**SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD**

# Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province

Draft Environmental Impact Assessment Report

| | |
|---|---|
| **DEA Reference:** | **14/12/16/3/3/2/1018** |
| **Issue Date:** | 31 October 2017 |
| **Version No.:** | **1.0** |
| **Project No.:** | 13622 |

| | |
|---|---|
| **Date:** | 31 October 2017 |
| **Document Title:** | Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province: Draft Environmental Impact Assessment Report |
| **Author:** | **Stephan Jacobs**<br>B.Sc. (Hons) Environmental Management & Analysis (UP)<br>BSc Environmental Sciences (UP)<br>**Shaun Taylor**<br>BA Geography and Environmental Science<br>BSc (Hons) Geography and Environmental Studies<br>MSc Aquatic Health |
| **Version Number:** | 1.0 |
| **Checked by:** | **Andrea Gibb**<br>B.Sc. (Hons) Environmental Management (UNISA)<br>BSc Landscape Architecture *Cum Laude* (UP) |
| **Approved:** | Tarryn Curtis |
| **Signature:** | |
| **For:** | SiVEST Environmental Division |

# KEY PROJECT INFORMATION

| FARM DESCRIPTION | 21 DIGIT SURVEYOR GENERAL CODE |
|---|---|
| Entire part of Portion 2 of the Farm Georg's Vley No. 217 | C01500000000021700002 |

| !XHA BOOM WIND FARM: APPLICATION SITE | | |
|---|---|---|
| **CORNER POINT COORDINATES** | | |
| **POINT** | **SOUTH** | **EAST** |
| XW_01 (NW) | S30° 16' 50.056" | E19° 13' 55.084" |
| XW_02 (NE) | S30° 15' 14.650" | E19° 17' 53.313" |
| XW_03 (SE) | S30° 21' 22.040" | E19° 16' 8.738" |
| XW_04 (SW) | S30° 19' 30.216" | E19° 14' 19.283" |
| **CENTRE POINT COORDINATES** | | |
| **POINT** | **SOUTH** | **EAST** |
| XW_05 | S30° 18' 2.587" | E19° 15' 47.612" |

| ENVIRONMENTAL BUILDABLE AREA | | | |
|---|---|---|---|
| **PHASE** | **AREA (HECTARES)** | **CENTRE POINT COORDINATES** | |
| | | **SOUTH** | **EAST** |
| !XHA BOOM WIND DEVELOPMENT AREA | 1988.5 | S30° 18' 1.765" | E19° 16' 5.680" |

The above-mentioned environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's buildable area proposed for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildbale area.

| !XHA BOOM WIND: COMPONENTS | |
|---|---|
| **CENTRE POINT COORDINATES (DD MM SS.sss)** | |
| **COMPONENT** | **OPTION 1** |
| SUBSTATION | S30° 17' 41.614" |
| | E19° 16' 50.509" |

Refer to **Appendix 9A** for the full list of coordinates.

**TITLE DEEDS**: These will be included in the Final Environmental Impact Assessment Report (FEIAr)

**PHOTOGRAPHS OF SITE**:

General Characteristics of the study area

**TYPE OF TECHNOLOGY**: Wind Turbines and associated infrastructure

**STRUCTURE HEIGHT**: Hub height up to 160m[1], and rotor diameter up to 160m.

**SURFACE AREA TO BE COVERED**: The total area of the application site is 3804 hectares (ha). The total environmental buildable area for the proposed !Xha Boom Wind Farm is approximately 1988.5 ha. It should be noted that the above-mentioned environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's buildable area proposed for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildbale area. The area occupied by each wind turbine will be up to 0.5 hectares (85m x 60m). This includes the hard standing area / platform of approximately 2 400m² (60m x 40m) per turbine that will be required for turbine crane usage. The temporary construction lay-down / staging area will be approximately 10 000m² and will include an access road and contractor's site office area of up to 5 000m². The administration and warehouse buildings will have a footprint of approximately 5 000m². Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of the proposed internal access roads will be reduced to approximately 6-8m for maintenance purposes during

[1] The AW125/3000 wind turbine generator which has a hub height of 100m, a rotor diameter of 125m and an output of 3MW was used to assess the Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI). Forty seven (47) turbines with a hub height of 150m was used during the calculations as requested by Mainstream. It should be noted that a more suitable turbine with different specifications may be available once the proposed wind farm is ready for construction. As such, turbines with a hub height of up to 160m and a rotor diameter of up to 160m will need to be authorised. A more accurate path loss and risk assessment cannot be re-done until the turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from Interference Testing and Consulting Services (Pty) Ltd (ITC) confirming this has been included in this Draft Environmental Impact Assessment Report (DEIAr) in **Appendix 9C**.

the operational phase. In addition, the internal access roads will include the net load carrying surface excluding any V drains that might be required. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project, after the project has been selected as a Preferred Bidder project under the Department of Energy's (DoE) Renewable Energy Independent Power Producers Procurement Programme (REIPPPP).

**TURBINE DESIGN**: The final design is not available but average specifications are presented below:

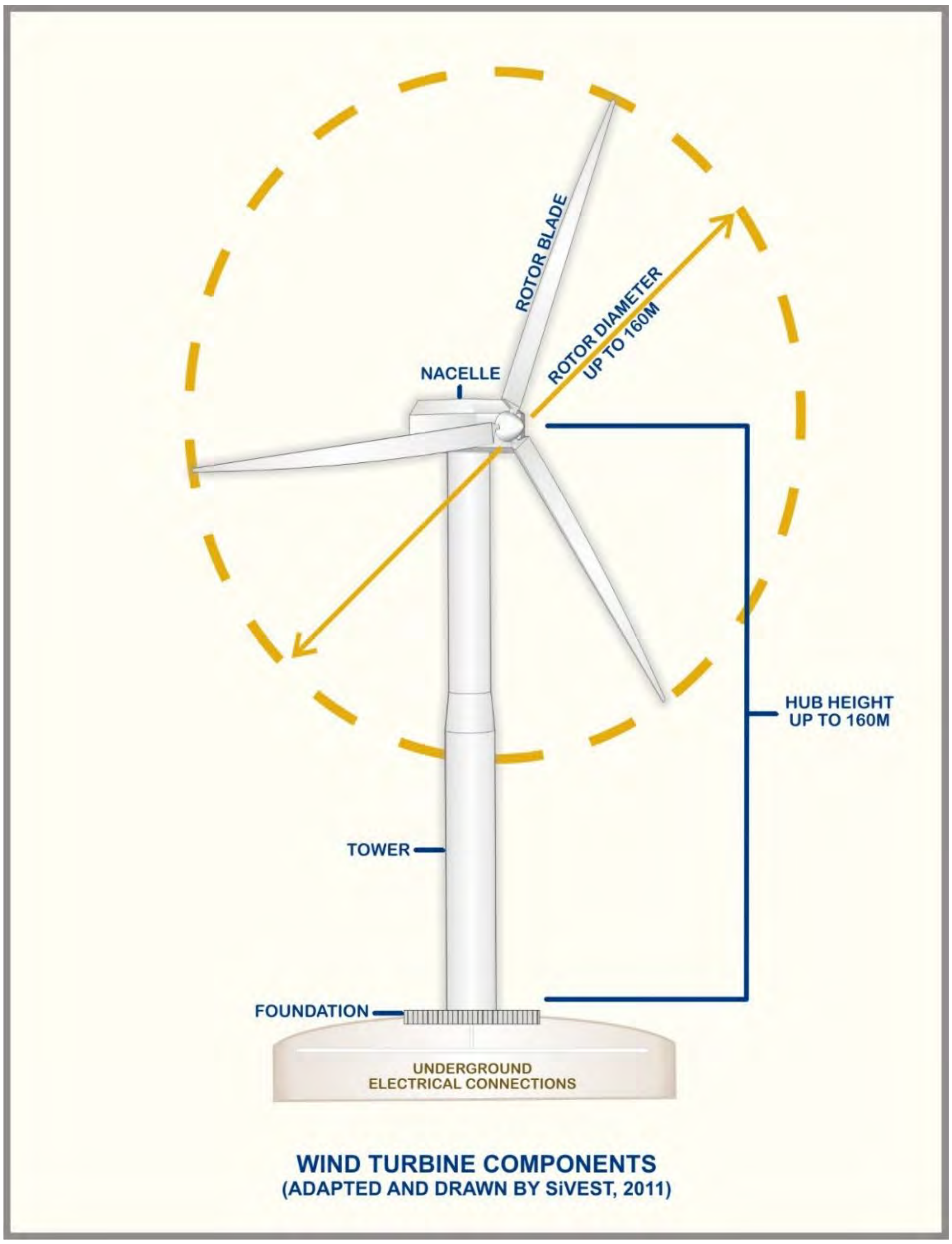



**Figure i:** Example of a Wind Turbine

**STRUCTURE ORIENTATION**: Wind Turbines - The turbine blades will not be fixed and will be able to rotate in order to catch the prevailing winds.

**FOUNDATION DIMENSIONS:** Each wind turbine, depending on geotechnical conditions, will have a foundation diameter of up to 35m, and will be approximately 3m deep. The hardstand area occupied by each wind turbine will be up to 0.5 hectares (85m x 60m). The excavation area, depending on geotechnical conditions, will be approximately 1 000m² in sandy soils due to access requirements and safe slope stability requirements. An area / platform of approximately 2 400$m^2$ (60m x 40m) per turbine will be required for turbine crane usage within the hardstand area.

**EXPORT CAPACITY**: The project will have a maximum export capacity of up to 235MW. The proposed wind farm will consist of up to 47 turbines, each with a generation capacity between 4MW and 8MW.

