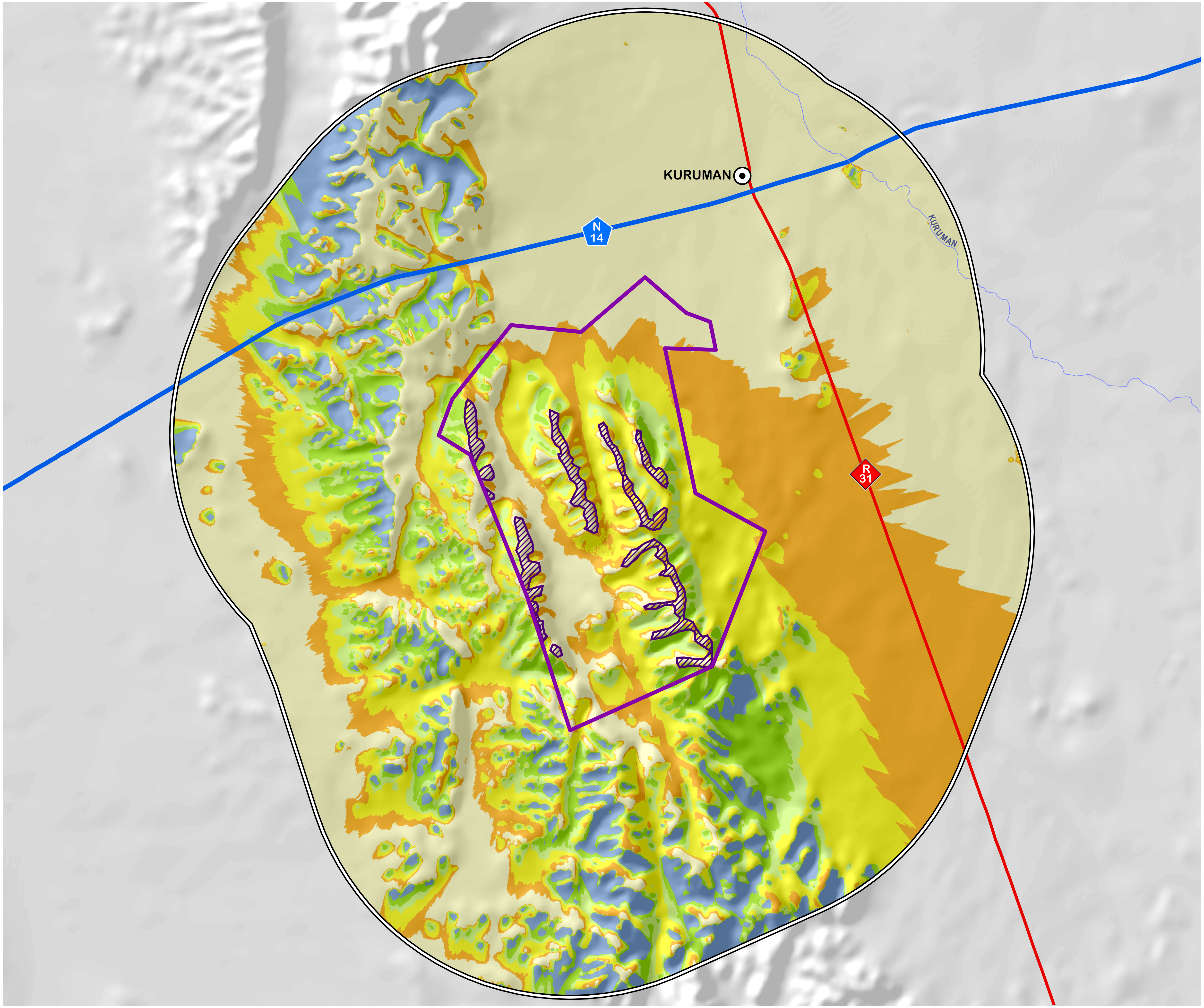
Map Ref No	**Revision**	**Date**
14869/SC1_04	0	________

Map 5 – Preliminary Visibility Analysis Map

PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: PRELIMINARY VISIBILITY ANALYSIS



Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Rivers
- Kuruman WEF Phase 1 Application Site
- Turbine Asessment Corridors
- 8km Visual Assessment Zone

Potential Visibility of Proposed Wind Turbines

- Most Visible
- Least Visible
- Not Visible

SOURCE:
NFEPA, 2011
NGI, 2014

N

0 1 2
Kilometers

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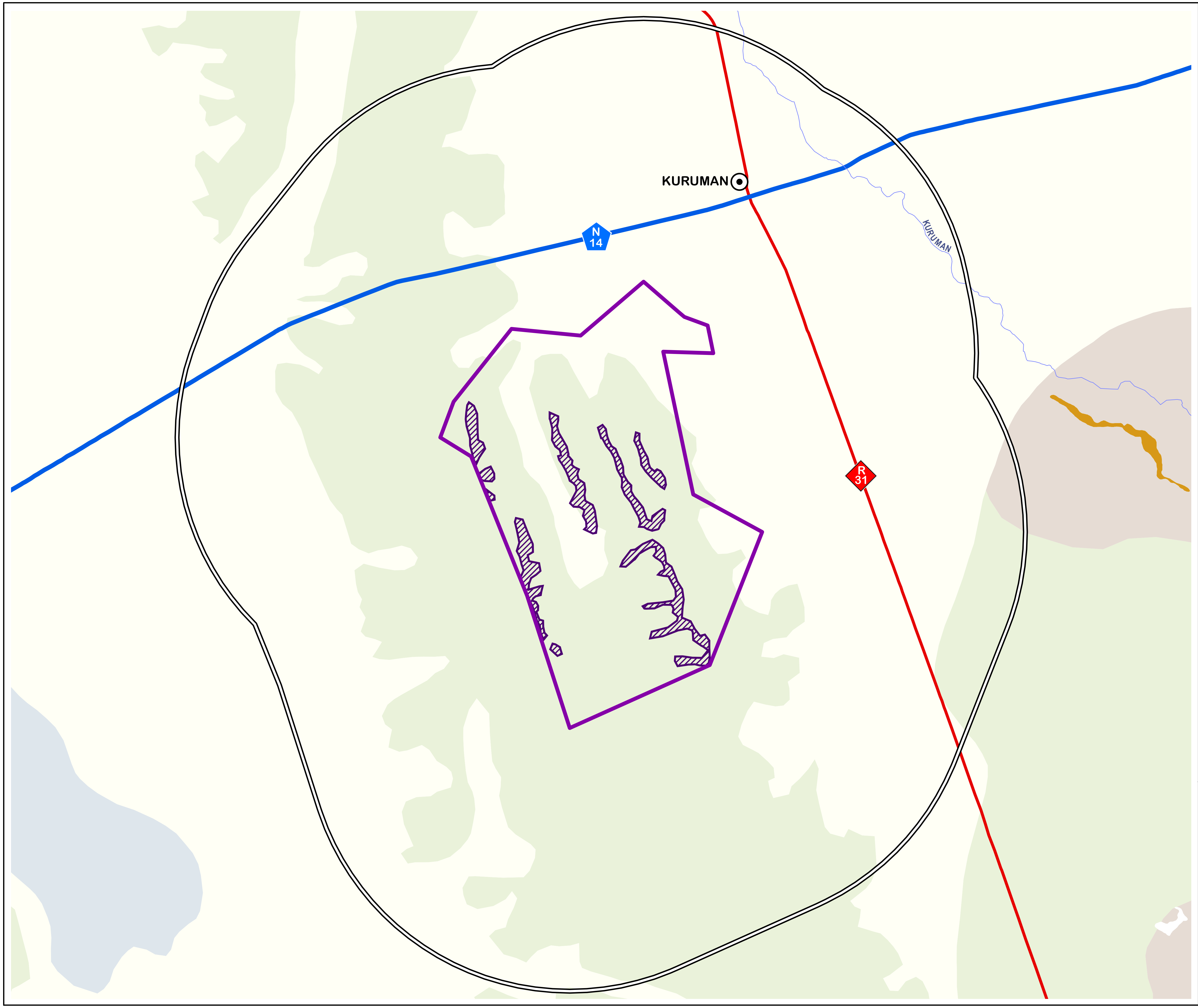
14869	KLS	09/03/2018
Map Ref No	**Revision**	**Date**
14869/SC1_09	0	________

Map 6 – Vegetation Classification Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: VEGETATION CLASSIFICATION

Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Rivers
- Kuruman WEF Phase 1 Application Site
- Turbine Asessment Corridors
- 8km Visual Assessment Zone

Vegetation Classification

- Kathu Bushveld
- Kuruman Mountain Bushveld
- Kuruman Thornveld
- Kuruman Vaalbosveld
- Southern Kalahari Mekgacha

SOURCE:
NFEPA, 2011
SANBI, 2012

N

0 1 2
Kilometers

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14869/SC1_05	0	________

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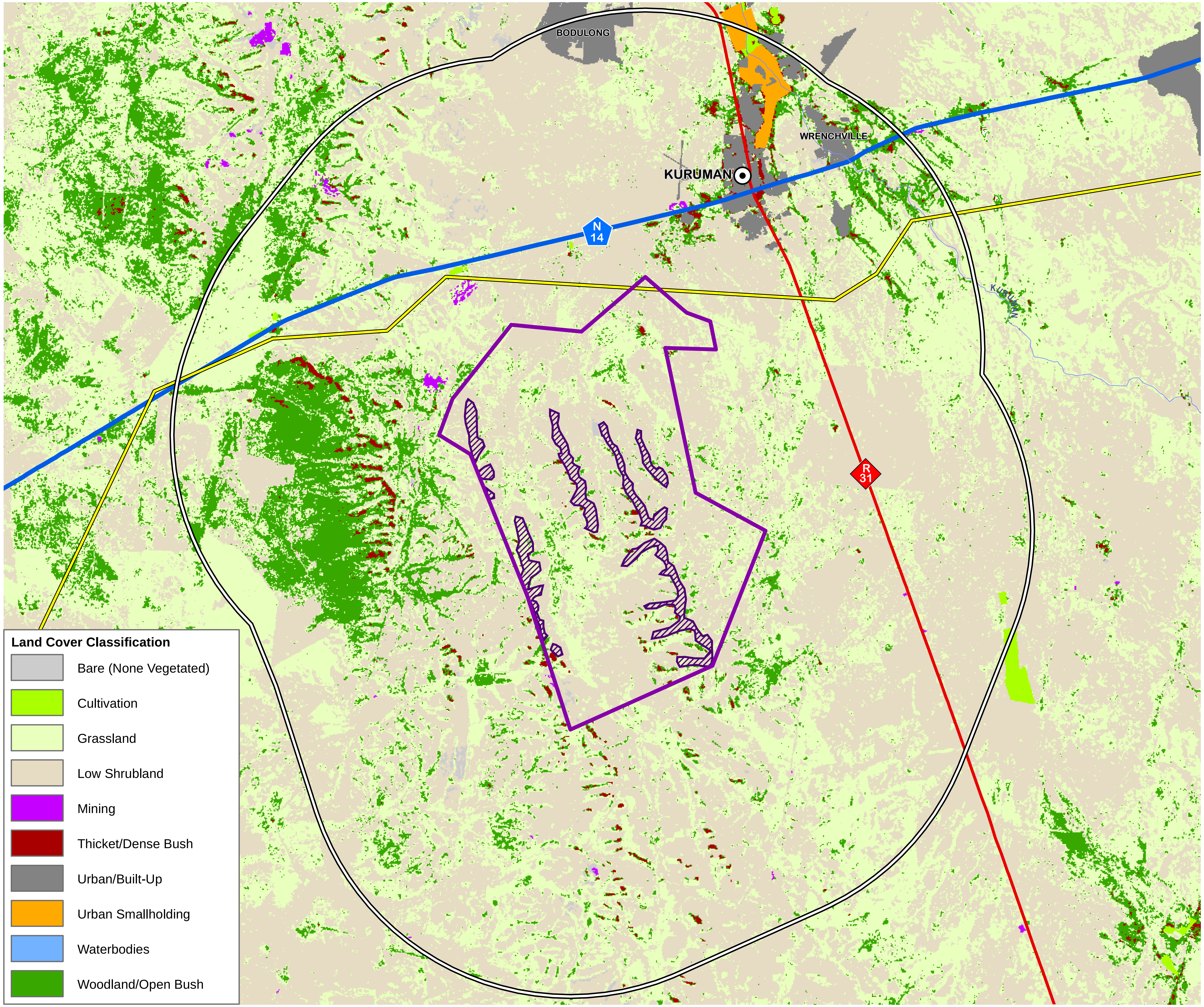
Map 7 – Land Cover Classification Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: BROAD LAND COVER CLASSIFICATION

Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Existing 400kV Power Line
- Rivers
- Kuruman WEF Phase 1 Application Site
- Turbine Assessment Corridors
- 8km Visual Assessment Zone

SOURCE:
NFEPA, 2011
2013-2014 SA NATIONAL LAND COVER
(© GEOTERRAIMAGE - 2014)

N

0 1 2

Kilometers

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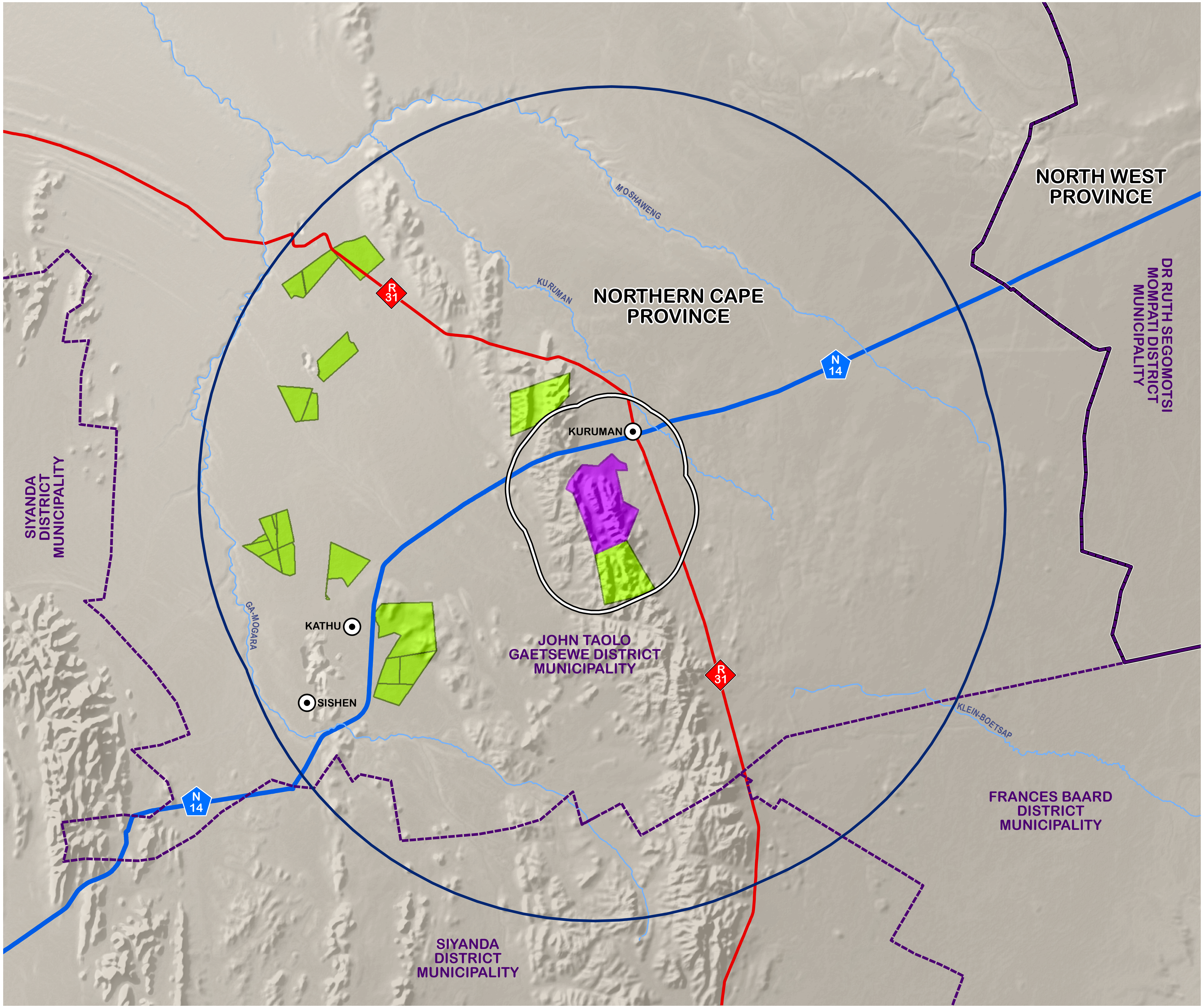
14869/SC1_06	0	________

Map 8 - Renewable Energy Developments within 50kms of the Application Site Map

PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: OTHER PROPOSED RENEWABLE ENERGY DEVELOPMENTS WITHIN 50KM RADIUS



Legend

- Main Towns
- Provincial Boundaries
- District Municipal Boundaries
- National Routes
- Main Arterial Routes
- Main Rivers
- Kuruman WEF Phase 1 Application Site
- 8km Visual Assessment Zone
- 50km Radius
- Renewable Energy Application Sites

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N
0 6 12
Kilometers

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Project No	Prepared By	Date
14869	KLS	09/03/2018
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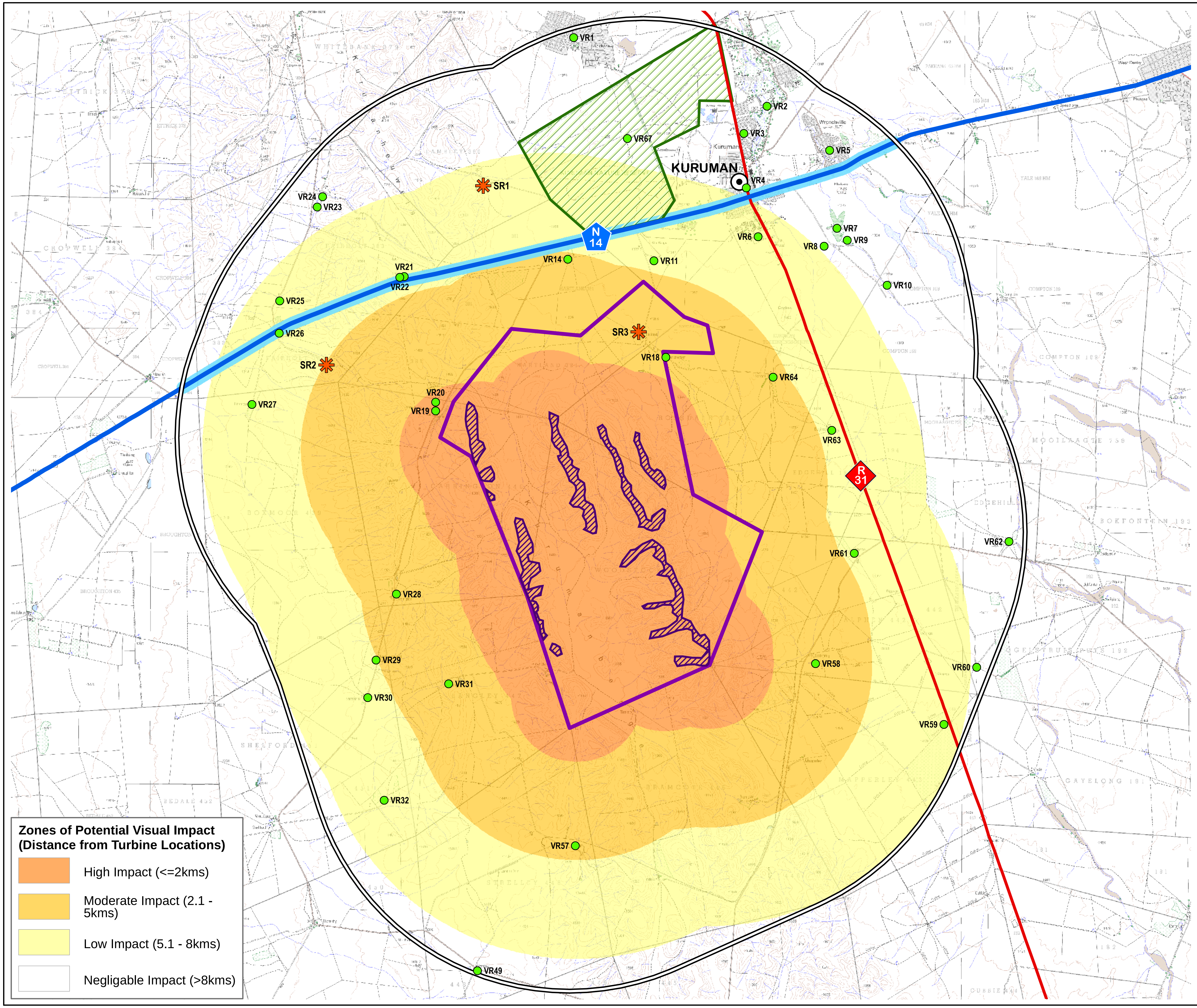
14869/SC1_07	0	________

Map 9 – Potentially Sensitive Receptor Locations Map

PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: POTENTIALLY SENSITIVE VISUAL RECEPTOR LOCATIONS



Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Rivers
- Nature Reserve
- Kuruman WEF Phase 1 Application Site
- Turbine Assessment Corridors
- 8km Visual Assessment Zone (Distance from Application Site)
- Sensitive Receptor Locations
- Potentially Sensitive Receptor Locations
- Receptor Road

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N

0 1 2

Kilometers

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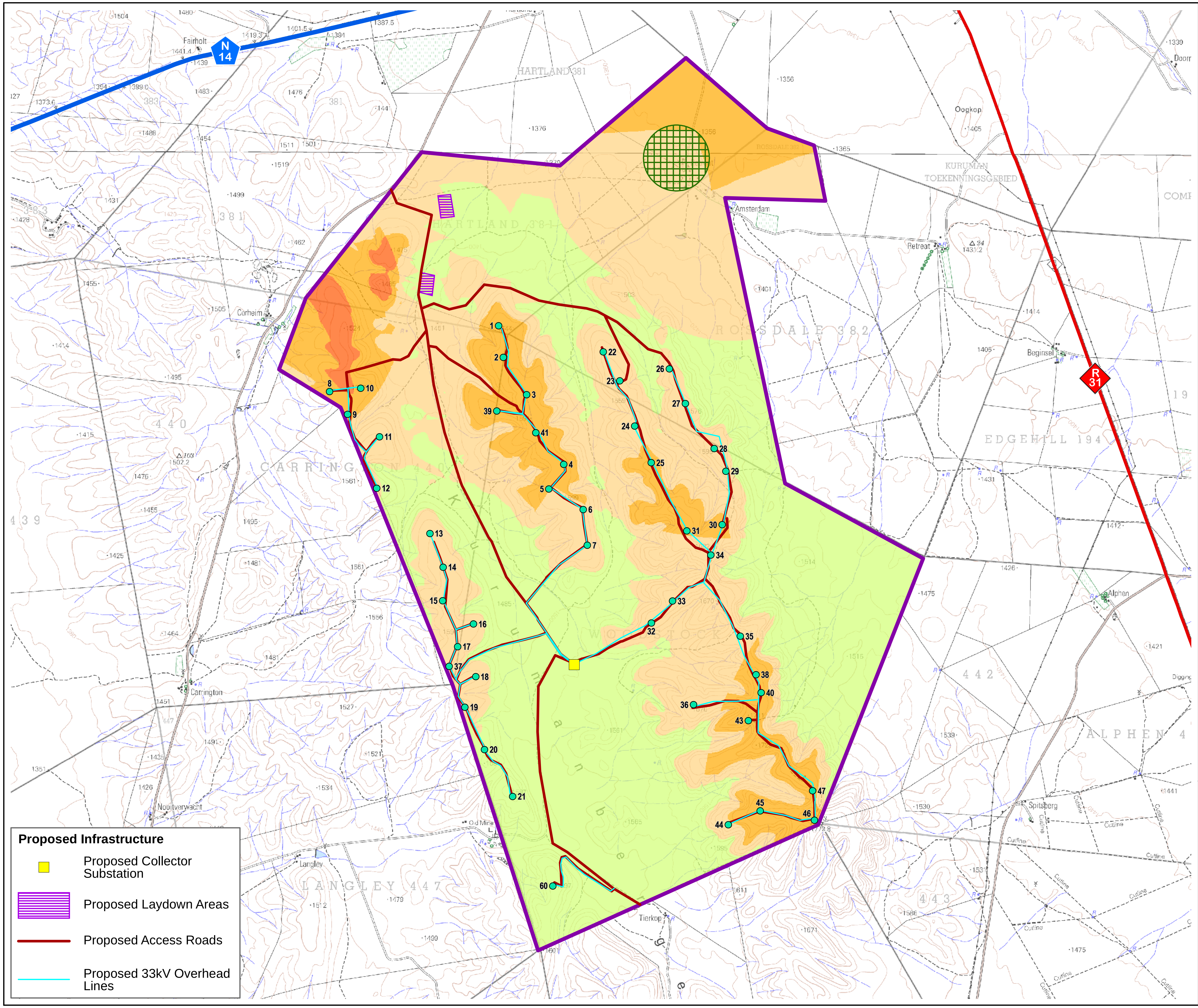
Project No	Prepared By	Date
14869	KLS	27/06/2018
Map Ref No	**Revision**	**Date**
14869/EA_08	0	________

Map 10 – Visual Sensitivity Map



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 1)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: VISUAL SENSITIVITY

Legend

- Main Towns
- National Route (N14)
- Main Arterial Routes
- Kuruman WEF Phase 1 Application Site
- 500m Exclusion Zone
- Proposed Turbine Positions

Visual Sensitivity

- High
- Medium
- Medium Low
- Low

SOURCE:
MULILO RENEWABLE POWER PROJECTS, 2017
NGI, 2014

N

0 0.75 1.5
Kilometers

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Project No	Prepared By	Date
14869	KLS	27/06/2018
Map Ref No	**Revision**	**Date**
14869/EA1_10	0	

Appendix D

SPECIALIST CV

CURRICULUM VITAE

Name	Andrea Gibb
Profession	Environmental Practitioner
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Senior Manager Environmental Division
Years with Firm	7 Years
Date of Birth	29 January 1985
ID Number	8501290020089
Nationality	South African

Education

Matriculated 2003, Full Academic Colours, Northcliff High School, Johannesburg, South Africa

Professional Qualifications

BSc (Hons) Environmental Management (University of South Africa 2008-2010)
Coursework**:** Project Management, Environmental Risk Assessment and Management, Ecological and Social Impact Assessment, Fundamentals of Environmental Science, Impact Mitigation and Management, Integrated Environmental Management Systems & Auditing, Integrated Environmental Management, Research Methodology.
Research Proposal**:** Golf Courses and the Environment

BSc Landscape Architecture (with distinction) (University of Pretoria 2004-2007)
Coursework: Core modules focused on; design, construction, environmental science, applied sustainability, shifts in world paradigms and ideologies, soil and plant science, environmental history, business law and project management.
Awards: Cave Klapwijk prize for highest average in all modules in the Landscape Architecture programme, ILASA book prize for the best Landscape Architecture student in third year design, Johan Barnard planting design prize for the highest distinction average in any module of plant science.

ArcGIS Desktop 1 (ESRI South Africa December 2010)
Environmental Impact Assessment (EIA) 2014 Legal Regime Workshop (Imbewu 2015)

Employment Record

Aug 2010 – to date	SiVEST SA (Pty) Ltd: Environmental Practitioner
Jan 2008 – July 2010	Cave Klapwijk and Associates: Environmental Assistant and Landscape Architectural Technologist
Feb 2006 – Dec 2006	Cave Klapwijk and Associates: Part time student

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Fluent	Fluent	Fluent

Key Experience

Specialising in the field of Environmental Management and Visual Assessment.

Andrea has 10 years' work experience and is employed by SiVEST Environmental as the Senior Manager heading up the Johannesburg office. She is primarily involved with managing large scale multifaceted Environmental Impact Assessments (EIAs) and Basic Assessments (BAs) (incl. Amendment Applications), undertaken according to International Finance Corporation (IFC) standards and Equator Principles, within the renewable energy generation and electrical distribution sectors. Andrea has extensive experience in overseeing public participation and stakeholder engagement processes and has also been involved in environmental feasibility and sensitivity analyses. She further specialises in undertaking and overseeing visual impact and landscape character assessments.

Skills include:

- Project Management (MS Project)
- Environmental Impact Assessment (EIA)
- Basic Assessment (BA)
- Public Participation Management
- Visual Impact Assessment (VIA)
- Landscape Assessment
- Strategic Environmental Planning
- Documentation / Quality Control
- Project Level Financial Management

Projects Experience

Aug 2010 – to date

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) / BASIC ASSESSMENT (BA)

- EIA for the proposed construction of the Grasskoppies Wind Farm near Loeriesfontein, Northern Cape Province.
- EIA for the proposed construction of the Ithemba Wind Farm near Loeriesfontein, Northern Cape Province.
- EIA for the proposed construction of the Hartebeest Leegte Wind Farm near Loeriesfontein, Northern Cape Province.
- EIA for the proposed construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province.
- Application for an Amendment of the Environmental Authorisation (EA) for the proposed construction of the Droogfontein II PV Plant near Kimberley, Northern Cape Province.
- Amendment and Resubmission of the FBAR for the Eskom Longdown Substation and Vyeboom 66kV Turn-in Power Lines near Villiersdorp, Western Cape Province.
- BA for the proposed construction of the Leeuwbosch Power Plant near Leeudoringstad, North West Province.
- BA for the proposed construction of the Wildebeestkuil Power Plant near Leeudoringstad, North West Province.
- EIA for the proposed development of the Tlisitseng 1 and 2 75MW Solar Photovoltaic (PV) Energy Facilities near Lichtenburg, North West Province.
- EIAs for the proposed development of the Sendawo 1, 2, and 3 75MW Solar PV Energy Facilities near Vryburg, North West Province.
- EIA for the proposed construction of the Sendawo Common Collector Substation and power line near Vryburg, North West Province.
- EIA for the proposed construction of the Aletta 140MW Wind Energy Facility near Copperton, Northern Cape Province.

- Application for an Amendment of the Environmental Authorisation (EA) for the proposed construction of the 100MW Limestone Solar Thermal Power Project near Danielskuil, Northern Cape Province.
- Applications for the Amendment of the EAs for the proposed construction of three 75MW solar PV facilities near Prieska, Northern Cape Province.
- Applications for the Amendment of the EAs for the proposed construction of the 75MW Arriesfontein and Wilger Solar Power Plants near Danielskuil, Northern Cape Province.
- Completion and submission of the final EIA report for the proposed Rooipunt PV Solar Power Park Phase 1 and proposed Rooipunt PV Solar Power Park Phase 2 near Upington, Northern Cape Province.
- EIAs for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- EIA for the proposed construction of the Nokukhanya 75MW Solar PV Power Plant near Dennilton, Limpopo Province.
- EIA for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- BA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province.
- BA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province.
- BA for the proposed Construction of the SSS1 5MW Solar PV Plant on the Western Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province.
- BA for the proposed Construction of the SSS2 5MW Solar PV Plant on the Eastern Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the proposed Bophirima Substation to the existing Schweizer-Reneke Substation, North West Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the Mookodi Substation to the existing Magopela Substation, North West Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province.
- Amendment of the Final Environmental Impact Report for the Proposed Mookodi 1 Integration Project near Vryburg, North West Province.
- BA for the proposed 132kV power line and associated infrastructure for the proposed Redstone Solar Thermal Energy Plant near Lime Acres, Northern Cape Province.
- BA for the proposed construction of a 132kV power line and substation associated with the 75MW PV Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province.
- BA for the proposed establishment of a Learning and Development Retreat and an Executive Staff and Client Lodge at Mogale's Gate, Gauteng Province.
- Application for an Amendment of the EA to increase the output of the proposed 40MW PV Facility on the farm Mierdam to 75MW, Northern Cape Province.
- BA for the proposed construction of a power line and substation near Postmasburg, Northern Cape Province.
- BA for the proposed West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng.
- EIA for the proposed construction of a wind farm and PV plant near Prieska, Northern Cape Province.
- Public Participation assistance as part of the EIA for the proposed Thyspunt Transmission Lines Integration Project – EIA for the proposed construction of 5 x 400kV transmission power lines between Thyspunt to Port Elizabeth, Eastern Cape Province.
- EIA assistance for the proposed construction of three Solar Power Plants in the Northern Cape Province.

- Public Participation as part of the EIA for the proposed Delareyille Kopela Power Line and Substation, North West Province.
- Public Participation as part of the EIA for the Middelburg Water Reclamation Project, Mpumalanga Province.

VISUAL IMPACT ASSESSMENT (VIA)

- VIA for the proposed construction of the Grasskoppies Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed construction of the Ithemba Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed construction of the Hartebeest Leegte Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed Phezukomoya Wind Energy Facility near Noupoort, Northern Cape Province.
- VIA for the proposed San Kraal Wind Energy Facility near Noupoort, Northern Cape Province
- VIA for the proposed Assagay Valley Mixed Use Development, KwaZulu-Natal Province.
- VIA for the proposed Kassier Road North Mixed Use Development, KwaZulu-Natal Province.
- VIA for the proposed construction of a power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces.
- VIA (Scoping Phase) for the proposed construction of a 3000MW Wind Farm and associated infrastructure near Richmond, Northern Cape Province.
- VIA for the proposed construction of the Aletta 140MW Wind Energy Facility near Copperton, Northern Cape Province.
- VIA for the proposed construction of a power line and associated infrastructure for the proposed Rooipunt Solar Thermal Power Plant near Upington, Northern Cape Province.
- VIAs (Impact Phase) for the proposed construction of the Sendawo 1, 2 and 3 solar PV energy facilities near Vryburg, North West Province.
- VIA (Impact Phase) for the proposed construction of the Sendawo substation and associated power line near Vryburg, North West Province.
- VIAs (Impact Phase) for the proposed construction of the Tlisitseng 1 and 2 solar PV energy facilities near Lichtenburg, North West Province.
- VIA for the proposed construction of the Tlisitseng substation and associated 132kV power line near Lichtenburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Sendawo substation and associated power line near Vryburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Sendawo 1, 2 and 3 solar PV energy facilities near Vryburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Tlisitseng 1 and 2 solar PV energy facilities near Lichtenburg, North West Province.
- Visual recommendations for Phase 1 of the proposed Renishaw Estate Mixed Use Development, KwaZulu-Natal Province.
- VIA for the proposed Tinley Manor South Banks Development, KwaZulu-Natal Province.
- VIAs (Impact Phase) for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- VIA (Scoping Phase) for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- Visual Due Diligence Report for the possible rapid rail extensions to the Gauteng network, Gauteng Province.
- Visual Status Quo and Constraints Report for the possible rapid rail extensions to the Gauteng network, Gauteng Province.
- VIA for the proposed agricultural components of the Integrated Sugar Project in Nsoko, Swaziland.

- VIA for the proposed Tweespruit to Welroux power lines and substation, Free State Province.
- VIA for the proposed construction of the Nokukhanya 75MW Solar PV Power Plant near Dennilton, Limpopo Province.
- VIA (Impact Phase) for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed amendment to the authorised power line route from Hera Substation to Westgate Substation, Gauteng Province.
- VIA (Impact Phase) for the Eastside Junction Mixed Use Development near Delmas, Mpumalanga Province.
- VIA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province.
- VIA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province.
- VIA (Scoping Phase) for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed Rorqual Estate Development near Park Rynie on the South Coast of KwaZulu Natal.
- VIA (Scoping Phase) for the proposed construction of a Coal-fired Power Station, Coal Mine and Associated Infrastructure near Colenso, KwaZulu-Natal Province.
- VIA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province.
- VIA for the proposed construction of the Duma transmission substation and associated Eskom power lines, KwaZulu-Natal Province.
- VIA for the proposed construction of the Madlanzini transmission substation and associated Eskom power lines, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Normandie substation to Hlungwane substation, Mpumalanga and KwaZulu-Natal Provinces.
- VIA for the proposed construction of the Nzalo transmission substation and associated Eskom power lines, KwaZulu-Natal Province.
- VIA for the proposed construction of the Sheepmoor traction substation with two 20MVA transformer bays and a new associated 88kV turn-in power line, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Uitkoms substation to Antra T-off, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Umfolozi substation to Eqwasha traction substation including an 88kV turn-in power line to Dabula traction substation, Kwazulu-Natal Province.
- VIA for the proposed construction of the new 88/25kV Vryheid traction substation with two 20MVA transforma bays and a new associated 88kV turn-in power line, KwaZulu-Natal Province.
- VIA for the proposed construction of a 132kV power line and substation associated with the 75MW PV Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province.
- VIA (Impact Phase) for the proposed Construction of a Solar PV Power Plant near De Aar, Northern Cape Province.
- VIA for the (Impact Phase) proposed Construction of the Renosterberg Wind Farm near De Aar, Northern Cape Province.
- VIA for the (Impact Phase) proposed Construction of the Renosterberg Solar PV Power Plant near De Aar, Northern Cape Province.
- VIA for the proposed construction of a 132kV power line for the Redstone Thermal Energy Plant near Lime Acres, Northern Cape Province.
- VIA for the proposed Mookodi Integration phase 2 132kV power lines and Ganyesa substation near Vryburg, North West Province.
- VIA for the proposed 132kV power lines associated with the PV Plants on Droogfontein Farm near Kimberley, Northern Cape Province.
- VIA (Scoping phase) for the Eastside Junction Mixed Use Development near Delmas, Mpumalanga Province.

- VIA for the proposed development of a learning and development retreat and an executive and staff lodge at Mogale's Gate, Gauteng Province.
- VIA for the proposed construction of a substation and 88kV power line between Heilbron (via Frankfort) and Villiers, Free State Province.
- Visual Status Quo Assessment for the Moloto Development Corridor Feasibility Study in the Gauteng Province, Limpopo Province and Mpumalanga Province.
- VIA the West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng.
- VIA for the proposed construction of a wind farm and solar photovoltaic plant near Loeriesfontein, Northern Cape Province.
- Visual sensitivity mapping exercise for the proposed Mogale's Gate Expansion, Gauteng.
- VIA (Scoping Phase) for the proposed Renosterberg Solar PV Power Plant and Wind Farm near De Aar, Northern Cape Province.
- Scoping level VIAs for the proposed construction of three Solar Power Plants in the Northern Cape Province.
- VIAs for the Spoornet Coallink Powerline Projects in KZN and Mpumalanga.
- Visual Constraints Analysis for the proposed establishment of four Wind Farms in the Eastern and Northern Cape Province.
- VIA (Scoping Phase) for the proposed development of a solar energy facility in De Aar, Northern Cape.
- VIA (Scoping Phase) for the proposed development of a solar energy facility in Kimberley, Northern Cape.

STRATEGIC ENVIRONMENTAL PLANNING

- Assistance with the Draft Environmental Management Framework for the Mogale City Local Municipality, Gauteng Province.
- Sensitivity Negative Mapping Analysis for the proposed Mogale's Gate Development, Gauteng Province.

AVIFAUNAL IMPACT ASSESSMENT:

Scoping and Environmental Impact Assessment for the proposed development of the Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape:

EIA REPORT

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services	Chris van Rooyen Consulting
P O Box 17001	30 Roosevelt Street
Congella, Durban, 4013	Robindale, Randburg
South Africa	2194

30 June 2018

SPECIALIST EXPERTISE

Chris van Rooyen

Chris has more than 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, Tanzania, 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-Endangered Wildlife 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 more than 160 power line and 30 renewable energy 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 (2017) 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 – Endangered Wildlife 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.