**TECHNCIAL DETAILS:**

| **Project Name** | **DEA Reference** | **Farm name and area** | **Technical details and infrastructure necessary for the proposed project** |
|---|---|---|---|
| !Xha Boom Wind Farm | 14/12/16/3/3/2/1018 | ▪ Entire part of Portion 2 of the Farm Georg's Vley No.217<br><br><u>Development Area:</u><br>**3804 ha**<br><br><u>Total Environmental Buildable Area:</u><br>**1897.20 ha** | ▪ Up to **47 wind turbines**, between 4 and 8MW, with a maximum export capacity up to 235MW.<br>▪ Wind turbines will have a hub height of up to 160m and a rotor diameter of up to 160m[1].<br>▪ **132kV on-site !Xha Boom IPP Substation**<br>▪ The turbines will be connected via **medium voltage cables** to the proposed 132kV on-site !Xha Boom IPP Substation**.**<br>▪ Internal **access roads** are proposed to be up to 20 m wide. This would however only be for the construction phase after which the width of the internal access roads will be reduced to 6 - 8m during the operational phase.<br>▪ A temporary construction **lay down area.**<br>▪ A **hard standing area / platform** per turbine.<br>▪ The **operations and maintenance buildings**, including an on-site spares |

| | | | |
|---|---|---|---|
| | | | storage building, a workshop and an operations building.<br>▪ **Fencing** (if required) will be up to 5m where required and will be either mesh or palisade. |

A3 Maps of all smaller maps included in the report are included in **Appendix 5**.

**ON-SITE MEASURED WIND PARAMETERS:** Although this information is considered to be confidential (by the developer) because of its commercial sensitivity, the following information can be provided:

- The project site was chosen based on an in-house study on the wind resource in the broader area;
- The findings of this study were supported by historic data from a local weather station, as well as from the Loeriesfontein and Khobab Met Masts, which have been measuring since 2012;
- Together this research provided a comprehensive macro wind model of the area, which clearly illustrated the preferred site as an optimal site for a wind farm;
- A met mast which was subsequently installed on site has confirmed the expected wind resource to be between 6 and 8m/s; and
- In addition to the wind resource, other key factors which indicated that the site is potentially suitable for a wind farm included but were not limited to proximity to and availability of Eskom grid, site access and constructability, and potential environmental and social sensitivities.

**FUTURE PLANS AFTER DECOMISSIONING / POTENTIAL UPGRADE:** The initial lifespan of the wind farm is proposed to be approximately 20 years, based primarily on the DoE PPA terms. Technically, through suitable maintenance and upgrade activities, the proposed wind farm could run for another 10 to 20 years, should Eskom or the DoE see a need for the continued need for the electricity being generated. The proposed project could also be paired with energy storage systems and potentially contribute to baseload capacity in the country.

Should the project be decommissioned, the farm would be restored to its original state, and as detailed by the EMPr, whereafter it could be returned to use as agricultural land.

Given the limited on-ground footprint of the wind farm infrastructure, essentially the farm could be re-used in various forms, be it upgrading the installed technology or reverting to a new land use.

**INFORMATION ON SERVICES REQUIRED ON THE SITE:** Generally, the final agreements with regards to the services required on the site are only concluded after the proposed project has been selected as a preferred bidder. Mainstream are however in the process of submitting the relevant applications for the services required on site to the relevant municipal departments. Copies of these applications will be included in the FEIAr. In addition, any comments received regarding the applications for the services required on the site will also be included in the FEIR accordingly.

# SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

# PROPOSED CONSTRUCTION OF THE !XHA BOOM WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

# DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

## Executive Summary

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as 'Mainstream') are proposing to construct a wind farm and associated infrastructure near Loeriesfontein in the Northern Cape Province of South Africa (hereafter referred to as the 'proposed development'). The proposed development will consist of a 235MW maximum export capacity wind farm referred to as !Xha Boom Wind Farm. The overall objective of the proposed development is to generate electricity to feed into the National Grid. SiVEST Environmental Division has subsequently been appointed by Mainstream as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed construction of the !Xha Boom Wind Farm and associated infrastructure.

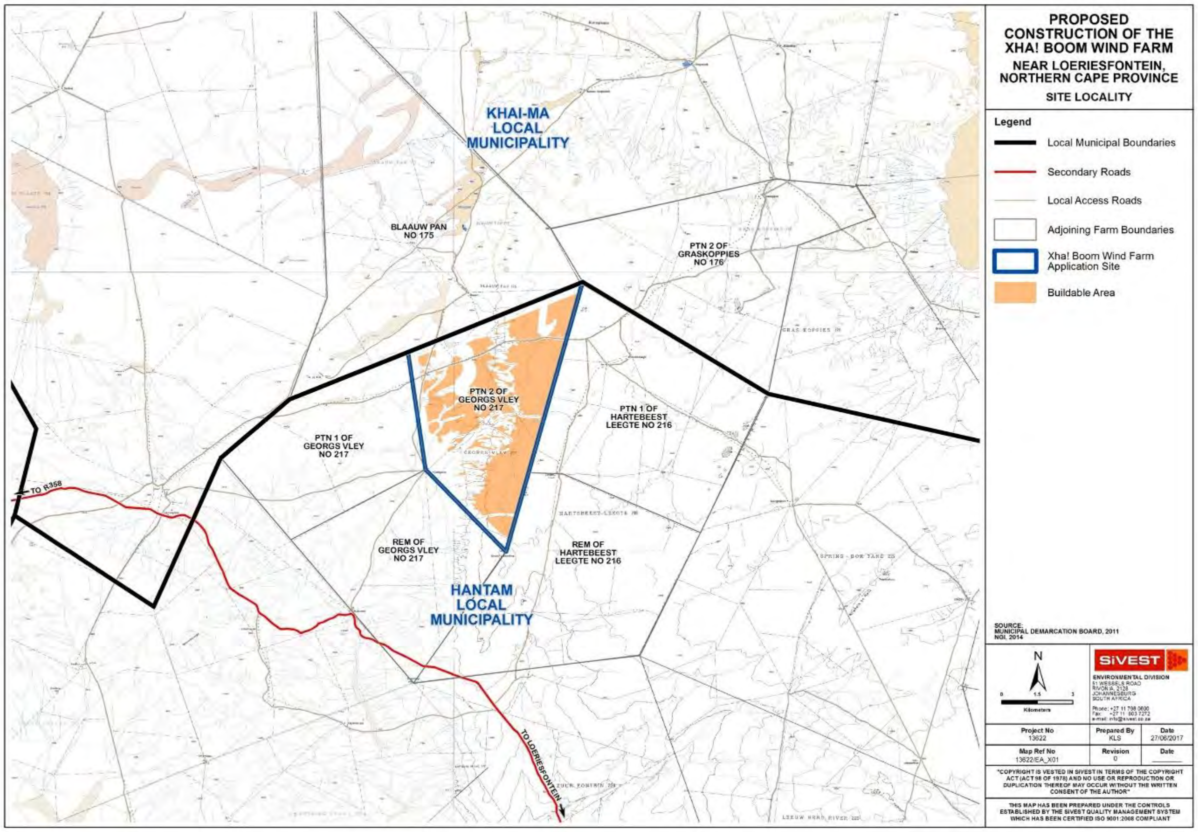



**Figure ii:** Site locality for the proposed !Xha BoomWind Farm

Additionally, Mainstream are proposing to develop the associated on-site !Xha Boom substation and power line to Helios transmission substation, both with a capacity of up to 132kV. This associated electrical infrastructure will however require a separate Environmental Authorisation (EA) and is being conducted as a part of a separate Basic Assessment (BA) process. The 132kV !Xha Boom power line has been included in the wind farm EIA for background information but will be authorised under a separate BA to allow for handover to Eskom. The proposed 132kV on-site !Xha Boom substation will include an Eskom portion and an Independent Power Producer (IPP) portion, hence the on-site substation has been included in the wind farm EIA and in the on-site substation and power line BA to allow for handover to Eskom. Although the wind farm and associated electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider both of the proposed developments. The potential environmental impacts associated with both developments will be assessed as part of the cumulative impact assessment. The DEA reference number allocated for the proposed 132kV on-site !Xha Boom substation and associated 132kV power line has not yet been allocated by the DEA. This will be provided in the Final Environmental Impact Assessment Report (FEIAr).

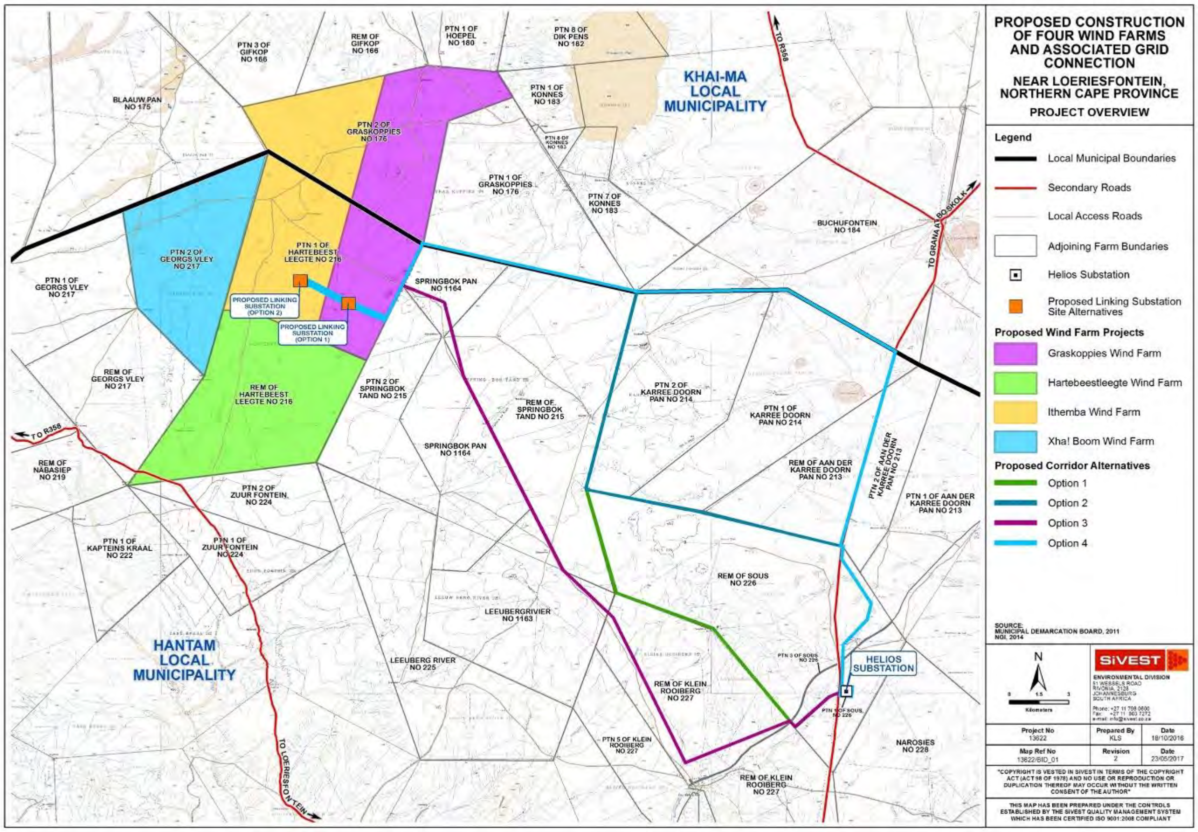



**Figure iii:** Site locality map showing all Mainstream Wind Farm and Electricity Eeneration (on-site IPP substation and 132kV power line) projects being proposed near Loeriesfontein in the Northern Cape Province as part of recent applications

| ENVIRONMENTAL BUILDABLE AREA | | | |
|---|---|---|---|
| **PHASE** | **AREA (HECTARES)** | **CENTRE POINT COORDINATES** | |
| | | **SOUTH** | **EAST** |
| !XHA BOOM WIND BUILDABLE AREA | 1988.5 | S30° 18' 1.765" | E19° 16' 5.680" |

The above-mentioned environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's buildable area proposed for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildbale area.

| **!XHA BOOM WIND: COMPONENTS** | |
|---|---|
| **CENTRE POINT COORDINATES (DD MM SS.sss)** | |
| **COMPONENT** | **OPTION 1** |
| SUBSTATION | S30° 17' 41.614" |
| | E19° 16' 50.509" |

Refer to **Appendix 9A** for the full project coordinates.

The proposed development requires EA from the Department of Environmental Affairs (DEA). However, the provincial authority will also be consulted (i.e. Northern Cape Department of Environment and Nature Conservation (NC DENC)). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 of the National Environmental Management Act (NEMA), which came into effect on 8 December 2014, and as amended on 7 April 2017. In terms of these regulations, a full EIA is required for the proposed development. All relevant legislations and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times.

As previously mentioned, the proposed development involves the construction of a 235MW maximum export capacity wind farm (referred to as !Xha Boom Wind Farm) and associated infrastructure. Various environmental specialists assessed the site during the scoping phase. Their assessments encompassed the entire proposed development site and included the identification of sensitive areas. These sensitive areas were used during the scoping phase to perform a preliminary comparison of layout alternatives. These layouts were then extensively investigated in the EIA phase of the project and sensitive areas were identified by the specialists. These are illustrated below:

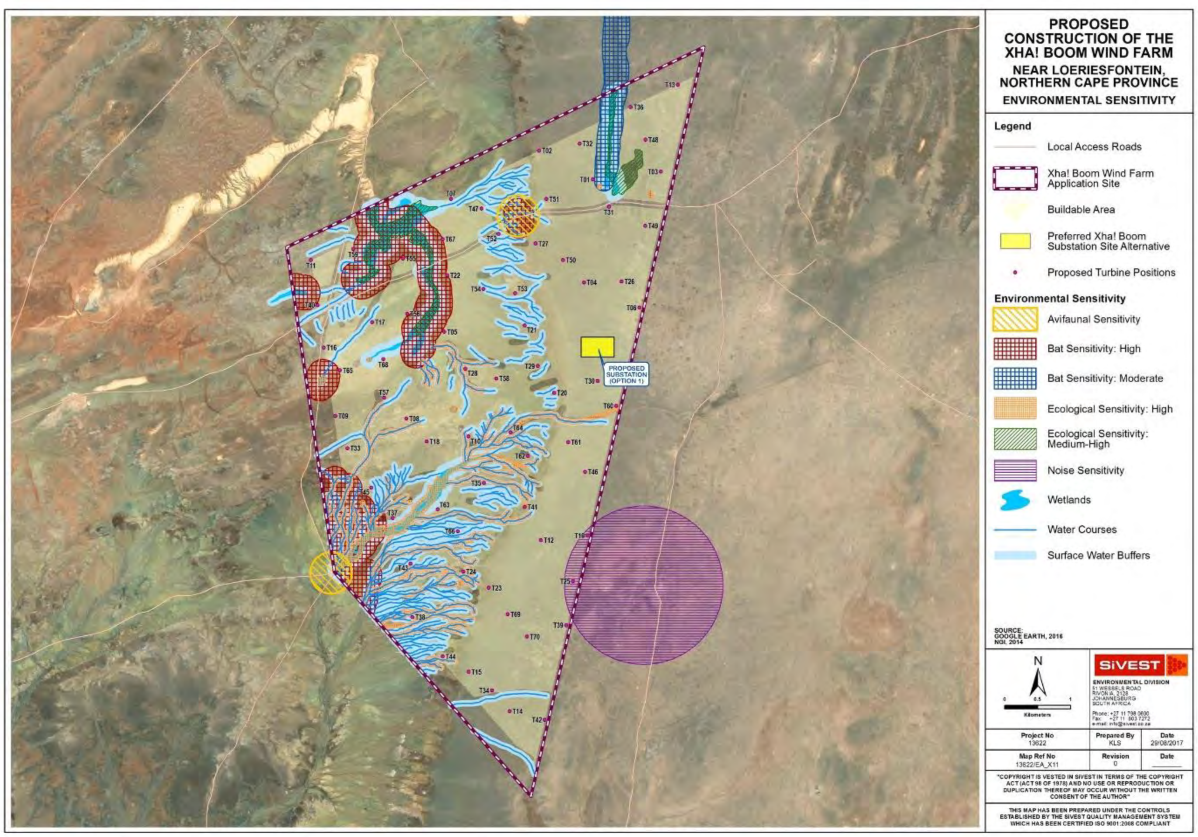



**Figure iii:** !Xha Boom Wind Farm EIA Phase Layout Alternatives in relation to Environmental Sensitive Areas

The study site is bisected by a ridgeline which runs from south to north along the entire length of the study site. To the east of the ridgeline, is a higher plateau area that gently undulates. From the ridgeline, going westwards, the terrain slopes generally to the south west into a wide floodplain area that contains a myriad of drainage lines comprising part of a greater network of channels. The channel network eventually drains into the Sandkraal watercourse approximately 6km to the south west of the study site. There is a slight watershed within the wide floodplain area located in the northern area of the study site. Here, the drainage lines flow generally in a northerly direction towards a larger major drainage line which eventually flows off-site.

Specialist studies were conducted for the following environmental parameters, as part of the EIA phase and as stipulated in the Plan of Study for EIA:

- Biodiversity Assessment (fauna and flora);
- Avifauna Assessment (including pre-construction monitoring);
- Bat Assessment (including pre-construction monitoring);
- Surface Water Impact Assessment;
- Soils and Agricultural Potential Assessment;
- Noise Assessment;
- Visual Impact Assessment;
- Heritage Assessment;
- Socio-economic Impact Assessment;
- Geotechnical Assessment;
- Traffic Impact Assessment; and
- Path Loss and Risk Assessment in terms of the Square Kilometre Array (SKA).

It should be noted that the specialists originally assessed a hub height of up to 150m and rotor diameter of up to 150m. Prior to submission of the application form however, the hub height was amended to be up to 160m and a rotor diameter of up to 160m.

**Table i:** Summary of findings

| Environmental Parameter | Summary of major findings | Recommendations |
|---|---|---|
| Biodiversity | The Xha! Boom Wind Farm consists largely of arid shrublands or grasslands on flat plains and gently sloping hills that are low sensitivity, with few species of conservation concern present. Development in these areas would generate low impacts of local significance only.<br><br>The only sensitive feature present at the site are some minor drainage lines in the southwest and some rocky outcrops along the transitional area between the grasslands of the east and the lower-lying Western Bushmanland Klipveld shrubland of the west. These more sensitive features occupy a small proportion of the site and would not be significantly affected by the development.<br><br>Due to the large number of proposed developments in the area, cumulative impacts are a potential concern. The total extent of habitat loss from all proposed developments in the area represents about 1% of the local area and less than 0.1% of the Bushmanland Basin Shrubland vegetation type. The analysis of cumulative impacts further indicates that the current developments in the area do not pose a risk of significantly impacting the national availability of the affected vegetation units or elevate them to a higher threat status. Overall cumulative impacts from all developments and the contribution of the !Xha Boom Wind Farm to cumulative impact are seen as being acceptable and would remain of low overall significance. | The report concludes that with the application of the recommended mitigation and avoidance measures, the impact of the !Xha Boom Wind Farm can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the wind farm that cannot be reduced to an acceptable level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding. |

| | | |
|---|---|---|
| Avifauna | The proposed Mainstream !Xha Boom Wind Farm will have a variety of impacts on avifauna which range from low to high. The impacts are (1) displacement of priority species due to disturbance during construction phase (2) displacement of priority species due to habitat destruction during construction phase (3) displacement of priority species due to disturbance during operational phase (4), collisions of priority species with the turbines in the operational phase, and (5) electrocution of priority species on the internal MV powerlines.<br><br>Displacement of priority species due to disturbance during construction phase is likely to be a temporary medium negative impact, but can be reduced to low with the application of mitigation measures.<br><br>Displacement of priority species due to habitat destruction during construction phase is likely to be a medium negative impact and will remain so, despite the application of mitigation measures.<br><br>Displacement of priority species due to disturbance during the operational phase is likely to be of low significance and it could be further reduced through the application of mitigation measures, namely the restriction of operational activities to the plant area and no access to other parts of the property unless it is necessary for wind farm related work.<br><br>Collisions of priority species with the turbines in the operational phase are likely to be a high negative impact but | Displacement of priority species due to disturbance during construction phase can be reduced to low with the application of the following mitigation measures:<br>▪ the restriction of construction activities to the construction footprint area, no access to the remainder of the property during the construction period,<br>▪ measures to control noise and dust,<br>▪ maximum use of existing access roads, and<br>▪ the implementation of a 300m exclusion zone around waterpoints.<br><br>Displacement of priority species due to habitat destruction during construction phase is likely to be a medium negative impact and will remain so, despite the application of mitigation measures. Mitigation measures comprise the following:<br>▪ the recommendations of the specialist ecological study must be strictly adhered to,<br>▪ maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum,<br>▪ a 300m exclusion zone should be implemented around the existing water points where no construction activity or disturbance should take place,<br>▪ post-construction monitoring should be implemented to make comparisons with baseline conditions possible, and if densities of key priority species are proven to be significantly reduced due to the operation of the wind farm, the management of the wind farm |