Nico Laubscher

Nico holds a D.Sc. from the University of Potchefstroom and was head of the Statistics Division, National Research Institute for Mathematical Sciences of the CSIR from 1959 – 1975. He retired in 1989 as head of the Centre for Statistical Consultation at the University of Stellenbosch. Nico held several offices, including President of the South African Statistical Association, and editor of the South African Statistical Journal. Nico has five decades' experience in statistical analysis and data science applications, including specialisation in model building with massive data sets, designing of experiments for process improvement and analysis of data so obtained, and statistical process control. He also has published peer reviewed papers in several leading statistical journals, including Annals of Mathematical Statistics, American Statistical Journal, Technometrics and The American Statistician. He currently operates as a private statistical consultant to industry and academia.

SPECIALIST DECLARATION

I, Chris van Rooyen, 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.

Name of Specialist: Chris van Rooyen

Date: 30 June 2018

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	22 years

Key Experience

Chris van Rooyen has twenty-two years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-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 consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project

23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Veld Solar One Project, Aggeneys, Northern Cape.

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV

6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation

60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV

115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
117. Matla-Glockner 400kV
118. Delmas North 44kV
119. Houwhoek 11kV Refurbishment
120. Clau-Clau 132kV
121. Ngwedi-Silwerkrans 134kV
122. Nieuwehoop 400kV walk-through
123. Booysendal 132kV Switching Station
124. Tarlton 132kV
125. Medupi - Witkop 400kV walk-through
126. Germiston Industries Substation
127. Sekgame 132kV
128. Botswana – South Africa 400kV Transfrontier Interconnector
129. Syferkuil – Rampheri 132kV
130. Queens Substation and associated 132kV powerlines
131. Oranjemond 400kV Transmission line
132. Aries – Helios – Juno walk-down

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Sommerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba's Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr

requirements

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Chris van Rooyen

EXECUTIVE SUMMARY

It is anticipated that the proposed Kuruman Phase 1 Wind Energy Facility (WEF) will have a moderate to low impact on priority avifauna (birds) after the implementation of mitigation measures . The impacts are:

- Displacement due to habitat transformation during construction of the wind farm and associated infrastructure
- Displacement due to disturbance during construction (and dismantling) of the wind farm and associated infrastructure;
- Collision mortality on the wind turbines;

An estimated 201 species could potentially occur in the study area, of which 133 were recorded at the WEF development area during pre-construction monitoring. Of the 201 species that could occur at the site, 17 are classified as priority species for wind farm developments (Retief *et al.* 2012). The results of the transect counts indicate a moderate diversity of avifauna at both the WEF development area and the control site. While this is to be expected to some extent of a fairly arid area such as this, the very low numbers or absence of some species e.g. Northern Black Korhaan is an indication that the avian populations might be under pressure from external factors, e.g. hunting. Flight activity of priority species at the WEF development area was also very low, with a passage rate of 0.05 birds/hour.

Displacement of priority species due to habitat destruction during operational lifetime of the WEF phase is likely to be a moderate negative impact and will remain at a moderate level even with the application of mitigation measures. Raptors are unlikely to be affected at all. Species most likely to be affected by the habitat fragmentation are the terrestrial species namely Grey-winged Francolin, Northern Black Korhaan, Kori Bustard and Secretarybird. The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated and will remain an impact for the duration of the operational life-time of the facility.

Displacement of priority species due to disturbance during the construction (and dismantling) phases of the WEF and associated infrastructure is likely to be a temporary, negative impact, but should be reduced to a low level with the application of mitigation measures. It is highly likely that most priority species will be temporarily displaced in the development area during the construction operations, due to the noise and activity. The risk of permanent displacement due to disturbance is bigger for large species such as Kori Bustard and Secretarybird.

Collisions of priority species with the turbines in the operational phase are likely to be a moderate negative impact and it could be reduced to a low negative impact through the application of mitigation measures. Species most likely to be at risk of collision with the turbines are Lesser Kestrel, Verreaux's Eagle and Jackal Buzzard. Very little Verreaux's Eagle and Jackal Buzzard flight activity was recorded, but that does not exclude the potential for collisions. The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance should be reduced to low.

There is currently one WEF planned within a 50km radius around the proposed WEF, and at least 11 solar PV facilities. The primary potential long-term impact of wind facility is mortality of priority species due to collisions with the turbines, and in the case of the solar facilities, it is displacement due to habitat transformation. The fact that only one other wind facility is currently planned within the 50km radius, and the low reporting rate for priority species, reduce the cumulative effect of this impact to a moderate level.

The mitigation measures pertaining specifically to avifauna in the existing applications for solar plants do not address the issue of displacement due to habitat transformation, as this impact cannot be effectively mitigated at solar facilities for the majority of avifauna. The question is therefore to what extent the relatively moderate envisaged impact of displacement of priority species at the WEF will increase in significance when viewed collectively with the aggregate impact of displacement of all the renewable energy facilities combined. It should be borne in mind that the actual development footprint for all these applications is usually considerably smaller than the land parcel. The significance of the cumulative displacement impact of the WEF, viewed with the other potential renewable energy projects, is still relatively moderate. Mitigation measures will address the issue of avifauna displacement to some extent, but due to the inherent nature of the displacement impact, the significance of the impacts will likely remain at a moderate level, even after mitigation.

It is our opinion that the proposed development of the Kuruman Phase 1 WEF be approved, subject to the strict implementation of the proposed mitigation measures detailed in this report.

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
ADU	Animal Demography Unit
BLSA	BirdLife South Africa
CWAC	The Coordinated Waterbird Count
EIA	Environmental Impact Assessment
EWT	Endangered Wildlife Trust
IBA	Important Bird Area
IKA	Index of Kilometric Abundance
SABAP1	South African Bird Atlas Project 1
SABAP2	South African Bird Atlas Project 2
VP	Vantage Point
WEF	Wind Energy Facility

GLOSSARY

Definitions	
Greater Study Area	The area which comprises the pentad where the study area is located, as well as the surrounding eight pentads.
Study Area	The combined area which comprises the WEF development area and the control area.
WEF development area	The area where turbines are planned.
Pentad	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- **a) details of-** **i. the specialist who prepared the report; and** **ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;**	Page 1-8
b) a declaration that the specialist 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;	Section 1.1.1 and 1.1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.6.5
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.5 and Appendix 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.3 and Appendix 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.6 and 1.7
g) an identification of any areas to be avoided, including buffers;	Section 1.3.3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 1.3.3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 1.9
k) any mitigation measures for inclusion in the EMPr;	Section 1.6
l) any conditions for inclusion in the environmental authorisation;	Section 1.8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8
n) a reasoned opinion- **i. as to whether the proposed activity, activities or portions thereof should be authorised;** **(iA) regarding the acceptability of the proposed activity or activities; and** **ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;**	Section 1.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None were received
q) any other information requested by the competent authority.	None were requested
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

TABLE OF CONTENTS

TABLES AND FIGURES

TABLES

FIGURES

BIRD IMPACT ASSESSMENT

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

The proposed Kuruman Phase 1 project is a Wind Energy Facility (WEF) located approximately 10km south-west of the town of Kuruman in the Northern Cape (see Figure 1).

The proposed Kuruman Phase 1 WEF would consist of the following infrastructural components:

Wind Turbines	Number of turbines: 47 MW output per turbine: 4.5 – 5.5 MW Hub Height: 140 m Blade Length: 80 m
Roads	New roads will be constructed with a width of 5 m and will connect all turbines Existing roads to be used will be extended to a width of 8 m
Distribution lines	33 kV underground lines
Collector substation	2 ha Height: 15 m
Laydown areas (additional to laydown areas next to each turbine)	Construction yards: 200m x 100m = 2 ha Three construction yards will be established It is anticipated that each construction yard will consist of the following: - Welfare facilities including; • Canteen • Toilette • Offices • Changing Rooms • Meeting Rooms • Parking - Storage including; • Bunded fuel areas • Oil storage areas - General stores (containers) - Skips

Figure 1: Lay-out of the proposed Kuruman Phase 1 WEF (WEF development area)

1.1.2. Terms of Reference

The terms of reference for this avifaunal impact assessment study are as follows:

- Describe the affected environment from an avifaunal habitat perspective.
- Discuss any applicable legislation pertaining to impacts on avifauna.
- Identify gaps in baseline data.
- Assess the expected impacts, including cumulative.
- Provide a sensitivity map of the proposed development site from an avifaunal perspective.
- Provide recommendations for the mitigation of impacts.

1.1.3. Approach and Methodology

The following approach and methods were applied to compile this report:

- 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 (ADU 2017), as a means to ascertain which avifaunal species occurs within the broader area i.e. within a block consisting of nine pentad grid cells within which the proposed WEF is situated. The nine pentad grid cells are the following: 2725_2315; 2725_2320; 2725_2325; 2730_2315; 2730_2320; 2730_2325; 2735_2315; 2735_2320; 2735_2325. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 15 August 2009 to 16 December 2017, 67 full protocol cards (i.e. 67 surveys lasting a minimum of two hours or more each) have been completed for this area. An additional 34 ad hoc protocol cards (surveys lasting less than two hours but still yielding valuable data) and 50 incidental records were completed for this area.
- Priority species were identified from the updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- 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 (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 (2017.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- The website of the Coordinated Waterbird Count project of the ADU was interrogated to establish if there are any potentially relevant important waterbodies which could be of relevance to the study.
- Information on potentially relevant areas included in the National Protected Areas Expansion Strategy was obtained from the South Africa National Biodiversity Institute (SANBI) website.
- Information on potentially relevant protected areas was sourced from the Protected Areas Database from the Department of Environmental Affairs (DEA).
- Satellite imagery from Google Earth was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- The main source of information on avifaunal abundance and species diversity was the 12-months pre-construction monitoring which was conducted from September 2015 to January 2017. Data at the WEF and a control site was collected through a combination of drive and walk transects, as well as the recording of flight activity from vantage points (VPs) (See Appendix 2 for a detailed explanation of the methodology employed in the pre-construction monitoring programme).
- The number and locality of priority species were recorded during transects surveys and incidental sightings to determine the abundance and spatial distribution of priority species at the WEF and control sites.
- The flight lines of priority species recorded during VP watches were mapped. This information was used to develop a basic collision risk index to identify the priority species most likely to collide with the turbines.
- One potential focal point of bird activity, a small dam, was identified and was monitored. The power lines running in the vicinity of the project area were also inspected for raptor nests.
- Information on the locality of renewable energy project applications within a 50km radius around the proposed WEF was obtained from the Department of Environmental Affairs website.

1.1.4. Assumptions and Limitations

The following assumptions and limitations are applicable to this study:

- A total of 67 full protocol lists have been completed to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours or more each). An additional 34 ad hoc protocol cards (surveys lasting less than two hours but still yielding valuable data) and 50 incidental records were completed for this area. This is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur in the 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 data from the pre-construction monitoring.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances, especially for a relatively new field in South Africa such as wind energy. However, power line and substation impacts can be predicted with a fair amount of certainty, based on a robust body of research stretching back over several decades.
- Few scientific publications are available on the impacts of wind farms on birds in South Africa. The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle (http://www.unep.org). The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: "in order to protect the environment, the precautionary approach shall be widely

applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."

- Predicted mortality rates are often inaccurate, indicating that this is still a fledgling science in many respects, even in developed countries like Spain with an established wind industry (Ferrer *et al.* 2012). Mortality data from post-construction monitoring programmes currently implemented at wind farms in South Africa was used to assist with the priority species risk assessments (Ralston – Paton *et al.* 2017).
- The greater study area was defined as the area which comprises the pentad where the study area is located, as well as the surrounding eight pentads. The study area was defined as the combined area which comprises the WEF development area and the control area. The WEF development area refers only to the area where turbines are planned.
- It is important to note that the assessment is made on the status quo as it is currently in the study area. A possible change in land use in the broader development area is not taken into account because the extent and nature of future developments are unknown at this stage. It is however highly unlikely that the land use will change in the foreseeable future.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Table 5.

1.1.5. Source of Information

The following are the primary sources of information used to compile the report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2).
- The Eskom Red Data Book of Birds of South Africa (Taylor *et al.* 2015).
- Robert's Birds of Southern Africa, seventh edition (Hockey *et al.* 2005).
- IUCN Red List of Threatened Species (2017.3) (http://www.iucnredlist.org/).
- Atlas of Southern African Birds 1 (SABAP1) (Harrison *et al.* 1997).
- The National Vegetation Map compiled by the South African National Biodiversity Institute (SANBI) (Mucina & Rutherford 2006).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015).
- The Coordinated Waterbird Count (CWAC) project of the ADU (http://cwac.adu.org.za/).
- The National Protected Areas Expansion Strategy from the Department of Environmental Affairs (DEA).
- The Protected Areas Database from the Department of Environmental Affairs (DEA).
- Renewable Energy EIA Application Database for SA from the Department of Environmental Affairs (DEA).
- Google Earth.
- The updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The main source of information on avifaunal abundance and species diversity was the 12-months pre-construction monitoring which was conducted from September 2015 to January 2017 at the WEF.
- Wind Energy Impacts on Birds in South Africa: A Preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa. BLSA. Occasional Report Series: 2. (Ralston-Patton *et al.* 2017).
- A total of 34 bird impact assessment studies compiled by the authors for potential wind energy facilities throughout South Africa since 2011.

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO AVIFAUNAL IMPACTS

The following project aspects are relevant from a bird impact perspective:

- Wind turbines: Potential risk of priority species mortality due to collisions.
- Service roads, hard stands, lay-down areas, substation: Habitat transformation leading to displacement of priority species.
- Construction activities: Disturbance leading to displacement of priority species.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1 Baseline description of the receiving environment

1.3.1.1 Important Bird Areas

The study area is not located in an Important Bird Area. The border of the closest Important Bird Area (IBA), the Spitskop Dam IBA SA028, is located approximately 127km away to the south-east from the centre of the proposed WEF development area (Marnewick *et al.* 2015). It is therefore not expected that the proposed WEF will have any impact on the avifauna in an IBA.

1.3.1.2 Coordinated Waterbird Counts (CWAC) sites

The Animal Demography Unit (ADU) launched the CWAC project in 1992 as part South Africa's commitment to International waterbird conservation. This is being done by means of a programme of regular mid-summer and mid-winter censuses at a large number of South African wetlands, known as CWAC sites.

The closest CWAC site is the Pudu Farm Dam, which is situated approximately 67km from the proposed WEF development area. Due to the distance from the WEF development area, no impacts on waterbirds at the Pudu Farm Dam are envisaged.

1.3.1.3 Protected Areas

The closest protected area to the WEF development site is the 1 131ha Billy Duvenhage Nature Reserve outside of Kuruman, where 115 bird species have been recorded (Olivier & Olivier 2005). This protected area forms part of the greater study area. The habitat in the reserve is primarily Kuruman Thornveld, which consists of a well-developed, closed shrub layer and well-developed open tree stratum consisting of *Vachellia erioloba* (Mucina & Rutherford 2005).

1.3.1.4 Biomes and vegetation types

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data.

The proposed WEF development area is situated in the savanna biome and consists of a series of parallel ridges with a general south-east to north-west orientation, known as the Kuruman Mountains, interspersed with broad valleys. The ridges consist of gentle slopes covered in short grassland with an open shrub layer, and a few exposed rocky ridges. The valleys are covered in tall grassland on red Kalahari sands with scattered trees. Two vegetation types are found in the WEF development area, namely Kuruman Mountain Bushveld and Kuruman Thornveld (Mucina & Rutherford 2006). The proposed turbines are located on the crest of the ridges in long, parallel lines. The elevation ranges roughly between 1500 – 1770 m.a.s.l. Kuruman normally receives about 266mm of rain per year, with most rainfall occurring during summer. It receives the lowest rainfall (0mm) in June and the highest (58mm) in February. The monthly distribution of average daily maximum temperatures ranges from 17.5°C in June to 32.6°C in January. The region is the coldest during June when the mercury drops to 0°C on average during the night (http://www.saexplorer.co.za/south-africa/climate/kuruman_climate.asp).

1.3.1.5 Habitat classes and avifauna in the study area

Whilst the distribution and abundance of the bird species in the study area can largely be explained by the description of the biomes and vegetation types above, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The bird habitat classes that were identified in the study area, are discussed below. See also Appendix 3 for a photographic record of the habitat in the study area.

- Savanna

This habitat class is described above under 1.3.1.4.

Priority species associated with savanna which occur or could potentially occur in the study area are African Rock Pipit (slopes), Black Harrier, Black-chested Snake-Eagle, Double-Banded Courser, Greater Kestrel, Grey-winged Francolin (slopes), Jackal Buzzard, Kori Bustard, Lesser Kestrel, Martial Eagle, Southern Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle (slopes), Steppe Buzzard, Lanner Falcon and Northern Black Korhaan (valleys) (see Table 2 below for a complete list of priority species which could potentially occur at the site).

- Waterbodies

Surface water is of specific importance to avifauna in this semi-arid study area. The WEF development area contains several boreholes with water troughs and a number of small, man-made farm dams. Priority species that could be attracted to surface water are mostly raptors such as Jackal Buzzard, Steppe Buzzard, Black Harrier, Black-chested Snake-Eagle, Greater Kestrel, Lanner Falcon, Martial Eagle and Verreaux’s Eagle.

- High voltage lines and telephone lines

High voltage lines are an important potential roosting and breeding substrate for large raptors in the study area (Van Rooyen 2006). There are no existing high voltage lines crossing the actual WEF development area, but the Mercury – Ferrum 400kV line crosses the study area to the north of the WEF development area, running more or less parallel to the N14 national road. The Moffat – Valley 66kV distribution line runs east and south of the WEF development area and terminates at the Valley Substation in the study area. The Gryppoort - Valley 66kV distribution line enters the study area from the south and terminates at the Valley Substation. These powerlines, as well as a number of smaller reticulation lines and telephone lines are used as perches by priority species such as Lesser Kestrel, Jackal Buzzard, Steppe Buzzard, Black Harrier, Black-chested Snake-Eagle, Greater Kestrel, Lanner Falcon, Martial Eagle and Verreaux’s Eagle. No raptor nests were recorded on any of the powerlines in the study area.

1.3.2 Results of the Field Study

An estimated 201 species could potentially occur in the study area, of which 133 were recorded at the WEF development area during pre-construction monitoring (see Appendix 1). Of the 201 species that could occur at the site, 18 are classified as priority species for wind farm developments (Retief *et al.* 2012).

Table 2 lists priority species[1] that could potentially occur in the study area. The list is based on a combination of the pre-construction monitoring that was conducted (see Appendix 2), supplemented with other data sources e.g. SABAP2 and personal experience of the avifauna occurring in the study area.

Table 3 lists the manner in which a specific priority species was recorded during pre-construction monitoring. Data was collected by means of drive transect and walk transects, vantage point (VP) watches, focal point counts and incidental sightings.

See Appendix 2 for a summary of the methodology employed in the pre-construction monitoring programme.

[1] Priority species were identified from the updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief et al. 2012).

Table 1: Priority species potentially occurring in the study area.

	Family name	Taxonomic name	Global status	Regional status	Endemic status South Africa	Endemic status Southern Africa	SABAP2 reporting rate	Recorded during pre-construction monitoring	Potential impacts		
									Collisions with turbines	Displacement through disturbance	Displacement through habitat transformation
1	Buzzard, Jackal	*Buteo rufofuscus*	LC		Near endemic	Endemic	4.48	yes	x		
2	Eagle, Booted	*Hieraaetus pennatus*	LC				0	no	x		
3	Eagle, Martial	*Polemaetus bellicosus*	VU	EN			0	yes	x	x*	
4	Eagle, Verreaux's	*Aquila verreauxii*	LC	VU			1.49	yes	x	x*	
5	Francolin, Grey-winged	*Scleroptila afra*	LC		Endemic (SA, Lesotho, Swaziland)	Endemic	0	yes	x	x*	
6	Goshawk, Southern Pale Chanting	*Melierax canorus*	LC			Near-endemic	14.93	yes	x		
7	Kestrel, Greater	*Falco rupicoloides*	LC				7.46	yes	x		
8	Kestrel, Lesser	*Falco naumanni*	LC				0	yes	x		
9	Pipit, African Rock	*Anthus crenatus*	LC	NT	Endemic (SA, Lesotho, Swaziland)	Endemic	1.49	yes	x	x*	
10	Buzzard, Steppe	*Buteo buteo*	LC				4.48	yes	x		
11	Eagle-owl, Spotted	*Bubo africanus*	LC				7.46	yes	x		
12	Falcon, Lanner	*Falco biarmicus*	LC	VU			0	no	x		
13	Harrier, Black	*Circus maurus*	VU	EN	Near endemic	Endemic	0	yes	x	x*	
14	Korhaan, Northern Black	*Afrotis afraoides*	LC			Endemic	4.48	no	x	x*	x
15	Courser, Double-banded		LC				1.49	yes		x*	
16	Bustard, Kori		NT	NT			0	yes		x*	x
17	Secretarybird	*Sagittarius serpentarius*	VU	VU			0	no	x	x*	x
18	Black-chested Snake-Eagle	*Circaetus pectoralis*	LC	LC			0	yes	x	x*	

* This is likely to be a temporary impact associated with the construction phase only

Table 2: The manner in which priority species were recorded during the pre-construction monitoring.

Priority Species	Taxonomic name	Transects at the WEF	Transects at the control	Vantage points at the WEF	Vantage point at the control	Incidental counts
African Rock Pipit	*Anthus crenatus*					*
Black Harrier	*Circus maurus*					*
Black-chested Snake-Eagle	*Circaetus pectoralis*	*				*
Double-Banded Courser	*Rhinoptilus africanus*					*
Greater Kestrel	*Falco rupicoloides*	*				*
Grey-winged Francolin	*Scleroptila africanus*	*		*		
Jackal Buzzard	*Buteo rufofuscus*	*		*		*
Kori Bustard	*Ardeotis kori*		*			
Lesser Kestrel	*Falco naumanni*	*		*		*
Martial Eagle	*Polemaetus bellicosus*					*
Southern Pale Chanting Goshaw	*Melierax canorus*	*	*		*	*
Spotted Eagle-Owl	*Bubo africanus*					*
Verreaux's Eagle	*Aquila verreauxii*	*		*		
13	**Total:**	**7**	**2**	**4**	**1**	**10**

1.3.2.1 Transect counts in the development area

See Appendix 2 for a detailed breakdown of the data capture methodology employed in the pre-construction programme, including the number of transects, vantage points and focal points.

The drive transect was surveyed three times per seasonal survey. A total of 2704 individual birds was recorded during drive transect counts at the proposed WEF development area, of which 27 were priority species and 2677 were non-priority species, belonging to 93 species (6 priority species and 86 non-priority species). At the control area, a total of 1748 birds was recorded during drive transect counts, of which 13 were priority species and 1735 non-priority species, belonging to 84 species (2 priority species and 82 non-priority species).

The walk transects were counted 32 times, i.e. 8 times per season. A total of 2456 individual birds were recorded at the proposed development area, of which 3 were priority species and 2453 non-priority species, belonging to 71 species (2 priority species and 69 non-priority species). At the control area, a total of 2570 birds were recorded, of which 5 were priority species and 2565 non-priority species, belonging to 84 species (1 priority species and 83 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. Figures 2 and 3 show the relative abundance of priority species recorded during the pre-construction monitoring through drive and walk transect counts. The IKA for all priority species combined recorded in the development area during drive transect counts was 0.091 birds/km, and 0.023 birds/km for walk transect counts. At the control site, the IKA for all priority species combined recorded during drive transect counts was 0.10 birds/km and 0.08 birds/km for walk transects.

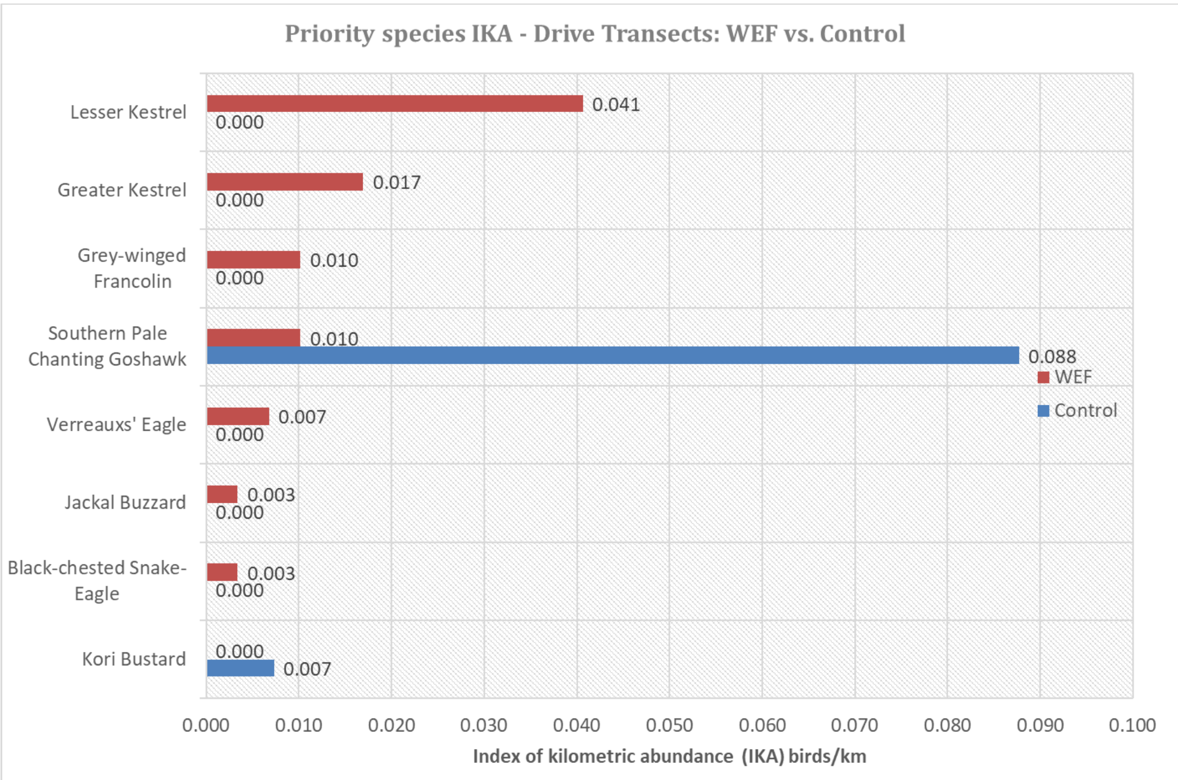

Figure 2: Priority species recorded in the study area through drive transect counts

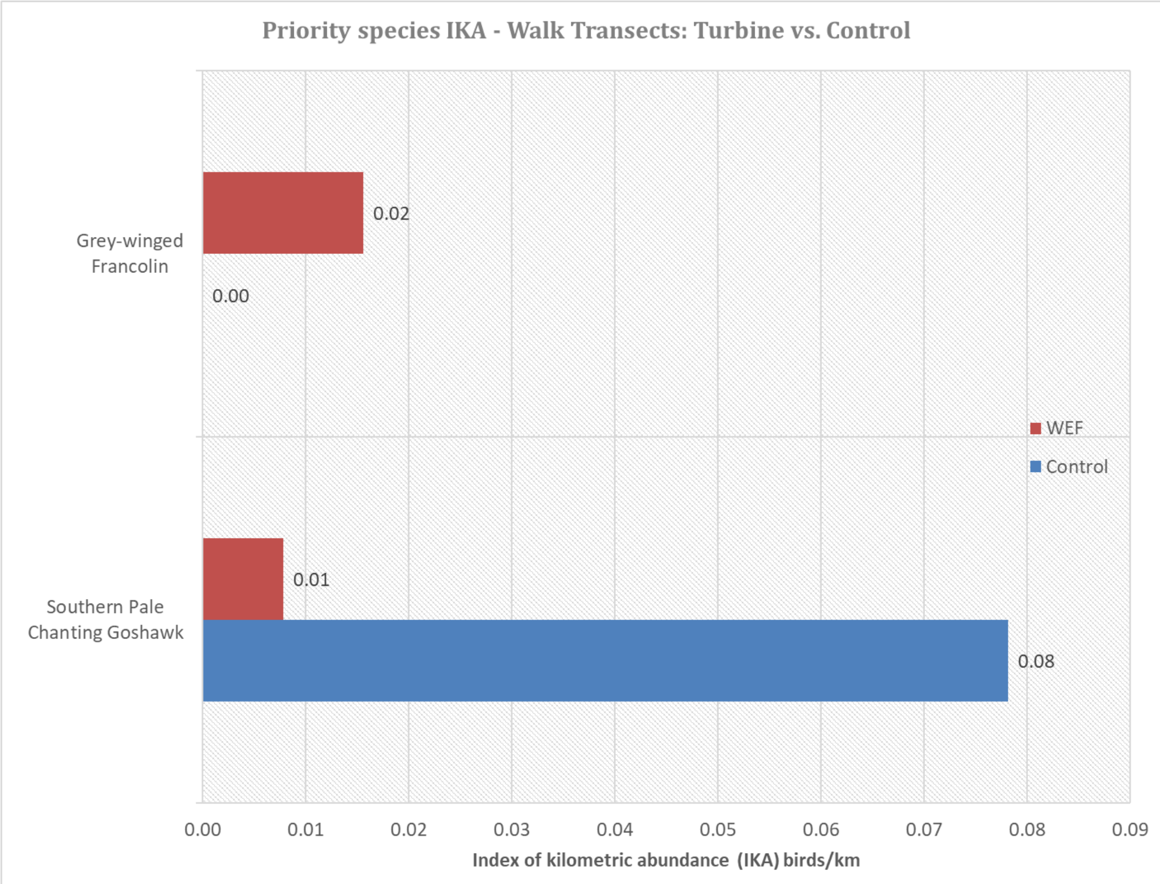

Figure 3: Priority species recorded in the study area through walk transect counts

1.3.2.2 Overall species composition

The results of the transect counts indicate a moderate diversity of avifauna at both the development area and the control site. While this is to be expected to some extent of a fairly arid area such as this, the very low numbers or absence of some species e.g. Northern Black Korhaan is an indication that the avian populations might be under pressure from external factors, e.g. hunting.

1.3.2.3 Abundance

The overall abundance of priority species at the WEF development area is very low, with 0.091 birds/km recorded during drive transect counts, and 0.023 birds/km during walk transect counts. The difference in overall numbers between the development area (n = 5160) and the control site (n = 4318) is likely to be a function of effort rather than inherent differences in habitat, as less time was spent on surveys in the control area than in the development area.

1.3.2.4 Spatial distribution of transect records and incidental sightings in the development area

Figure 4 below indicates the spatial distribution of priority species recorded during transect counts and incidental sightings.

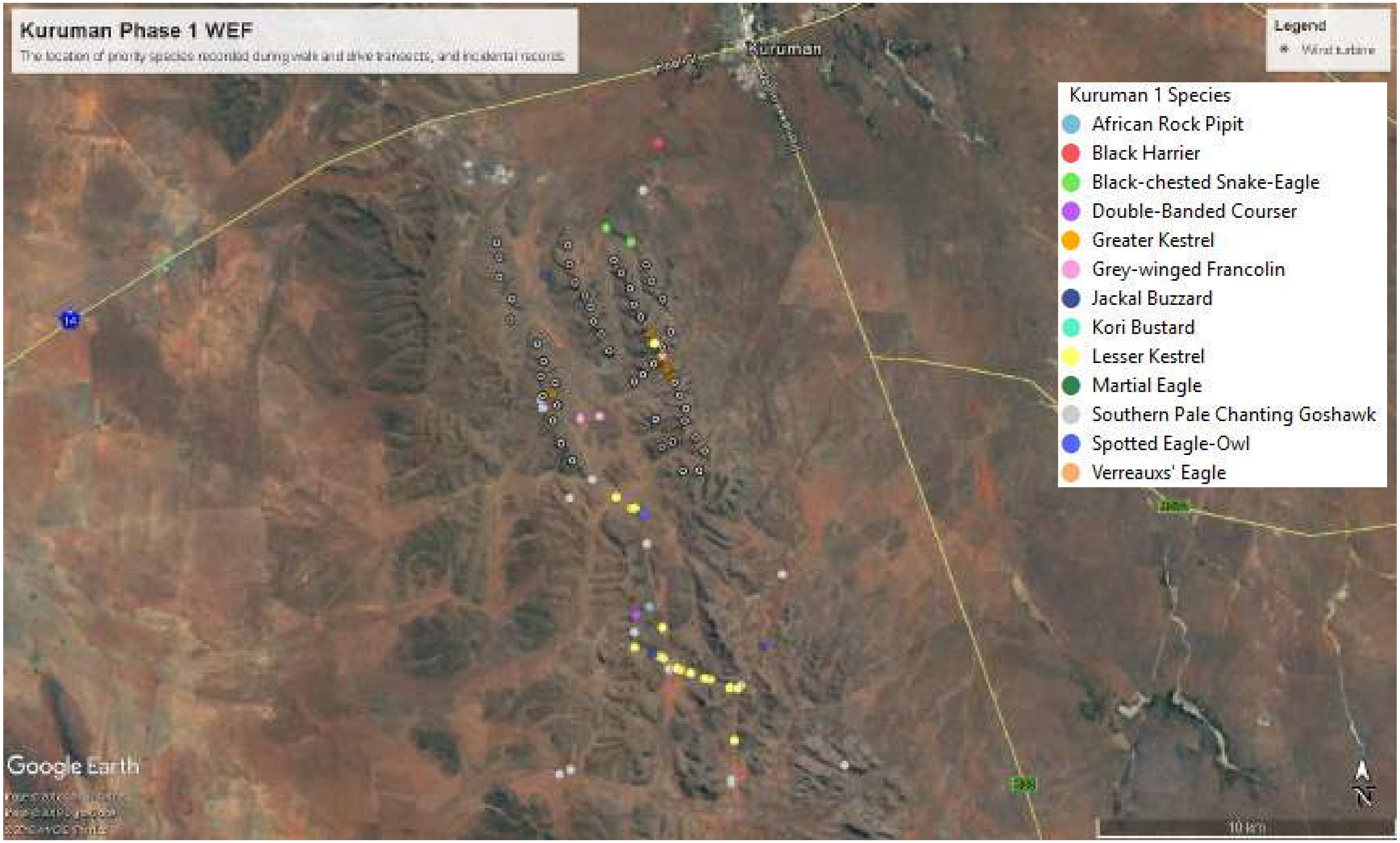

Figure 4: Spatial distribution of sightings of priority species recorded during transect counts (includes incidental sightings).

1.3.2.5 Vantage point watches

Four priority species were recorded during VP watches in the proposed WEF development area. A total of 192 hours of vantage point watches (12 hours per sampling period per vantage point) was completed at 4 VPs in order to record flight patterns of priority species. In the four sampling periods, priority species were recorded flying over development areas for a total of 23 minutes and 45 seconds. A total of 9 individual flights was recorded. Of these, 0 (0%) flights were at high altitude (>220m), 7 (77.7%) were at medium altitude (between 30m and 220m) and 2 (22.2%) were at a low altitude (<30m). The passage rate for priority species (all flight heights) was 0.05 birds/hour[2]. See Figure 5 below for the duration of flights for each priority species, at each height class[3].

For purposes of flight analyses, priority species recorded during VP watches at the site were classified in two classes (see also statistical analysis Appendix 4):

- Terrestrial species: Birds that spend most of the time foraging on the ground. They do not fly often and then generally short distances at low to medium altitude, usually powered flight. Some larger species undertake longer distance flights at higher altitudes, when commuting between foraging and roosting areas. Korhaans, bustards, and francolins were included in this category.
- Soaring species: Species that spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering and gliding at medium to high altitudes. All the diurnal raptor species were included in this class.

[2] 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.

[3] 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.

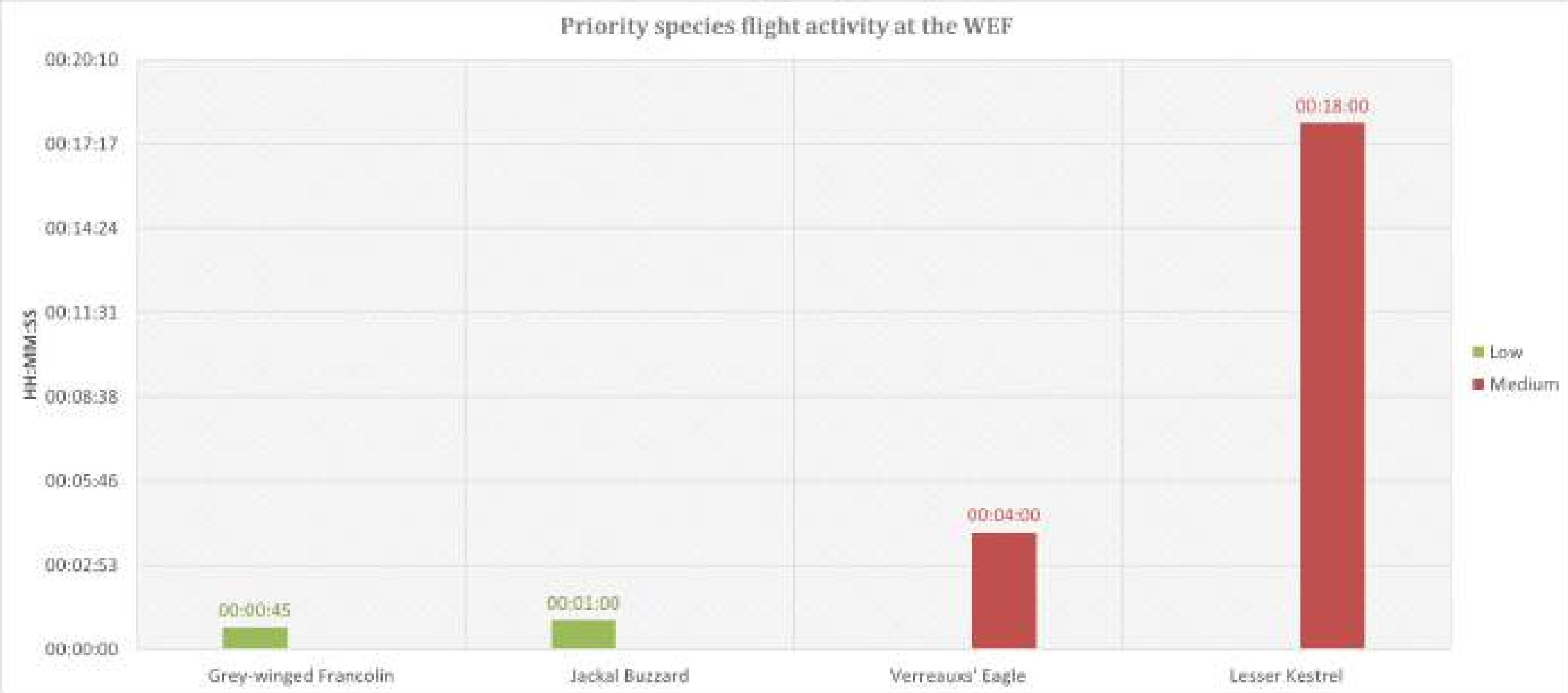

Figure 5: Flight duration and heights recorded for priority species within the WEF development area. Duration (hours: minutes: seconds) are indicated on the bars.

1.3.2.6 Collision risk rating

A collision risk rating for each priority species recorded during VP watches was calculated to give an indication of the likelihood of an individual of a specific priority species to collide with the turbines. This was calculated taking into account the following factors:

- The duration of all rotor height flights;
- the susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief *et al*. 2012); and
- the overall number of proposed turbines.