| | | |
|---|---|---|
| | it could be reduced to medium negative through the application of mitigation measures.<br><br>The electrocution of priority species on the internal MV powerlines is rated as a potentially medium impact which could be reduced to low through the use of bird friendly designs.<br><br>Finally, it is concluded that, after taking into account the expected impact of proposed renewable energy projects within a 40km radius around Helios MTS, that the cumulative impact of the proposed !Xha Boom WEF on priority avifauna, if appropriate mitigation is implemented, will range from minor to insignificant. | must be engaged to devise ways of reducing the impact on these species.<br><br>Displacement of priority species due to disturbance during the operational phase could be further reduced through the application of mitigation measures, namely the restriction of operational activities to the plant area and no access to other parts of the property unless it is necessary for wind farm related work.<br><br>Collisions of priority species with the turbines in the operational phase could be reduced to medium negative through the application of the following mitigation measures:<br>▪ A 300m no-go buffer is proposed around water points as they serve as focal points for bird activity,<br>▪ formal monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the best practice guidelines (as an absolute minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in year 5, and again every five years thereafter),<br>▪ the minimum turbine tip height should ideally be no less than 50m to reduce the risk of Red Lark mortality during display flight activity,<br>▪ depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, |

| | | |
|---|---|---|
| | | including selective curtailment of problem turbines during high risk periods if need be,<br>▪ if turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations),<br>▪ lighting of the wind farm (for example security lights) should be kept to a minimum, and lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).<br><br>The electrocution of priority species on the internal MV powerlines could be reduced to low through the use of bird friendly designs.<br><br>Finally, it is concluded that, after taking into account the expected impact of proposed renewable energy projects within a 40km radius around Helios MTS, that the cumulative impact of the proposed !Xha Boom WEF on priority avifauna, if appropriate mitigation is implemented, will range from minor to insignificant. |
| Bats | The site was visited over the period of November 2015 to December 2016 wherein data was collected from the five 10m mast and one meteorological mast, where after the systems were decommissioned. The long-term data was analysed by means of identifying the bat species detected by the monitoring systems and the periods of high bat activity. | General mitigation measures include the following:<br>▪ Adhere to the sensitivity map during turbine placement.<br>▪ If a bat roost is discovered close to a turbine position during construction, and if blasting is required, a bat specialist should be consulted before the blasting occurs. |

| | | |
|---|---|---|
| | A number of technical failures occurred with the monitoring systems. The failures should not compromise the study since an adequate amount of data was recorded during the 12 months.<br><br>*Tadarida aegyptiaca* is the most abundant bat species recorded by all systems. Common and abundant species, such as *Neoromicia capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis*, are of a larger value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species due to their higher numbers.<br><br>*Miniopterus natalensis* is the only migratory species detected on site. It was detected by all the monitoring systems, with Short Mast 3 detecting the highest number of passes. The results of the full 12 months monitoring study were analysed for the presence of a migratory event in order to determine whether the site is located within a migratory route. There were no signs and activity levels indicative of a migratory event however, an event may occur in the future and the Operational Phase Bat Monitoring Study must be designed such that a migratory event would be detected if it occurred.<br><br>Met Mast monitoring system indicates the highest amount of bat passes, followed by Short Mast 3.<br><br>The average nightly bat passes per month is used to show the general trend in bat activity across the different month of the year. All the masts show higher bat activity from January | ▪ Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles.<br>▪ Damaged areas not required after construction should be rehabilitated by a vegetation succession specialist.<br>▪ Adhere to the sensitivity maps. Avoid areas of high bat sensitivity and their buffers as well as preferably avoid areas of Moderate bat sensitivity and their buffers.<br>▪ Adhere to operational mitigation measures described in Section 1 of the Bat specialist's comment letter on the final turbine layout.<br>▪ An operational phase bat monitoring study must be implemented as soon as the facility has been constructed.<br>▪ Utilize lights with wavelengths that attract less insects (low thermal/infrared signature).<br>▪ If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors.<br>▪ Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or large vehicles and keep to designated roads with all large vehicles.<br>▪ Damaged areas not required after decommissioning should be rehabilitated by a vegetation succession specialist.<br>▪ It is essential that project specific mitigations be applied and adhered to for each project, as there is no |

| | | |
|---|---|---|
| | to April with predominant peaks for the month of March, except for Short Mast 4 which has a peak in January 2016, except for Short Mast 2 which was not recording during January as explained above. Bat activity decreased as the seasons changed into winter. An increase in bat activity, for all the monitoring systems, occurred again from August to November as the seasons changed from winter to spring.<br><br>A sensitivity map was drawn up indicating potential roosting and foraging habitat. The High Bat Sensitivity areas are expected to have elevated levels of bat activity and support greater bat diversity. High Bat Sensitivity areas are 'no – go' areas due to expected elevated rates of bat fatalities due to wind turbines. The layout has been amended by the proponent to ensure that no turbines are located within High or Moderate sensitivities or their buffers.<br><br>Peak activity times across the night and monitoring period were identified, as well as wind speed and temperature parameters during which most bat activity was detected. | overarching mitigation that can be recommended on a regional level due to habitat and ecological differences between project sites.<br>▪ Adhere to the sensitivity map during any possible further turbine layout revisions.<br><br>It is recommended that curtailment be applied from the start of operation at Level 3 on all turbines for every night from dusk until dawn, from 1 August to 30 April every year (thus months of May, June and July are excluded).<br><br>Should robust and scientifically defendable data gathered during the operational study phase reveal higher bat mortalities than currently anticipated, the mitigations in **Table 161** should be applied to the turbines identified as causing the highest impacts. Such curtailment specified in **Table 161** will have to be at a maximum of Level 5.<br><br>**Table 161** is based on the passive data collected. It infers mitigation be applied (only when needed as described in the table) during the peak activity periods and times specified in the table, and when the advised wind speed and temperature ranges are prevailing simultaneously, considering conditions in which 80% of bat activity occurred (normalised data). Bat activity at 80m height were used, with wind speed data at 61m and temperature data at 40m. |
| Surface Water | Findings from the fieldwork undertaken show that the following surface water resources were identified on the study site: | General mitigation measure include the following:<br>▪ Designation of Highly Sensitive Areas.<br>▪ Establishment of Internal Road Crossing Areas. |

| | | |
|---|---|---|
| | ▪ Two (2) Depression Wetlands;<br>▪ Three (3) Major Drainage Lines (drainage lines with channel width >5m);<br>▪ Two hundred and thirty, seven (237) Drainage Lines (drainage lines with a channel width <5m).<br><br>An ecological buffer zone of 100m for major drainage lines and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied to protect the above surface water resources. These buffer zones have been implemented to provide additional safety against the potential direct and indirect impacts on the drivers (hydrology, soils, water quality, biota and habitat) of the hydrological systems that may occur in the construction and operation phases of the proposed development.<br><br>No comparative assessment was undertaken as no alternative layouts have been proposed.<br><br>It was identified that several potential impacts may affect the surface water resources within the proposed development area during the construction, operation and decommissioning phases as alluded to above. These include the following:<br>▪ Impacts to Surface Water Resources Habitat during construction;<br>▪ Impacts to the Geomorphology of Surface Water Resources during construction;<br>▪ Impacts to the Fauna associated with Surface Water Resources during construction; | ▪ Control of Alien and Invasive Vegetation in Surface Water Resources<br>▪ Avoidance of Direct Impact to Delineated Surface Water Resources.<br>▪ Emergency Measures.<br>▪ Post-construction Rehabilitation.<br>▪ Buffer Zone Specific Mitigation Measures.<br><br>Specialist recommendations include the following:<br>▪ All surface water resources and buffer zones must be avoided as far as practically possible in the layouts (including road access and service roads) to be designed in order to minimise and potentially avoid potential impacts as far as possible.<br>▪ Where it is not possible to avoid impacts to surface water resources as a result of roads, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.<br>▪ All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.<br>▪ With implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding road design) and therefore, may by environmentally authorised. |

| | | |
|---|---|---|
| | ▪ Impacts to the Geomorphology of Surface Water Resources during operation; and<br>▪ Impacts to the Hydrology of Surface Water Resources during operation.<br><br>It is not anticipated that the proposed development will need to be decommissioned. Should this need to take place, the same impacts as identified for the construction phase of the proposed development can be anticipated. Hence, the same impacts are expected to occur and the stipulated mitigation measures where relevant must be employed to minimise impacts.<br><br>Potential cumulative impacts were assessed given that numerous proposed and currently constructed renewable energy developments can be found in the surrounding area. As such, it was found that from a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a considerable distance between the proposed development and the nearest surrounding development. The two sites are also separated by two low ridges that act as watersheds and occupy separate local catchments. Drainage from the proposed development is in | |

| | | |
|---|---|---|
| | a western direction, whilst drainage for the Kokerboom 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible due to distance from each project site and no site specific loss of surface water resources, as stated above.<br><br>In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2017), as no specific road layout was available at this time, it has been provisionally identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to potential direct impacts due to roads, thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that there are a number of surface water resources which may be affected by roads and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. Additionally however, if it can be determined that the proposed development will be associated with a LOW risk as per the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229), it may be possible that General Authorisation can be | |