This was done in order to gain some understanding of which species are likely to be most at risk of collision. The formula used is as follows[4]:

Collision risk rating = duration of medium altitude flights (decimal hours) x collision susceptibility score calculated as the sum of morphology and behaviour ratings in the Avian Wind Farm Sensitivity Map of South Africa x number of planned turbines ÷ 100.

The results are displayed in Table 4 and Figure 8 below.

Table 3: **Site specific collision risk rating for all priority species recorded during VP watches in the development area.**

Species	Duration of flights (hr)	Avian Wind Farm Sensitivity Map Collision rating	Number of turbines	Collision Risk Rating
Grey-winged Francolin	0.00	50	47	0.00
Jackal Buzzard	0.00	95	47	0.00
Verreauxs' Eagle	0.07	110	47	3.45
Lesser Kestrel	0.30	72	47	10.15
Average	**0.09**	**81.75**		**3.40**

[4] It is important to note that the formula does not incorporate avoidance behaviour. This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010). It is also important to note that there is not necessarily a direct correlation between time spent at rotor height, and the likelihood of collision.

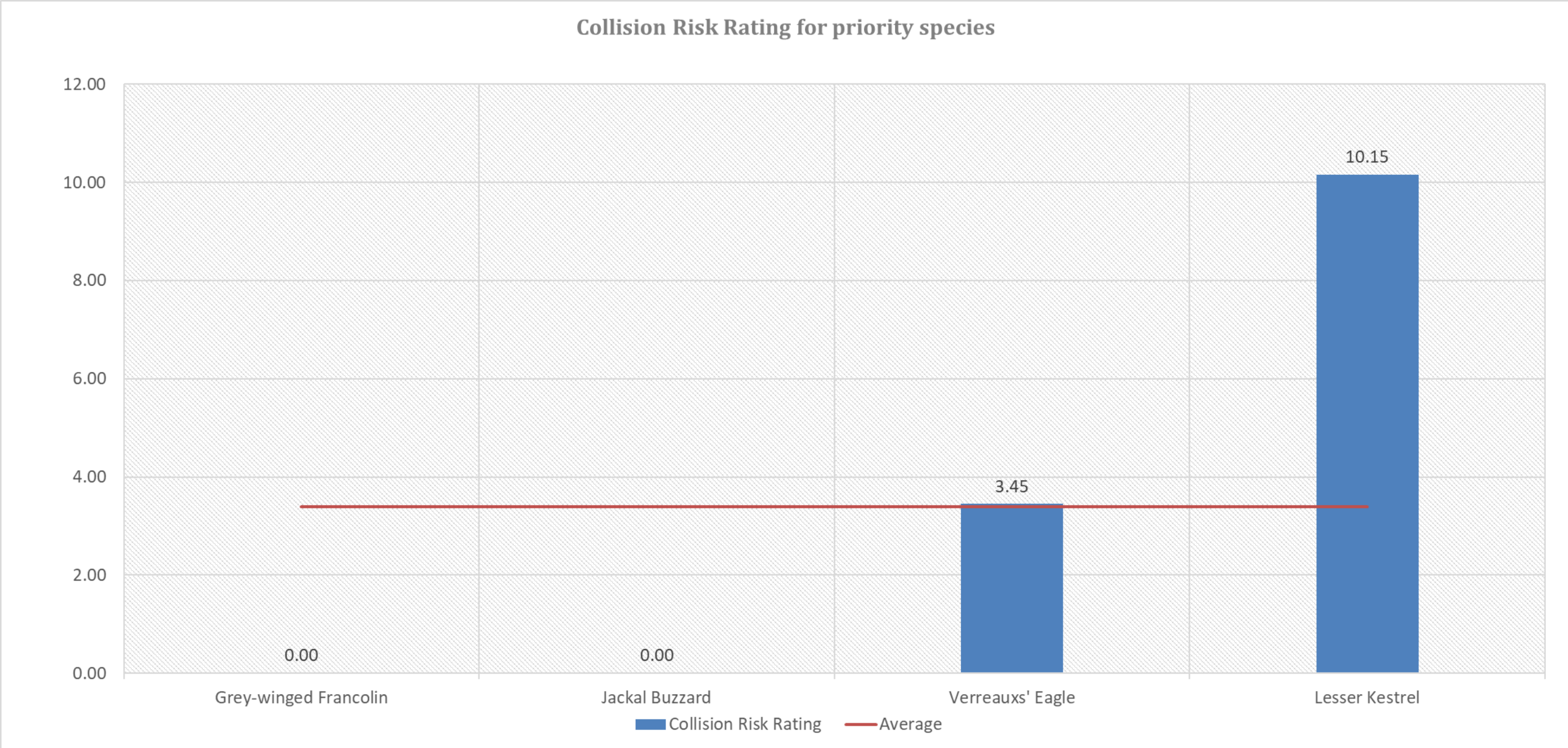

Figure 6: Site specific collision risk rating for priority species recorded in the development area.

1.3.2.7 Sample size and representativeness of flight data

The computations and the outcome of the data exhibited in the tables and graphs in the statistical analysis (Appendix 4) show that the surveys may be taken to be statistically representative of the flight activity of priority species of birds that occur in the area during the sampling periods. It has also been demonstrated that more samples would not yield a meaningful improvement in the accuracy and precision.

See Appendix 4 for a detailed explanation of the statistical methods.

1.3.2.8 Spatial distribution of flight activity

Flight maps were prepared for the two priority species with average to above average collision ratings, indicating the spatial distribution of flights observed from the various vantage points during the 12-month pre-construction monitoring programme (see Figures 7 - 8 below). This was done by overlaying a 100m x 100m grid over the survey area. Each grid cell was then given a weighting score taking into account the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell. It is important to interpret these maps bearing in mind the amount of time that each species spent flying over the site e.g. the “High” (flight concentration) category on the map for Lesser Kestrel is not equivalent to the “High” (flight concentration) category on the map for Verreaux’s Eagle, as the flight duration of flights for Lesser Kestrel is much higher than the flight duration for Verreaux’s Eagle (see Figure 5).

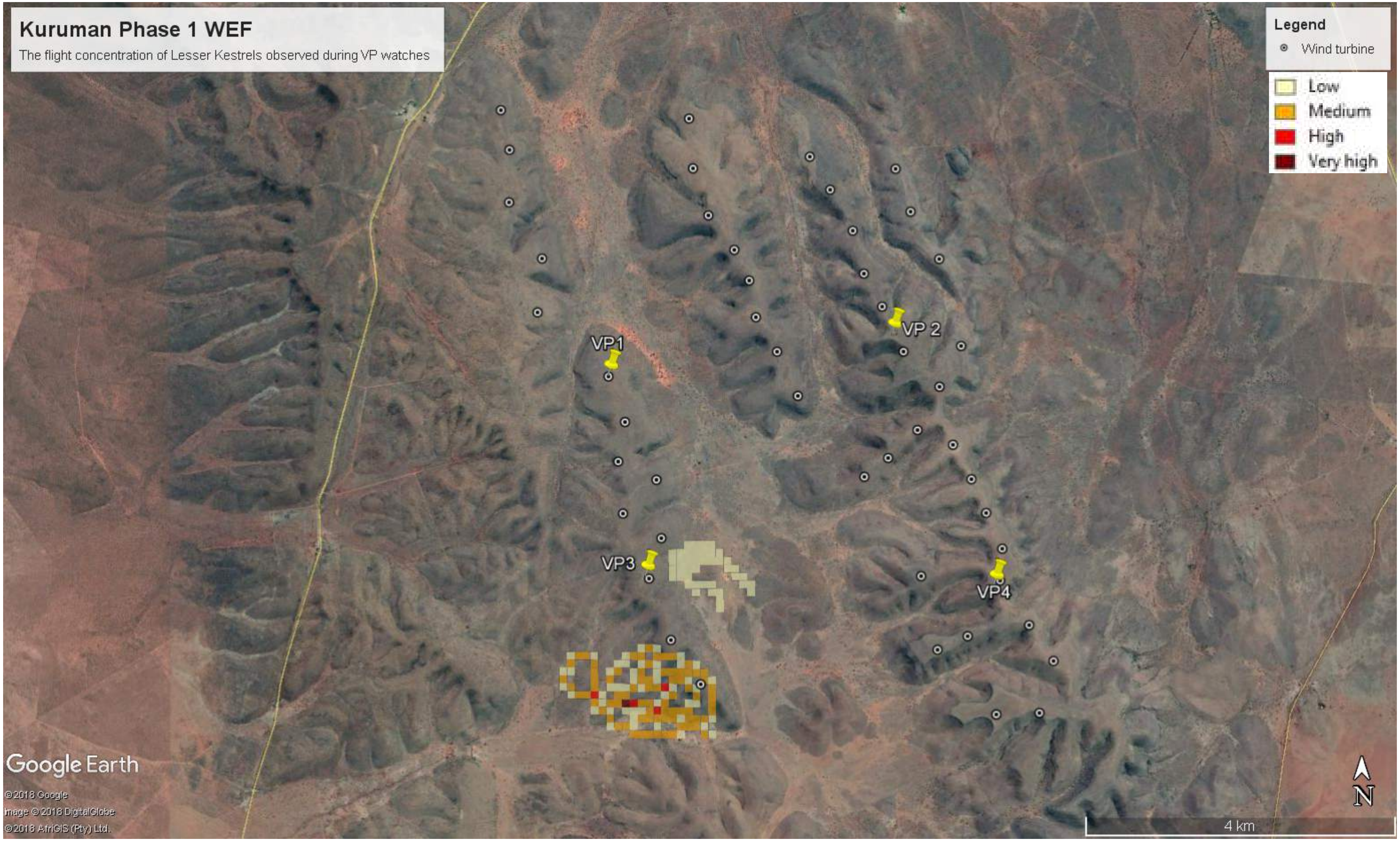

Figure 7: **Spatial distribution and concentration of rotor height flights of Lesser Kestrel.**

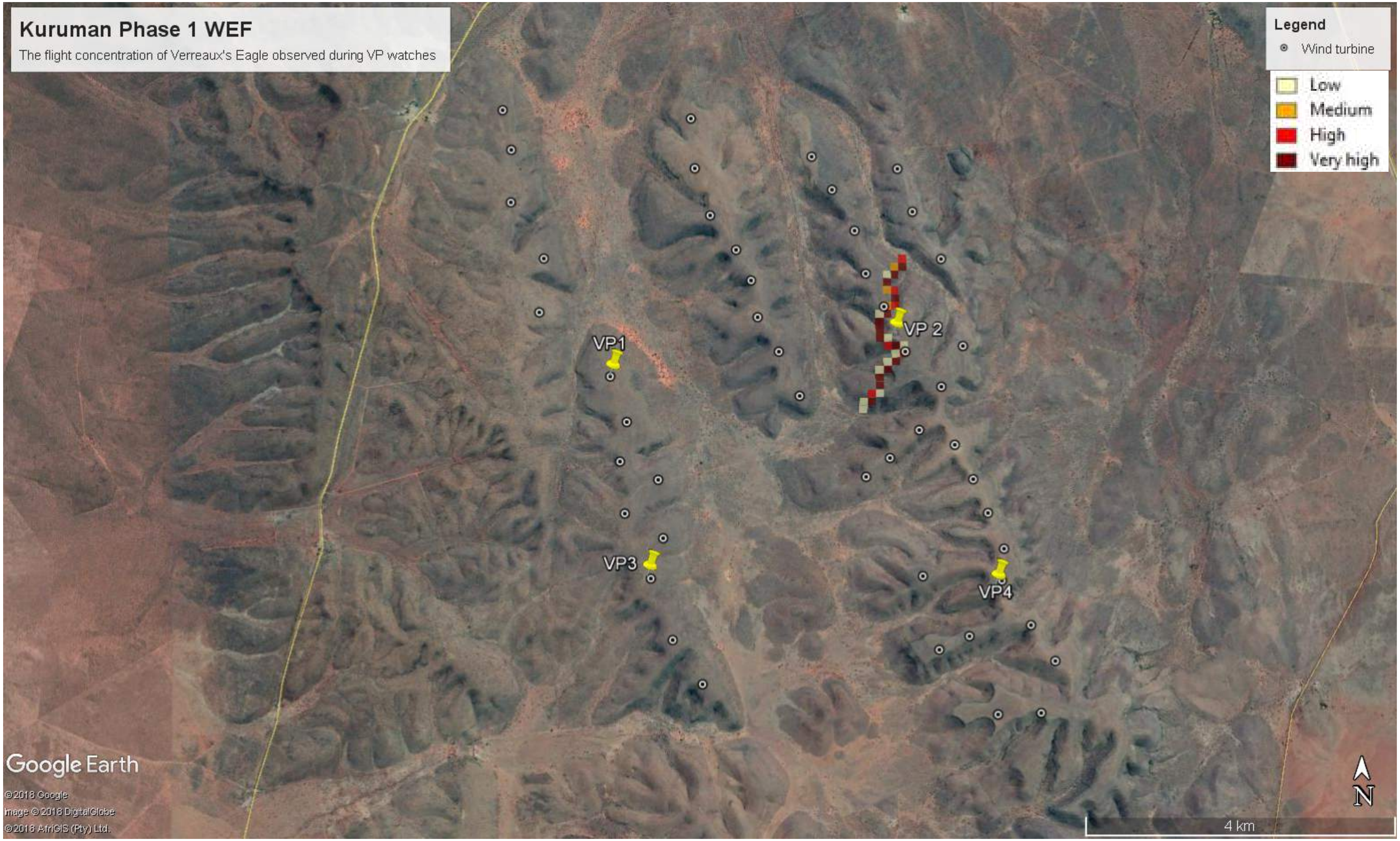

Figure 8: Spatial distribution and concentration of rotor height flights of Verreaux's Eagle.

1.3.2.9 Focal points

One potential focal point of bird activity, a small dam, was identified during the initial site inspection and monitored during seasonal field surveys. The power lines in the study area were also inspected for raptor nests during each seasonal survey, but no raptor nests were recorded on the powerlines during any of the seasonal surveys. The small dam never held water during any of the surveys, which accounts for the lack of priority species.

1.3.3 Environmental Sensitivity Map

The sensitive areas that have been identified from a bird impact perspective, are areas of surface water and ridge edges. A 300m no-turbine-zone (other infrastructure allowed) is recommended around all areas of surface water to reduce the risk of collisions for priority species, particularly raptors which are attracted to the surface water to drink and bath (see Figure 9 below). A 100m no turbine setback buffer (other infrastructure allowed) is recommended to reduce the risk of collisions for soaring raptors.

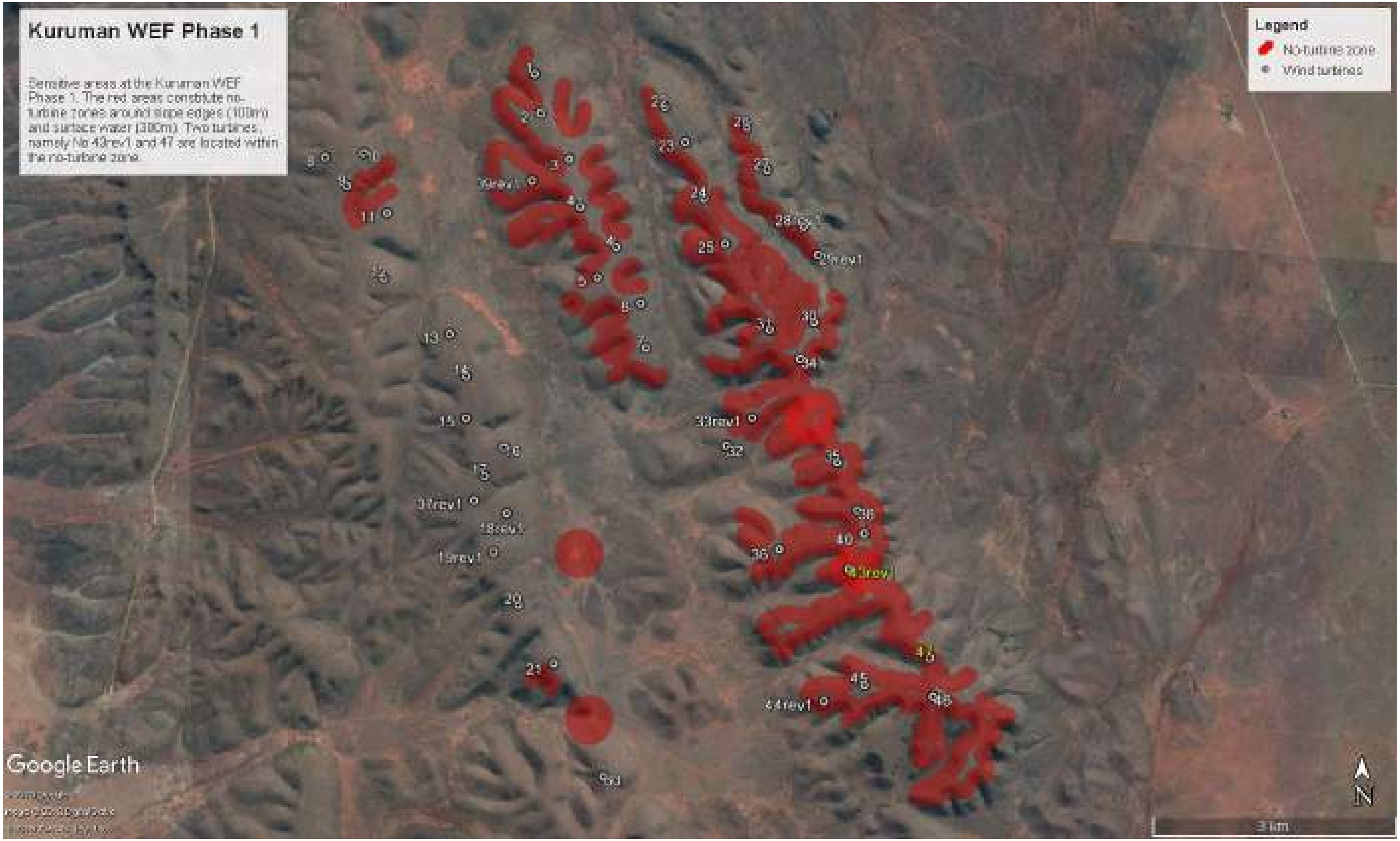

Figure 9: The location of high sensitivity areas in the WEF development area. The two turbines indicated in yellow falls within the no-turbine zone. Other infrastructure is allowed within the high sensitivity areas.

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

1.4.1. Agreements and conventions

Table 4 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna (BirdLife International 2018).

Table 4: Agreements and conventions which South Africa is party to and which is 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

1.4.2. Best Practice Guidelines

The latest edition of the South African *"Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (*Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011) are followed for this study. This document was published by the Endangered Wildlife Trust (EWT) and Birdlife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1. Key Issues Identified During the Scoping Phase

The most important issue that has been identified during the Scoping Phase is the potential for avifaunal collisions with the turbines, especially raptors using the declivity air currents generated by the slopes and/or being attracted to surface water, i.e. water troughs at boreholes.

No comments were received from the public during the Scoping Phase on the potential impacts of the proposed WEF on avifauna.

1.5.2. Identification of Potential Impacts

The potential impacts assessed during the EIA assessment are as follows:

1.5.1.1 Construction Phase

- Displacement of priority species due to disturbance associated with the construction activities
- Displacement of priority species due to habitat transformation

1.5.1.2 Operational Phase

- Mortality of priority species due to collisions with the wind turbines

1.5.1.3 Decommissioning Phase

- Displacement of priority species due to disturbance associated with the de-commissioning activities

1.5.1.4 Cumulative impacts

- Displacement of priority species due to habitat transformation
- Mortality of priority species due to collisions with the wind turbines

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected, and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision).

1.6.1 Displacement of priority species due to habitat transformation (Construction Phase)

1.6.1.1 Nature

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general it, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al.* 2006 as cited by Drewitt & Langston 2006). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor, though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

However, the results of habitat transformation may be subtler, whereas the actual footprint of the wind farm may be small in absolute terms, the effects of the habitat fragmentation brought about by the associated infrastructure (e.g. power lines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under power lines, but a study done in Spain (Lane *et al.* 2001 as cited by Raab *et al.* 2009) indicates that the total observation of Great Bustard flocks were significantly higher further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard generally avoid the immediate proximity of roads within a 500m buffer. This means that power lines and roads also cause loss and fragmentation of the habitat used by the population in addition to the potential direct mortality. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab *et al.* 2010). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Alan *et al.* 1997).

Raptors are unlikely to be affected by the habitat transformation.

1.6.1.2 Significance of impact without mitigation

The physical footprint of the proposed wind farm is likely to be fairly insignificant. The habitat fragmentation is likely to have a more significant displacement impact on priority species. It is expected that the densities of most priority species will decrease due to this impact, but complete displacement is unlikely. Indications are that bustards continue to use the wind farm areas (M. Langlands 2016 pers. comm, Rossouw 2016 pers.comm,). Raptors are unlikely to be affected at all. Species most likely to be affected by the habitat fragmentation are the terrestrial species namely Grey-winged Francolin, Northern Black Korhaan, Kori Bustard and Secretarybird. The overall significance of this impact prior to mitigation is regarded to be moderate.

1.6.1.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to habitat transformation are as follows:

- The recommendations of the specialist ecological study must be strictly adhered to.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.

Rationale: The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated and will remain an impact for the duration of the operational life-time of the facility.

1.6.1.4 Significance of impact after mitigation

While the mitigation will have some effect, very little can be done about the habitat fragmentation, therefore the impact will remain at a moderate level.

1.6.2 Displacement of priority species due to disturbance (Construction Phase)

1.6.2.1 Nature

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance in effect can amount to a form of habitat loss. Displacement may occur primarily during the construction phase of wind farms and may occur as a result of construction activities. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before-and-after and control-impact (BACI) assessments. Onshore, disturbance distances (in other words the distance from wind farms up to which birds are absent or less abundant than expected) up to 800 m (including zero) have been recorded for wintering waterfowl (Pedersen & Poulsen 1991 as cited by Drewitt & Langston 2006), though 600m is widely accepted as the maximum reliably recorded distance (Drewitt & Langston 2006). The variability of displacement distances is illustrated by one study which found lower post-construction densities of feeding European White-fronted Geese *Anser albifrons* within 600 m of the turbines at a wind farm in Rheiderland, Germany (Kruckenberg & Jaene 1999 as cited by Drewitt & Langston 2006), while another showed displacement of Pink-footed Geese *Anser brachyrhynchus* up to only 100–200 m from turbines at a wind farm in Denmark (Larsen & Madsen 2000 as cited by Drewitt & Langston 2006). Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens *et al.* 2013, Hale *et al.* 2014). There also seem to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins *et al.* 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al.* 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15–53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

The effect of birds altering their migration flyways or local flight paths to avoid a wind farm is also a form of displacement. This effect is of concern because of the possibility of increased energy expenditure when birds have to fly further, as a result of avoiding a large array of turbines, and the potential disruption of linkages between distant feeding, roosting, moulting and breeding areas otherwise unaffected by the wind farm. The effect depends on species, type of bird movement, flight height, distance to turbines, the layout and operational status of turbines, time of day and wind force and direction, and can be highly variable, ranging from a slight 'check' in flight direction, height or speed, through to significant diversions which may reduce the numbers of birds using areas beyond the wind farm (Drewitt & Langston 2006). A review of the literature suggests that none of the barrier effects identified so far have significant impacts on populations (Drewitt & Langston 2006). However, there are circumstances where the barrier effect might lead indirectly to population level impacts; for example, where a wind farm effectively blocks a regularly used flight line between nesting and foraging areas, or where several wind farms interact cumulatively to create an extensive barrier which could lead to diversions of many tens of kilometres, thereby incurring increased energy costs.

1.6.2.2 Significance of impact without mitigation

None of the priority species are likely to be permanently displaced due to disturbance, although displacement in the short term during the construction phase is very likely. The risk of permanent displacement due to disturbance is bigger for large species such as Kori Bustard and Secretarybird although displacement of the closely related Denham's Bustard (*Neotis denhami*) is evidently not happening at existing wind farms in the Eastern Cape (M. Langlands 2016 pers. comm, Rossouw 2016 pers.comm). The overall significance of this impact prior to mitigation is regarded to be moderate, due to its temporary nature.

1.6.2.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to disturbance associated with construction activities are as follows:

- Restrict the construction activities to the construction footprint area.
- Do not allow any access to the remainder of the property during the construction period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.

1.6.2.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

1.6.3 Mortality of priority species due to collisions with the turbines (Operational Phase)

1.6.3.1 Nature[5]

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur *et al.*, 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a main ecological drawback of wind energy (Drewitt and Langston, 2006).

Collisions with wind turbines appear to kill fewer birds than collisions with other man-made infrastructures, such as power lines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some

[5] This section is adapted from a review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira, Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies. Biological Conservation 179 (2014) 40–52

species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.* 1998).

High bird fatality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles (*Aquila chrysaetos*), Tarifa in Southern Spain for Griffon vultures (*Gyps fulvus*), Smøla in Norway for White-tailed eagles (*Haliaatus albicilla*), and the port of Zeebrugge in Belgium for gulls (Larus sp.) and terns (Sterna sp.) (Barrios and Rodríguez, 2004; Drewitt and Langston, 2006; Everaert and Stienen, 2008; May *et al.* 2012a; Thelander *et al.* 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for a large number of fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull *et al.* 2013; May *et al.* 2012b). An in-depth understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures.

Species-specific factors

- Morphological features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. The most likely reason for this is that large birds often need to use thermal and orographic updrafts to gain altitude, particularly for long distance flights. Thermal updrafts (thermals) are masses of hot, rising wind that form over heated surfaces, such as plains. Being dependent on solar radiation, they occur at certain times of the year or the day. Conversely, orographic lift (slope updraft), is formed when wind is deflected by an obstacle, such as mountains, slopes or tall buildings. Soaring birds use these two types of lift to gain altitude (Duerr *et al.* 2012). Janss (2000) identified weight, wing length, tail length and total bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wing span squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas *et al.* 2008; Herrera-Alsina *et al.* 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture (*Gyps fulvus*), seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards (*Buteo buteo*) and Short-toed Eagles (*Circaetus gallicus*), and this pattern is not related with their local abundance (Barrios and Rodríguez, 2004; De Lucas *et al.* 2008). High wing-loading is associated with low flight manoeuvrability (De Lucas *et al.* 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

- Sensorial perception

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt and Langston, 2008; Erickson *et al.* 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Krijgsveld *et al.* 2009). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin, 2011; McIsaac, 2001). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin, 2011). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps sp.) cranes and bustards (Martin and Katzir, 1999; Martin and Shaw, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Furthermore, for some species, their high-resolution vision areas are often found in the lateral fields of view, rather than frontally (e.g. Martin and Shaw, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin and Shaw, 2010; Martin, 2011). For example, the visual fields of vultures (Gyps sp.) include extensive blind areas above, below and behind the head and enlarged supra-orbital ridges (Martin *et al.* 2012). This, combined with their tendency to angle their head toward the ground in flight, might make it difficult for them to see wind turbines ahead, which might at least partially explain their high collision rates with wind turbines (Martin, 2012).

Currently, there is little information on whether noise from wind turbines can play a role in bird collisions with wind turbines. Nevertheless, wind turbines with whistling blades are expected to experience fewer avian collisions than silent ones, with birds hearing the blades in noisy (windy) conditions. However, the hypothesis that louder blade noises (to birds) result in fewer fatalities has not been tested so far (Dooling, 2002).

- Phenology

It has been suggested that resident birds would be less prone to collision, due to their familiarity with the presence of the structures (Drewitt and Langston, 2008). However, recent studies have shown that, within a wind farm, raptor collision risk and fatalities are higher for resident than for migrating birds of the same species. An explanation for this may be that resident birds generally use the wind farm area several times while a migrant bird crosses it just once (Krijgsveld *et al.* 2009). However, other factors like bird behaviour are certainly relevant. Katzner *et al.* (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes, where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes. Also, Johnston *et al.* (2014) found that during migration when visibility is good Golden Eagles can adjust their flight altitudes and avoid the wind turbines.

At two wind farms in the Strait of Gibraltar, the majority of Griffon Vulture deaths occurred in the winter. This probably happened because thermals are scarcer in the winter, and resident vultures in that season probably relied more on slope updrafts to gain lift (Barrios and Rodríguez, 2004). The strength of these updrafts may not have been sufficient to lift the vultures above the turbine blades, thereby exposing them to a higher collision risk. Additionally, migrating vultures did not seem to follow routes that crossed these two wind farms, so the number of collisions did not increase during migratory periods. Finally, at Smøla, collision risk modelling showed that White-tailed Eagles are most prone to collide during the breeding season, when there is increased flight activity in rotor swept zones (Dahl *et al.* 2013).

The case seems to be different for passerines, with several studies documenting high collision rates for migrating passerines at certain wind farms, particularly at coastal or offshore sites. However, comparable data on collision rates for resident birds is lacking. This lack of information may result from fewer studies, lower detection rates and rapid scavenger removal (Johnson *et al.* 2002; Lekuona and Ursua, 2007). One of the few studies reporting passerine collision rates (from Navarra, northern Spain) documents higher collision rates in the autumn migration period, but it is unclear if this is due to migratory behaviour or due to an increase in the number of individuals because of recently fledged juveniles (Lekuona and Ursua, 2007).

- Bird behaviour

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight, which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed

Hawks (*Buteo jamaicensis*) at APWRA (Hoover and Morrison, 2005). The hovering behaviour exhibited by Common Kestrels (*Falco tinnunculus*) when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios and Rodríguez, 2004). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover and Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009).

Collision risk may also be influenced by behaviour associated with a specific sex or age. In Belgium, only adult Common Terns (*Sterna hirundo*) were impacted by a wind farm (Everaert and Stienen, 2007) and the high fatality rate was sex-biased (Stienen *et al.* 2008). In this case, the wind farm is located in the foraging flight path of an important breeding colony, and the differences between fatality of males and females can be explained by the different foraging activity during egg-laying and incubation (Stienen *et al.* 2008). Another example comes from Portugal, where recent findings showed that the mortality of the Skylark (Alauda arvensis) is sex and age biased and affecting mainly adult males. This was related with the characteristic breeding male song-flights that make them more vulnerable to collision with wind turbines (Morinha *et al.* 2014). It seems this may also be responsible for mortalities of Red-capped Lark (*Calandrella cinerea*) at a wind farm in South Africa (Ralston, M. in litt. 2016).

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña 2012a). The same may be true for Blue Crane, as preliminary indications are that the species are not particularly vulnerable to turbine collisions (Ralston *et al.* 2017), despite being highly vulnerable to powerlines collisions.
Several collision risk models incorporate other variables related to bird behaviour. Flight altitude is widely considered important in determining the risk of bird collisions with offshore and onshore wind turbines, as birds that tend to fly at the height of rotor swept zones are more likely to collide (e.g. Band *et al.* 2007; Furness *et al.* 2013; Garthe and Hüppop, 2004).

- Avoidance behaviours

Collision fatalities are also related to displacement and avoidance behaviours, as birds that do not exhibit either of these behaviours are more likely to collide with wind turbines. The lack of avoidance behaviour has been highlighted as a factor explaining the high fatality of White-tailed Eagles at Smøla wind farm, as no significant differences were found in the total amount of flight activity within and outside the wind farm area (Dahl *et al.* 2013). However, the birds using the Smøla wind farm are mainly sub-adults, indicating that adult eagles are being displaced by the wind farm (Dahl *et al.* 2013).

Two types of avoidance have been described (Furness *et al.*, 2013): 'macro-avoidance' whereby birds alter their flight path to keep clear of the entire wind farm (e.g. Desholm and Kahlert, 2005; Plonczkier and Simms, 2012; Villegas-Patraca *et al.* 2014), and 'micro-avoidance' whereby birds enter the wind farm but take evasive actions to avoid individual wind turbines (Band *et al.* 2007). This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010). It is also important to note that there is not necessarily a direct correlation between time spent at rotor height, and the likelihood of collision.

Displacement due to wind farms, which can be defined as reduced bird breeding density within a short distance of a wind turbines, has been described for some species (Pearce-Higgins *et al.* 2009). Birds exhibiting this type of displacement behaviour when defining breeding territories are less vulnerable to collisions, not because of morphological or site-specific factors, but because of altered behaviour.

- Bird abundance

Some authors suggest that fatality rates are related to bird abundance, density or utilization rates (Carrete *et al.* 2012; Kitano and Shiraki, 2013; Smallwood and Karas, 2009), whereas others point out that, as birds use their territories in a non-random way, fatality rates do not depend on bird abundance alone (e.g. Ferrer *et al.* 2012; Hull *et al.* 2013; Smallie 2015). Instead, fatality rates depend on other factors such as differential use of specific areas within a wind farm (De Lucas *et al.* 2008). For example, at Smøla, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl *et al.* 2013). In the APWRA, Golden Eagles, Red-tailed Hawks and American Kestrels (*Falco spaverius*) have higher collision fatality rates than Turkey Vultures (*Cathartes aura*) and Common Raven (*Corvus corax*), even though the latter are more abundant in the area (Smallwood *et al.* 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas *et al.* 2008).

- Landscape features

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly (see previous section). Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios and Rodríguez, 2004; Drewitt and Langston, 2008; Katzner *et al.* 2012; Thelander *et al.* 2003). In APWRA, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander *et al.* 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano and Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

- Flight paths

Although the abundance of a species per se may not contribute to a higher collision rate with wind turbines, as previous discussed, areas with a high concentration of birds seem to be particularly at risk of collisions (Drewitt and Langston, 2006), and therefore several guidelines on wind farm construction advise special attention to areas located in migratory paths (e.g. Atienza *et al.* 2012; CEC, 2007; USFWS, 2012). As an example, Johnson *et al.* (2002) noted that over two-thirds of the carcasses found at a wind farm in Minnesota were of migrating birds. At certain times of the year, nocturnally migrating passerines are the most abundant species at wind farm, particularly during spring and fall migrations, and are also the most common fatalities (Strickland *et al.* 2011).

For territorial raptors like Golden Eagles, foraging areas are preferably located near to the nest, when compared to the rest of their home range. For example, in Scotland 98% of movements were registered at ranges less than 6 km from the nest, and the core areas were located within a 2–3 km radius (McGrady *et al.* 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas closed to ridges, can be used to predict the areas used by the species to forage (McLeod *et al.* 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright *et al.* 2006). In Spain, on the other hand, a study spanning 7 provinces with an estimated Golden Eagle population of 384 individuals, with a combined total of 46 years of post-construction monitoring, involving 5 858 turbines, collisions did not occur at the nearest wind farm to the nest site but occurred in hunting areas with high prey availability far from the breeding territories, or randomly. A subset of data was used to investigate, inter alia, the relationship between collision mortality and proximity to wind turbines. Data was gathered for over a 12-year period. Analysis revealed that collisions are not related with the distance from the nest to the nearest turbine (Camiña 2014).

Wind farms located within flight paths can increase collision rates, as seen for the wind farm located close to a seabird breeding colony in Belgium (Everaert and Stienen, 2008). In this case, wind turbines were placed along feeding routes, and several species of gulls and terns were found to fly between wind turbines on their way to marine feeding grounds. Additionally, breeding adults flew closer to the structures when making frequent flights to feed chicks, which potentially increased the collision risk.

- Food availability

Factors that increase the use of a certain area or that attract birds, like food availability, also play a role in collision risk. For example, the high density of raptors at the APWRA and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover and Morrison, 2005; Smallwood *et al.* 2001). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). It is speculated that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the opportunistic foraging due to availability of food (Smallie 2015).

- Weather

Certain weather conditions, such as strong winds that affect the ability to control flight manoeuvrability or reduce visibility, seem to increase the occurrence of bird collisions with artificial structures (Longcore *et al.* 2013). Some high bird fatality events at wind farms have been reported during instances of poor weather. For example, at an offshore research platform in Helgoland, Germany, over half of the bird strikes occurred on just two nights that were characterized by very poor visibility (Hüppop *et al.* 2006). Elsewhere, 14 bird carcasses were found at two adjacent wind turbines after a severe thunderstorm at a North American wind farm (Erickson *et al.* 2001). However, in these cases, there may be a cumulative effect of bad weather and increased attraction to artificial light. Besides impairing visibility, low altitude clouds can in turn lower bird flight height, and therefore increasing their collision risk with tall obstacles (Langston and Pullan, 2003). For wind farms located along migratory routes, the collision risk may not be the same throughout a 24-h period, as the flight altitudes of birds seem to vary. The migration altitudes of soaring birds have been shown to follow a typically diurnal pattern, increasing during the morning hours, peaking toward noon, and decreasing again in the afternoon, in accordance with general patterns of daily temperature and thermal convection (Kerlinger, 2010; Shamoun-Baranes *et al.* 2003).

Collision risk of raptors is particularly affected by wind. For example, Golden Eagles migrating over a wind farm in Rocky Mountain showed variable collision risk according to wind conditions, which decreased when the wind speed raised and increased under head- and tailwinds when compared to western crosswinds (Johnston *et al.* 2014).

- Turbine features

Turbine features may play a role in collision risk. Older lattice-type towers have been associated with high collision risk, as some species exhibiting high fatality rates used the turbine poles as roosts or perches when hunting (Osborn *et al.* 1998; Thelander and Rugge, 2000). However, in more recent studies, tower structure did not influence the number of bird collisions, as it was not higher than expected according to their availability when compared to collisions with tubular turbines (Barrios and Rodríguez, 2004).

Turbine size has also been highlighted as an important feature, as higher towers have a larger rotor swept zone and, consequently, a larger collision risk area. While this makes intuitive sense, the majority of published scientific studies indicate that an increase in rotor swept area do not automatically translate into a larger collision risk. Turbine dimensions seem to play an insignificant role in the magnitude of the collision risk in general, relative to other factors such as topography, turbine location, morphology and a species' inherent ability to avoid the turbines and may only be relevant in combination with other factors, particularly wind strength and topography (see Howell

1997, Barrios & Rodriguez 2004; Barclay *et al.* 2007, Krijgsveld *et al.* 2009, Smallwood 2013; Everaert 2014). However, some studies did find a correlation between turbine hub height and mortality (De Lucas *et al.* 2008; Loss *et al.* 2013). In the most recent paper on the subject by Thaxter *et al.* (2017), the authors conducted a systematic literature review of recorded collisions between birds and wind turbines within developed countries. They related collision rate to species-level traits and turbine characteristics to quantify the potential vulnerability of 9538 bird species globally. For birds, larger turbine capacity (megawatts) increased collision rates; however, deploying a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output. In other words, although there was a positive relationship between wind turbine capacity and collision rate per turbine, the strength of this relationship was insufficient to offset the reduced number of turbines required per unit energy generation with larger turbines. Therefore, to minimize bird collisions, wind farm electricity generation capacity should be met through deploying fewer, large turbines, rather than many, smaller ones.

Rotor speed (revolutions per minute) also seems to be relevant, as faster rotors are responsible for higher fatality rates (Thelander *et al.* 2003). However, caution is needed when analysing rotor speed alone, as it is usually correlated with other features that may influence collision risk as turbine size, tower height and rotor diameter (Thelander *et al.* 2003), and because rotor speed is not proportional to the blade speed. In fact, fast spinning rotors have fast moving blades, but rotors with lower resolutions per minute may drive higher blade tip speeds.

- Blade visibility

When turbine blades spin at high speeds, a motion smear (or motion blur) effect occurs, making wind turbines less conspicuous. This effect occurs both in the old small turbines that have high rotor speed and in the newer high turbines that despite having slower rotor speeds, achieve high blade tip speeds. Motion smear effect happens when an object is moving too fast for the brain to process the images and, as a consequence, the moving object appears blurred or even transparent to the observer. The effect is dependent on the velocity of the moving object and the distance between the object and the observer. The retinal-image velocity of spinning blades increases as birds get closer to them, until it eventually surpasses the physiological limit of the avian retina to process temporally changing stimuli. As a consequence, the blades may appear transparent and perhaps the rotor swept zone appears to be a safe place to fly (Hodos, 2003). For example, McIsaac (2001) showed that American Kestrels were not always able to distinguish moving turbine blades within a range of light conditions.

Recent experiments at the Smøla Wind Power facility in Norway where one turbine blade was painted black to reduce motion smear, led to a 70.9% reduction in the number of recorded collisions per search (Stokke *et al.* 2017).

- Wind farm configuration

Wind farm lay-out can also have a critical influence on bird collision risk. For example, it has been demonstrated that wind farms arranged perpendicularly to the main flight path may be responsible for a higher collision risk (Everaert *et al.* 2002 & Isselbacher and Isselbacher, 2001 in Hötker *et al.* 2006). At APWRA, wind turbines located at the ends of rows, next to gaps in rows, and at the edge of local clusters were found to kill disproportionately more birds (Smallwood and Thellander, 2004). In this wind farm, serially arranged wind turbines that form wind walls are safer for birds (suggesting that birds recognize wind turbines and towers as obstacles and attempt to avoid them while flying), and fatalities mostly occur at single wind turbines or wind turbines situated at the edges of clusters (Smallwood and Thellander, 2004). However, this may be a specificity of APWRA. For instance, De Lucas *et al.* (2012a) found that the positions of the wind turbines within a row did not influence the turbine fatality rate of Griffon Vultures at Tarifa. Additionally, engineering features of the newest wind turbines require a larger minimum distance between adjacent wind turbines and in new wind farms it is less likely that birds perceive rows of turbines as impenetrable walls. In fact, in Greece it was found that the longer the distance between wind turbines, the higher is the probability that raptors will attempt to cross the space between them (Cárcamo *et al.* 2011).

1.6.3.2 Significance of impact without mitigation

Species-specific factors

Priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are Northern Black Korhaan, Grey-winged Francolin and Kori Bustard. It is noted though that no bustard mortalities have as yet been reported in published literature at wind farms in South Africa, despite initial concerns that they might be vulnerable in this respect (Ralston - Patton *et al.* 2017). Specific behaviour of some terrestrial species might put them at risk of collision, e.g. display flights of Northern Black Korhaan might place them within the rotor swept zone, but the species was not recorded during pre-construction monitoring, possibly due to hunting pressure. It is also noted that very little flight activity of terrestrial species was recorded during the 12-months pre-construction monitoring.

Many of the priority species potentially occurring at the proposed WEF development area probably have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g. Northern Black Korhaan, Grey-winged Francolin, African Rock-Pipit and Double-banded Courser. The possible exceptions to this are the raptors which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better. It is therefore unlikely that differences in sensorial perception will play a significant role in the collision risk associated with priority species at the proposed wind farm, as behaviour is more important from a risk perspective.

While it is anticipated that birds at the proposed wind farm will successfully avoid the wind turbines most of the time, possible exceptions might be raptors (especially Lesser Kestrel, Jackal Buzzard and possibly Verreaux's Eagle) engaged in hunting which might serve to distract them and place them at risk of collision, or birds engaged in display behaviour, e.g. Northern Black Korhaan (see earlier point).

Based on the potential time spent flying at rotor height, soaring species are likely to be at greater risk of collision, especially Lesser Kestrel, which may be highly vulnerable to turbine collisions (Ralston-Patton *et al.* 2017). The closely related Amur Falcon is currently the species with the highest confirmed mortality due to collisions with wind turbines at South African wind farms (Ralston-Patton *et al.* 2017), it is therefore expected that Lesser Kestrel, which has a similar style of foraging, would display a similar high vulnerability to collisions. Verreaux's Eagle, which was recorded briefly, emerged with the second highest collision risk rating, which indicates that while the risk of collisions for the species may not be as high as a site with an active breeding pair, it cannot be entirely excluded. The risk rating for Jackal Buzzard is very low, compared to wind farm sites elsewhere (Van Rooyen *et al.* unpublished data)[6], yet the species is highly vulnerable to collisions with turbines, therefore the potential for collisions cannot be discounted.

The abundance of priority species at the proposed wind farm site will fluctuate depending on season of the year, and particularly in response to rainfall. This is a common phenomenon in arid ecosystems, where stochastic rainfall events can trigger irruptions of insect populations which in turn attract large numbers of birds. This is particularly likely to be the case with Lesser Kestrels. In general, higher populations of priority species are likely to be present when the veld conditions are good, especially in the rainy season. In the case of Verreaux's Eagles, mortality has been correlated with high flight activity (Ralston-Patton *et al.* 2017), but at least one Verreaux's Eagle mortality has been confirmed at a wind farm where no pre-construction flight activity was recorded for the species (Van Rooyen unpubl. data), indicating that for this species, low abundance does not entirely exclude the potential for collision mortality. As far as Jackal Buzzard is concerned, the

[6] A dataset comprising 12 potential wind farm sites where the species was recorded during monitoring, recorded collision risk ratings for Jackal Buzzard ranging from 1.38 to 283.

species has proven to be highly susceptible to wind turbine collisions (Ralston-Patton *et al.* 2017), and the low reporting rate for the species at the WEF development area therefore does not exclude the possibility of collisions.

<u>Site-specific factors</u>

Landscape features are likely to play an important role at the WEF development area. The proposed turbine zones at the WEF development area are virtually surrounded by slopes. The slopes are generally not very steep, but in some areas the drop-off from the plateau at the ridge top is more pronounced. The slopes are likely to be important landscape features for soaring species, particularly raptors such as Jackal Buzzard, Booted Eagle, Verreaux's Eagle and Lesser Kestrel, due to the presence of declivity currents, especially at the steeper slopes, which will require a set-back from the edge to reduce the risk of collision for soaring raptors. The flight activity map for Verreaux's Eagle points towards a concentration of flight activity along the ridges. In the case of the Lesser Kestrels, the grass covered slopes seems to be the area of choice. It is therefore necessary to buffer the edges of the escarpment, as it is likely to be the area where most of the raptor flight activity will take place at turbine height. Other areas which can be specifically pinpointed as potentially sensitive are the water points, i.e. areas of surface water, which are likely to attract a variety of raptors. See Figure 9 indicating proposed avifaunal turbine-free buffer zones, linked to the presence of surface water and slopes.

The proposed WEF development area is not located on any known migration route. The migratory Lesser Kestrels at the site can be regarded as summer residents as they will remain in the area as long as there are adequate food supplies. In semi-arid zones such as where this proposed wind farm is located, food availability is often linked to rainfall. It is a well-known fact that insect outbreaks may occur after rainfall events, which could draw in various priority species, and particularly Lesser Kestrel. This in turn could heighten the risk of collisions.

Rock piles which are created as a result of construction activities at the proposed site could create habitat for Rock Hyrax, which in turn could result in Verreaux's Eagles being attracted to the area and exposing themselves to collision risk. However, the habitat at the wind farm as it currently stands is not ideal for Rock Hyrax as it lacks the boulder strewn slopes that the animal require for shelter. It is therefore not expected that Verreaux's Eagles will regularly forage over the site, but occasional forays cannot be excluded.

Weather conditions at the proposed wind farm are likely to influence flight behaviour in much the same manner as has been recorded elsewhere at wind farms. Analysis of the flight data collected during the pre-construction monitoring indicates that the majority of soaring flights happened during fresh breezes, in winds with a predominantly easterly orientation (see Appendix 4 tables F and G). However, the overall low incidence of priority species flight activity means the confidence in these predictions are low due to paucity of data.

<u>Wind farm-specific factors</u>

Due to the fact that the turbine dimensions are constantly changing as newer models are introduced, it is best to take a pre-cautionary approach in order to anticipate any future potential changes in the turbine dimensions. The pre-construction monitoring programme worked on a potential rotor swept area of 30m – 220m above ground to incorporate a wide range of models, which accommodates the current proposed turbines. The latest published literature on the subject recommends that to minimize bird collisions, wind farm electricity generation capacity should be met through deploying fewer, large turbines, rather than many, smaller ones (Thaxter *et al.* 2017). Any reduction of the current complement of 47, 4.5 – 5.5 MW proposed turbines should therefore lower the collision risk for birds. Two of the proposed turbines, i.e. No 43 rev1 and No 47, are currently placed within the proposed no-turbine zones, which heightens the risk of collisions for soaring raptors with those turbines.

Conclusion

The pre-mitigation impact of mortality due to turbine collisions is rated to be of moderate significance. While the topography of the terrain (many slopes) contributes to the risk of collisions, especially for soaring species, the very low reporting rate for priority species[7] reduces the chances of the impact materialising with regularity.

1.6.3.3 Proposed mitigation measures

The following proposed mitigation measures could reduce the risk of mortality through collisions with the turbines:

- A 100m no-turbine set-back buffer zone (other infrastructure is allowed) is recommended around selected ridge edges to minimise the risk of collisions for slope soaring species (see Figure 9). Two turbines i.e. No 43rev1 and No 47, are located within this no-turbine zone and will have to be relocated.
- A 300m no turbine buffer zone (other infrastructure allowed) is recommended around selected water points (see Figure 9). One turbine, No 43rev1, is currently within this no-turbine zone and will have to be relocated.
- Care should be taken not to create habitat for prey species that could draw Verreaux's Eagles into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax.
- The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority species anticipated to be at risk of collision mortality, prior to the wind farm going operational.
- If estimated collision rates approach the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations.
- In the event of a massive influx of Lesser Kestrels due to an irruption of insects, pro-active curtailment must be implemented under the guidance of the avifaunal specialist. A site-specific regime must be designed in consultation with the wind farm operator which will specify the duration of the curtailment period as well as the specific time of the day when the turbines will be curtailed.

Rationale: The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance should be reduced to low.

1.6.3.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

1.6.4 Displacement of priority species due to disturbance (De-commissioning Phase)

1.6.4.1 Nature

Displacement occurs primarily during the construction phase of wind farms and may occur as a result of construction activities (see 1.6.2 above). However, temporary displacement could also happen due to activities related to the dismantling of the wind farm after its operational life-time. In theory, the wind farm's operational lifetime is about 20 – 25 years, after which it is supposed to be de-commissioned and dismantled. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis.

1.6.4.2 Significance of impact without mitigation

[7] The passage rate of 0.05 birds/hour is equal to the lowest of all the passage rates for priority species at 36 potential wind farms sites where the authors implemented pre-construction monitoring.

None of the priority species are likely to be permanently displaced due to disturbance during the de-commissioning phase, although displacement in the short term is very likely. The overall significance of this impact prior to mitigation is regarded to be moderate, due to the temporary nature.

1.6.4.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to disturbance associated with de-commissioning activities are as follows:

- Restrict the activities to the footprint area.
- Do not allow any access to the remainder of the property during the de-commissioning period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.

1.6.4.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

1.6.5 Cumulative Impacts

Table 5 lists the renewable energy applications are currently registered with DEA within a 50km radius around the proposed WEF:

Table 5: Renewable energy facilities proposed within a 50km radius around the proposed WEF

Name	DEA reference number	Status	Was a bird impact assessment study compiled?	Recommendations pertaining specifically to bird impacts
Kuruman Phase 2 wind energy facility		EIA phase	Yes	• Restrict the activities to the footprint area. • Do not allow any access to the remainder of the property during the de-commissioning period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should

				be made of existing access roads and the construction of new roads should be kept to a minimum. • If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifauna specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed. • 100m anti-collision setback buffer zone around selected ridges. • 300m anti-collision no-turbine buffer zone around selected water points and powerlines. • Removal of rock piles to prevent them from becoming Rock Hyrax habitat. • Curtailment of turbines if mortality levels exceed pre-determined mortality thresholds. • Curtailment of turbines in the event of an influx of Lesser Kestrels.
Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province	14/12/16/3/3/1/475	Approved	Unknown, no reports were found on the internet	Unknown
Solar farm for Bestwood, Kgalagadi District Municipality, NC	12/12/20/1906	Approved	Yes. The findings were that the project should have minimal impact on Red Data avifauna	None listed in the EIA report
Kathu Solar PV Energy Facility	14/12/16/3/3/2/911	Approved	No, only an ecological report	None
75 MW AEP Legoko Photovoltaic Solar Facility	14/12/16/3/3/2/819	Approved	No, only an ecological report	None

75 MW AEP Mogobe Photovoltaic Solar Facility	14/12/16/3/3/2/820	Approved	No, only an ecological report	None
Kalahari Solar Power Project	12/12/20/1994/AM4	Approved	No, only an ecological report	• Avoiding the removal of Acacia trees that have breeding raptors present until the conclusion of the breeding season at the end of November; • Raptor-proofing all open reservoirs, dams or ponds to allow birds to drink and bathe, preventing drowning, and thus contributing to raptor conservation • Bird-unsafe electrical servitudes must be modified by Eskom to insulate dangerous live components, and to cut a gap in the earth wire – perch deterrents can also be installed to keep birds away from the dangerous areas on the structure.
San Solar Energy Facility	14/12/16/3/3/2/273/AM1	Approved	No, only an ecological report	Fit power-lines with suitable reflectors to enhance their visibility to birds, and fit pylons with suitable deterring structures to discourage birds from perching on such structures
115 Megawatt (MW) Boitshoko Solar Power Plant	14/12/16/3/3/2/935	Approved	Yes	All new transmission lines be marked with bird diverters, as they go up. The priority areas - those with the highest mortality rate - should be considered first. There are three classes of mitigation for the PV panels: (i) move them well away from highly sensitive bird area (especially pans or other well-used bird areas), or (ii) employ bird-diverters to deter birds mistaking the panels for open water. If, in the post-construction monitoring, hornbills are found to attack their own reflections in the panels, and smash

				them, then covering the affected panels with a fine wire mesh is recommended. It is also recommended that Boitshoko install video cameras above some panels for postconstruction monitoring of any mortality of birds in the vicinity, through direct observation and carcass searches in a systematic and regular fashion.
25MW Kathu2 Solar Energy Facility, Northern Cape Province	12/12/20/1858/2/AM2	Approved	No information on this project as available on the internet	No information on this project as available on the internet
Sishen Solar Farm	12/12/20/1977	Lapsed/ withdrawn	N/A	N/A
150mw Adams Photo-Voltaic Solar Energy Facility	12/12/20/2567	Approved	No, only an ecological report	None
Proposed renewable energy generation project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park	14/12/16/3/3/2/616	Approved	No, only an ecological report	The high-risk sections of the power line should be marked with a suitable anti-collision marking device on the earth wire as per the Eskom guidelines

1.6.5.1 Nature

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.

There is currently one wind energy planned within a 50km radius around the proposed WEF, and at least 11 solar PV facilities. The primary potential long-term impact of wind facility is mortality of priority species due to collisions with the turbines, and in the case of the solar facilities, it is displacement due to habitat transformation.

1.6.5.2 Significance of impact before mitigation

The fact that only one other wind facility is currently planned within the 50km radius, and the low reporting rate for priority species, reduce the cumulative effect of this impact to a moderate level.

The mitigation measures pertaining to avifauna in the existing applications for solar plants do not address the issue of displacement due to habitat transformation, as this impact cannot be effectively mitigated at solar facilities for the majority of avifauna. The question is therefore to what extent the relatively moderate envisaged impact of displacement at the WEF will increase in significance when viewed collectively with the aggregate impact of displacement of all the renewable energy facilities combined. The total land parcel area covered by current solar applications is approximately 222km². This amounts to 2.7% of the total area of 8 136km² contained in the 50km radius around the proposed WEF. The land parcel area for the WEF is approximately 73km². If this is added to the solar applications, it comes to 295km², or approximately 3.6% of the total area encompassed in a 50km radius around the proposed WEF. While this is a significant increase in the area to be potentially transformed, it still only a fraction of the total available habitat. It should also be borne in mind that the actual development footprint for all these applications is usually considerably smaller than the land parcel. It therefore follows that the significance of the cumulative displacement impact of the WEF, viewed with the other potential renewable energy projects, is still relatively moderate.

1.6.5.3 Proposed mitigation measures

As mentioned already, the impact of displacement due to habitat transformation is difficult to mitigate in the case of solar plants, because it involves the physical footprint of the infrastructure, which cannot be avoided. In the case of the WEF, the impact not only involves the physical footprint of the infrastructure, which is relatively minor, but also the habitat fragmentation which is caused by the network of roads.

The mitigation measures listed below, or variations of them, are recommended at all the proposed renewable energy projects:

- The recommendations of the specialist ecological study must be strictly adhered to, to limit the habitat destruction.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.
- Restrict the activities to the footprint area.
- Do not allow any access to the remainder of the property during the de-commissioning period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.
- 100m anti-collision setback buffer zone around selected ridges.
- 300m anti-collision no-turbine buffer zone around selected water points and powerlines.
- Removal of rock piles to prevent them from becoming Rock Hyrax habitat.
- Curtailment of turbines if mortality levels exceed pre-determined mortality thresholds.
- Curtailment of turbines in the event of an influx of Lesser Kestrels.

1.6.5.4 Significance of impact after mitigation

The mitigation measures listed above will address the issue of displacement to some extent, but due to the inherent nature of the displacement impact, the significance of the impacts will likely remain at a moderate level, even after mitigation.

In the case of the proposed wind facilities, the mitigation measures aimed at reducing the risk of priority species mortality due to collision with the turbines should reduce the cumulative impact to low, if applied diligently.

1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above a collated in Table 6 to 8 below. The potential impacts identified in this impact assessment study have been assessed based on the criteria and methodology outlined in Chapter 4 of the Draft EIA Report, and will not be repeated here.

Table 6: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Avifauna	Displacement of priority species due to habitat transformation	Negative	Local	Long term	Substantial	Likely	Moderate	Low	• The recommendations of the specialist ecological study must be strictly adhered to. • Maximum used should be made of existing access roads and the Construction of new roads should be kept to a minimum. • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.	Moderate	Moderate	3	Medium
Avifauna	Displacement of priority species due to disturbance associated with the construction activities	Negative	Local	Short term	Substantial	Likely	High	Low	• Restrict the construction activities to the construction footprint area. • Do not allow any access to the remainder of the property during the construction period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The ECO must then, during audits/site visits, make a concerted effort to look out for breeding activities of priority species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.	Moderate	Low	4	Medium

Table 7: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Avifauna	Mortality of priority species due to collisions with the turbines	Negative	International (Lesser Kestrels are Palearctic summer migrants)	Long term	Substantial	Likely	High	Low	• A 100m no-turbine set-back buffer zone (other infrastructure is allowed) is recommended around selected ridge edges to minimise the risk of collisions for slope soaring species (see Figure 9). Turbines 43rev1 and 47 will require relocation. • A 300m no turbine buffer zone (other infrastructure allowed) is recommended around selected water points (see Figure 9). Turbine 43rev1 will require relocation. • Care should be taken not to create habitat for prey species that could draw Verreaux's Eagles into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax. • Formal monitoring should be resumed for period of two years once the turbines have been constructed, as per the most recent edition of the best practice guidelines (Jenkins *et al*. 2011). The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management. • The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority anticipated to be at risk of collision mortality, prior to the wind farm going operational. • If estimated collision rates approach the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations. • In the event of a massive influx of Lesser Kestrels due to an irruption of insects, pro-active curtailment must be implemented under the guidance of the avifaunal specialist. A site-specific regime must be designed in consultation with the wind farm operator which will specify the duration of the curtailment period as well as the specific time of the day when the turbines will be curtailed.	Moderate	Low	4	Medium

Table 8: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Avifauna	Displacement of priority species due to disturbance associated with the decommissioning activities	Negative	Local	Short term	Substantial	Likely	High	Low	• Restrict the construction activities to the footprint area. • Do not allow any access to the remainder of the property during for the duration of the decommissioning activities. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The ECO must then, during audits/site visits, make a concerted effort to look out for breeding activities of priority species, and such efforts may include the training of staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.	Moderate	Low	4	Medium

Table 9: Impact assessment summary table for cumulative impacts

Cumulative impacts													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Avifauna	Primarily displacement of priority species due to habitat transformation	Negative	Local	Long term	Substantial	Likely	High	Low	The mitigation measures listed below, or variations of them, are recommended at all the proposed renewable energy projects: • The recommendations of the specialist ecological study must be strictly adhered to, to limit the habitat destruction. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.	Moderate	Moderate	3	Medium
Avifauna	Mortality due to collisions with the wind turbines	Negative	International (Lesser Kestrels are Palearctic summer migrants)	Long term	Substantial	Likely	High	Low	• 100m anti-collision setback buffer zone around selected ridges. • 300m anti-collision no-turbine buffer zone around selected water points and powerlines. • Removal of rock piles to prevent them from becoming Rock Hyrax habitat. • Curtailment of turbines if mortality levels exceed pre-determined mortality thresholds. • Curtailment of turbines in the event of an influx of Lesser Kestrels.	Moderate	Low	4	Medium

1.8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

Table 10 below provides a description of the key monitoring recommendations for each applicable mitigation measure identified for all phases of the project for inclusion in the EMPr or environmental authorisation.

Table 10: Environmental Management Plan for Avifauna

Activity	Mitigation and Management Measure	Responsible Persor	Applicable Development Phase	Include as Condition of Authorisatio	Monitoring requirements
Displacement of priority species due to <u>disturbance</u> during construction operations	1) A site-specific Environmental Management Plan (EMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMP and should apply good environmental practice during construction. 2) Environmental Control Officer (ECO) to oversee activities and ensure that the site-specific EMP is implemented and enforced via regular inspections. 3) The ECO must be trained by the avifaunal specialist to identify the potential priority species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. 4) Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road as well as the final turbine positions, to identify any nests/breeding/roosting activity of priority species. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.	ECO and Avifaunal specialist	Construction	Yes	If a priority species nest is discovered during the construction phase, the ECO must conduct weekly inspections of the nes to monitor the breeding effort, in consultation with the avifaunal specialist.
Displacement of priority species due to <u>habitat transformation</u> during construction phase	1) A site-specific Environmental Management Plan (EMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the EMP and should apply good environmental practice during construction. EMP should include the following: • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • No off-road driving; • ECO to hold regular inspections ensure that the EMPr is implemented and enforced; • Any clearing of stands of alien trees on site should be approved first by the avifaunal specialist. • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration	ECO Avifaunal specialist Rehabilitation specialist	Construction	Yes	ECO to oversee activities and ensure that the site-specific EMPr is implemented and enforced via regular inspections;

Activity	Mitigation and Management Measure	Responsible Person	Applicable Development Phase	Include as Condition of Authorisation	Monitoring requirements
	plan is to be developed by a rehabilitation specialist and included within the EMPr.				
Priority species mortality due to <u>collisions with the turbines</u>	1) Mortality thresholds should be determined by the avifaunal specialist in consultation with BirdLife SA, for priority species recorded during the pre-construction monitoring, prior to the wind farm becoming operational. 2) Once the turbines have been constructed, operational monitoring should be implemented under the guidance of an avifaunal specialist to assess collision rates, in accordance with the latest version of the Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. 3) If collision rates indicate mortality exceeding threshold levels of priority species, curtailment must be implemented during high risk periods. These periods, and the number of turbines to be curtailed, will be determined by the avifaunal specialist in consultation with the wind farm management. 4) Regular inspections must be conducted by the ECO to ensure that rock piles are removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax (Dassie)Procavia capensis. 5) A 100m no-turbine set-back buffer zone (other infrastructure is allowed) must be implemented around selected ridge edges to minimise the risk of collisions for slope soaring species (see Figure 8). 6) A 300m no turbine buffer zone (other infrastructure allowed) is recommended around selected water points (see Figure 9). Turbine 43rev1 will require relocation.	Wind farm management, ECO, and avifaunal specialist (in consultation with BirdLife SA) Design team	Operational Construction phase Design phase Design phase Design/Construction phase	Yes	Once the turbines have been constructed, operational monitoring should be implemented under the guidance of an avifaunal specialist to assess collision rates in accordance with the latest version of the Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.
Displacement of priority species due to disturbance during decommissioning operations	1) A site-specific Environmental Management Plan (EMPr) must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the EMP and should apply good environmental practice during decommissioning. 2) Following decommissioning, rehabilitation of all areas disturbed must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and included within the Environmental Management Plan (EMPr).	Site management Rehabilitation specialist	Decommissioning	Yes	None

1.9. CONCLUSION AND RECOMMENDATIONS

It is anticipated that the proposed Kuruman Phase 1 Wind Energy Facility will have a moderate impact on priority avifauna. The impacts are:

- Displacement due to habitat transformation during construction of the wind farm and associated infrastructure
- Displacement due to disturbance during construction (and dismantling) of the wind farm and associated infrastructure;
- Collision mortality on the wind turbines;

An estimated 201 species could potentially occur in the study area, of which 133 were recorded at the WEF development area during pre-construction monitoring. Of the 201 species that could occur at the site, 17 are classified as priority species for wind farm developments (Retief *et al.* 2012). The results of the transect counts indicate a moderate diversity of avifauna at both the WEF development area and the control site. While this is to be expected to some extent of a fairly arid area such as this, the very low numbers or absence of some species e.g. Northern Black Korhaan is an indication that the avian populations might be under pressure from external factors, e.g. hunting. Flight activity of priority species at the WEF development area was also very low, with a passage rate of 0.05 birds/hour.

Displacement of priority species due to habitat destruction during operational lifetime of the wind energy facility phase is likely to be a moderate negative impact and will remain at a moderate level even with the application of mitigation measures. Raptors are unlikely to be affected at all. Species most likely to be affected by the habitat fragmentation are the terrestrial species namely Grey-winged Francolin, Northern Black Korhaan, Kori Bustard and Secretarybird. The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated and will remain an impact for the duration of the operational life-time of the facility.

Displacement of priority species due to disturbance during the construction (and dismantling) phases of the wind energy facility and associated infrastructure is likely to be a temporary, negative impact, but should be reduced to a low level with the application of mitigation measures. It is highly likely that most priority species will be temporarily displaced in the development area during the construction operations, due to the noise and activity. The risk of permanent displacement due to disturbance is bigger for large species such as Kori Bustard and Secretarybird.

Collisions of priority species with the turbines in the operational phase are likely to be a moderate negative impact and it could be reduced to a low negative level through the application of mitigation measures. Species most likely to be at risk of collision with the turbines are Lesser Kestrel, Verreaux's Eagle and Jackal Buzzard. Very little Verreaux's Eagle and Jackal Buzzard flight activity was recorded, but that does not exclude the potential for collisions. The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance should be reduced to low.

There is currently one wind energy planned within a 50km radius around the proposed WEF, and at least 11 solar PV facilities. The primary potential long-term impact of wind facility is mortality of priority species due to collisions with the turbines, and in the case of the solar facilities, it is displacement due to habitat transformation. The fact that only one other wind facility is currently planned within the 50km radius, and the low reporting rate for priority species, reduce the cumulative effect of this impact to a moderate level.

The mitigation measures pertaining specifically to avifauna in the existing applications for solar plants do not address the issue of displacement due to habitat transformation, as this impact cannot be effectively mitigated at solar facilities for the majority of avifauna. The question is therefore to what extent the relatively moderate envisaged impact of displacement of priority species at the WEF will increase in significance when viewed collectively with the aggregate impact of displacement of all the renewable energy facilities combined. It should be borne in mind that the actual development footprint for all these applications is usually considerably smaller than the land parcel. The significance of the cumulative displacement impact of the WEF, viewed with the other potential renewable energy projects, is still relatively moderate. Mitigation measures will address the issue of avifauna displacement to some extent, but due to the inherent nature of the displacement impact, the significance of the impacts will likely remain at a moderate level, even after mitigation.

It is our opinion that the proposed development be approved, subject to the strict implementation of the proposed mitigation measures detailed in this report.

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1.11. APPENDICES

APPENDIX 1: SPECIES THAT POTENTIALLY OCCUR AT THE WEF DEVELOPMENT AREA

NT: Near threatened **VU: Vulnerable** **EN: Endangered** **LC: Least concern**

Species	Taxonomic name	Reporting rate	Global Status (IUCN)	Regional Status (Taylor *et al.* 2015)	Priority species
African Rock Pipit	*Anthus crenatus*	1.49	LC	NT	x
Black Harrier	*Circus maurus*	0	VU	EN	x
Black-chested Snake-Eagle	*Circaetus pectoralis*	0			x
Booted Eagle	*Hieraaetus pennatus*	0			x
Double-banded Courser	*Rhinoptilus africanus*	1.49			x
Greater Kestrel	*Falco rupicoloides*	7.46			x
Grey-winged Francolin	*Francolinus africanus*	0			x
Jackal Buzzard	*Buteo rufofuscus*	4.48			x
Kori Bustard	*Ardeotis kori*	0	NT	NT	x
Lanner Falcon	*Falco biarmicus*	0	LC	VU	x
Martial Eagle	*Polemaetus bellicosus*	0	VU	EN	x
Northern Black Korhaan	*Afrotis afraoides*	4.48			x
Secretarybird	*Sagittarius serpentarius*	0	VU	VU	x
Southern Pale Chanting Goshawk	*Melierax canorus*	14.93			x
Spotted Eagle-Owl	*Bubo africanus*	7.46			x
Steppe Buzzard	*Buteo vulpinus*	4.48			x
Verreaux's Eagle	*Aquila verreauxii*	1.49	LC	VU	x
Acacia Pied Barbet	*Tricholaema leucomelas*	76.12			
African Black Swift	*Apus barbatus*	0			
African Grey Hornbill	*Tockus nasutus*	1.49			
African Hoopoe	*Upupa africana*	43.28			
African Palm-Swift	*Cypsiurus parvus*	25.37			
African Paradise-Flycatcher	*Terpsiphone viridis*	1.49			
African Pipit	*Anthus cinnamomeus*	13.43			
African Purple Swamphen	*Porphyrio madagascariensis*	2.99			
African Quailfinch	*Ortygospiza atricollis*	4.48			
African Red-eyed Bulbul	*Pycnonotus nigricans*	97.01			
African Reed-Warbler	*Acrocephalus baeticatus*	1.49			
African Sacred Ibis	*Threskiornis aethiopicus*	16.42			
African Stonechat	*Saxicola torquatus*	11.94			
Alpine Swift	*Tachymarptis melba*	1.49			
Amethyst Sunbird	*Chalcomitra amethystina*	0			
Anteating Chat	*Myrmecocichla formicivora*	40.3			

Species	**Taxonomic name**	**Reporting rate**	**Global Status (IUCN)**	**Regional Status (Martin *et al.* 2015)**	**Priority species**
Ashy Tit	*Parus cinerascens*	26.87			
Banded Martin	*Riparia cincta*	2.99			
Barn Owl	*Tyto alba*	11.94			
Barn Swallow	*Hirundo rustica*	19.4			
Barred Wren-Warbler	*Calamonastes fasciolatus*	4.48			
Bearded Woodpecker	*Dendropicos namaquus*	2.99			
Black Cuckoo	*Cuculus clamosus*	4.48			
Black-chested Prinia	*Prinia flavicans*	67.16			
Black-collared Barbet	*Lybius torquatus*	8.96			
Black-crowned Night-Heron	*Nycticorax nycticorax*	1.49			
Black-faced Waxbill	*Estrilda erythronotos*	25.37			
Black-headed Heron	*Ardea melanocephala*	2.99			
Blacksmith Lapwing	*Vanellus armatus*	17.91			
Black-throated Canary	*Crithagra atrogularis*	37.31			
Black-winged Stilt	*Himantopus himantopus*	2.99			
Blue Waxbill	*Uraeginthus angolensis*	4.48			
Bokmakierie	*Telophorus zeylonus*	35.82			
Bradfield's Swift	*Apus bradfieldi*	8.96			
Brown-crowned Tchagra	*Tchagra australis*	32.84			
Brown-hooded Kingfisher	*Halcyon albiventris*	2.99			
Brown-throated Martin	*Riparia paludicola*	2.99			
Brubru	*Nilaus afer*	13.43			
Buffy Pipit	*Anthus vaalensis*	7.46			
Burchell's Coucal	*Centropus burchellii*	1.49			
Cape Bunting	*Emberiza capensis*	17.91			
Cape Crow	*Corvus capensis*	1.49			
Cape Glossy Starling	*Lamprotornis nitens*	73.13			
Cape Penduline-Tit	*Anthoscopus minutus*	17.91			
Cape Robin-Chat	*Cossypha caffra*	31.34			
Cape Shoveler	*Anas smithii*	1.49			
Cape Sparrow	*Passer melanurus*	76.12			
Cape Turtle-Dove	*Streptopelia capicola*	43.28			
Cape Wagtail	*Motacilla capensis*	56.72			
Cape White-eye	*Zosterops virens*	4.48			
Cardinal Woodpecker	*Dendropicos fuscescens*	14.93			
Cattle Egret	*Bubulcus ibis*	19.4			
Chat Flycatcher	*Bradornis infuscatus*	8.96			
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	80.6			

Species	Taxonomic name	Reporting rate	Global Status (IUCN)	Regional Status (Martin *et al.* 2015)	Priority species
Cinnamon-breasted Bunting	*Emberiza tahapisi*	23.88			
Common Fiscal	*Lanius collaris*	52.24			
Common Moorhen	*Gallinula chloropus*	5.97			
Common Myna	*Acridotheres tristis*	14.93			
Common Ostrich	*Struthio camelus*	1.49			
Common Quail	*Coturnix coturnix*	1.49			
Common Scimitarbill	*Rhinopomastus cyanomelas*	22.39			
Common Swift	*Apus apus*	5.97			
Common Waxbill	*Estrilda astrild*	4.48			
Crested Barbet	*Trachyphonus vaillantii*	14.93			
Crimson-breasted Shrike	*Laniarius atrococcineus*	62.69			
Crowned Lapwing	*Vanellus coronatus*	25.37			
Desert Cisticola	*Cisticola aridulus*	16.42			
Diderick Cuckoo	*Chrysococcyx caprius*	17.91			
Double-banded Sandgrouse	*Circaetus pectoralis*	0			
Dusky Sunbird	*Cinnyris fuscus*	14.93			
Eastern Clapper Lark	*Mirafra fasciolata*	13.43			
Egyptian Goose	*Alopochen aegyptiacus*	2.99			
European Bee-eater	*Merops apiaster*	44.78			
Fairy Flycatcher	*Stenostira scita*	8.96			
Familiar Chat	*Cercomela familiaris*	65.67			
Fawn-coloured Lark	*Calendulauda africanoides*	16.42			
Fiscal Flycatcher	*Sigelus silens*	70.15			
Fork-tailed Drongo	*Dicrurus adsimilis*	13.43			
Gabar Goshawk	*Melierax gabar*	10.45			
Glossy Ibis	*Plegadis falcinellus*	2.99			
Golden-breasted Bunting	*Emberiza flaviventris*	38.81			
Golden-tailed Woodpecker	*Campethera abingoni*	25.37			
Great Sparrow	*Passer motitensis*	1.49			
Greater Honeyguide	*Indicator indicator*	1.49			
Greater Striped Swallow	*Hirundo cucullata*	50.75			
Green-winged Pytilia	*Pytilia melba*	40.3			
Grey Heron	*Ardea cinerea*	1.49			
Grey-backed Cisticola	*Cisticola subruficapilla*	11.94			
Grey-backed Sparrowlark	*Eremopterix verticalis*	1.49			
Groundscraper Thrush	*Psophocichla litsipsirupa*	47.76			
Hadeda Ibis	*Bostrychia hagedash*	34.33			
Harlequin Quail	*Coturnix delegorguei*	0			

Species	Taxonomic name	Reporting rate	Global Status (IUCN)	Regional Status (Martin *et al.* 2015)	Priority species
Helmeted Guineafowl	*Numida meleagris*	41.79			
Hottentot Teal	*Anas hottentota*	1.49			
House Sparrow	*Passer domesticus*	59.7			
Jacobin Cuckoo	*Clamator jacobinus*	2.99			
Kalahari Scrub-Robin	*Cercotrichas paena*	76.12			
Karoo Eremomela	*Eremomela gregalis*	0			
Karoo Long-billed Lark	*Certhilauda subcoronata*	8.96			
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	4.48			
Karoo Thrush	*Turdus smithi*	34.33			
Kurrichane Buttonquail	*Turnix sylvaticus*	4.48			
Large-billed Lark	*Galerida magnirostris*	0			
Lark-like Bunting	*Emberiza impetuani*	25.37			
Laughing Dove	*Streptopelia senegalensis*	88.06			
Laughing Dove	*Spilopelia senegalensis*	0			
Layard's Tit-Babbler	*Parisoma layardi*	7.46			
Lesser Grey Shrike	*Lanius minor*	10.45			
Lesser Kestrel	*Falco naumanni*	0			
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	5.97			
Levaillant's Cisticola	*Cisticola tinniens*	1.49			
Lilac-breasted Roller	*Coracias caudatus*	7.46			
Little Grebe	*Tachybaptus ruficollis*	1.49			
Little Swift	*Apus affinis*	25.37			
Long-billed Crombec	*Sylvietta rufescens*	31.34			
Long-billed Pipit	*Anthus similis*	10.45			
Mallard Duck	*Anas platyrhynchos*	1.49			
Marico Flycatcher	*Bradornis mariquensis*	25.37			
Marico Sunbird	*Cinnyris mariquensis*	16.42			
Mountain Wheatear	*Oenanthe monticola*	2.99			
Namaqua Dove	*Oena capensis*	47.76			
Namaqua Sandgrouse	*Pterocles namaqua*	7.46			
Neddicky	*Cisticola fulvicapilla*	22.39			
Orange River Francolin	*Scleroptila levaillantoides*	14.93			
Orange River White-eye	*Zosterops pallidus*	13.43			
Pale-winged Starling	*Onychognathus nabouroup*	53.73			
Pearl-spotted Owlet	*Glaucidium perlatum*	4.48			
Pied Crow	*Corvus albus*	58.21			
Pied Starling	*Spreo bicolor*	2.99			
Pink-billed Lark	*Spizocorys conirostris*	1.49			

Species	Taxonomic name	Reporting rate	Global Status (IUCN)	Regional Status (Martin *et al.* 2015)	Priority species
Plain-backed Pipit	*Anthus leucophrys*	4.48			
Pririt Batis	*Batis pririt*	47.76			
Purple Heron	*Ardea purpurea*	1.49			
Pygmy Falcon	*Polihierax semitorquatus*	1.49			
Red-backed Shrike	*Lanius collurio*	5.97			
Red-billed Firefinch	*Lagonosticta senegala*	7.46			
Red-billed Quelea	*Quelea quelea*	29.85			
Red-billed Teal	*Anas erythrorhyncha*	1.49			
Red-breasted Swallow	*Hirundo semirufa*	1.49			
Red-capped Lark	*Calandrella cinerea*	2.99			
Red-crested Korhaan	*Lophotis ruficrista*	5.97			
Red-eyed Dove	*Streptopelia semitorquata*	29.85			
Red-faced Mousebird	*Urocolius indicus*	61.19			
Red-headed Finch	*Amadina erythrocephala*	23.88			
Red-knobbed Coot	*Fulica cristata*	4.48			
Red-winged Starling	*Onychognathus morio*	0			
Reed Cormorant	*Phalacrocorax africanus*	1.49			
Rock Dove	*Columba livia*	11.94			
Rock Kestrel	*Falco rupicolus*	16.42			
Rock Martin	*Hirundo fuligula*	74.63			
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	7.46			
Rufous-eared Warbler	*Malcorus pectoralis*	2.99			
Sabota Lark	*Calendulauda sabota*	13.43			
Scaly-feathered Finch	*Sporopipes squamifrons*	56.72			
Shaft-tailed Whydah	*Vidua regia*	16.42			
Short-toed Rock-Thrush	*Monticola brevipes*	23.88			
Sociable Weaver	*Philetairus socius*	14.93			
South African Shelduck	*Tadorna cana*	1.49			
Southern Grey-headed Sparrow	*Passer diffusus*	25.37			
Southern Masked-Weaver	*Ploceus velatus*	85.07			
Southern Red Bishop	*Euplectes orix*	8.96			
Southern Yellow-billed Hornbill	*Tockus leucomelas*	4.48			
Speckled Mousebird	*Colius striatus*	1.49			
Speckled Pigeon	*Columba guinea*	50.75			
Spike-heeled Lark	*Chersomanes albofasciata*	5.97			
Spotted Flycatcher	*Muscicapa striata*	11.94			
Spotted Thick-knee	*Burhinus capensis*	10.45			
Swallow-tailed Bee-eater	*Merops hirundineus*	29.85			

Species	Taxonomic name	Reporting rate	Global Status (IUCN)	Regional Status (Martin *et al.* 2015)	Priority species
Three-banded Plover	*Charadrius tricollaris*	2.99			
Tinkling Cisticola	*Cisticola rufilatus*	4.48			
Violet-eared Waxbill	*Granatina granatina*	38.81			
Wattled Starling	*Creatophora cinerea*	1.49			
White-backed Mousebird	*Colius colius*	71.64			
White-browed Scrub-Robin	*Cercotrichas leucophrys*	0			
White-browed Sparrow-Weaver	*Plocepasser mahali*	34.33			
White-fronted Bee-eater	*Merops bullockoides*	5.97			
White-rumped Swift	*Apus caffer*	25.37			
White-throated Canary	*Crithagra albogularis*	1.49			
White-throated Swallow	*Hirundo albigularis*	1.49			
Willow Warbler	*Phylloscopus trochilus*	2.99			
Yellow Canary	*Crithagra flaviventris*	64.18			
Yellow-bellied Eremomela	*Eremomela icteropygialis*	22.39			
Yellow-billed Duck	*Anas undulata*	7.46			
Zitting Cisticola	*Cisticola juncidis*	2.99			

APPENDIX 2: PRE-CONSTRUCTION MONITORING METHODOLOGY

1. Objectives

The objective of the pre-construction monitoring at the proposed Kuruman Phase 1 Wind Project was to gather baseline data over a period of at least four seasons on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the WEF development area and a suitable control site to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the wind farm sites to measure the potential collision risk with the turbines.