| | | |
|---|---|---|
| | issued. The applicability of these water uses and the relevant licensing process can however only be confirmed once a more detailed layout containing road infrastructure is available. | |
| Soils and Agricultural Potential | The proposed development is on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed site is on land which is of extremely low agricultural potential, and which is only suitable as grazing land.<br><br>The key findings of this study are:<br><br>▪ Soils across the site are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms.<br>▪ The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils.<br>▪ As a result of these limitations, the site is unsuitable for cultivation and agricultural land use is limited to low intensity grazing.<br>▪ The land capability is classified as Class 7 - non-arable, low potential grazing land. The site has a very low grazing capacity of 45 hectares per large stock unit.<br>▪ There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.<br>▪ The significance of all agricultural impacts is kept low by two (2) important factors. The first is that the actual footprint of disturbance of the wind farm is very small in | ▪ The following mitigation measures were recommended:<br>o Implement an effective system of storm water run-off control;<br>o Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas;<br>o Control dust through appropriate dust suppression methods;<br>o Strip and stockpile topsoil before disturbance and re-spread it on the surface as soon as possible after disturbance;<br>o Manage any sub-surface spoils from excavations in such a manner that they will not bury the topsoil of agricultural land;<br>o Minimise road footprint and control vehicle access on designated roads only; and<br>o Implement effective spillage and waste management system.<br><br>▪ There are no conditions resulting from this assessment that need to be included in the environmental authorisation. |

| | | |
|---|---|---|
| | relation to the available grazing land. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing.<br>▪ Six (6) potential negative impacts of the development on agricultural resources and productivity were identified as:<br>○ Loss of agricultural land use caused by direct occupation of land by the energy facilities' footprint.<br>○ Soil Erosion caused by alteration of the surface characteristics.<br>○ Generation of dust caused by alteration of the surface characteristics.<br>○ Loss of topsoil in disturbed areas, causing a decline in soil fertility.<br>○ Degradation of surrounding grazing land due to vehicle trampling.<br>○ Soil contamination from hydrocarbon spills during construction.<br>▪ Two (2) potential positive impacts of the development on agricultural resources and productivity were identified as:<br>○ Generation of additional land use income through renting land for energy generation which makes a positive contribution to farming cash flow and thereby improves the financial sustainability of farming on site.<br>○ Increased security against stock theft due to the presence of the energy facility. | |

| | | |
|---|---|---|
| | ▪ All impacts were assessed as having low significance.<br>▪ Because of the low agricultural potential, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development. This includes cumulatve agricultural impact.<br>▪ Cumulative impact is also assessed as low. Furthermore it is 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.<br>▪ There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts. | |
| Noise | **<u>Baseline Assessment:</u>**<br>Daytime measured data indicate an area with elevated noise levels, but, considering the spectral data and sounds heard, these sounds are mainly due to natural activities (wind-induced). Night-time measurements indicated a very quiet environment, even with low winds (around 0 – 2 m/s). Considering the measurements, and measurements conducted in the last few years in similar environments, acceptable rating levels for the area would be typical of a rural noise district.<br><br>There is a high confidence in the ambient sound levels measured and the subsequent Rating Levels determined. For the purpose of this Environmental Noise Impact Assessment study, the strictest rating level (rural) will be | **<u>Management and Mitigation of Noise Impact:</u>**<br>There is a potential for a noise impact of medium significance during the construction phase due to the development of access roads as well as construction traffic (especially at night). It will be easily mitigated if the access roads are planned further away from the potential noise-sensitive receptors, with the recommendations including amongst others:<br>▪ planning construction activities (road construction) close to the dwellings of potential noise-sensitive receptors during periods they are not using their dwellings for residential purposes;<br>▪ locating the contractors camp and storage areas at locations where construction traffic will pass occupied dwellings minimally; |

| | | |
|---|---|---|
| | used as defined in SANS 10103:2008 (35 dBA at night, 45 dBA during the day) for all the receptors living in the area.<br><br>**Need and Desirability of Project:**<br>The proposed project will not raise the noise levels at the potential noise-sensitive developments in the area. The project in addition will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa. People in the area that are not directly affected by increased noises will have a positive perception of the project and will see the need and desirability of the project.<br><br>**Findings of Assessment:**<br>This assessment indicates that the proposed project could have a noise impact on the surrounding area, as there are noise-sensitive developments within the (potential) area of acoustical influence of the construction activities.<br><br>The construction of access roads as well as construction traffic may increase the noise levels sufficiently to result in noise impacts of medium significance (especially at night). Mitigation measures are available and easy to implement to reduce the potential significance of the noise impact to low.<br><br>There is slight potential for a noise impact during the operational phase but this assessment determined the significance to be low. | ▪ relocating access roads further from houses. To minimize noise levels below a low significance ensure that roads are further than 220m from dwellings used for residential purposes during the construction period if only daytime construction activities are proposed. Due to the low ambient sound levels, it is highly recommended that no construction activities are allowed within 580m from occupied dwellings if night-time construction activities are anticipated. This includes construction of roads, power line pylons or construction of wind turbines;<br>▪ ideally, do not allow construction traffic to drive past dwellings used for residential purposes at night. If people, material or equipment must be moved at night, no traffic should be allowed closer than 250m from receptors. Minimize night-time traffic as much as possible. If significant traffic (more than 10 vehicles per hour) is anticipated at night, access roads must be located further than 580m from receptors.<br><br>**Recommendations:**<br>There is a high confidence in the findings of this report and the project can be authorized from a noise perspective, subject to the implementation of the recommendations contained in the Noise Impact Assessment Report. |

| | | |
|---|---|---|
| | **<u>Management and Mitigation of Noise Impact:</u>**<br>There is a potential for a noise impact of medium significance during the construction phase due to the development of access roads as well as construction traffic (especially at night). The operational noise impact would be of a low significance for all identified receptors in the vicinity of the !Xha Boom WF. Mitigation is not required, but due to the significant number of wind turbines operating in the area there exists a potential for cumulative noises. | |
| Visual | Due to the dominant livestock (i.e. sheep) rearing practices and relatively limited human habitation in the surrounding area, no sensitive visual receptors (such as Guesthouses and other tourism facilities) were identified within the study area. It was however ascertained that the proposed !Xha Boom Wind Farm development is likely to visually impact f our (4) farmsteads / homesteads identified within the visual assessment zone. These farmsteads / homesteads are used to house the local farmers as well as their farm workers and are thus regarded as <u>potentially</u> sensitive visual receptor locations, as the impact on them would be subjective and is relative to the perceptions of the viewer. Addtioanlly, there are no visually sensitive roads within the study area.<br><br>The impact assessment revealed that overall the proposed !Xha Boom Wind Farm is expected to have a low negative visual impact during construction (Pre-mitigation rating of -24) and a medium negative visual impact during operation (Pre-mitigation rating of -38), with relatively few mitigation measures available. In addition, the infrastructure associated | It is recommended that all mitigation measures should be implemented. |

| | | |
|---|---|---|
| | with the proposed !Xha Boom Wind Farm would have a low negative visual impact during both construction (Pre-mitigation rating of -22) and operation (Pre-mitigation rating of -26). The impact assessment further revealed that the cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby would have a medium negative visual impact rating during both construction (Pre-mitigation rating of -32) and operation (Pre-mitigation rating of -40).<br><br>It should be noted that, based on the findings from the various specialist scoping phase assessments it was recommended that only Substation Option 1 be taken through to the EIA phase. As such, only Substation Option 1 was assessed during the EIA phase from a visual perspective and a comparative assessment of alternatives was thus not necessary.<br><br>Several renewable energy developments (both wind and solar) are being proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site. A cumulative impact assessment, including a literature review of other other visual impact assessments / studies conducted for the other renewable energy developments being proposed and/or constructed in the area was undertaken. It was determined that the greatest cumulative impact will be experienced from VR 13 as this potentially sensitive receptor location could potentially be visually exposed to the proposed Graskoppies, Hartebeest Leegte and Ithemba Wind Farms, in addition to the proposed !Xha Boom Wind | |

| | | |
|---|---|---|
| | Farm, should they all be constructed. The literature review revealed that the mitigation measures and recommendations provided in this report are similar to those identified in the other visual impact assessments / studies and are therefore deemed to be acceptable. A few additional recommendations and/or mitigation measures have however been included by the other visual specialist assessments and have thus been considered and implemented in this report in order to ensure that all visual impacts are adequately investigated and addressed.<br><br>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. The visual impact of the proposed development on half the potentially sensitive visual receptors identified within the study area was rated as being medium, while the visual impact on the other half of the potentially sensitive visual receptors was rated as being high. 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. | |
| Heritage | The HSR completed in October 2016 has shown that the proposed !Xha Boom site to be developed as a WEF may have heritage resources present on the property. This has been confirmed through archival research and evaluation of aerial photography of the sites.<br><br>The subsequent field work completed for the October 2016, has confirmed the presence of 3 heritage resources as well | The mitigation measures proposed are as follows:<br><br>**<u>Pre-Construction:</u>**<br>1. A walk down of the final layout to determine if any significant sites will be affected.<br>2. Monitor find spot areas if construction is going to take place through them. |

| | | |
|---|---|---|
| | as several areas with existing infrastructure such as fenced off camps, windmills and reservoirs.<br><br>No identified heritage resources are affected by the proposed WEF layout and the impact assessment tables are based on this fact.<br><br>The design process and methodology followed by the developer for this project will enabled the heritage assessment to provide input into the proposed layouts. This resulted in cognisance being taken of the positions of the heritage resources and thus the reduction of impacts at an early design phase.<br><br>**Palaeontology:**<br>In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.<br><br>**Cumulative Impact**<br>It is the heritage specialist's considered opinion that this additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate. | 3. A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. Possible surface collections for sites with a medium to high significance as well as conducting a watching brief by heritage practitioner during the construction phase.<br><br>**Palaeontology:**<br>In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.<br><br>However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably in situ) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.<br><br>The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. |