2. Methods

The monitoring protocol for the site was designed according to the latest version (2015) 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 surveys were conducted at the proposed WEF development area and a control site by four field monitors during the following periods:

- 22 – 26 September 2015
- 14 – 17 April 2016
- 11 – 15 September 2016
- 14 – 18 January 2017

Monitoring was conducted in the following manner:

- One drive transect was identified totalling 24.5km on the turbine site and one drive transect in the control site with a total length of 11.4km.
- Two observers travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the 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, four walk transects of 1km each were identified at the turbine site, and two at the control site, 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 (calm; moderate; strong);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
    - Co-ordinates (priority species only).

- Four vantage points (VPs) were identified from which the majority of the proposed turbine area could be observed (the "VP area"), to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m);
    - Flight mode (soar; flap; glide; kite; hover); and
    - Flight time (in 15 second-intervals).

The aim with 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 (November 2014) BLSA list of priority species for wind farms.

One potential focal point of bird activity, a small dam, was identified and was monitored. The power lines running through the study area were also inspected for raptor nests.

Figure 1 below indicates the WEF development area where monitoring is taking place.

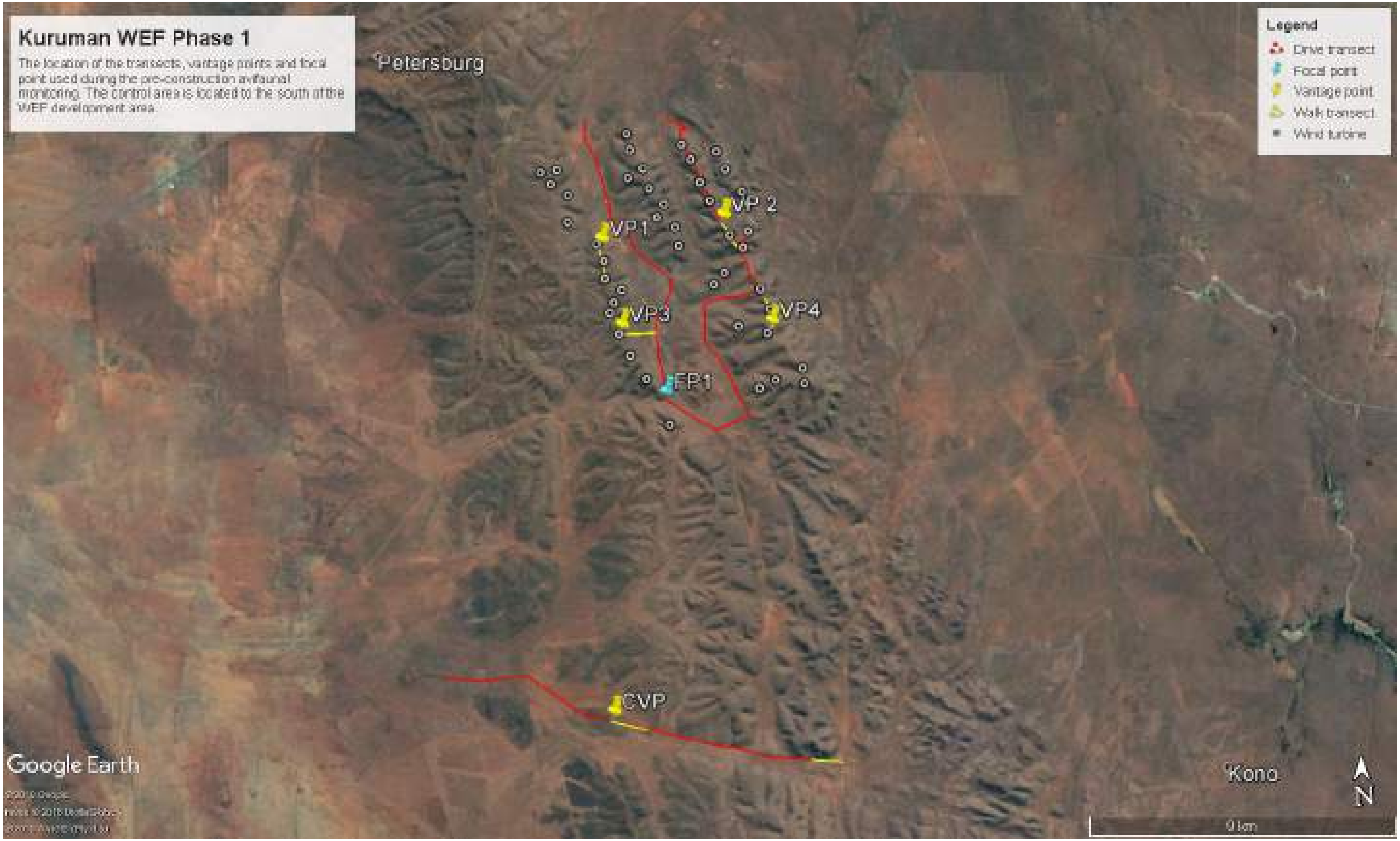


Figure 1: The area where monitoring was conducted for Kuruman WEF Phase 1.

APPENDIX 3: BIRD HABITAT

Figure 1: Open savanna habitat with scattered trees in the valleys between the ridges

Figure 2: An example of the habitat on the ridge tops, consisting of open shrub with a well-developed grass layer


Figure 3: A view of the steep slopes in the south-eastern part of the WEF development area


Figure 4: Another view of the steep slopes in the south-eastern part of the WEF development area

APPENDIX 4: STATISTICS

Kuruman WEF Phase 1, Vantage point surveys: Statistical analysis

This report is based on data captured in the Microsoft Excel file "*Kuruman 1 VP Sp_Au_Wi_Su_af 20180102 v1.xls*", containing records for each individual contact of priority species birds recorded at four vantage points set up at the Kuruman 1 wind farm. Observations were recorded in sampling units (SU) of time referred to as "watch periods", each of which was of three hours duration.

A group of birds flying or associating together is referred to as a "*contact"*, not counting the number of individuals in the group. The number of individual birds in a contact is referred to as the "*individuals*" count. When no birds were seen during a watch period, the species was identified by the label "*None*". Every species is categorised into a "*Contact Class".* In this survey two contact classes were recorded viz. "Soaring" and "Terrestrial".

There were *64 watch periods* of three hours each, spread over the four vantage points, equally allocated to each of the four seasons as set out in Table *1*. Environmental and other relevant information were also recorded (e.g. Temperature, Wind Direction, Wind Speed, categories of height at which the birds were observed, etc.).

Table *1*. The survey dates.

Start Date	End Date	Season	Watch Periods	Hours Observed
2015-09-22	2015-09-26	Spring '15	16	48
2016-03-13	2016-03-17	Autumn '16	16	48
2016-09-11	2016-09-15	Winter '16	16	48
2017-01-14	2017-01-17	Summer '16	16	48

Basic summary statistics concerning the data are presented in tables *A – G* in Section *A* of the Appendix at the end of this report. The matter of whether the data obtained are representative of the true occurrence of the priority species birds is investigated. The sample size (number of watch periods) is also considered to establish the validity of the estimates of the average number of birds observed.

Statistical terminology and other relevant statistical technical material are presented in Sections *B* - *D* of the Appendix.

1 Descriptive statistics

Several tables of descriptive statistics are presented. The watch periods were all of length three hours and counts, averages and variabilities are expressed per *3*-hour watch period.

The following statistics were computed and presented in Section *A* of the Appendix.

- A count of the total number of individual birds (by contact class and species) observed during the survey against the *Height* at which they were observed*.* These data are displayed as Table *A* in Section *A* of the *Appendix*.
- Table *B* shows the times that the soaring and terrestrial birds flew at medium height and at all heights. The times spent at medium height are expressed as a percentage of the total observed times at all heights. These percentages have to be interpreted with care and should always be seen together with the total flight time.

- Tables *C – G* provide summary statistics of the behaviour of the species observed w.r.t. their presence according to season and their occurrence profiles during various weather conditions such as temperature, wind direction and wind strength.
- Counts of the priority species, separately done for soaring and terrestrial birds, were collated from the raw data for each watch period by season and vantage point. These tables are used to construct the basic statistics and graphs for this report and are stored in a data folder for the Kuruman 1 data.

The computations were done using STATISTICA statistical software (Dell Inc., *2016*) and with routines developed for this purpose in "Statistica Visual Basic", the programming language of STATISTICA.

2 Estimation of the population mean

Average values (*Avge*) and standard deviations (*Std.Dev.*) from the available samples of the counts for soaring and terrestrial birds form the backbone of descriptive statistics for the true populations. These statistics alone provide an idea of the sizes and variabilities of the respective populations and are presented in Tables *3 – 4*. However, insight into the confidence that can be placed in these point estimates is only achieved by also presenting confidence intervals (with lower and upper limits, LCL and UCL) for the true mean count per watch period in each of the seasons and overall.

The computation of confidence intervals rests on certain assumptions to be met by the underlying distribution of counts. The counts distribution is investigated by starting with plotting the raw data counts for soaring and terrestrial contact counts per watch period in their time sequence (Figure *1*).

Figure *1*: Sequential time plot (by consecutive watch period number) of soaring and terrestrial contact counts.

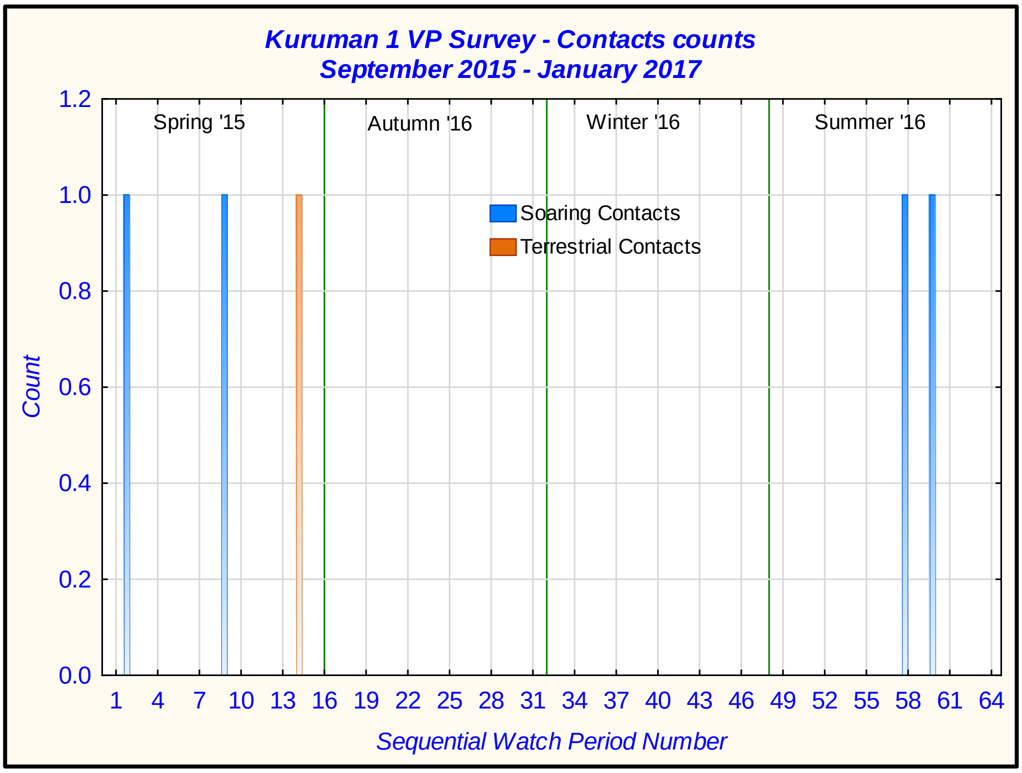
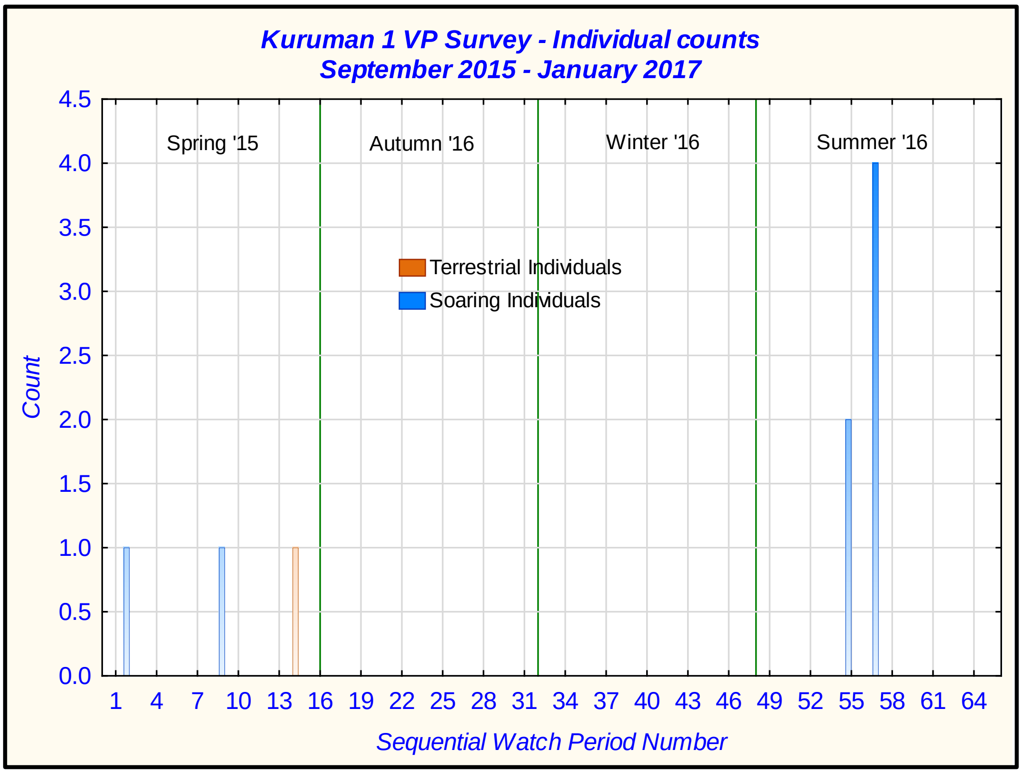


Figure 1, which plots both soaring and terrestrial contacts, shows that quite few priority species (and individuals) were encountered. The corresponding chart for individual counts, Figure 2, shows that the individual counts are equally low.

Figure 2: **Sequential time plot (by consecutive watch period number) of soaring and terrestrial individual counts.**



Denote the probability of seeing a priority species bird (soaring or terrestrial), during a 3h sampling unit by p. If p is constant by season, then the probability of encountering such a bird in the Spring (for example) is estimated as 3/16 = 0.1875. A 95% confidence interval for p, using binomial theory (Zar, 2010, p. 543) is (0.04 to 0.46). That means that at best there is less than a 50:50 chance of encountering a priority species bird in a 3h watch period in Spring.

The distribution of the counts (separately for soaring and terrestrial birds) is the supporting information required for estimating the average number of birds with selected confidence. For this purpose it is contacts (rather than individual counts) that will be considered to investigate the counts distribution since contacts are thought to be the random events that materialise in each SU and thus enables the estimation of the distribution.

One possibility is to assume it to be the normal distribution which is the default standard for such computations in statistical software packages for data in general, but not necessarily for counts. In general, for situations where *counts* are made per fixed SU (in this case a watch period of 3*h*) the Poisson distribution is often found to fit reasonably well. The Poisson process is a probability model in which events (e.g. the sighting of a contact of birds) occur randomly and uniformly in time or space. The assumptions supporting such a model are independence of the events, individuality of each event and the uniform arrival of events over the time period of the sampling unit. Details of this are discussed by Kalbfleisch, 1985, pp. *128 – 133*. There may be arguments against the validity of this family of distributions underlying bird counts but they are probably as close to reality as can be hoped for. One way to recognise the Poisson distribution is that its average value and variance are identical (see Kalbfleisch, *1985*, p. *172*). This property is not unique to the Poisson - other distributions may also possess it.

Even though the bird counts are very low for both contact classes we consider the distribution of *soaring* birds. There are 64 sampling units of 3h each and they are taken to be randomly distributed over the four seasons. A (single) contact of soarers were recorded in only 4 of these. In the 60 others none (zero contacts) were observed. The average number of soaring contacts is thus estimated as 4/64 = 0.0625 per SU. The variance of the 64 data counts for soaring contacts (computed from the raw data) is 0.0595 which closely approximates the mean value which points to the possibility of a Poisson distribution.

Table 2 assumes a Poisson distribution with mean value λ = 0.0625 and calculates the expected number of times that 0, 1, 2, … contacts are expected to occur if that distribution was the underlying distribution and compares it to the number of contacts that actual occurred.

Table 2. Probability for a Poisson distribution with λ = 0.0625 to have a count of X as well as the expected counts from observing 64 SUs.

X	0	1	2	3
Probability	0.9394	0.0587	0.0018	0.00004
Expected count (out of 64 SUs)	60.12	3.76	0.12	0.003
Observed count	60	4	0	0

Thus it is expected to find 60.12 counts of zero contacts from 64 SUs, etc. This shows that the Poisson provides a good fit to the data for contact counts of soarers. Accordingly the estimation of accuracy and precision will be based on the Poisson as underlying distribution.

3 Basic statistics and Precision

A sample estimate (such as the average count per SU) has to be *accurate* (close to its true value) as well as *precise* (small variability). For definition of precision, see section B in the Appendix). Sample size influences the estimation of both accuracy and precision – the larger the sample size, the better both accuracy and precision.

Basic statistics originating from the raw data are presented in Tables *3 – 4* and those enable estimates of precision. These computations are done for the *individuals* counts only as there is little difference between the number of contacts and the number of individuals in this survey. The mathematical details of computing the confidence intervals and precisions, based on the Poisson distribution, are presented in section *C* of the Appendix.

Table *3*. Soaring birds, Individual counts: basic statistics with *95%* confidence interval and precision for the number of contacts per *3*h watch period.

Season	Watch periods	Soaring birds: Individual counts						
		Count	Avge	Variance	Std.Dev.	95% LCL	95% UCL	Precision
Spring '15	16	2	0.13	0.12	0.34	0.02	0.45	0.22
Autumn '16	16	0	0.00	0.00	0.00	0.00	0.23	0.12
Winter '16	16	0	0.00	0.00	0.00	0.00	0.23	0.12
Summer '16	16	6	0.38	1.18	1.09	0.14	0.82	0.34
All Seasons	64	8	0.13	0.33	0.58	0.05	0.25	0.10

The data in Table *3* are to be interpreted typically as follows. The *95%* confidence interval for the average count in the Spring survey, for example, is (*0.02 – 0.45*). The precision for that season, which is a summary statistic for the quality of the estimate of the mean, is *0.22*. This means that the true mean per watch period is expected (with 95% certainty) to deviate by not more than a count of *0.22* birds from the sample estimate. The other entries and those in Table *4* are interpreted similarly.

Table *4*. Terrestrial birds, Individual counts: basic statistics with *95%* confidence interval and precision for the number of individuals per *3*h watch period.

Season	Watch periods	Terrestrial birds: Individual counts						
		Count	Avge	Variance	Std.Dev.	95% LCL	95% UCL	Precision
Spring '15	16	1	0.06	0.06	0.25	0.00	0.35	0.17
Autumn '16	16	0	0.00	0.00	0.00	0.00	0.23	0.12
Winter '16	16	0	0.00	0.00	0.00	0.00	0.23	0.12
Summer '16	16	0	0.00	0.00	0.00	0.00	0.23	0.12
All Seasons	64	1	0.02	0.02	0.13	0.00	0.09	0.04

The largest (poorest) precision for the estimate of the average count per watch period (for both soaring and terrestrial individual counts) that occurs in Tables *3* and *4* is $d = 0.34$ (Summer survey, soaring individual counts). Thus the estimated average for that data set may be approximated by 0.38 ± 0.34. This means, at worst over the entire survey, that the true mean per watch period is expected (with 95% certainty) to deviate by less than ½ a bird from the sample estimate.

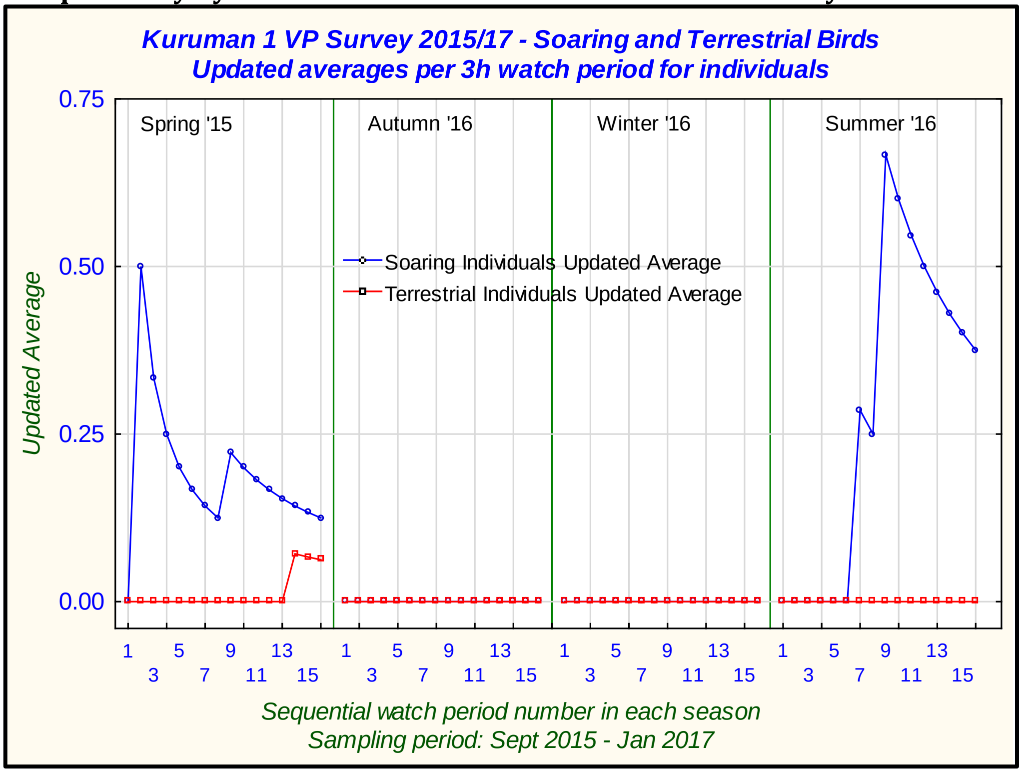
Thus, the estimates achieved in the survey over all seasons are believed to be of adequate precision.

4 Accuracy and Sample Size

Insight into the accuracy (i.e. closeness to the true value), as well as representativeness and stability of the counting process may be obtained by noting that as the counts data are gathered watch period by watch period an improved estimate of the average number of birds occurring in the area will be achieved for each added count. The more data are gathered the more accurate the estimate will become.

To investigate the behaviour of this process the average *individual* count per *3*h watch period is computed from all preceding data at the end of each consecutive 3h watch period. These *updated averages* are expected to vary to some extent in the initial stages of sampling but to stabilise as more data become available. The counts may vary substantially from season to season (as can be seen from Tables *3 – 4*). This means that the assumed Poisson distributions for the counts will have differing parameters (mean values) for each season, as is seen in the mentioned tables. The updated averages are thus computed *separately* for each season. These are plotted by season in Figure *3* (for soaring and terrestrial birds together).

Figure 3. **Updated averages for soaring and terrestrial individual counts sequentially by watch number over the seasons of the survey.**



The small number of individuals (both for soarers and terrestrials) has the effect that the updated averages stabilise quite well. This is an indication of good accuracy. It can also be concluded that the seasonal averages would not differ by much from those achieved by allocating more watch periods. Thus it is judged that the sample size of 16 watch periods per season is sufficiently large for the purpose.

5 Conclusion

The statistics exhibited in the tables and graphs show that there is only a small population of priority species birds present in the area. Also, the survey may be taken to be statistically representative of the soaring and terrestrial priority species birds that occur in the area. It is also concluded that more samples are not likely to yield a meaningful improvement in the accuracy and precision of estimating the average number of birds per watch period.

6 References

Brownlee, K.A., (1960), *Statistical Theory and Methodology in Science and Engineering.* John Wiley: New York.

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Kalbfleisch, J.G., (1985), *Probability and statistical inference, Vol. 1: Probability.* Springer Verlag: New York.

Zar, J.H., (2010), *Biostatistical Analysis* (5th ed.), Prentice-Hall, Inc., Upper Saddle River: NJ 07458.

APPENDIX

Additional Statistics

Table A. Number of individual priority species birds recorded during the survey by Contact Class, Species and Flying Height distribution.

Contact Class	Species	Flying Height			Row Totals
		Low	Medium	High	
Soaring	Jackal Buzzard	1	0	0	1
	Lesser Kestrel	0	6	0	6
	Verreaux's' Eagle	0	1	0	1
Soaring Total		1	7	0	8
Terrestrial	Grey-winged Francolin	1	0	0	1
Terrestrial Total		1	0	0	1
Column Total		2	7	0	9

Table B. Number of individual priority species birds recorded during the survey by Contact Class, Species, the number (N) that flew at medium / all heights and Individuals Contact Duration (minutes) at medium / all heights. The time at medium height is expressed as a percentage of the time at all heights.

Contact Class	Species	Medium Height (N)	Medium Heigh (Minutes)	All Height (N)	All Heights (Minutes)	% Time at Medium Ht
Soaring	Jackal Buzzard	0	0	1	1	0%
	Lesser Kestrel	6	18	6	18	100%
	Verreaux's' Eagle	1	4	1	4	100%
Soaring Total		7	22	8	23	96%
Terrestrial	Grey-winged Francolin	0	0	1	0.75	0%
Terrestrial Total		0	0	1	0.75	0%
Overall Total		7	22	9	23.75	93%

Table C: Number of individual priority species birds recorded by Contact Class, Species and Season.

Contact Class	Species	Season				Row Totals
		Spring '15	Autumn '16	Winter '16	Summer '16	
Soaring	Jackal Buzzard	1	0	0	0	1
	Lesser Kestrel	0	0	0	6	6
	Verreaux's' Eagle	1	0	0	0	1
Soaring Total		2	0	0	6	8
Terrestrial	Grey-winged Francolin	1	0	0	0	1
Terrestrial Total		1	0	0	0	1
Column Total		3	0	0	6	9

Table D: Number of individual priority species birds recorded by Contact Class, Species and Temperature.

Contact Class	Species	Temperature Cold	Temperature Mild	Temperature Hot	Row Totals
Soaring	Jackal Buzzard	0	1	0	1
	Lesser Kestrel	4	2	0	6
	Verreaux's' Eagle	0	1	0	1
Soaring Total		4	4	0	8
Terrestrial	Grey-winged Francolin	0	0	1	1
Terrestrial Total		0	0	1	1
Column Total		4	4	1	9

Table E: Number of individual priority species birds, by Contact Class, Species and Weather Condition.

Contact Class	Species	Cloudy	Partly Cloudy	Sunny	Row Totals
Soaring	Jackal Buzzard	0	0	1	1
	Lesser Kestrel	0	4	2	6
	Verreaux's' Eagle	0	0	1	1
Soaring Total		0	4	4	8
Terrestrial	Grey-winged Francolin	0	1	0	1
Terrestrial Total		0	1	0	1
Column Total		0	5	4	9

Table F: Number of individual priority species birds recorded by Species and Wind Direction.

Contact Class	Species	Wind Direction									Row Totals
		None	N	NE	E	SE	S	SW	W	NW	
Soaring	Jackal Buzzard	0	1	0	0	0	0	0	0	0	1
	Lesser Kestrel	0	0	0	6	0	0	0	0	0	6
	Verreaux's' Eagle	0	1	0	0	0	0	0	0	0	1
Soaring Total		0	2	0	6	0	0	0	0	0	8
	Grey-winged Francolin	0	0	0	0	0	0	0	0	1	1
Terrestrial Total		0	0	0	0	0	0	0	0	1	1
Column Total		0	2	0	6	0	0	0	0	1	9

Table G: Number of individual priority species birds recorded by Contact Class, Species and wind strength (Beaufort scale)

Contact Class	Species	Beaufort Scale				Row Totals
		Light Air	Light Breeze	Fresh Breeze	Strong Breeze	
Soaring	Jackal Buzzard	0	0	0	1	1
	Lesser Kestrel	2	0	4	0	6
	Verreaux's' Eagle	0	1	0	0	1
Soaring Total		2	1	4	1	8
	Grey-winged Francolin	0	0	1	0	1
Terrestrial Total		0	0	1	0	1
Column Total		2	1	5	1	9

Definition of terms

These notes explain some of the terminology used in the report.

Average: The *average value* (also referred to as the *mean value*) is a measure of the location of the centre of gravity of a data distribution.

Variability: The *variance* is a measure of the variability of the observed data (e.g. counts per *3*h) around the mean value of the data. Its square root, the *standard deviation*, does the same but is scaled to the same units as those of the observed data.

Confidence Interval: A *confidence interval* for the true mean of a population (e.g. the true mean of the number of terrestrial birds occurring in an area) is an interval, computed from a random sample, that reflects the uncertainty of the estimate based on a single sample. If it were possible to take the infinite number of all possible samples of size *N* per season (in the present case of sampling) and a *95%* confidence interval for the mean is computed in each case, then *0.95*N* of those intervals will contain the true mean value. The larger the sample size, the narrower the confidence interval. On the other hand, the larger the standard deviation of a distribution, the wider the confidence interval for the mean. The lower limit of the confidence interval is denoted by LCL and the upper limit by UCL.

Accuracy and Precision: A sample *estimate* of a parameter that describes a population (e.g. its true mean) depends on the sample size and is desired to be close to the true value of the parameter. The closeness of such an estimate to the true value is known as its *accuracy*. The precision of an estimate relates to the variability of the measurements. The closer together the data, the more precise the estimate. Half the width of the confidence interval for the parameter is defined as the *precision* (denoted by *d*) of its estimate. This means that the estimated confidence interval for the true mean can be stated to be $\overline{X} \pm d$, where $\overline{X}$ is the sample mean. The larger the sample size the better (smaller) the precision.

Distribution of counts: It is recognised that counts of events (randomly distributed over space or time) that took place, for example, in a fixed time period (e.g. the count of birds in a watch period of fixed length) may have a *Poisson distribution* when the events occur randomly over time. The mean value and variance (the squared standard deviation) of a Poisson distribution are identical. This means that large mean values (of counts per SU) imply poorer precision.

Poisson distribution – confidence interval

If the count of birds per sampling unit (SU) [i.e. a watch period] is assumed to have a Poisson distribution with an (unknown) average value of λ and if *N* SUs were sampled (for example 2h watch periods are sampled *N = 30* times) the sum of the *N* counts also has a Poisson distribution (with true average λN), see Brownlee, *1960*, p. *141*.

The Poisson probability (which is characterised uniquely by its average parameter (in this case λN) for finding a count of X = x birds from the *N* SUs is given by: $P(X = x) = e^{-\lambda N}(\lambda N)^x \,/\, x!$, for values of $x = 0, 1, 2, \ldots$.

A ($1 - \beta$) confidence interval for the mean value, λN, of this Poisson is determined by a lower limit $L_1 = \frac{1}{2}\chi^2_{\beta/2}(2X)$ and an upper limit $L_2 = \frac{1}{2}\chi^2_{1-\beta/2}(2X+2)$, see Zar (2010), pp. 587 – 589. Here $\chi^2_\alpha(\nu)$ is the α-point of the chi-squared distribution with ν degrees of freedom, i.e. the χ^2 - value with cumulative probability of α up to that value. *X* denotes the count of the number of birds over *N* SUs.

This means that the coverage probability for λN, based on a count of X birds per N SUs is $P(L_1 \le \lambda N \le L_2) = 1 - \beta$. Thus a $1 - \beta$ confidence interval for λ (the expected average value per SU) is given by the interval $(L_1 / N; \quad L_2 / N)$.

These formulas were used to determine the confidence intervals in the Tables in Section *3* of the report.

Poisson distribution – Sample Size

Consider the question of how many watch periods (i.e. sampling units, N) must be sampled in order to obtain an estimate of the true count per SU with *precision* of "*d*" units with prescribed probability, e.g. 95%. Thus, what must N be so that the true mean count per SU lies in an interval of half-width d with certainty of $1 - \beta$?

As was indicated in the previous section, this interval is $(L_1 / N; \quad L_2 / N)$ and thus the precision is $d = \frac{1}{2}(L_2 - L_1) / N$. The true average is estimated from the observed total count, X, and is given by $\hat{\lambda} = X / N$. This estimate is NOT in the centre of the confidence interval, but even so, we shall take half of the width of the confidence interval and call it the *$1 - \beta$ precision*. A sample size that will be sufficiently large to provide an estimate of the true mean count per SU with an acceptable value for its precision (say $d = d_0$) must thus satisfy the inequality: $\frac{1}{2}(L_2 - L_1) / N \le d_0$ or, solving for N:

(1) $$N \ge \tfrac{1}{2}(L_2 - L_1) / d_0 = \left(\chi^2_{1-\beta/2}(2X + 2) - \chi^2_{\beta/2}(2X) \right) / 4d_0 .$$

From a practical point of view, if it is expected that the average value per SU is μ, then (with N SU's taken) an estimate for the count that is expected to be seen is $X \approx N\mu$. From equation (1) it then follows that the estimated number of SU's to be taken should satisfy the equation

(2) $$4d_0N - \left(\chi^2_{1-\beta/2}(2N\mu + 2) - \chi^2_{\beta/2}(2N\mu) \right) \ge 0.$$

This means that if some knowledge of the average number of birds per SU for a given site is available, and this has to be estimated with prescribed precision from a sample of SU's, then that sample size is the smallest value of N satisfying (2).

Bat Specialist EIA Assessment:

for the Proposed Development of the Phase 1 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: EIA REPORT

Report prepared for:

CSIR – Environmental Management Services

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20 July 2018

Report ref: R-1807-17

SPECIALIST EXPERTISE

Summary of qualifications

2008 *University of Johannesburg*
MSc (Biodiversity and Conservation) – Cum laude

2006 *University of Johannesburg*
Hons (Biodiversity and Conservation)

2005 *University of Johannesburg*
BSc (Zoology and Botany)

-

Affiliations to professional bodies and societies

- Pr.Sci.Nat.– SACNASP (Zoological Science; registration number 400169/10)
- Resigned steering committee panel member of the SABAA (South African Bat Assessment Association).
- Served on the research committee of the Gauteng and Northern Regions Bat Interest Group (GNoRBIG).
- Served on the steering committee of the Zoological Society of the University of Johannesburg.

Experience

i. 2008 – Current Founder of Animalia Consultants (Pty) Ltd (previously a Close Corporation). Animalia has completed more than **440 specialist reports and numerous large-scale projects** under the supervision and lead of Werner Marais.

i. 2008 University of Johannesburg

- Sensitivity and biodiversity surveys of five caves in the Cradle of Humankind World Heritage Site (COHWHS) and Pretoria areas.
- Preliminary survey to investigate the correlation between insectivorous bats and prey insects in the Krugersdorp Game Reserve.

i. 2007, 2008 Bertie van Zyl (Pty) Ltd.(ZZ2 Tomato Farms), University of Johannesburg

Two-year project to research the biological pest control method of utilizing insectivorous bats in agriculture. Required to conduct an in-depth study of bat (Microchiroptera) behavior and ecologically important factors.

v. 2006 University of Johannesburg

Six-month survey of cave dwelling arthropods in the Cradle of Humankind World

Heritage Site.

Additional:

Invited by the EWT (Endangered Wildlife Trust) and ESSA (Exploration Society of Southern Africa) to deliver presentations on current ecological issues regarding bats and wind energy.

Co-author for the: "South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities – ed 1. South African Bat Assessment Association. Sept 2017"

Co-author for the: "South African Good Practice Guidelines for Operational Monitoring of Bats at Wind Energy Facilities. First Edition July 2014"

Contributing editor for the: "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments – Pre-construction; Edition 4.1, 2017"

As a co-author, received the Dow Greeff price for best annual scientific publication: "Die karst-ekologie van die Bakwenagrot (Gauteng)" published in the Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie, Vol. 31(1), 2012.

Presented the following papers at conferences:

- ***The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas. The Zoological Society of Southern Africa's 50th Anniversary Conference. July 2009.***

- ***Inseketende vlermuise (Microchiroptera) en vlermuishuise in landbougebiede. Suid Afrikaanse Akademie vir Wetenskap en Kuns se 100 jaar Eufees kongres. October 2009.***

Interviewed for two popular magazine articles on ecological aspects of biological pest control utilising bats; published in two consecutive issues of Farmers Weekly.