| | | |
|---|---|---|
| Palaeontology (Desktop) | The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian rocks of the lower part of the Ecca Group (Karoo Supergroup). This include the Prince Albert, Whitehill and Tierberg Formations (in order of decreasing age). Permian and Jurassic bedrocks are mantled with a range of superficial deposits, mostly Late Caenozoic (Quaternary to Recent) in age. The intrusive Karoo dolerites are of no direct palaeontological significance and the Late Caenozoic superficial deposits are generally of very low palaeontological sensitivity.<br><br>The Dwyka Group is known for trace fossils, organic-walled microfossils, marine invertebrates fish and vascular plants. Fossil material of aquatic vertebrates (fish, mesosaurid reptiles,) invertebrates (*e.g.* crustaceans) and petrified wood is known from the Whitehill Formation. These fossils are more scarce in the Prince Albert and Tierberg Formations. However, fossils other than trace assemblages are generally scarce and most of the Dwyka and Ecca sediments are of low overall palaeontological sensitivity.<br><br>The proposed Leeuwberg wind farm development is thus unlikely to pose a substantial threat to local fossil heritage. In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary. | Pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.<br><br>However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist.<br><br>The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. |
| Socio-economic | Relevant national, provincial, and local government policies reveal that the development of RE technologies is strongly | Considering that a number of other similar facilities has already been proposed for the establishment in the same |

| | | |
|---|---|---|
| | supported by government. It is seen as the means to diversify the energy mix in the country, achieve climate change commitments, and stimulate economic development in the country while creating new employment opportunities. Indeed, the assessment of the proposed project revealed that stimulation of the economy, job creation, increased household income, and growing government revenue are among the positive impacts that can ensue from the proposed project during both construction and operational phase. The local municipality is expected to benefit specifically from the proposed development due to its small economic base and a large unemployment rate. However, the project is also expected to result in a number of negative socio-economic impacts, most of which will be applicable to the construction phase only, but could notably worsen the health of the local communities, reduce access to social services and economic infrastructure locally, and increase the incidence of social ills if not adequately mitigated.<br><br>The following positive and negative impacts are expected to take during the construction phase:<br>▪ Temporary employment creation (high +);<br>▪ Skills development and training (high +);<br>▪ Impact on health (medium -);<br>▪ Change in demographics due to migration (medium -);<br>▪ Increase in social pathologies (medium -);<br>▪ Investment in local community (high +);<br>▪ Impact on personal safety and stock theft (low -);<br>▪ Change in sense of place (low -); | local municipality, mitigation of the negative impacts of the project will need to be a prerequisite for its approval. This specifically refers to the mitigations measures proposed to address the potential negative impacts on health, social services, economic infrastructure and crime. |

| | | |
|---|---|---|
| | ▪ Temporary increase in production and temporary stimulation of GDP-R (high +);<br>▪ Demand for social facilities (low -);<br>▪ Added pressure on basic services (low -);<br>▪ Temporary increase in household income (medium +);<br>▪ Establishment of informal hospitality industry (medium +); and<br>▪ Temporary increase in government revenue (medium +).<br><br>The following positive and negative impacts are expected during the operation phase:<br>▪ Sustainable employment creation (low +);<br>▪ Skills development and training (low +);<br>▪ Sustainable increase in production and GDP (medium +);<br>▪ Sustainable increase in household income (low +); and<br>▪ Increase in government revenue (medium +).<br><br>Overall, considering the current knowledge of the socio-economic environment where the proposed project is to be developed and the envisaged socio-economic impacts that could be exerted by the facility during its construction and operation, it can be reasonably concluded that the project should be approved for the development. However, considering that a number of other similar facilities has already been proposed for the establishment in the same local municipality, mitigation of the negative impacts of the project will need to be a prerequisite for its approval. This specifically refers to the mitigations measures proposed to | |

| | | |
|---|---|---|
| | address the potential negative impacts on health, social services, economic infrastructure and crime. | |
| Geotechnical | From a geotechnical perspective, the major findings suggest that the site is relatively flat with local ridges associated with dolerite intrusions. The only prominent hill is Groot Rooiberg, on the southern site boundary. The water table is 10m below the ground level during the winter months and consequently the site is dry throughout the year.<br><br>From the available site information, conditions on the site are generally seen as favourable for the proposed development. However precautionary measures for foundations will have to be incorporated in the design and construction of the proposed development due to the medium hard/ hard excavatability of hardpan (cemented) calcrete, soft rock shale, soft rock dolerite and hard rock shale. Also the instability of excavation side walls within fractured bedrock. | Greening interventions are recommended during construction of the wind farm. These include water and energy related interventions, material re-use and solid waste management. The site, being vacant, currently generates no solid waste and it is proposed that onsite composting, sorting and recycling will reduce the overall volume of waste being collected and removed from the site.<br><br>In addition, precautionary measures for foundations will have to be incorporated in the design and construction of the proposed development due to the medium hard/ hard excavatability of hardpan (cemented) calcrete, soft rock shale, soft rock dolerite and hard rock shale. Also the instability of excavation side walls within fractured bedrock.<br><br>The following recommendations were made:<br>▪ Material for construction purposes must be sourced from site to reduce costs;<br>▪ A detailed Geotechnical and Electrical investigation will be required.<br>▪ A detailed soil chemical analysis and soil resistivity test will also be required.<br>▪ It is recommended that the 400kV connection option be investigated further as a possible grid connection option. This option may be easier to implement although consultation with Eskom will be extensive given that it is a transmission backbone asset. |

| | | |
|---|---|---|
| Traffic | Both the abnormal and legal vehicles were reviewed in terms of their type of activity; i.e. construction traffic, traffic associated with the transportation of the wind turbine components, or traffic associated with the transportation of materials, equipment and people. The key issues associated with the construction and operational phases of the project that will be assessed as part of the transport study include:<br><br>▪ Increase in traffic generation throughout the lifetime of the project;<br>▪ Increase in road maintenance required; and<br>▪ Ability to transport wind turbine components to site safely and efficiently.<br><br>With regards to transport, an assessment was undertaken to determine the impact that the proposed wind farm will have on the operation of the existing road network, both during construction and post completion. It is anticipated that during construction up to 100 vehicles will travel to the site in the morning peak hour, the majority travelling from the proposed construction camp along the R358. In addition, other transportation aspects relating to the proposed project, including access, internal circulation and abnormal vehicle transportation were investigated and form part of this report.<br><br>In summary, the access route (option 4) via the R358 in combination with the N7 is the preferred route both for abnormal vehicles as well as other legal vehicles. Legal vehicle have the added option to utilise the DR2972 (option 2) as an alternative, although allowing multiple site entrances | The report recommends the primary access to the site to be via the R358 which links directly to the N7. This route is appropriate for both standard vehicles as well as abnormal vehicles carrying the wind turbine components.<br><br>Additionally, even though the traffic generated would not be significant, the following requirements should still be met by the developer during the construction phase:<br>▪ All abnormal loads must be transport under a permit;<br>▪ A route study be undertaken to confirm the most appropriate route to site;<br>▪ Dust suppression techniques should be utilised to reduce the impact on air quality for the surrounding area;<br>▪ 4A Traffic Management Plan must be prepared once the Project advances to the preliminary phase. This plan should ensure that vehicles arrive in a dispersed manner throughout the day to reduce the impact to other road users. The plan should also promote the use of car sharing, especially from Loeriesfontein and the construction camp. Methods to improve driver safety should also be outlined, e.g. the use of speed cameras or Average Speed Over Distance (ASOD) cameras along particular sections such as the R358 to Loeriesfontein. |

| | | |
|---|---|---|
| | adds additional security/operational complications which might not be desirable. | |
| Radiation Emissions (SKA) | In order to determine whether the planned wind farm development could have any influence on the Square Kilometre Array (SKA), Mainstream requested a risk evaluation of the planned development to SKA activities. This risk assessment assumes the use of 47 Acciona AW 125 TH100A turbines within the !Xha Boom development and will be compared to known radiated emission data from the AW125 TH100A Acciona WTG as presented in the Acciona Control Plan. The Acciona AW 125 TH 100A is the model within the AW 3000 platform that will be evaluated for this project. This assessment will be updated based on additional measurement results and design information as it becomes available.<br><br>The intent of this evaluation is to ensure that the !Xha Boom facility poses a low risk of detrimental impact on the SKA by using known radiated emission amplitudes of the Acciona AW3000/125 TH100 50Hz wind turbine. Specific mitigation measures to be implemented on the AW3000/125 TH100 50Hz wind turbine in order to achieve 40 dB of attenuation has been reviewed and agreed by SKA South Africa as described in the Acciona Control Plan.<br><br>The current Emission Control Plan for the AW125 TH100A WTG provides for a 40dB reduction in radiated emissions to ensure the cumulative emission level of previously assessed wind farms where the Acciona AW 125 TH100A WTG will be used is within the requirements of SKA. This requirement is | To verify overall wind farm emissions, ambient measurements should be done at the new site before construction starts. Tests points should be carefully selected based on test equipment sensitivity with the objective to observe the increase in ambient emissions as construction progresses. Final site tests will be done on completion of the project to confirm the radiated emission levels. Although not anticipated, proper mitigation measures on identified emitters will be studied and implemented if final test shows emissions exceeding the SKA threshold. |

| | | |
|---|---|---|
| | based on measurements on the Acciona AW 125 TH100A WTG at the Gouda facility in South Africa and Barosoain wind farm, Navarra, Spain. Two WTG locations (WTG 1 and WTG 36) and two SKA installations (Rem Opt 7 and SKA 2377) were used for the evaluation. Due to natural terrain barriers and the 52.6km distance between !Xha Boom and Rem-opt 7, the closest SKA unit, no degradation of performance is expected when the mitigated AW 125 TH100A Acciona turbines are installed[2]. This shown by the 10dB to 20dB higher path loss for !Xha Boom compared to Garob.<br><br>The Karoo area is ideally suited for the installation and commissioning of renewable energy projects, but is also host to the Department of Science and Technology's SKA radio telescope project. Due to the sensitivity of the telescope receivers, there is a risk that unintentional emissions from the systems and associated equipment associated with renewable energy projects will desensitize or saturate the SKA receivers resulting in interference to celestial observations and/or data loss. Such interference is typically referred to as 'Radio Frequency Interference' (or 'RFI'). The NITIA TM-89-139 calculation of 17.9dB (REM OPT 7 location) and 18.4dB (SKA ID 2377 location) to be added to the emissions from a single unit to allow for the cumulative effect of 500 units appears to be conservative when compare | |