SPECIALIST DECLARATION

I, ..Werner Marais........................, 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 Specialist: ____Werner Marais________________________________

Date: __________20 July 2018______________________________________

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
WEF	Wind Energy Facility
SM	Short Mast
Met Mast	Meteorological mast

TABLE OF CONTENTS

Bat Specialist EIA Assessment

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

This report comprises the Bat Impact Assessment for the Kuruman Phase 1 Wind Energy Facility EIA. It considers the, 12 months of passive bat data gathered by the long-term preconstruction assessment. The Bat Impact Assessment for the EIA Report serves to inform the project of the expected impacts, mitigation measures and a reasoned opinion as to whether the proposed activity, or portions of the activity should be authorised.

1.1.2. Terms of Reference

- A description of the baseline characteristics and conditions of the receiving environment (e.g. site and/or surrounding land uses including urban and agricultural areas).
- Compilation of a bat sensitivity map.
- Presentation of field data gathered and analysed during the 12-month preconstruction study.
- Consider and evaluate the cumulative impacts in terms of the current and proposed activities in the area.
- Recommendations to avoid negative impacts, as well as feasible and practical mitigation, management and/or monitoring options to reduce negative impacts that can be included in the Environmental Management Programme.
- A reasoned opinion as to whether the proposed activity, or portions of the activity should be authorised.

1.1.3. Approach and Methodology

The study originally started in January 2016, when the two Short Mast systems was set up and a passive bat detector was installed on Met Mast K1. The study was then put on hold until September 2016 by the proponent, and it was put on hold again in December 2016. These months gathered some limited passive bat activity data, but the systems encountered many problems, and some recording parameters were different from current practices. Therefore, the data set from the 4th visit in May 2017 will be included in this assessment. The study resumed in May 2017 with a site visit where all the passive systems were overhauled and repaired (referred to as the 4th site visit) and will continue until May 2018 in order to have gathered a 12-month data set.

Three factors need to be present for most South African bats to be prevalent in an area: availability of roosting space, food (insects/arthropods or fruit), and accessible open water sources. However, the dependence of a bat on each of these factors depends on the species, its behaviour and ecology. Nevertheless, bat activity, abundance and diversity are likely to be higher in areas supporting all three above mentioned factors.

Therefore, the site is evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water) to identify bat species that may be impacted by wind turbines. These comparisons are done chiefly by briefly studying the geographic literature of the site, available satellite imagery and by groundtruthing with site visits. Species probability of occurrence based on the above-mentioned factors are estimated for the site and the surrounding larger area, but also considers species already confirmed on site as well as surrounding areas.

Bat activity is monitored using active and passive bat monitoring techniques. Active monitoring is carried out on site visits by the means of driven transects. A bat detector mounted on a vehicle is used and transect routes are chosen based on road accessibility. Sampling effort and prevalent weather conditions are considered for each transect.

Passive detection is continuing by means of passive bat monitoring systems on the meteorological masts and short masts on site (**Figures 1.1-1 and 1.1-2**). The data of the passive systems from both Kuruman Phases 1 and 2 will be considered in the EIA study report of each phase, as they are located in terrain and habitat applicable to both phases and will provide insight into the terrain of both.

During each site visit the passive data of the bat activity are downloaded from the monitoring systems. The data is analysed by classifying (as near to species level as possible) and counting positive bat passes detected by the systems. A bat pass is defined as a sequence of ≥1 echolocation calls where the duration of each pulse is ≥2ms (one echolocation call can consist of numerous pulses). A new bat pass is identified by a >500ms period between pulses. These bat passes are summed into hourly intervals which are used to calculate nocturnal distribution patterns over time. Times of sunset and sunrise are automatically adjusted with the time of year. The **Table 1.1 - 1** below summarizes the equipment setup.

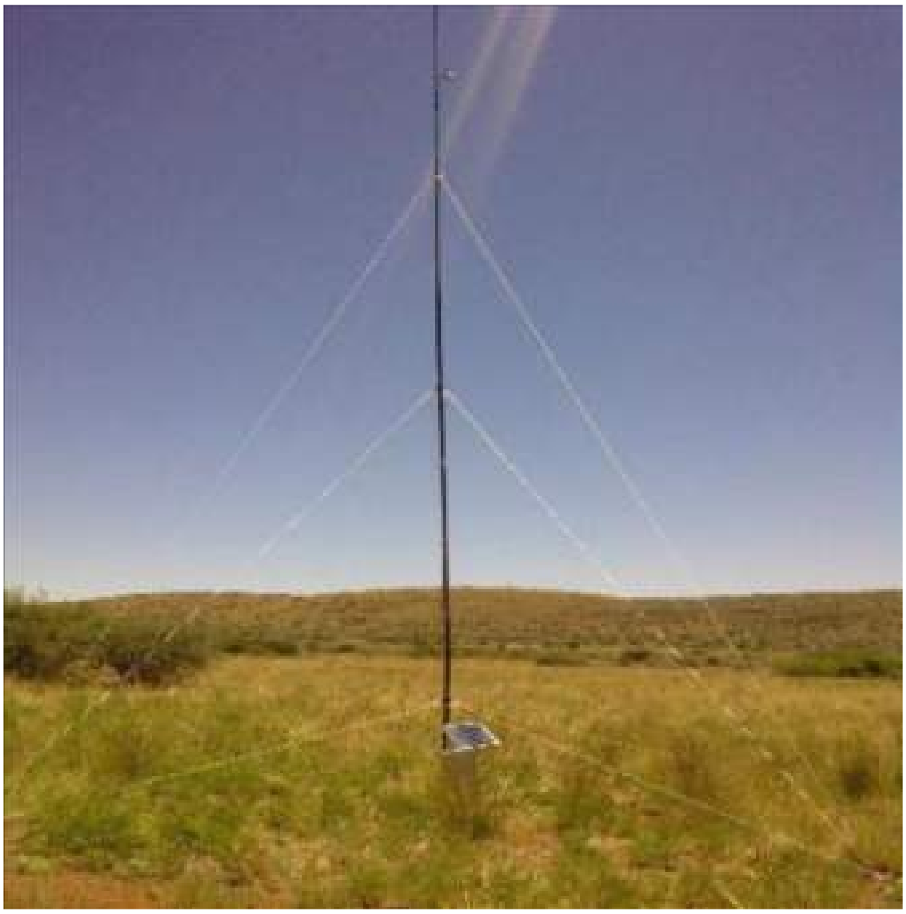

Figure 1.1-1: Short mast monitoring system set up.

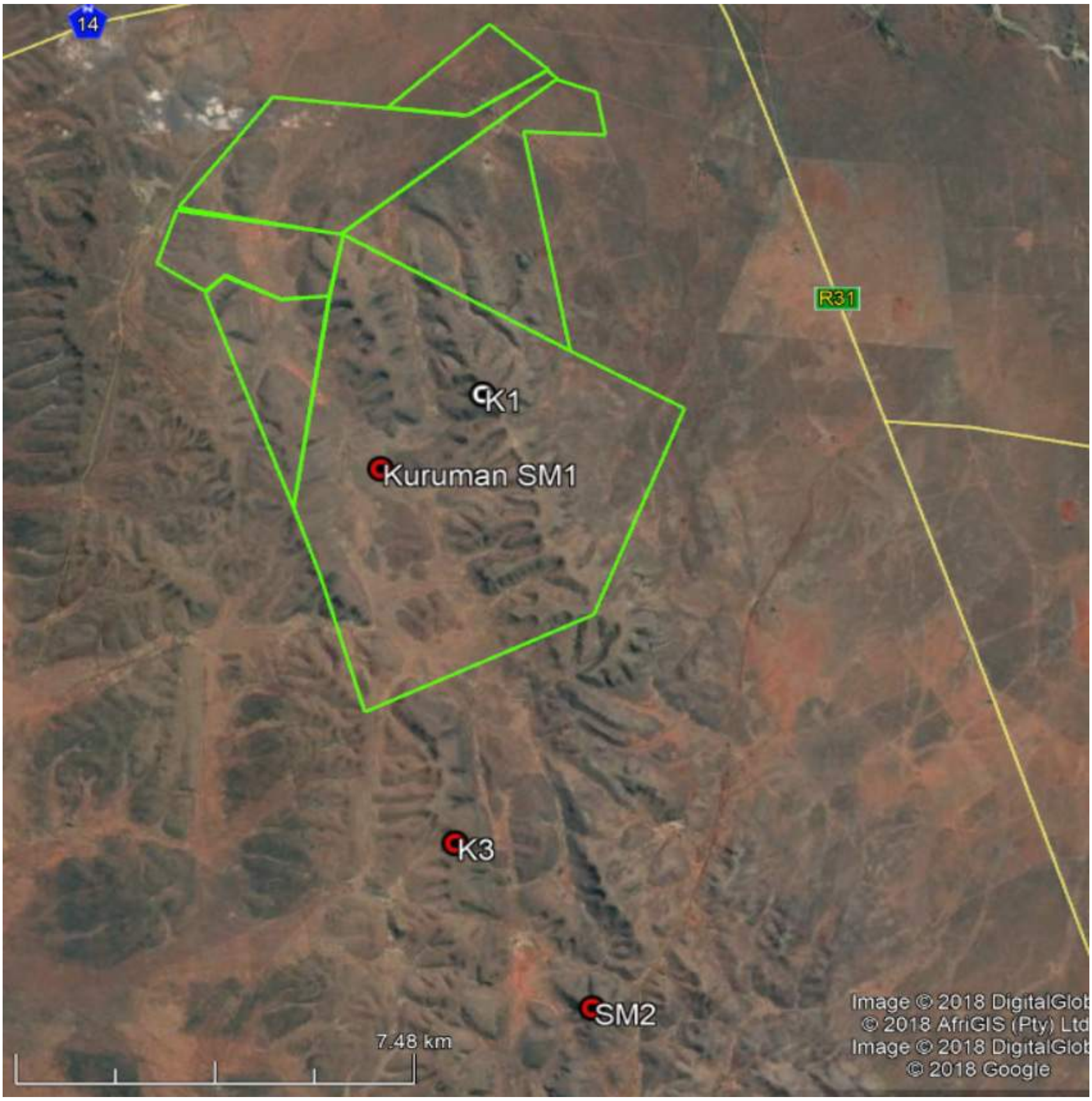

Figure 1.1-2: Locations of the passive systems on site.

Table 1.1-1: Equipment setup and site visit information.

<table>
<tr><td colspan="2" rowspan="8">Site visit dates</td><td>First Visit</td><td>22 – 26 January 2016 (Installation of bat monitoring systems)</td></tr>
<tr><td>Second Visit</td><td>12 – 16 September 2016</td></tr>
<tr><td>Third Visit</td><td>11 – 14 December 2016</td></tr>
<tr><td>Fourth Visit</td><td>15 – 19 May 2017</td></tr>
<tr><td>Fifth Visit</td><td>1 – 4 August 2017</td></tr>
<tr><td>Sixth Visit</td><td>27 – 30 October 2017</td></tr>
<tr><td>Seventh Visit</td><td>22 – 25 January 2018</td></tr>
<tr><td>Eight Visit</td><td>14 - 16 May 2018</td></tr>
<tr><td rowspan="3">Met mast passive bat detection systems</td><td>Amount on site</td><td colspan="2">2
(Met K3 was only ready for the passive bat detector by approximately May 2017, therefore no data exist for K3 prior to May 2017).</td></tr>
<tr><td>Microphone heights</td><td colspan="2">10m; 60m (K1)
10m; 80m (K3)</td></tr>
<tr><td>Coordinates</td><td colspan="2">Met K1: 27° 33.177'S; 23° 24.100'E
Met K3: 27° 37.922'S; 23° 23.782'E</td></tr>
<tr><td rowspan="3">Short mast passive bat detection systems</td><td>Amount on site</td><td colspan="2">2</td></tr>
<tr><td>Microphone height</td><td colspan="2">10m</td></tr>
<tr><td>Coordinates</td><td colspan="2">SM1: 27° 33.957'S; 23° 22.913'E
SM2: 27° 39.668'S; 23° 25.307'E</td></tr>
<tr><td colspan="4">Replacements/ Repairs/ Comments</td></tr>
<tr><td colspan="2">First Site Visit</td><td colspan="2">The microphones were mounted such that they pointed approximately 30 degrees downward to avoid excessive water damage. Measures were taken for protection against birds, without compromising effectiveness significantly. Crows have been found to peck at microphones and damage them.
The bat detectors were mounted inside weather-proof boxes together with all peripherals, to provide protection against the elements.</td></tr>
<tr><td colspan="2">Second Site Visit</td><td colspan="2">All detectors were operational even after they have been unattended for nearly a year, although microphone quality degraded. The Met Mast K3 has not been constructed yet.</td></tr>
</table>

Third Site Visit	The Met Mast K1 shows indication that the microphones require replacing due to a lack of data on the memory cards. SM1 mast has broken in half and the microphone was on ground level. The Met Mast K3 has not been constructed yet.
Fourth Visit	All the passive systems were overhauled and repaired, which included battery and microphone replacements. Met Mast K3 was constructed and the microphones were installed at 10m and 80m on this mast.
Fifth Visit	Short masts were serviced, and guy ropes tightened. All systems had good quality data on their SD cards.
Sixth Visit	Short masts were serviced, and guy ropes tightened. All systems had good quality data on their SD cards.
Seventh Visit	Short masts were serviced, and guy ropes tightened. All systems had good quality data on their SD cards.
Eight Visit	The SD cards in the system on SM2 (Short Mast 2) were corrupt and the data could not be retrieved.
Type of passive bat detector	SM2BAT+, Real Time Expansion (RTE) type. SM3BAT, Real Time Expansion (RTE) type.
Recording schedule	Each detector was set to operate in continuous trigger mode from dusk each evening until dawn (times were automatically adjusted with latitude, longitude and season).
Trigger threshold	>16KHz, 18dB
Trigger window (time of recording after trigger ceased)	500 ms
Microphone gain setting	12dB (SM2BAT+)
Compression	WAC0
Single memory card size (each system uses 4 cards)	32GB
Battery size	17Ah; 12V
Solar panel output	20 Watts
Solar charge regulator	6 - 8 Amp with low voltage/deep discharge protection

Other methods	Terrain was investigated during the day for general characteristics.

1.1.4. Assumptions and Limitations

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large-scale effect on migratory species. This limitation however should be partly overcome with the long-term sensitivity assessment.
- The sensitivity map is based partially on satellite imagery, and there is always the possibility that what has been mapped may differ slightly to what is on the ground.
- Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence with no harmful effects on bats being surveyed.
- Automated species identification by the Kaleidoscope software may produce a smaller portion of incorrect identifications or unknown identifications. In last mentioned case the dominant frequency of the unknown call was simply used to group the bat into a family or genus group, using dominant frequency only as the determining factor. However, the automated software is very effective at distinguishing bat calls from ultrasonic noise, therefore the number of bat passes will not significantly be overestimated.
- It is not possible to determine actual individual bat numbers from acoustic bat activity data, whether gathered with transects or the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.
- Spatial distribution of bats over the study area cannot be accurately determined by means of transects, although the passive systems can provide comparative data for different areas of the site. Transects may still possibly, in rare cases, uncover high activity in areas where it is not necessarily expected and thereby increase insight into the site.
- Exact foraging distances from bat roosts or exact commuting pathways cannot be determined by the current methodology. Radio telemetry tracking of tagged bats is required to provide such information, if needed.

1.2. APPLICABLE LEGISLATION AND GUIDELINES

Legislation dealing with biodiversity applies to bats and includes the following:

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97)

The act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive additional attention to those listed as Threatened or Protected.

Applicable guidelines that informs the methodology and mortality threshold numbers are:
Sowler, S., Stoffberg, S., MacEwan, K., Aronson, J., Ramalho, R., Forssman, K., Lötter, C. 2017. **South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: Edition 4.1**. South African Bat Assessment Association.

MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. September 2017. **South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities – ed 1**. South African Bat Assessment Association.

NORTHERN CAPE NATURE CONSERVATION ACT, No. 9 of 2009.

1.3. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE BAT EIA SPECIALIST ASSESSMENT

Although most bats are highly capable of advanced navigation through the use of echolocation and excellent sight, they are still at high risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines and, in a case study conducted by Johnson et al. (2003), were found to be directly related to collisions. Despite the high incidence of deaths caused by direct impact with the blades, many bat mortalities have been found to be caused by barotrauma (Baerwald et al. 2008). This is a condition where low air pressure found around the moving blades of wind turbines, causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz et al. 2007). Baerwald et al. (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma.

The presence of lights on wind turbines have also been identified as possible causes for increased bat fatalities for non-cave roosting species. This is thought to be due to increased insect densities that are attracted to the lights and subsequently encourage foraging activity of bats (Johnson et al. 2003).

South African operational monitoring studies currently point to South African bats being just as vulnerable to mortality from turbines as international studies have previously indicated. The main species of concern are *Neoromicia capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis*. These species roost in crevices and last-mentioned species in caves and other hollows. They will be foraging more actively in low-lying areas with less wind, as well as the slopes of hills that are well sheltered and rocky. Such as the 'amphitheater' topography found at some valley hill slopes on the site.

There's a marked decrease in bat activity with an increase of altitude on site (e.g. low-lying areas vs. hilltops), therefore larger turbines with a higher minimum rotor swept height will decrease the probability of bat mortalities due to moving blades.

1.4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.4.1. Description of the receiving environment

1.4.2. Land Use, Vegetation, Climate and Topography

The site is situated in two vegetation units: Kuruman Thornveld and Kuruman Mountain Bushveld. Kuruman Mountain Bushveld occupies the largest part of the site with the Kuruman Thornveld mostly appearing on the edges and in a valley (**Figure 1.4 – 1)**. Proposed turbine locations are all inside the Kuruman Mountain Bushveld. The site is located within the broader Kalahari Xeric Savanna ecoregion as classified by Olson et al. (2001).

The Kuruman Mountain Bushveld vegetation unit consists of rolling hills with generally gentle to moderate slopes and hill pediment areas with an open shrubveld with Lebeckia macrantha prominent in places. Grass layer is well developed. The Kuruman and Asbestos Hills consist of banded iron formation with jaspilite, chert and riebeckite-asbestos of the Asbestos Hills subgroup of the Griqualand West Supergroup. The area has summer and autumn rainfall with very dry winters. The incidence of frost is frequent in winter. MAP about 250-500mm. The unit corresponds in part to cluster 17 of the 27 in the physio-climatic classification of South Africa's woodland areas with summer rainfall. Conservation is least threatened with a target of 16%. None of the unit is conserved. Very little of the unit is conserved and erosion is very low to low. Some parts in the north are heavily utilised for grazing. (Mucina and Rutherford 2006).

The Kuruman Thornveld vegetation unit consists of flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting of Acacia erioloba. The geology of the area consists of Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments with red wind-blown sand. Locally rocky pavements are formed in places. The area has summer and autumn rainfall with very dry winters. MAP about 300-450mm. Temperatures in the area range from a maximum of 35.9° in January and a minimum of -3.3° in July. There is frequent frost in winter. Target 16%. None of the unit is conserved. Only 2% already transformed. Erosion is very low.

Vegetation units and geology are of great importance as these may serve as suitable sites for the roosting of bats and support of their foraging habits (Monadjem et al. 2010). Houses and buildings may also serve as suitable roosting spaces (Taylor 2000; Monadjem et al. 2010). The importance of the vegetation units and associated geomorphology serving as potential roosting and foraging sites have been described in **Table 1.4 - 1**.

The site is predominantly utilised as a game farm, and infrastructure as well as anthropogenic impacts are low. Natural habitats are dominating the site.

Table 1.4-1: Potential of vegetation to serve as suitable roosting and foraging spaces for bats.

Vegetation Unit	Roosting Potential	Foraging Potential	Comments
Kuruman Thornveld	Moderate - High	Moderate - High	The abundance of trees provides roosting and foraging of several insectivorous bat species.
Kuruman Mountain Bushveld	Moderate - High	Moderate	The landscape features provide roosting space for bat species inhabiting rock crevices and hollows. The grassland provides opportunities for open-air foraging bat species.

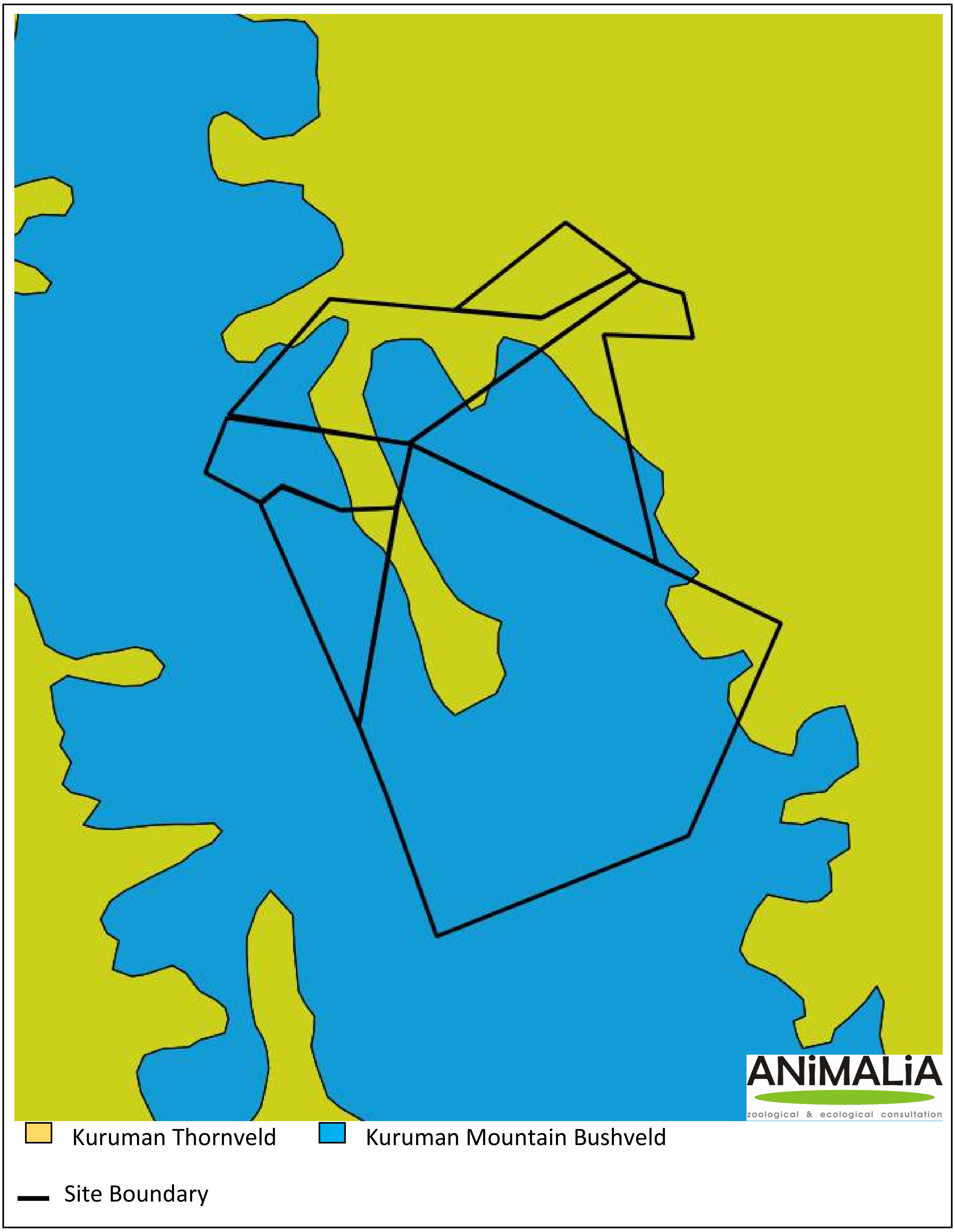

Figure 1.4-1: Vegetation units present on the site (Mucina and Rutherford 2006).

1.4.3. *Currently Confirmed, Previously Recorded as well as Literature Based Species Probability of Occurrence*

"Probability of Occurrence" is assigned based on consideration of the presence of roosting sites and foraging habitats on the site, compared to literature described preferences, species records from nearby and adjacent WEF's, and species currently confirmed on site. The probability of occurrence is also influenced by the likelihood of encountering the bat species on site (e.g. it's scarcity in general, or if the distribution is marginal to the site location).

The column of "Likely risk of impact" describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by Sowler et al. (2017) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

Table 1.4-2: Table of species that are currently confirmed on site, have been previously recorded in the area and have the highest likelihood of occurring based on literature. Roosting or foraging in the study area based, the possible site-specific roosts, and their probability of occurrence based on literature as well as recordings and observations in the surrounding area, is also briefly described (Monadjem et al. 2010; ACR, 2016).

Species	**Common name**	**Probability of occurrence (%)**	**Conservation status**	**Possible roosting habitat on site**	**Possible foraging habitat utilised on site**	**Likelihood of risk of fatality (Sowler, *et al.*, 2017)**
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern	Roosts in rock crevices, hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of natural and urbanised habitats.	High
Sauromys petrophilus	Robert's flat-headed bat	Confirmed on site	Least Concern	Roosts in rock crevices that may be found on site.	Open air forager that will fly over vast areas of flat terrain.	High
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site	Least Concern (2016 Regional Listing) Near Threatened (2004 National Listing) Protected (Northern Cape Conservation Act, 2009)	Cave and hollow dependent, closest cave approximately 5km from site. Will also roost in small groups or individually in culverts and other hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium - High
Neoromicia capensis	Cape serotine	Confirmed on site	Least Concern Protected (Northern Cape	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs.	Medium - High

			Conservation Act, 2009)		But is predominantly a medium height clutter edge forager.	
Eptesicus hottentotus	Long-tailed serotine	Confirmed on site	Least Concern Protected (Northern Cape Conservation Act, 2009)	It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Rock crevices in valleys on site.	It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally.	Medium
Rhinolophus denti	Dent's horseshoe bat	70-80	Near Threatened (2004 National Listing; 2016 Regional Listing) Protected (Northern Cape Conservation Act, 2009)	Roosts in caves and mine adits, closest cave approximately 5km from site. May utilise man made hollows.	Clutter forager, will be more prevalent in valleys and low-lying areas with thickets.	Low
Rhinolophus clivosus	Geoffroy's horseshoe bat	80-90	Least Concern (2016 Regional Listing) Near Threatened (2004 National Listing) Protected (Northern Cape Conservation Act, 2009)	Roosts in caves and mine adits, closest cave approximately 5km from site. May utilise man made hollows.	Clutter forager, will be more prevalent in valleys and low-lying areas with thickets.	Low
Rhinolophus damarensis	Darling's horseshoe bat	70-80	Least Concern (2016 Regional Listing)	Roosts in caves and old mines, closest cave approximately 5km from site.	Clutter forager, will be more prevalent in valleys and low-lying areas with thickets.	Low

			Near Threatened (2004 National Listing) Protected (Northern Cape Conservation Act, 2009)			
Nycteris thebaica	Egyptian slit-faced bat	50-60	Least Concern Protected (Northern Cape Conservation Act, 2009)	Roosts in hollows, aardvark burrows, culverts under roads and the trunks of dead trees.	It appears to occur throughout the savannah and Karoo biomes but avoids open grasslands. May possibly occur in the thickets of low-lying valleys and drainage areas.	Low

1.4.4. Ecology of bat species that may be impacted the most by the Kuruman WEF Phase 1

There are several bat species in the vicinity of the site that occur commonly in the area. Some of these species are of special importance based on their likelihood of being impacted by the proposed WEF, due to high abundances and certain behavioural traits. The relevant species are discussed below.

Tadarida aegyptiaca

The Egyptian Free-tailed Bat, *Tadarida aegyptiaca*, has a wide distribution and high abundance throughout South Africa and is part of the Free-tailed bat family (Molossidae). It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem et al. 2010). This species is protected by national legislation in South Africa (ACR 2010).

They roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem et al. 2010). Thus, man-made structures and large trees on the site would be important roosts for this species.
Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem et al. 2010).

The Egyptian Free-tailed bat is considered to have a High likelihood of risk of fatality due to wind turbines (Sowler et al. 2017). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species.

After a gestation of four months, a single young is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August. Maternity colonies are apparently established by females in November.

Neoromicia capensis

Neoromicia capensis is commonly called the Cape serotine and it is found in high numbers and is widespread over much of Sub-Saharan Africa. High mortality rates of this species due to wind turbines would be a cause of concern as *N. capensis* is abundant and widespread and as such has a more significant role to play within the local ecosystem than the rarer bat species. They do not undertake migrations and thus are considered residents of the site.

It roosts individually or in small groups of two to three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will use most man-made structures as day roosts which can be found throughout the site and surrounding areas (Monadjem et al. 2010).

They are tolerant of a wide range of environmental conditions as they survive and prosper within arid semi-desert areas to montane grasslands, forests, and savannas; indicating that they may occupy several habitat types across the site, and are amenable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but can occasionally forage in open spaces. They are thought to have a Medium-High likelihood of risk of fatality due to wind turbines (Sowler et al. 2017).

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occurs. They give birth to twins during late October and November but single pups, triplets and quadruplets have also been recorded (van der Merwe 1994 and Lynch 1989).

Miniopterus natalensis

Miniopterus natalensis, also commonly referred to as the Natal long-fingered bat, occurs widely across the country but mostly within the southern and eastern regions.

This bat is a cave-dependent species and identification of suitable roosting sites may be more important in determining its presence in an area than the presence of surrounding vegetation. It occurs in large numbers when roosting in caves with approximately 260 000 bats observed making seasonal use of the De Hoop Guano Cave in the Western Cape, South Africa. Culverts and mines have also been observed as roosting sites for either single bats or small colonies. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem et al. 2010).

Mating and fertilisation usually occur during March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem et al. 2010 & Van Der Merwe 1979).

The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines if a wind farm is placed within a migratory path (Sowler et al. 2016). The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route and such turbines are not effectively mitigated. Very little is known about the migratory behaviour and paths of *M. natalensis* in South Africa with migration distances exceeding 150 kilometers. If the site is located within a migratory path the bat detection systems may possibly detect high numbers and activity of the Natal long-fingered bat, this will be examined over the course of the 12-month monitoring survey.

A study by Vincent et al. (2011) on the activity and foraging habitats of Miniopteridae found that the individual home ranges of lactating females were significantly larger than that of pregnant females. It was also found that the bats predominately made use of urban areas (54%) followed by open areas (19.8%), woodlands (15.5%) orchards and parks (9.1%) and water bodies (1.5%) when selecting habitats. Foraging areas were also investigated with the majority again occurring in urban areas (46%), however a lot of foraging also occurred in woodland areas (22%), crop and vineyard areas (8%), pastures, meadows and scrubland (4%) and water bodies (4%). Sowler et al. (2017) advise that *M. natalensis* faces a medium to high risk of fatality due to wind turbines.

1.5. RESULTS OF THE FIELD STUDY

1.5.1. Passive data

Abundances and Composition of Bat Assemblages

Average hourly bat passes detected per night and total number of bat passes detected over the monitoring period by the systems are displayed in **Figures 1.5-1 to 1.5-8**. Five bat species were detected namely *Eptesicus hottentotus, Tadarida aegyptiaca, Sauromys petrophilus, Neoromicia capensis* and *Miniopterus natalensis.* Some less identifiable calls were grouped in their families: Miniopteridae is the family for cave bats from the genus *Miniopterus*, Vespertilionidae includes many species of which *N. capensis* is part of, Molossidae is the Free-tailed bat family of which *T. aegyptiaca* is part of, and Rhinolophidae is the horseshoe bat family whose members are clutter foragers.

Tadarida aegyptiaca were most commonly detected by all the monitoring systems on site, for all heights. Such abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers. Short Mast 1 had the highest bat activity levels, probably due to it being located in a low-lying area, different vegetation unit and inside a high sensitivity area.

Neoromicia capensis had the second highest occurrence rate, especially at 10m monitoring height. Activity levels and diversity at 10m were significantly higher than at 60m or 80m.

The monitoring systems detected the migratory species, *Miniopterus natalensis*. The temporal distribution of this species did not indicate evidence of migratory events, according to best current knowledge.

Activity and risk levels of bats are rated according to the table "Estimated turbine related bat fatality risk levels based on bat activity levels for different terrestrial ecoregions" as depicted in the "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: Edition 4.1" (Sowler et al., 2017). This rating is measured as an annual average bat passes per hour and is specific to each ecoregion, and the risk can be rated as low, medium, or high. The highest annual average bat passes/hour at 10m was for SM1 at 4.94, and at 60m was for K1 with 0.41. The Kalahari Xeric Savanna ecoregion, to which the site belongs, does not have any risk ratings in above mentioned table of the Guidelines. This is likely due to a lack of substantive supportive data that's required for the risk rating calculations. Therefore, the maximum annual average bat passes per hour of 0.41 for K1 at 60m cannot be meaningfully interpreted at this stage.

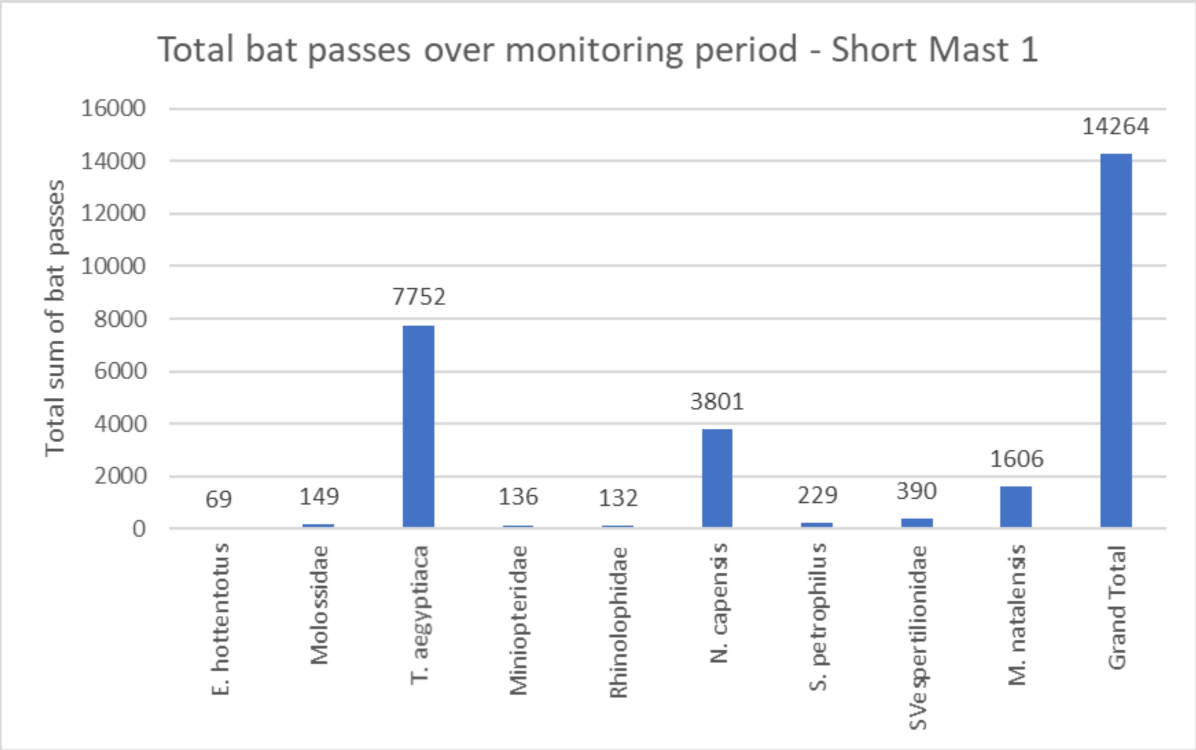

Figure 1.5-1: Total bat passes recorded over the monitoring period by SM1.

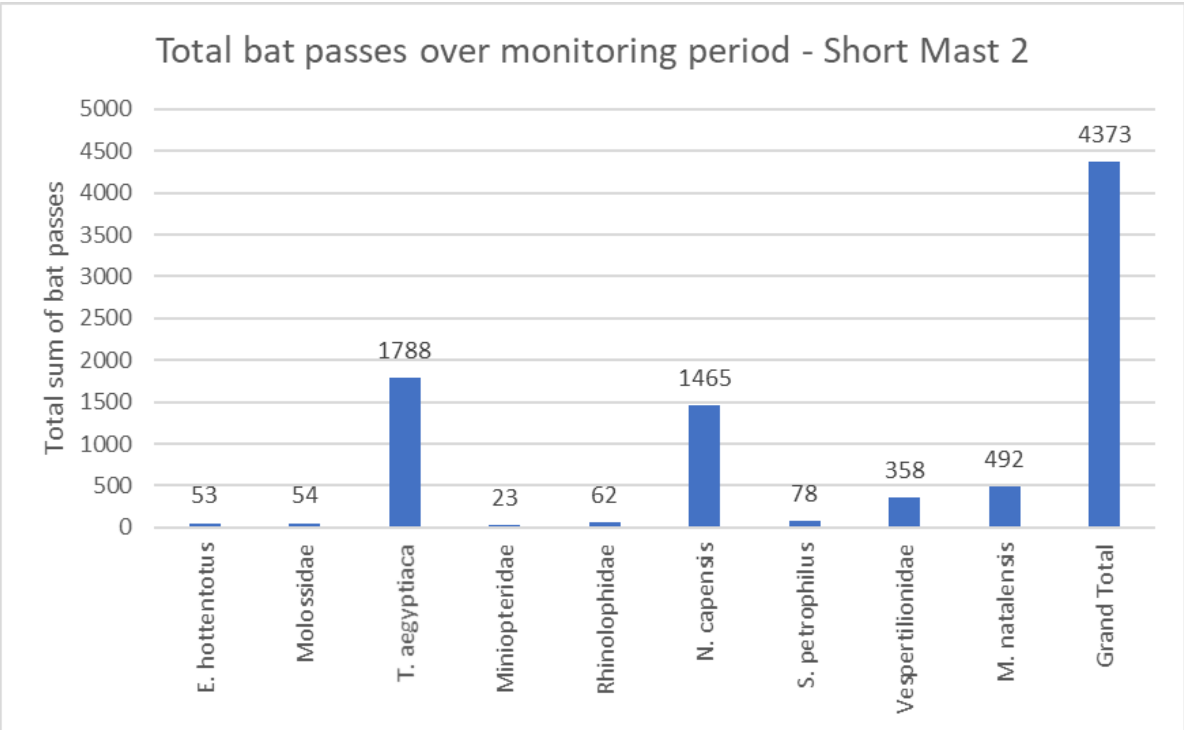

Figure 1.5-2: Total bat passes recorded over the monitoring period by SM2.