[2] Please note that the Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI) studies were based on the currently available worst case scenario turbines. Due to technology improvements a different turbine will be used for the proposed development. The chosen turbine would have to be subjected to the same EMI and RFI studies. As previously mentioned, these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, it is recommended that the DEA include a condition that final modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process as has been done to date.

| | | |
|---|---|---|
| | to general man-made noise data (<10dB increase measured at various locations). The >60 degree beamwidth assumed during the NITIA TM-89-139 calculations will result in over estimation of the cumulative effect due to a higher number of emitters in the beamwidth. The 40dB mitigation is a border line figure when considering all the adjacent projects resulting in a relatively high emitter density.<br><br>It should be noted that the specialist was requested to compile a letter which details the impacts associated with the change in the proposed turbine dimensions from a hub height of up to 150m and rotor diameter of up to 150m, to a hub height of up to 160m and a rotor diameter of up to 160m from an SKA perspective.<br><br>According to the specialist, the risk of interference between wind turbines and the SKA radio telescope is primarily a function of the following factors:<br>▪ Radiated emission amplitude from turbine;<br>▪ Turbine hub height;<br>▪ Number of turbines;<br>▪ Distance between turbine and SKA infrastructure; and<br>▪ Terrain between the turbine and the SKA infrastructure (line of sight or natural barriers between the installations).<br><br>The dB increase in the electromagnetic noise by increasing the number of turbines from 47 units to 70 units can be estimated with the standard 10 x Log (N), where N is the number of turbines, formula as a reasonable assumption. | |

| | | |
|---|---|---|
| | Changing the number of turbines from 47 to 70 will therefor result in a 13.6dB increase in electromagnetic noise.<br><br>Increasing the turbine hub height could result in the nacelle being elevated above the natural terrain barriers that provided a shield between the turbine and the SKA infrastructure at a lower hub height. The change in interference risk profile will have to be re-evaluated if the nacelle height is different from the initial proposed height to verify the line of sight/ terrain shielding conditions.<br><br>Further studies would in any case be required at a later stage once a final turbine type has been confirmed, at this stage all these uncertainties would be clarified. | |

These specialist studies were conducted to address the potential impacts relating to the proposed development that were identified during the scoping phase. An impact assessment was conducted to ascertain the level of each identified impact, as well as mitigation measures which may be required. The potential positive and negative impacts associated within these studies have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed project.

Prior to the submission of the DEIAr, Mainstream intended to construct 70 turbines on the proposed Wind Farm site. However, in order to ensure that the proposed wind farm development avoids the EIA phase sensitive areas and does not result in significant environmental impacts, an alternative turbine layout was put forward for assessment with the total number of turbines being reduced to 47. This design amendment was done taking the environmental considerations into account. In an attempt to show that the new proposed 47 turbine layout will result in lower / fewer environmental impacts and will ultimately be preferred to the 70 turbine layout from an environmental perspective, the new proposed 47 turbine layout was compared to the previously assessed 70 turbine layout by the specialists during the EIA phase (prior to the submission of the DEIAr) and assessed as a design alternative. In light of the above, the specialists were requested to compile letters commenting on the environmental impact of the final proposed 47 turbine layout. These are included along with their respective EIA phase specialist reports in **Appendix 6**.

Based on the above-mentioned specialist comment letters on the final turbine layout, the new proposed 47 turbine layout, using larger turbine capacity, was deemed to be the preferred design alternative from an environmental perspective when compared to the previously assessed 70 turbine layout, with a smaller individual capacity. **Table ii** below highlights the reasons provided by the specialists for preferring the 47 turbine layout over the 70 turbine layout. It should be noted only **Substation Option 1** was assessed by the various specialists during the EIA phase and a comparative assessment of alternatives was subsequently not undertaken as it was recommended that only this layout alternative be taken through to the EIA phase based on the findings from the various specialist scoping phase assessments.

**Table ii:** Alternatives Assessment summarising the reasons provided by the specialists for preferring the 47 turbine layout over the 70 turbine layout

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| **47 TURBINE LAYOUT** | | |
| Biodiversity | PREFERRED | The reduction in the number of turbines from 70 down to 47 is seen as positive as this will reduce noise as well as the overall turbine footprint from the development. In addition, the location of the turbines is considered acceptable and no turbines are located in areas considered to be no-go areas or areas of high sensitivity. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| Avifauna | PREFERRED | The new turbine layout represents a 32.8% reduction in the number of turbines. This is a positive development from a bird impact assessment perspective, as it reduces the risk of priority species collisions and reduces the potential displacement impact of habitat fragmentation. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Bats | PREFERRED | The 47 turbine layout is favourable since it avoids all High and Moderate bat sensitivities and their buffers. Additionally, the presence of less turbines lowers the probability of mortality impacts on bat populations in the greater area. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Surface Water | PREFERRED | Overall, whilst the capacity change of wind turbines from 2 – 5MW to 4 – 8MW, and the change in materials to be used for the wind turbines have no discernible impact on surface water resources, the change in number and distribution of wind turbines have generally resulted in a slight increase in overall construction phase potential impact. However, mitigation measures have been stipulated which will reduce the impact to a low level. Despite the fact that the change in turbine layout will result in an increase in the construction phase potential impacts, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Soils and Agricultural Potential | PREFERRED | Because of the low impacts of the development on agriculture, there is no significant difference between the assessments of the new 47 turbine layout vs the old 70 turbine layout. Although the assessment for a reduction in turbines is not significantly different in terms of the assessment categories, there is nevertheless a very small difference and the reduced turbines is preferred because it has a lower footprint on agricultural land. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Noise | PREFERRED | The latest layout locates the wind turbines further from the closest potential noise-sensitive receptors, |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
| --- | --- | --- |
| | | at the same time reducing the number of wind turbines within a distance of 2,000m from these receptors. This change in the layout will have a definite benefit in terms of acoustics, further reducing the projected noise levels. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Visual | PREFERRED | The reduction in the number of turbines from 70 to 47 results in fewer visible turbines and turbines that are more widely dispersed across the site. This will reduce the visual contrast and visual intrusion of the wind farm development. In addition, with fewer turbines on the site, there will be fewer new light sources and thus the night time impacts resulting from the wind farm will be reduced. The new turbine layout is considered acceptable as none of the turbines are located in areas considered to be visually sensitive and only one turbine is located in closer proximity to the potentially sensitive visual receptors than previously determined. The decrease in the distance between the receptor (VR44) and the nearest turbine (T30) is however not significant enough to change the impact rating applied to this receptor. Changes in turbine range will have no visual implications as the hub height and rotor diameter of the turbines will remain the same. In addition, the changes in the material proposed for the turbine towers are not considered to be visually significant. Thus, from a visual impact perpective, the reduction in the number of turbines is seen as favourable. |
| Heritage and Palaeontology | PREFERRED | The redesign of the turbine layout has resulted in the moving of turbine positions away from the identified heritage resources. The reduction of turbines and change in layout will also result in a reduction in foot print area and thus a reduction in the possibility of disturbing unidentified heritage resources. The additional hardstand areas is off set by the reduction in turbines and will show and overall footprint reduction. This will inevitably result in a reduction of the overall impact of the WEF on |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| | | heritage resources. It is the specialist's considered opinion that the change in design layout will not have an additional negative impact by the proposed WEF on heritage resources. If at all it will result in a reduction of the projected impact as contained in the HIA for the project. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Socio-economic | PREFERRED | Some changes to the socio-economic impacts identified to ensue during construction may take place, which include the temporary employment creation, skills development and training, change in sense of place as well as the impact on production and GDP. However, the expected changes to the assessment categories for these impacts will be insignificant and will not affect the overall rating of these impacts. In addition, the reduced number of wind turbines to be included in the project is also likely to be more acceptable by the affected parties due to the lower chances and smaller areas of veld that may be impacted by construction activities. Although the number of turbines to be built will be reduced, the local municipality is still expected to benefit from the proposed development due to its small economic base and a large unemployment rate. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |

As depicted in **Table ii** above, the new proposed 47 turbine layout was clearly selected as the preferred alternative when compared to the previously assessed 70 turbine layout. The new proposed 47 turbine layout in combination with on-site IPP **Substation Option 1** should therefore be considered and authorised by the DEA. It should be noted that the extent of the proposed on-site IPP substation site has been reduced in order to avoid the identified environmentally sensitive areas. In addition, the shorter distance to the connecting linking substation[3] is expected to result in this on-site substation site alternative being preferred. From a technical perspective, the shorter distance between the on-site substation and the linking substations reduces the amount of electrical losses experienced, which is also preferred.

It is important to note that no fatal flaws were identified and the layout avoids all no-go areas and therefore both of the alternatives mentioned above are considered to be acceptable, although not necessarily

[3] The connecting linking substation is being assessed as part of a separate Basic Assessment (BA) process

preferable from an environmental perspective. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in **Figure v** below.