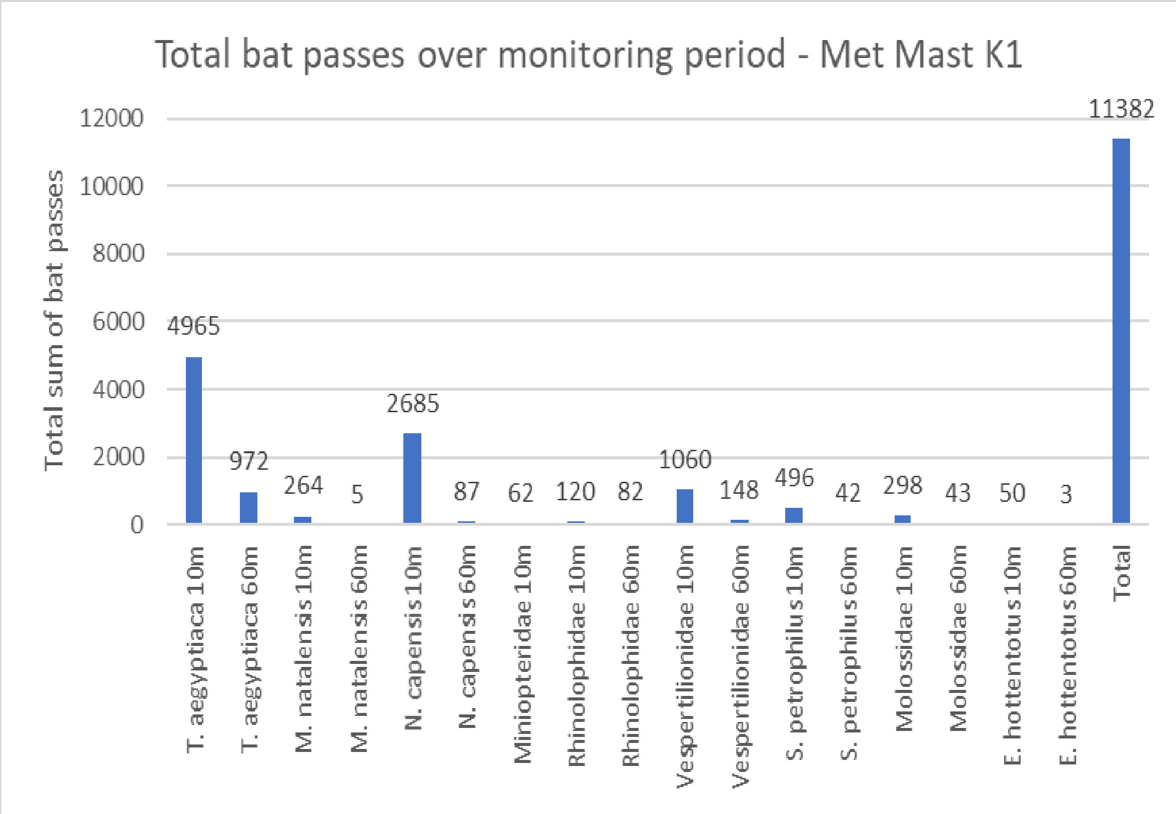

Figure 1.5-3: Total bat passes recorded over the monitoring period by Met Mast K1.

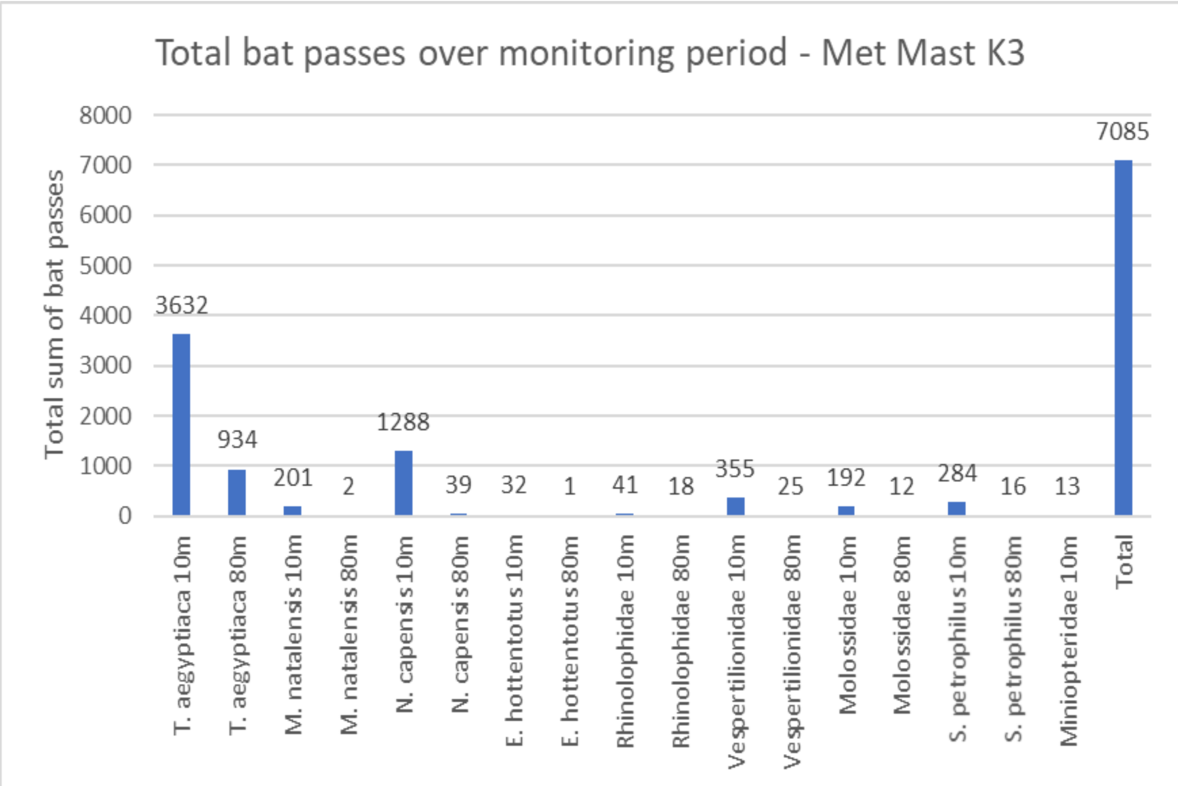

Figure 1.5-4: Total bat passes recorded over the monitoring period by Met Mast K3.

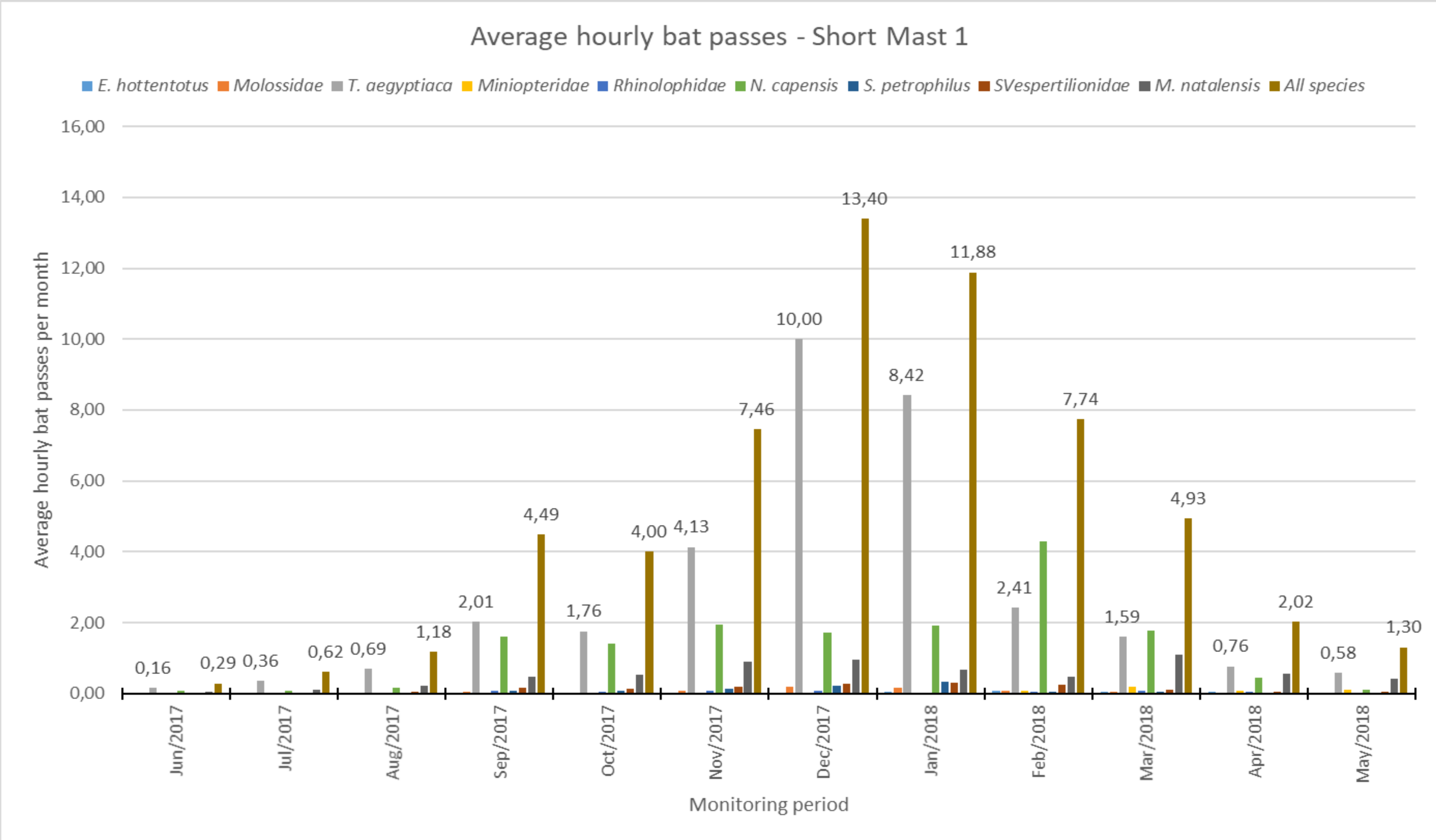

Figure 1.5-5: Average hourly bat passes recorded per month by SM1.

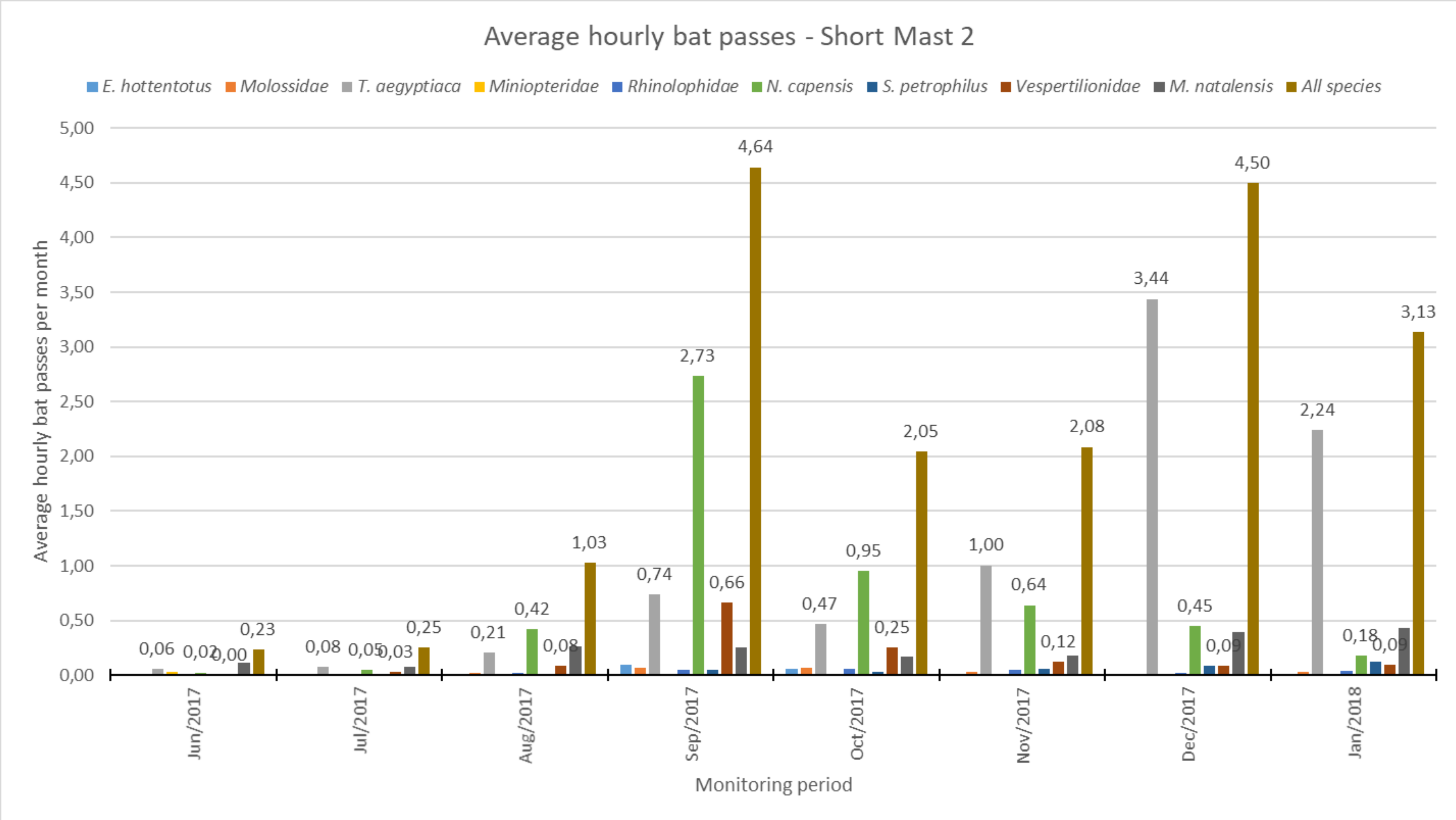

Figure 1.5-6: Average hourly bat passes recorded per month by SM2.

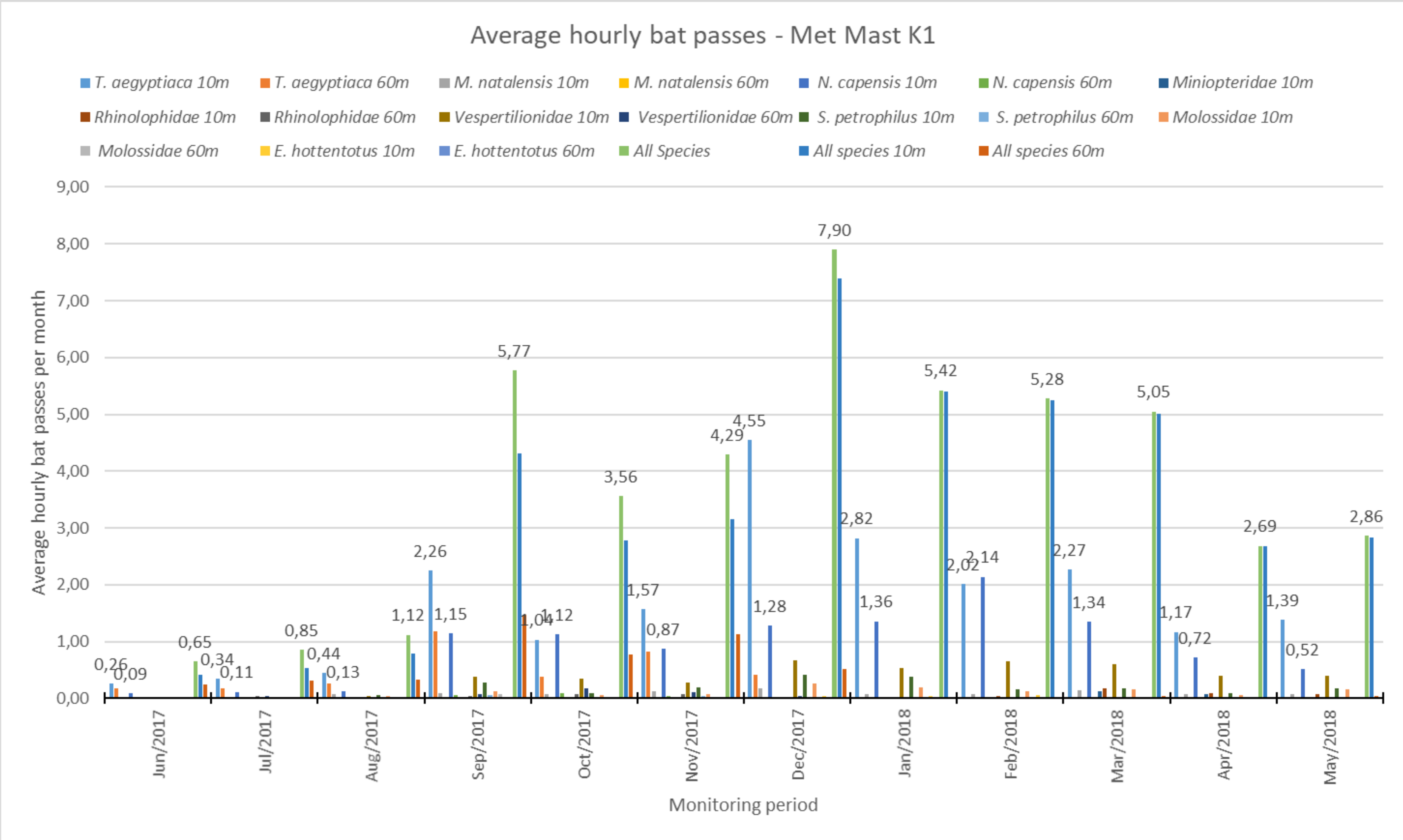

Figure 1.5-7: Average hourly bat passes recorded per month by Met Mast K1.

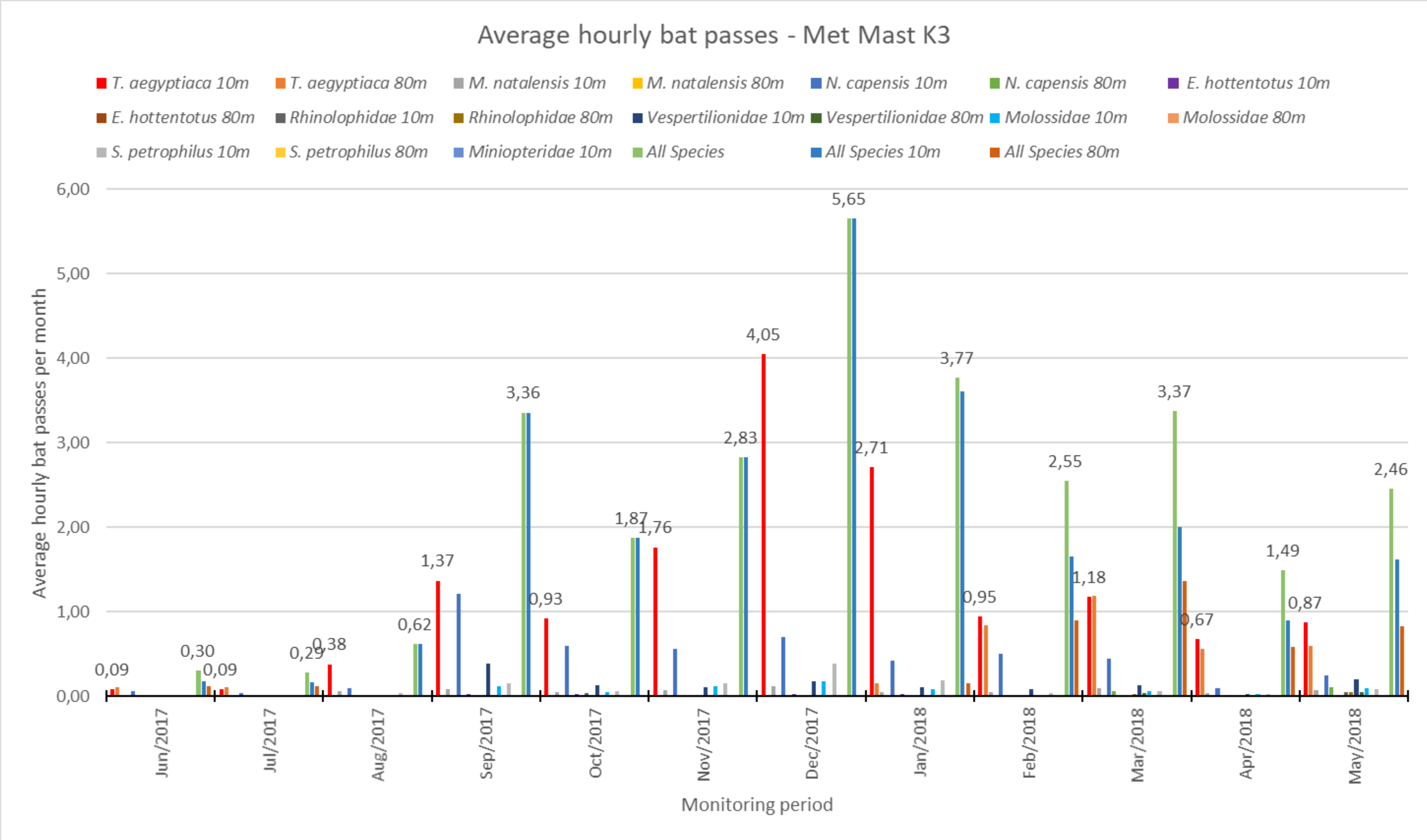

Figure 1.5-8: Average hourly bat passes recorded per month by Met Mast K3.

Temporal Distribution of Bat Activity

The sum of all bat passes recorded by the monitoring systems are displayed per night over the monitoring period so far (**Figures 1.5-9 to 1.5-12**). This information is useful to graphically compare seasonal differences and indicate peak activity periods that occurred. It can also be used during the operational study to inform a schedule for mitigation measures, if mitigation measures are found to be required.

Generally, on site the higher bat activity was in two peaks in the periods of spring and summer, with lower activity in winter months.

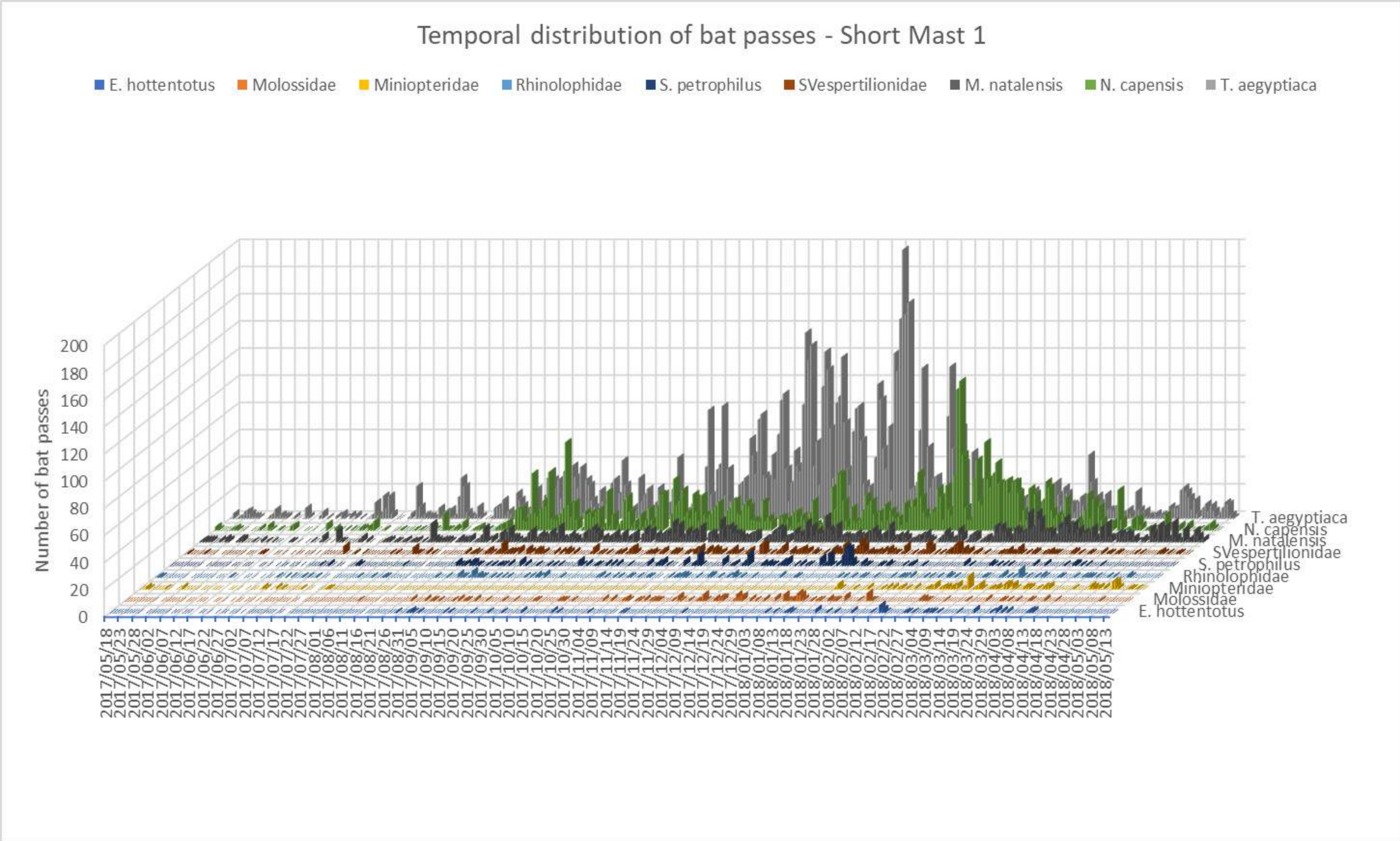

Figure 1.5-9: Temporal distribution of bat passes detected by SM1.

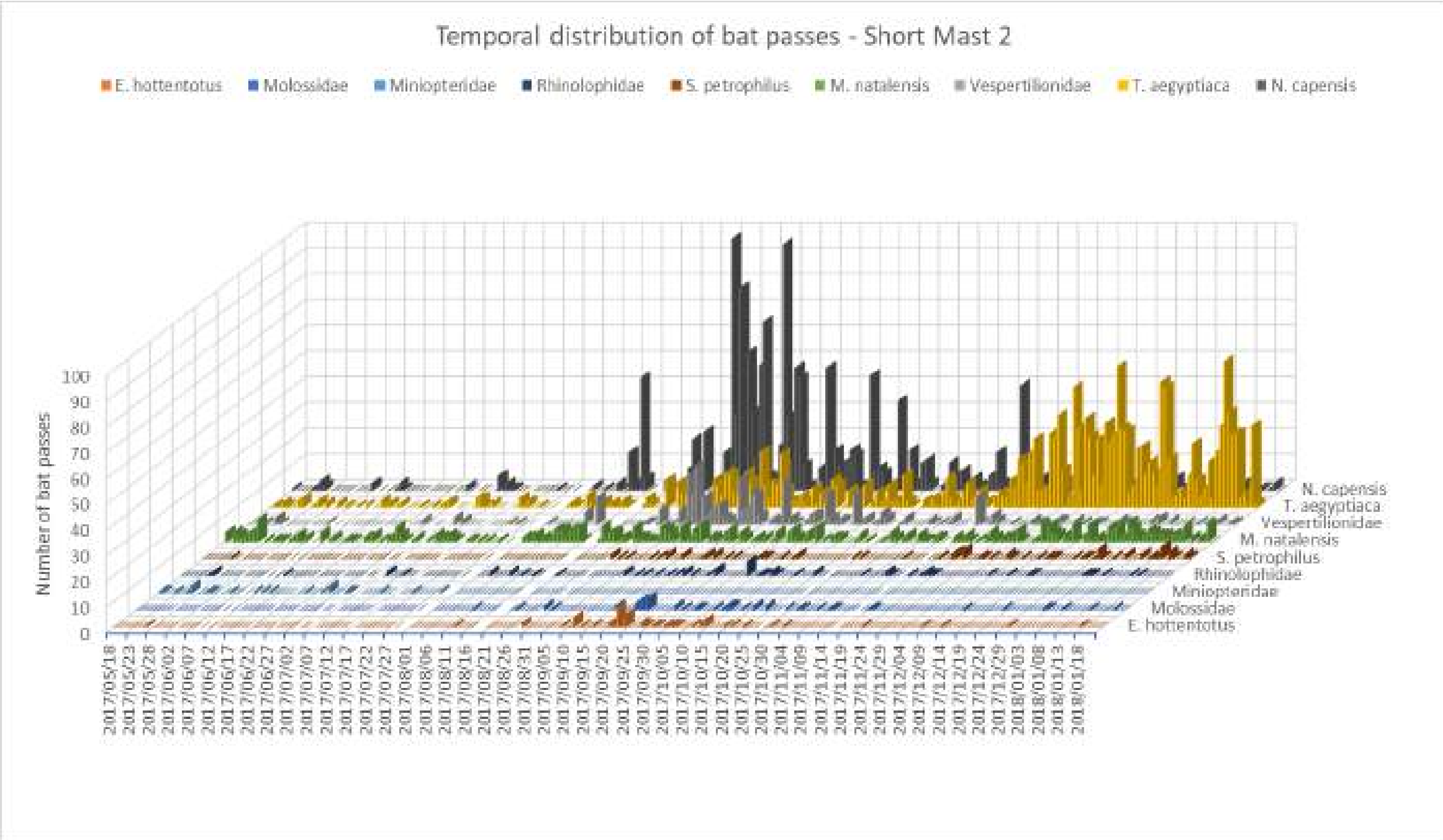

Figure 1.5-10: Temporal distribution of bat passes detected by SM2.

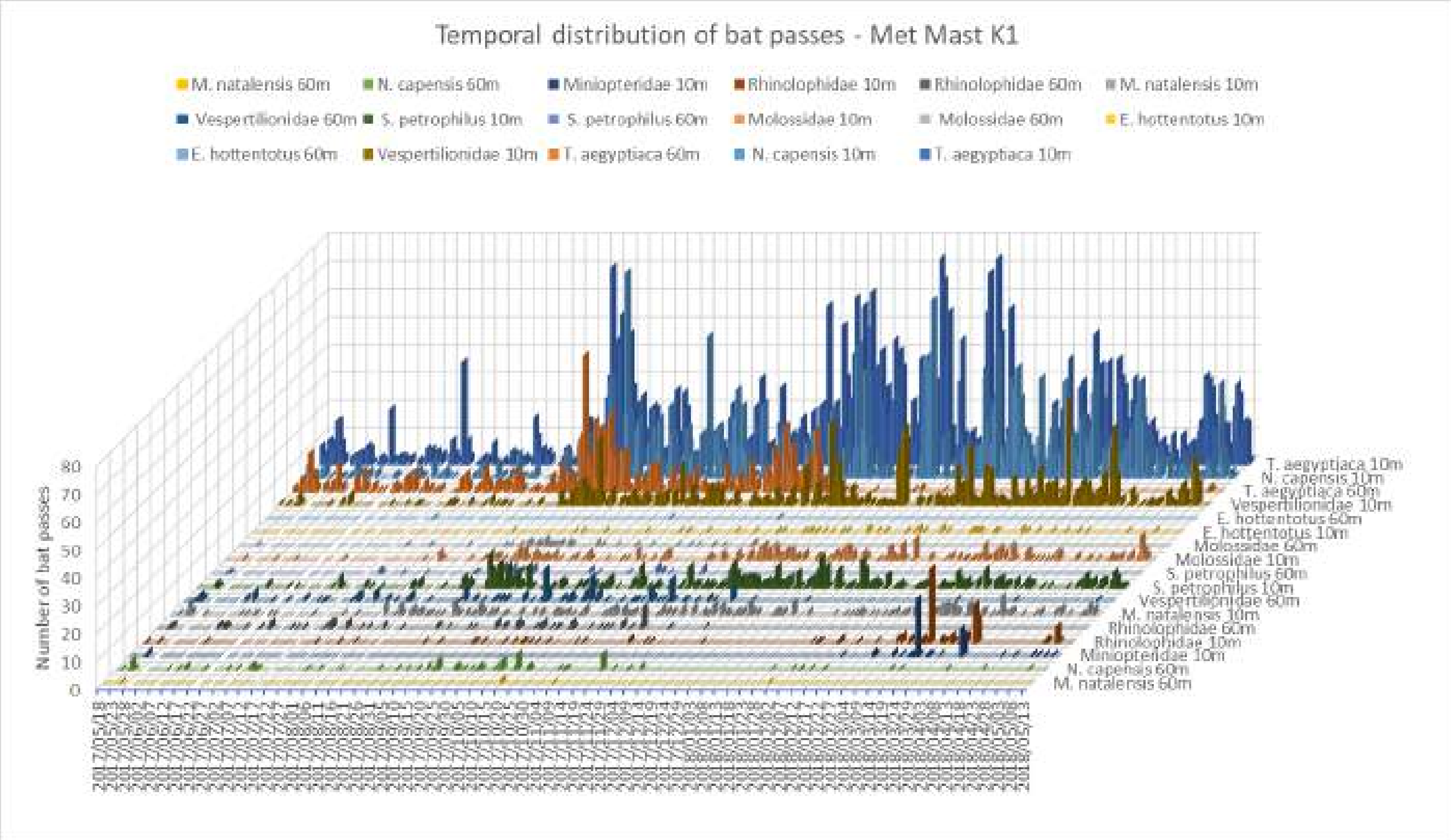

Figure 1.5-11: Temporal distribution of bat passes detected by Met Mast K1.

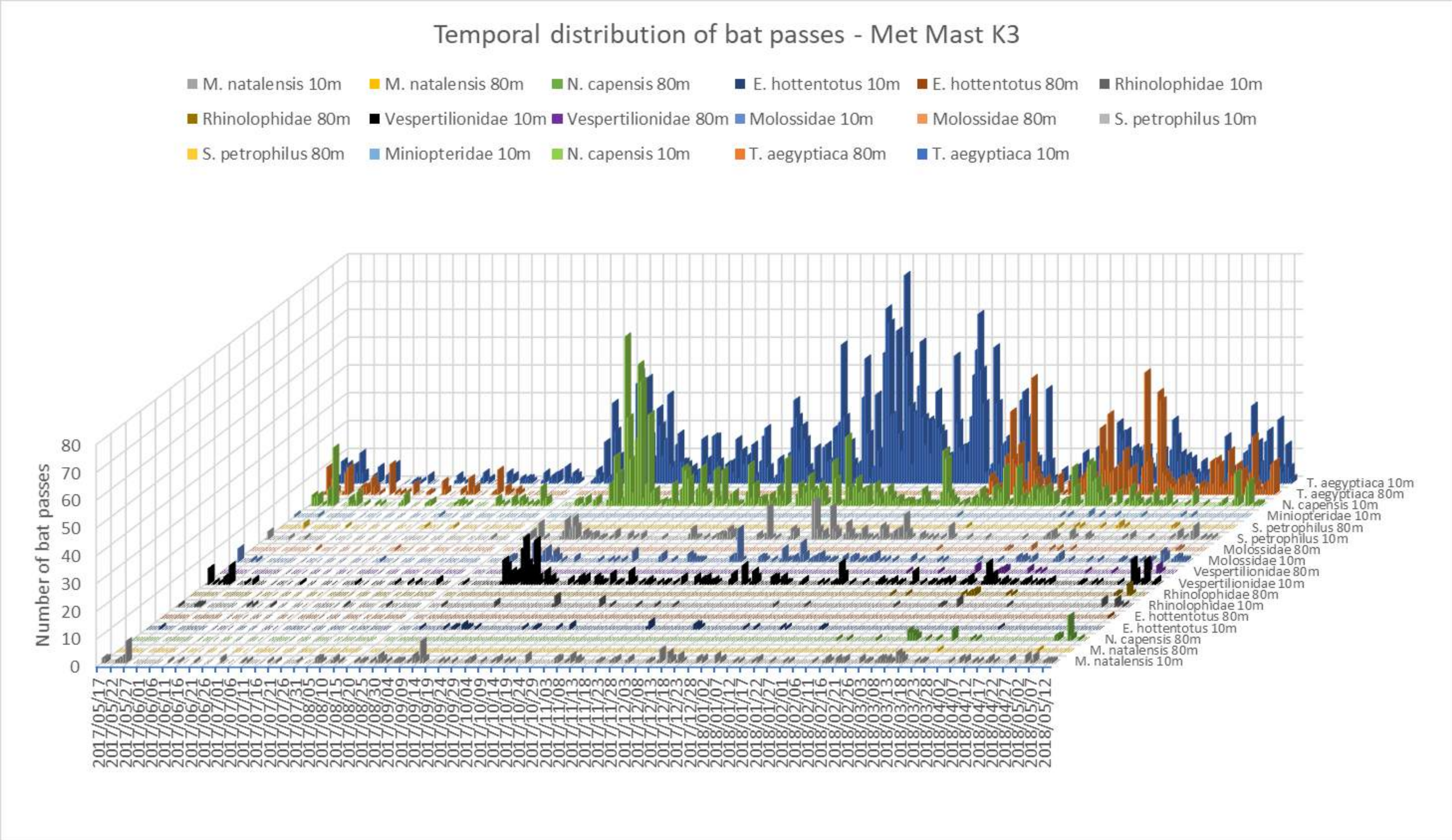

Figure 1.5-12: Temporal distribution of bat passes detected by Met Mast K3.

1.5.2. Transects

The purpose of transects are to further provide extra and additional insight into the habitat of the site and is not considered to be critical quantitive data. Note in the figures below the higher bat activity in lower lying areas. The following transects were carried out on the following site visits:

4th Site Visit

Figure 1.5-13 below indicates the transect routes during the fourth site visit. Transect routes were not calculated and were carried out based on available access to the farms and condition of the farm roads. The SM2BAT+ Real time expansion type detector was used. **Table 1.5-1** displays the sampling effort and weather conditions prevalent during the transect survey. Basic weather for Kuruman from www.worldweatheronline.com.

Phase 1 was covered during the 17th of May, but an error on the detector SD card did not allow for meaningful transect data gathering on the 18th. Note the more condensed bat passes recorded in valleys and low-lying areas.

Table 1.5-1: Transect distance, duration and average weather conditions experienced during the fourth site visit.

Date	Time started	Distance (km)	Duration (hours and minutes)	Temperature (˚C)	Rain (mm)	Wind speed (km/h)
17 May 2017	**19:54**	**39km**	**4h 08 min**	**17.5**	**0**	**9.5**
18 May 2017	**Equipment fault**					

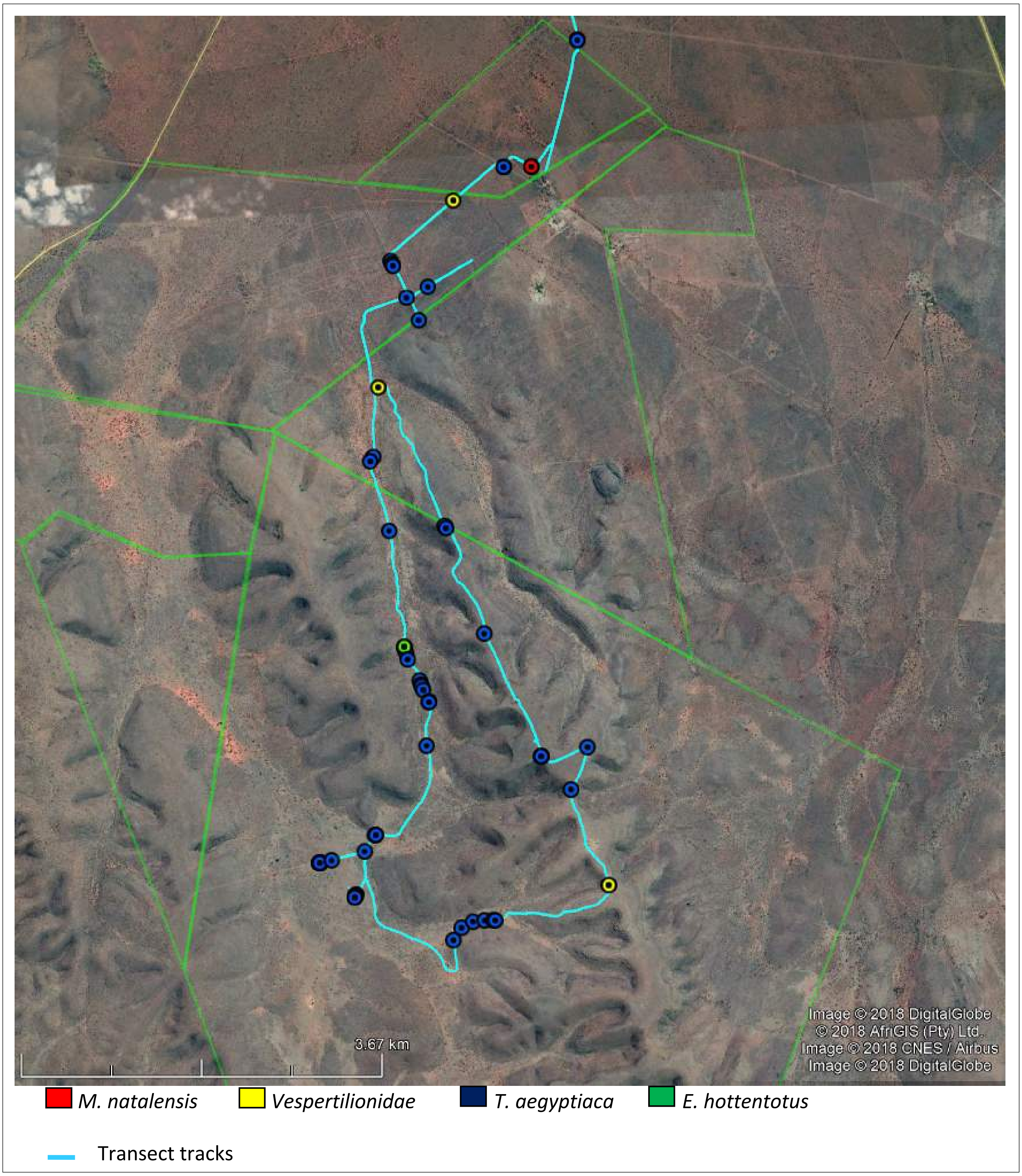

Figure 1.5-13: Transect results for the 4th visit on the Phase 1 site.

5 ***th*** ***Site Visit***

Figure 1.5-14 below indicates the transect routes during the fifth site visit. Transect routes were not calculated and were carried out based on available access to the farms and condition of the farm roads. The SM2BAT+ Real time expansion type detector was used. **Table 1.5-2** displays the sampling effort and weather conditions prevalent during the transect survey. Basic weather for Kuruman from www.worldweatheronline.com.

Table 1.5-2: Transect distance, duration and average weather conditions experienced during the fourth site visit.

Date	Time started	Distance (km)	Duration (hours and minutes)	Temperature (˚C)	Rain (mm)	Wind speed (km/h)
1 August 2017	**18:36**	**89km**	**3h 28 min**	**20**	**0**	**15**
2 August 2017	**18:56**	**72km**	**2h 51 min**	**19**	**0**	**12**

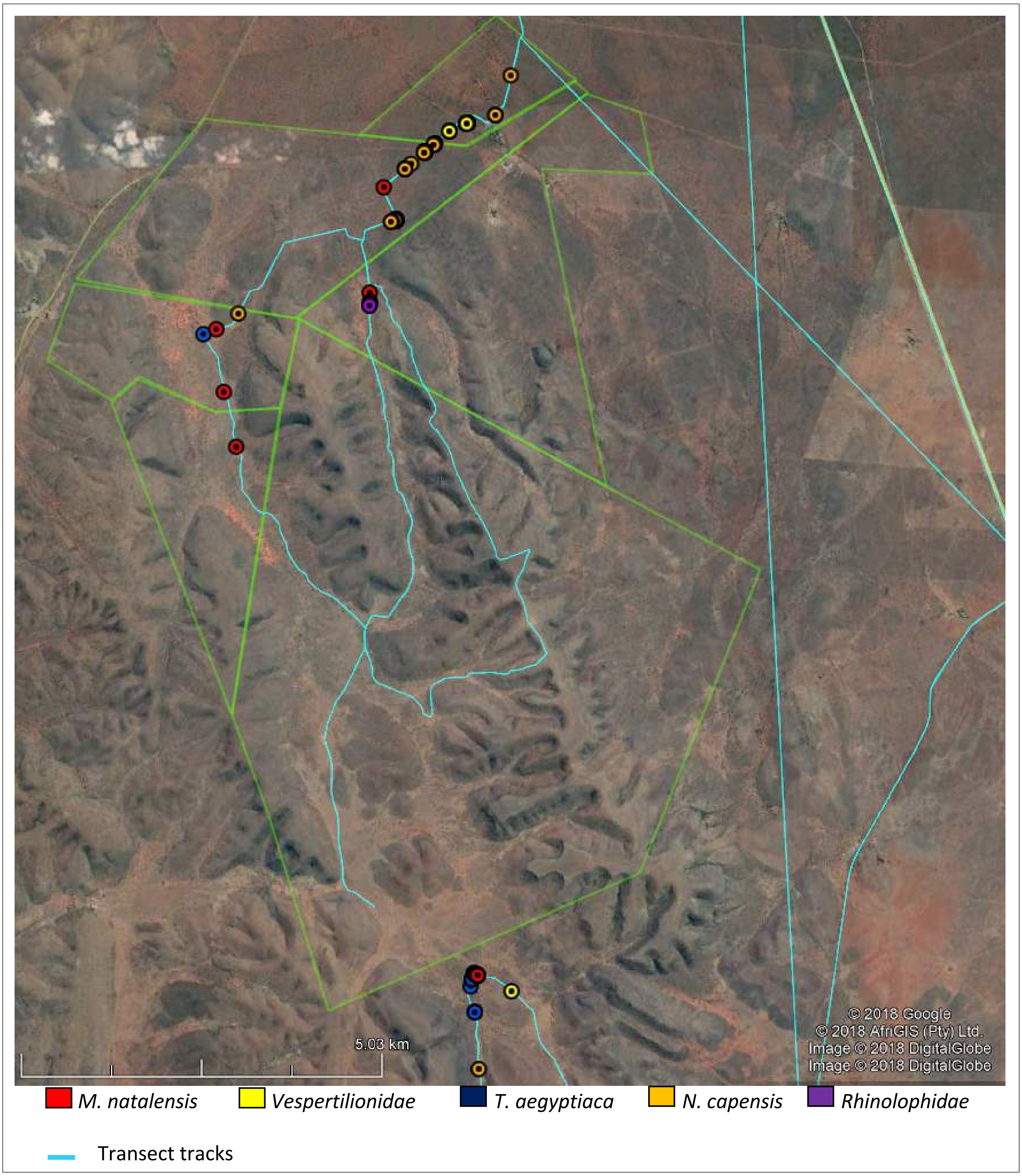

Figure 1.5-14: Transect results for the 5th visit on Phase 1.

1.5.3. Presence of caves

Several caves and mines are located in the vicinity of the site, ranging from 5km to 115km from the site (**Figure 1.5-15**). The closest is the Eye of Kuruman cave at 5km, and the second closest is Wonderwerk cave at 31km. This is very important since these caves may support migration routes between them and/or elevated levels of cave bats foraging in the area around the cave. Impacts on such colonies of cave bats will also negatively impact the ecosystem inside the cave/mine roost, since the guano of the bats are the only source of energy input into such a subterranean ecosystem.

However, the activity levels of bats from the family Miniopteridae, and especially *M. natalensis*, were relatively well dispersed over the timeline and not indicative of any migration events that may be visible by a very prominent peak in activity over the timeline.

A study by Monadjem *et al.* (2008) estimated *M. natalensis* numbers to be 2000 for Koegelbeen Cave, 100 – 150 for Hopefield Mine, 1200 for Soetfontein Cave, and none for Blinkklip Cave and the Eye of Kuruman Cave. The closest of these caves are 80km from site, with the exception of the Eye of Kuruman. The general activity levels of *M. natalensis* were also not particularly high throughout the monitoring period, with SM1 recording the most and SM2 recording the second most bat passes of this species. It's important to note that SM1 is in a low-lying area that's inside a high bat sensitivity area. The Met Mast K1 which is on a hill and the closest to the Eye of Kuruman, also did not record elevated levels of this species. SM2 however, is elevated on a hill in the south and in almost similar terrain as the Met Masts, presuming that it may be located closer to the foraging ranges of *M. natalensis*.

Dolomite geology increases the likelihood of undiscovered caves and in general subterranean caverns and karst environments, **Figure 1.5-16** indicates the presence of dolomite in relation to the site. There are several non-operational asbestos mines in the area of the site, most of these are small and tend to be open cast or shallow declines with some possibility of adits. Due to their open cast or shallow nature, the probability of them being utilised by cave dwelling bats are low.

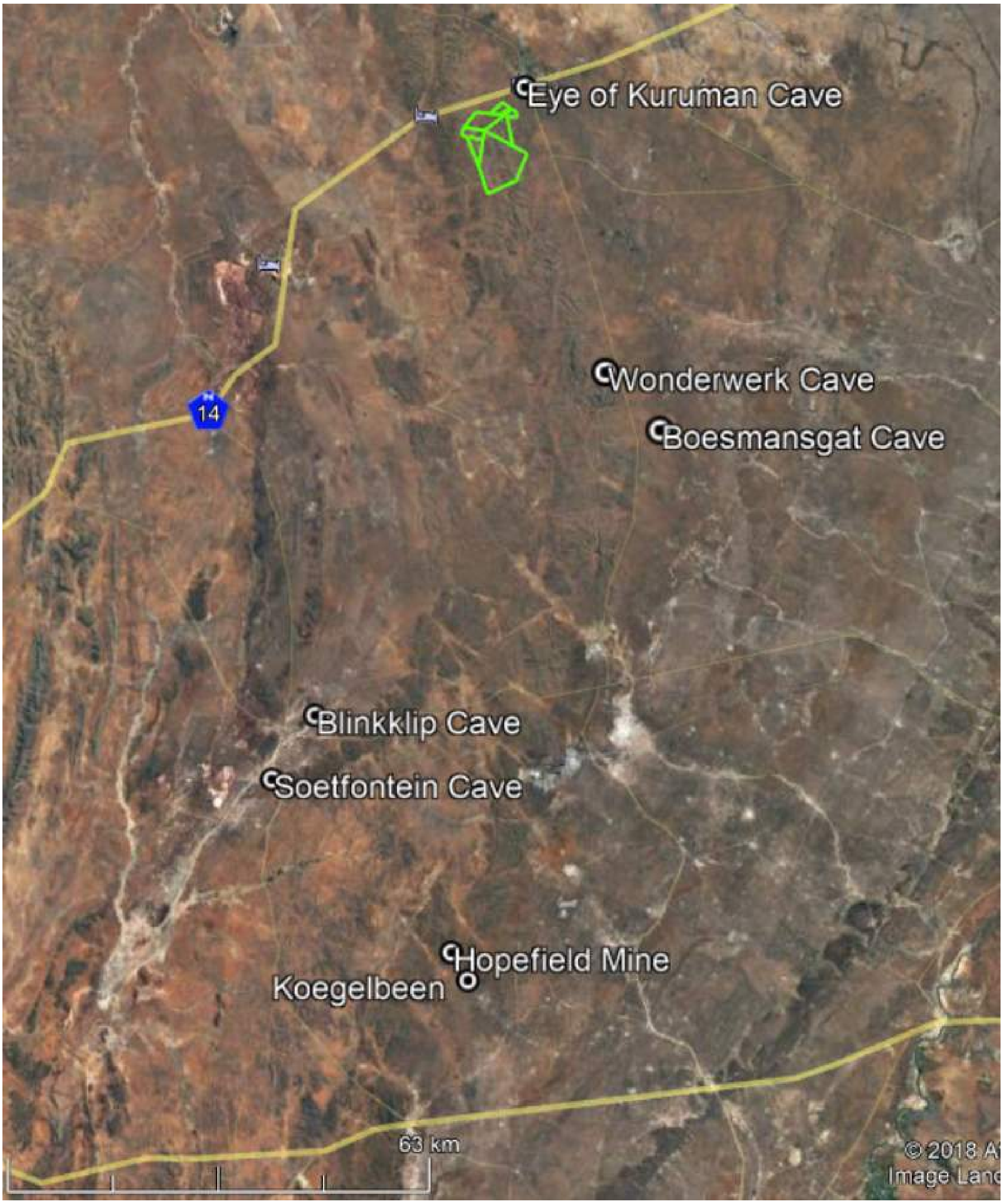

Figure 1.5-15: Caves and a mine that are located in the vicinity of the site (green polygon)

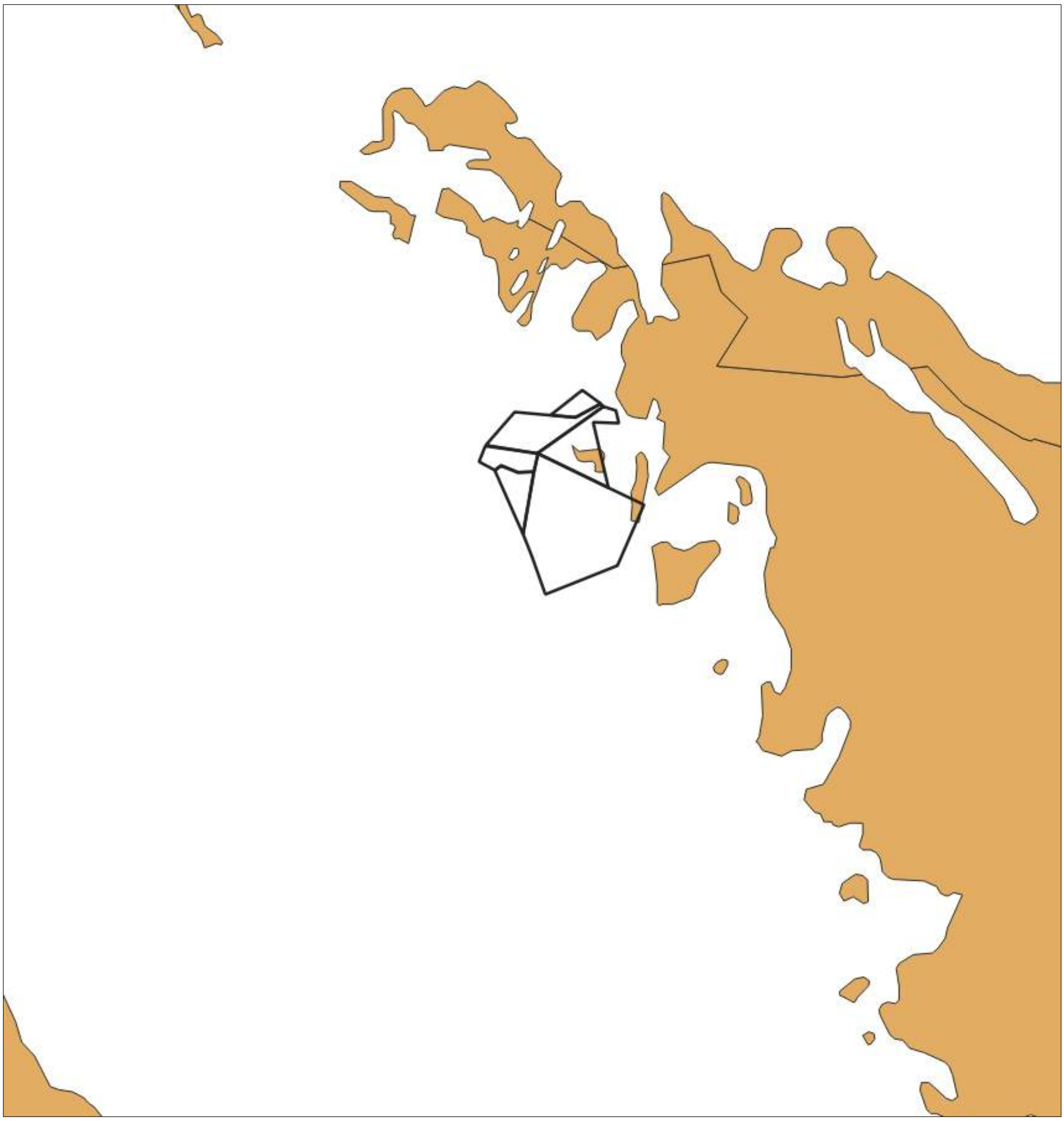

Figure 1.5-16: The location of dolomite geology in relation to the site.

1.5.4. Environmental Sensitivity Map

Figure 1.5-17 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the most prevalent species occurring on site, and which have the highest likelihood of being impacted on by the WEF. Thus, the sensitivity map is based on species ecology and habitat preferences. This map can be used as a pre-construction mitigation in terms of improving turbine placement with regards to bat preferred habitats on site.

The area marked as Non-permanent high bat sensitivity is an open water source from a man-made cement dam. This feature will attract bats and is therefore treated as high sensitive, but it can also be relocated or closed at its top and thereby be downgraded to Moderate or Low sensitivity.

Table 1.5-3: Description of parameters used in the construction of the sensitivity map.

Last revision	21 April 2018
High sensitivity buffer	200m radial buffer
Moderate sensitivity buffer	150m radial buffer on all Moderate sensitivities
Features used to develop the sensitivity map	Manmade structures, such as buildings, houses, barns and sheds. These structures provide easily accessible roosting sites.
	Altitude appears to play a significant role in bat activity levels on this site, lower lying areas have therefore been deemed as sensitive.
	The different vegetation types and landform. Valleys and slopes can offer airspace sheltered from wind for insect prey and subsequently attract insectivorous bats. Larger woody shrubs or small trees can offer similar sheltered airspace or offer some roosting spaces.
	Open water sources, be it man-made farm dams or seasonal natural areas. They are important sources of drinking water and provide habitat that host insect prey.

Table 1.5-4: Description of sensitivity categories and their significance in the sensitivity map**.**

Sensitivity	**Description**
Moderate Sensitivity and its buffers	Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology. Turbines within these areas and their buffers may acquire priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them. Turbines in these areas may remain but are at a higher risk of possible costly mitigations.
High Sensitivity and its buffers	Areas that are deemed critical for bat populations, capable of elevated levels of bat activity and support greater bat diversity/activity than the rest of the site. These areas are 'no-go' zones and turbines (including turbine blades) may not be placed in these areas and their buffers.

Table 1.5-5: Turbines located within bat sensitive areas and their buffers (including turbine blades), using the 21 September 2018 layout.

Bat sensitive area	**Proposed turbine layout**
High bat sensitivity area	None
High bat sensitivity buffer	None
Moderate bat sensitivity area	None
Moderate bat sensitivity buffer	Turbines 3, 4, 5, 6, 7, 14, 15, 20rev1, 21, 29rev3, 36, 40rev1, 4, 43rev2, 44rev2, 45, 46, 47rev1

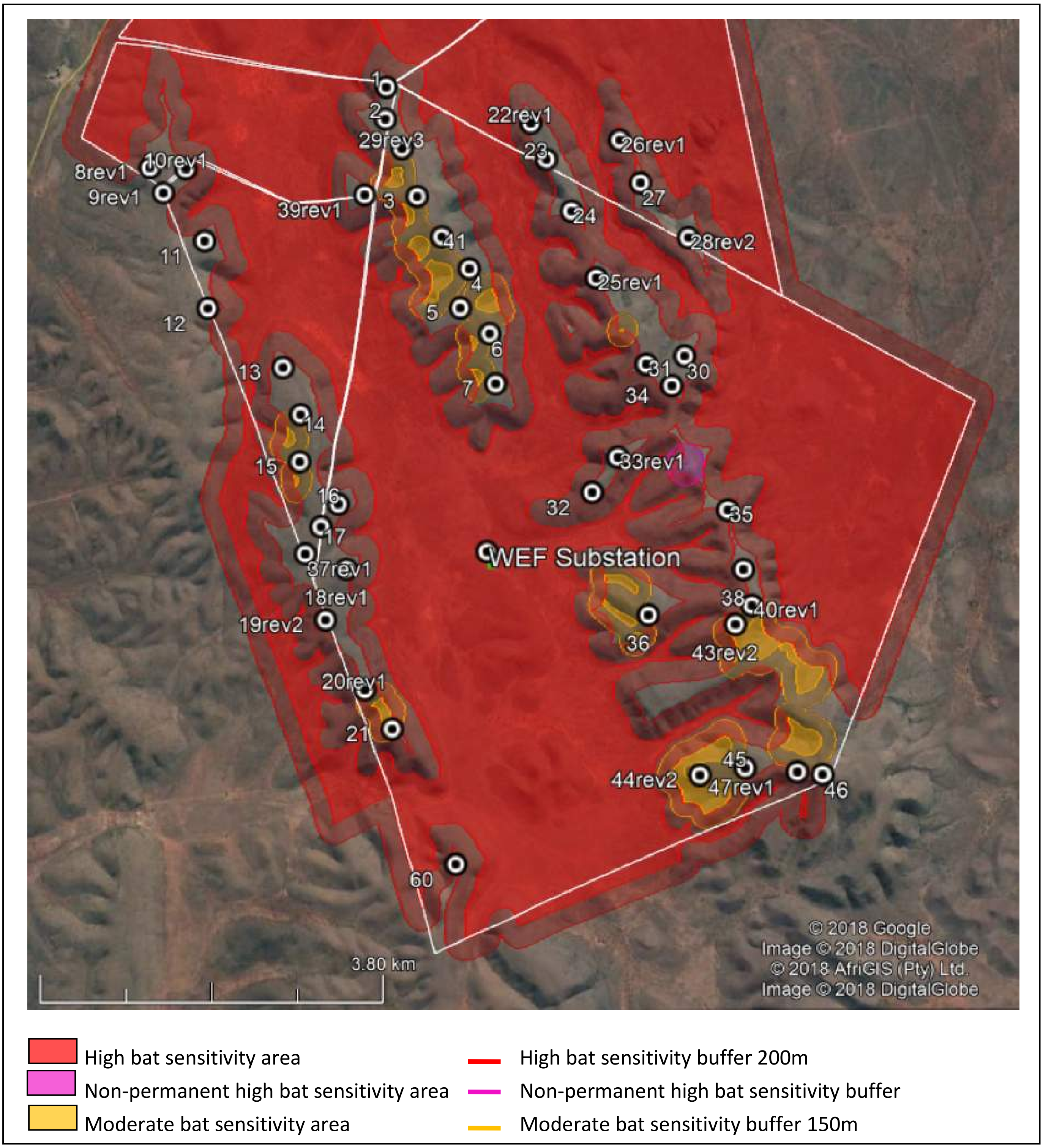

Figure 1.5-17: Bat sensitivity map for the proposed Kuruman Phase 1 WEF.

1.5.5. Cumulative impacts

Apart from the adjacent proposed Kuruman Phase 2 WEF, there are no other WEF proposed or existing within 100km of the site. Therefore, the cumulative impacts will be assessed in more detail in the impact assessment ratings and tables of this report.

1.5.6. Relation between Bat Activity and Weather Conditions

Several sources of literature describe how numerous bat species are influenced by weather conditions (O'Farrell et al. 1967, Rachwald 1992, Arnett et al. 2010). Weather may influence bats in terms of lowering activity, changing time of emergence and flight time. It is also important to note the environmental factors are never isolated and therefore a combination of the environmental factors can have synergistic or otherwise contradictory influences on bat activity. For example, a combination of high temperatures and low wind speeds will be more favourable to bat activity than low temperatures and low wind speed, whereas low temperature and high wind speed will be the least favourable for bats. Below are short descriptions of how wind speed, temperature and barometric pressure influences bat activity.

Wind speed

Some bat species show reduced activity in windy conditions. Strong winds have been found to suppress flight activity in bats by making flight difficult (O'Farrell et al. 1967). Several studies at proposed wind facilities in South Africa have documented discernibly lower bat activity during higher wind speeds.

Wind speed and direction also affects availability of insect prey as insects on the wing often accumulate on the lee side of wind breaks such as tree lines (Peng et al. 1992). At edges exposed to wind, flight activity of insects, and thus bats may be suppressed and at edges to the lee side of wind, and bat activity may be greater.

Temperature

Flight activity of bats generally increases with temperature. Flights are of shorter duration on cooler nights and extended on warmer nights. Rachwald (1992) noted that distinct peaks of activity disappeared in warm weather such that activity was mostly continuous through the night. During nights of low temperatures bats intensified foraging shortly after sunset (Corbet and Harris 1991).

Peng (1991) found that many families of aerial dipteran (flies) insects preferred warm conditions for flight. A preference among insects for warm conditions has been reported by many authors suggesting that temperature is an important regulator of bat activity, through its effects on insect prey availability.
The aim of such an analysis is to determine the wind speed and temperature range within which 80% of bat passes were detected. These values of wind speed and temperature may be used, if found to be necessary during the operational phase, to inform mitigation measures for turbines based on conserving 80% of detected bat passes. This is keeping in mind the synergistic or otherwise contradictory effects that the combination of wind speeds and temperatures can have on bat activity.

This analysis is not included in this report since bat activity levels could not be assigned a risk level as described in the "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: Edition 4.1" (Sowler et al., 2017). This is due to a lack of substantive supportive data that's required for the risk rating calculations for the Kalahari Xeric Savanna ecoregion. However, if found during the operational bat mortality monitoring study that bats are being killed in unsustainable numbers, the analysis can be performed with climatic and bat activity data from the most applicable turbines and most applicable date periods.

1.6. IDENTIFICATION OF IMPACTS

1.6.1. *Key Issues Identified During the Scoping Phase*

The potential bat impact issues identified during the scoping phase of this EIA process include:

- Destruction of foraging habitat.
- Bat mortalities due to moving turbine blades (resident populations).
- Bat mortalities due to moving turbine blades (migrating populations).
- Indirect impact: Cave ecosystem collapse due to bat mortalities of cave dwelling bat populations.
- Light pollution causing increased bat mortalities due to moving turbine blades.
- Increased area of potential bat mortality impact by turbine blades, due to proposed neighbouring Kuruman Phase 2 WEF.

1.6.2. *Identification of Potential Impacts*

The potential impacts identified during the EIA assessment are:

1.6.3. *Construction Phase*

- Potential impact 1: Destruction of foraging habitat during infrastructure clearance and other related activities.

1.6.4. *Operational Phase*

- Potential impact 2: Bat mortalities due to moving turbine blades (resident populations).
- Potential impact 3: Bat mortalities due to moving turbine blades (migrating populations).
- Potential impact 4: Indirect impact: Cave ecosystem collapse due to bat mortalities of cave dwelling bat populations.
- Potential impact 5: Light pollution causing increased bat mortalities due to moving turbine blades.

1.6.5. *Decommissioning Phase*

- No impacts identified for the decommissioning phase.

1.6.6. *Cumulative impacts*

- Cumulative impact 1: Increased area of potential bat mortality impact by turbine blades, due to proposed neighbouring Kuruman Phase 2 WEF.

1.7. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.7.1. Potential Impact 1 (Construction Phase): Destruction of foraging habitat during infrastructure clearance and other related activities.

- **Nature of the impact**
  During construction some very limited foraging habitat will inevitably be destroyed to clear ground for the WEF. Apart from the hardstands this includes roads, substations, laydown areas, etc. However, this impact is not considered to have a significant effect on bat populations due to the small overall area of vegetation cleared.

- **Significance of impact without mitigation measures**
  The impact has a low significance even without mitigations, since the areas affected is relatively small and bats are flying animals that can readily forage around the affected areas.

- **Proposed mitigation measures**
  Adhere to the planned footprint areas and attempt to re-use all pathways and laydown/storage areas.

- **Significance of impact with mitigation measures**
  The impact has a very low significance after mitigations are applied, due to the reasons described above.

1.7.2. Potential Impact 2 (Operational Phase): Bat mortalities due to moving turbine blades (resident populations).

- **Nature of the impact**
  Foraging bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.3)

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of bats can have detrimental long-term effects on the local bat populations.

- **Proposed mitigation measures**
  Keep turbines and turbine blades outside high sensitivity buffers.. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions (curtailment). Acoustic deterrents are developed well enough to be trailed with if needed. An operational bat mortality study must be conducted during the first 2 years of the wind energy facility's operation.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although excessive curtailment can be costly and therefore proper turbine layout (out of sensitivity buffers) is the preferred primary mitigation.

1.7.3. Potential impact 3 (Operational Phase): Bat mortalities due to moving turbine blades (migrating populations).

- **Nature of the impact**
  Migrating bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.3)

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of migrating bats can have detrimental long-term effects on various bat populations in a larger region. The consequence is identified as Severe, but the probability as Unlikely since no migration routes are known in the area.

- **Proposed mitigation measures**
  Keep turbines and turbine blades outside high sensitivity buffers.. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions when bats may be migrating (curtailment). Acoustic deterrents are developed well enough to be trailed with if needed. An operational bat mortality study must be conducted during the first 2 years of the wind energy facility's operation.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although curtailment can be costly, for migration events it will be applied for a short time period only at select turbines. However, proper turbine layout (out of sensitivity buffers) is still the preferred primary mitigation.

1.7.4. Potential impact 4 (Operational Phase): Indirect impact: Cave ecosystem collapse due to bat mortalities of cave dwelling bat populations.

- **Nature of the impact**
  Cave ecosystems can collapse if the resident bat colonies that inhabit caves are killed. This is due to the fact that the bat guano is the primary source of energy input into the cave ecosystem.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation. The consequence is identified as Severe, but the probability as Unlikely since no migration routes are known in the area and the cave ecology of the area is not well known.

- **Proposed mitigation measures**
  Keep turbines and turbine blades outside high sensitivity buffers. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions when bats may be migrating (curtailment). Acoustic deterrents are developed well enough to be trailed with if needed. An operational bat mortality study must be conducted during the first 2 years of the wind energy facility's operation.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although curtailment can be costly, for migration events it will be applied for a short time period only at select turbines. However, proper turbine layout (out of sensitivity buffers) is still the preferred primary mitigation.

1.7.5. Potential impact 5 (Operational Phase): Light pollution causing increased bat mortalities due to moving turbine blades.

- **Nature of the impact**
  Security and/or operational lights used close to or on turbines will attract high insect numbers and thereby attract additional insectivorous bat activity. This will significantly increase the likelihood of impacts by turbine blades. This is not applicable to red aviation lights.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since permanent light sources will create regular insect pooling spots and thereby nightly foraging hotspots in the dangerous rotor swept zone.

- **Proposed mitigation measures**
  Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools. All lights should be down hooded, including lights at the substation building. Lighting at the substation should be kept to the minimum required.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be very easily applied and will be very effective when applied.

1.7.6. Potential impact 6 (Decommissioning Phase): No significant impacts on bats are identified for the decommissioning phase.

1.7.7. Cumulative impact 7: Increased area of potential bat mortality impact by turbine blades, due to proposed neighbouring Kuruman Phase 2 WEF.

- **Nature of the impact**
  Foraging bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.3). If more turbines are present in the area the likelihood of mortalities can increase.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of bats can have detrimental long-term effects on the local bat populations. It should be noted that apart from the proposed Kuruman Phase 2 WEF, there are no other proposed or existing WEF's in 100km radius of the site.

- **Proposed mitigation measures**
  Mitigations must be applied, when needed, for all phases of the Kuruman WEF's and all turbine layout adjustments must respect sensitivity maps. Where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions (curtailment). Acoustic deterrents are developed well enough to be trailed with if needed. An operational bat mortality study must be conducted during the first 2 years of the wind energy facility's operation.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although excessive curtailment can be costly and therefore

proper turbine layout (out of sensitivity buffers) of all nearby turbines the preferred primary mitigation.

1.8. IMPACT ASSESSMENT SUMMARY

Table 1.8 -1 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of vegetation	Foraging habitat loss	Negative	Site	Long-Term	Moderate	Very likely	Moderate	Low	Adhere to planned impact footprint	Low	Very low	5	High

Table 1.8 -2 Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Moving turbine blades	Bat mortalities (resident)	Negative	Local	Long-Term	Substantial	Likely	Moderate	Moderate	Layout, curtailment, acoustic deterrents.	Moderate	Low	4	High

Moving turbine blades	Bat mortalities (migrating)	Negative	Regional	Long-Term	Severe	Unlikely	Moderate	Moderate	Layout, curtailment, acoustic deterrents.	Moderate	Low	4	Low
Light pollution	Increased mortality probability	Negative	Local	Long-Term	Substantial	Likely	Moderate	Moderate	Motion sensor lights	Moderate	Low	4	High

Table 1.8 -3 Impact assessment summary table for the Operational Phase (Indirect impact)

Operational Phase													
Indirect Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Mortalities of cave bat population	Cave ecosystem collapse	Negative	Regional	Long-Term	Severe	Unlikely	Low	High	Layout, curtailment, acoustic deterrents.	Moderate	Low	4	Low

Table 1.8 -4 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Increased number of turbines	Increased mortality probability	Negative	Regional	Long-Term	Substantial	Likely	Moderate	Moderate	Layout, curtailment, acoustic deterrents.	Moderate	Low	4	High

1.9. PROPOSED INITIAL MITIGATION MEASURES

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area and is recommended as the initial and preferred method of mitigation, therefore the sensitivity map needs to be adhered to.

Additional to mitigation by location, other options that may be utilized when necessary include curtailment, blade feathering, blade lock, acoustic deterrents or light lures. The following terminology applies:

Curtailment:
Curtailment is defined as the act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by locking or feathering the turbine blades, with the aim to raise the cut-in speed without free-wheeling.

Cut-in speed:
The cut-in speed is the wind speed at which the generator is connected to the grid and producing electricity. For some turbines, their blades will spin at full or partial Revolutions per Minute (RPMs) below cut-in speed when no electricity is being produced.

Feathering or Feathered:
Feathering refers to adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation. Normally operating turbine blades are angled almost perpendicular to the wind at all times.

Free-wheeling:
Free-wheeling occurs when the blades are allowed to rotate below the cut-in speed or even when fully feathered and parallel to the wind. In contrast, blades can be “locked” and cannot rotate, which is a mandatory situation when turbines are being accessed by operations personnel.

Acoustic deterrents:
This is a developing technology and will need further investigation closer to time of wind farm operation; opportunities to test such devices may be available during the operation of the facility.

Increasing cut-in speed:
The turbine’s computer system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) is programmed to a cut-in speed higher than the manufacturer’s set speed, and turbines are programmed to be feathered at 90° until the increased cut-in speed is reached over some average number of minutes (usually 5 – 10 min), thus triggering the turbine blades to pitch back “into the wind” and begin to spin normally and produce power.

Blade locking or feathering that renders blades motionless below the manufacturers cut-in speed, and don’t allow free rotation without the gearbox engaged, is more desirable for the conservation of bats than allowing free rotation below the manufacturer’s cut-in speed. This is because bats can still collide with rotating blades even when no electricity is being produced.

Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds under environmental conditions favourable to bats.

A basic "6 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation is structured as follows:

1. No curtailment (free-wheeling is unhindered below manufacturer’s cut-in speed so all momentum is retained, thus normal operation).

2. Partial feathering (45-degree angle) of blades below manufacturer's cut-in speed in order to allow the free-wheeling blades half the speed it would have had without feathering (some momentum is retained below the cut-in speed).

3. Ninety-degree feathering of blades below manufacturer's cut-in speed so it is exactly parallel to the wind direction as to minimize free-wheeling blade rotation as much as possible without locking the blades.

4. Ninety-degree feathering of blades below manufacturer's cut-in speed, with partial feathering (45-degree angle) between the manufacturer's cut-in speed and mitigation cut-in conditions.

5. Ninety-degree feathering of blades below mitigation cut-in conditions.

6. Ninety-degree feathering throughout the entire night.

It is recommended that Level 3 mitigation be applied to all turbines on site from the start of operation, from sunset until sunrise every night for the months of September, December, January and February. This implies 90-degree feathering below the manufacturer's cut in speed to minimise free-wheeling, which does not result in high production loss but can lessen likelihood of bat impacts significantly. Currently, apart from the mitigations recommended in Sections 1.7 and 1.8, no additional mitigations are required.

However, if found during the operational bat mortality monitoring study that bats are being killed in unsustainable numbers, specific and more stringent curtailment or acoustic deterrent regimes may be recommended at the most applicable turbines and most applicable date periods.

1.10. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

The key monitoring recommendations for each applicable mitigation measure identified for all phases of the project, for inclusion in the EMPr or environmental authorisation, are as follows:

Table 1.10-1: Key monitoring recommendations for each mitigation measure.

Mitigation measure	Monitoring recommendations
Adhere to sensitivity map for turbine placement.	All turbines in High bat sensitivities or High bat sensitivity buffers, must be moved outside such buffers during turbine layout revisions, before turbine construction commences. This applies to turbine base locations as well as the rotor swept envelope (blade length).
Lights at turbine bases (if applicable), must be fitted with low sensitivity motion sensors.	The functionality of the motion sensors on such lights must be tested regularly, and any lights at turbine bases that remains switched on must be reported by personnel that are on site during the night. Including security personnel.
Curtailment or blade feathering as described in Section 1.9.	The regime must be programmed into the SCADA/operational system of the turbines. This must commence on the commercial operational date. The specialist conducting the bat operational mortality study must be made aware of the regime.

1.11. CONCLUSION

The preconstruction bat monitoring study concluded in May 2018 and informs this Bat Impact Assessment for the EIA report. The passive data indicate that three bat species are most likely to be impacted on by the proposed WEF are *Neoromicia capensis, Tadarida aegyptiaca* and *Miniopterus natalensis*. These more abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers.

Several caves and mines are located in the vicinity of the site, ranging from 5km to 115km from the site (**Figure 1.5-15**). The closest is the Eye of Kuruman cave at 5km, and the second closest is Wonderwerk cave at 31km. This is very important since these caves may support migration routes between them and/or elevated levels of cave bats foraging in the area around the cave. Impacts on such colonies of cave bats will also negatively impact the ecosystem inside the cave/mine roost, since the guano of the bats are the only source of energy input into such a subterranean ecosystem. However, the activity levels of bats from the family Miniopteridae, and especially *M. natalensis*, were relatively well dispersed over the timeline and not indicative of any migration events that may be visible by a very prominent peak in activity over the timeline.

The general activity levels of *M. natalensis* were also not particularly high throughout the monitoring period, with SM1 recording the most and SM2 recording the second most bat passes of this species. It's important to note that SM1 is in a low-lying area that's inside a high bat sensitivity area. The Met Mast K1 which is on a hill and the closest to the Eye of Kuruman, also did not record elevated levels of this species. SM2 however, is elevated on a hill in the south and in almost similar terrain as the Met Masts, presuming that it may be located closer to the foraging ranges of *M. natalensis*.

A sensitivity map was drawn up indicating potential roosting and foraging areas. The High Bat Sensitivity areas are expected to have elevated levels of bat activity and support greater bat diversity. High Bat Sensitivity areas and their buffers are 'no – go' areas due to expected elevated rates of bat fatalities due to wind turbines. No turbines or turbine blades are within high sensitivities or high sensitivity buffers..

It is recommended that Level 3 mitigation (see Section 1.9) be applied to all turbines on site from the start of operation, from sunset until sunrise every night for the months of September, December, January and February. This implies 90-degree feathering below the manufacturer's cut in speed to minimise free-wheeling, which does not result in high production loss but can lessen likelihood of bat impacts significantly. Currently, apart from the mitigations recommended in Sections 1.7 and 1.8, no additional mitigations are required.
However, if found during the operational bat mortality monitoring study that bats are being killed in unsustainable numbers, specific and more stringent curtailment or acoustic deterrent regimes may be recommended at the most applicable turbines and most applicable date periods. Such a curtailment regime will be influenced by bat mortality patterns, bat activity patterns and the relationships with wind and temperature conditions.

It is critical that an operational bat monitoring programme to detect or monitor bat mortality be conducted during the first 2 years of the wind energy facility's operation. In order to determine if further mitigation measures may be required, and to inform specific details of such additional mitigations based on the mortality data patterns.

If the recommend mitigation measures and the no-go, highly sensitive and buffer areas in the sensitivity map are adhered to, the specialist is of the opinion that the proposed Kuruman Phase 1 wind energy may be authorised.

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