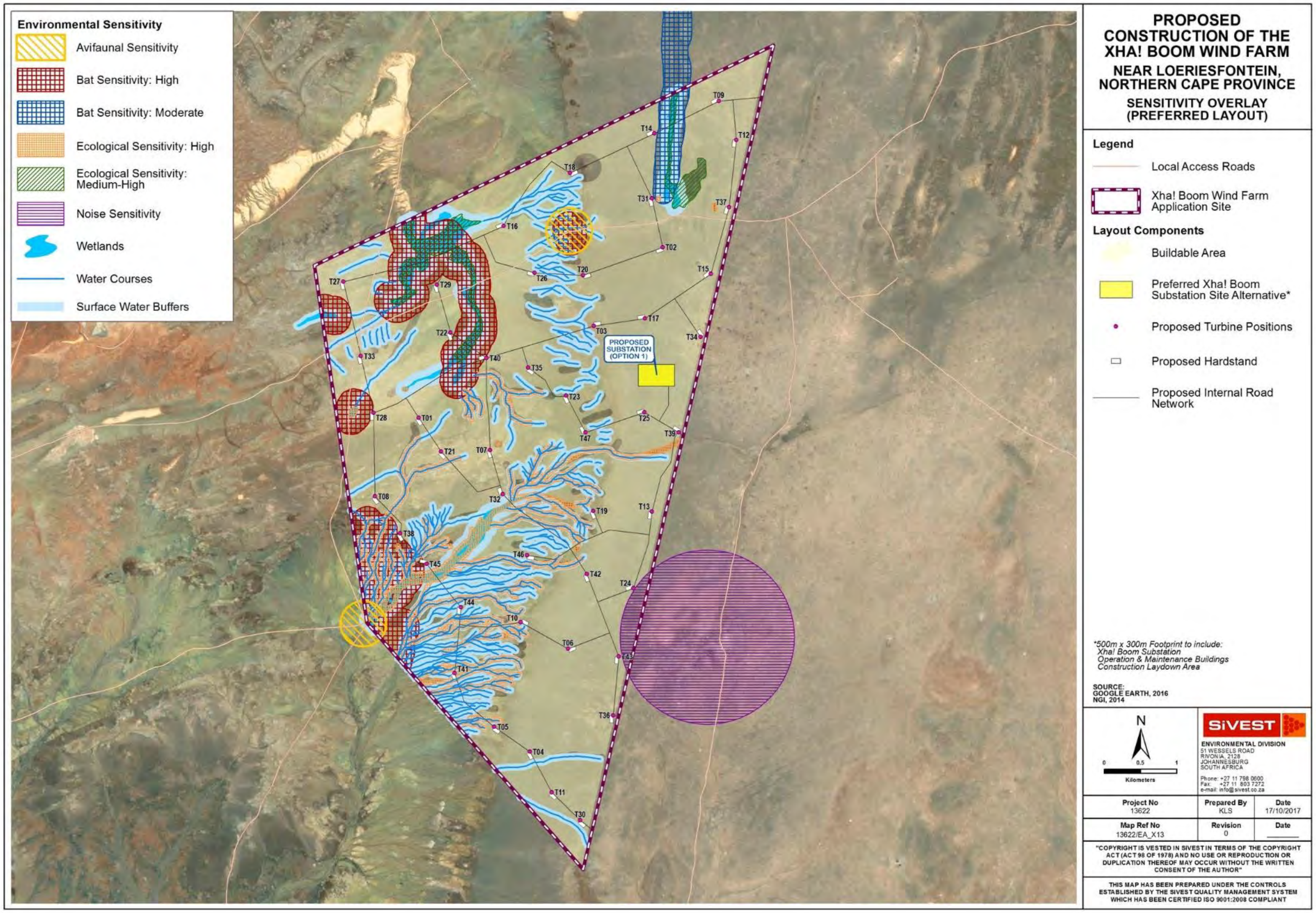



**Figure v:** Preferred !Xha Boom 47 Turbine Layout showing Environmentally Sensitive Areas

As previously mentioned, several no-go areas were also identified by some of the specialists and were subsequently incorporated into the EIA phase layout. As a result of the no-go areas, the site layout was amended and the number of turbines were reduced in order to avoid these areas. The preferred site layout in relation to the no-go areas identified by the specialists are indicated in **Figure vi** below.

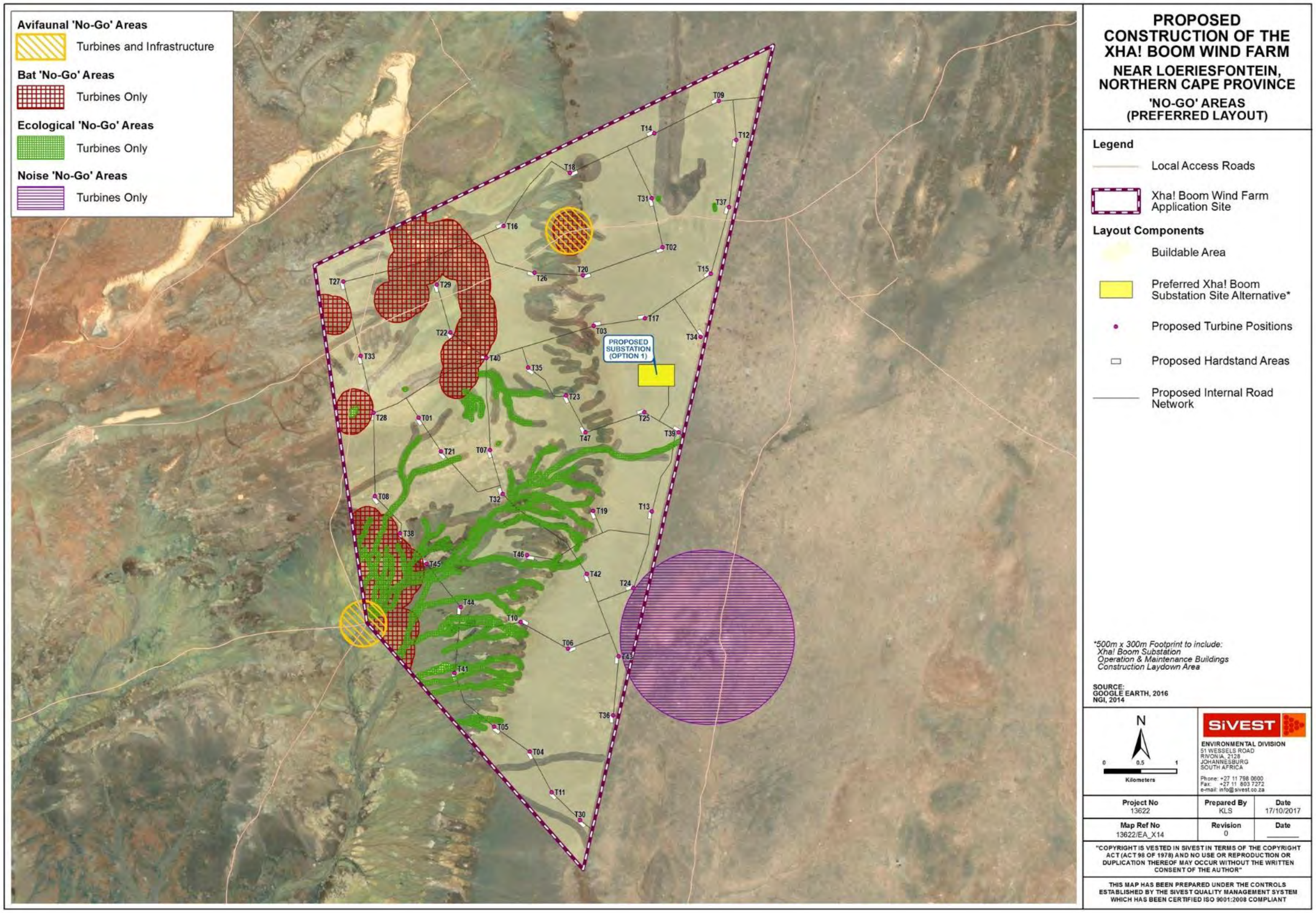



**Figure vi:** Preferred !Xha Boom 47 Turbine Layout showing No-go Areas

It should be noted that micro-siting may be required within the development area during the detailed design phase to avoid any additional sensitive areas. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

It is important to note that the preferred site layout provided above is only the EIA phase layout and therefore not the final layout for the proposed development. This is due to the following reasons:

- The technology is constantly changing where higher yielding a more efficient turbines are being bought into the marked and as a result the Developer cannot commit to a specific turbine, and associated layout, at this stage.
- The Engineering, Procurement and Construction (EPC) Contractor has not been appointed and hence the turbine manufacturer is unknown. The EPC contractor is only appointed once the project has been selected as a Preferred Bidder.
- The final turbine manufacturer is unknown and hence the final turbine generation capacity is unknown. The turbine generation capacity directly determines how many turbines will be present in the project area. The wind farm will consist of up to a maximum of 47 wind turbines. However, the generation capacity of each may vary between 4MW and 8MW. At a later stage, depending on the final design, the number of wind turbines may decrease in numbers but will not exceed the maximum of 47 wind turbines.
- The relocation, adding or removing of a single wind turbine has an impact on the entire wind farm. With a single change, a new yield assessment and model must be conducted to determine the highest yielding layout. Hence a facility with 50 turbines will have a completely different layout to a facility with 70 turbines. The EPC contractor may also insist on their own optimised layout for the facility at a later stage.
- The current project has four (4) 500m corridors where turbines have been preliminary excluded from. Depending on the final power line corridor selection, turbines may be relocated to be within the remaining corridors.
- If surrounding wind projects are bid and selected as Preferred Bidders before the !Xha Boom Wind Farm, then the adjacent wind projects final layouts may include turbines on the boundary of the !Xha Boom Wind Farm and hence these neighbouring turbines will have to be considered into the final !Xha Boom Wind Farm layout once it has been selected as a Preferred Bidder.
- As the turbine positions are still not final, the road and ancillary infrastructure layouts are also potentially subject to change.

It must be noted however, that the specialist sensitivities and no-go areas will be incorporated into the layout design when completing the final layout.

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Furthermroe, it is the opinion of the EAP, that based on the findings of the EIA that the proposed development should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- Due to the fact that the final modelling will have to be done again once the final turbine has been chosen, as well as the fact that the EMI and RFI studies can only be re-done once a final turbine has been chosen, it is recommended that the DEA include a condition that final modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process as has been done to date.
- All feasible and practical mitigation measures recommended by the various specialists must be implemented.
- All micro siting of the turbines and associated infrastructure must be repositioned within the authorised buildable area and must exclude all no-go areas identified by the specialists.
- Where applicable monitoring should be undertaken to evaluate the success of the mitigation measures recommended by the various specialists.
- Final EMPr should be approved by DEA prior to construction.
- The final layouts should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST, as the EAP, is therefore of the view that:

- An environmentally preferred on-site IPP substation site has been identified which is less environmentally sensitive compared to the alternative sites considered throughout the EIA process.
- The new revised 47 turbine layout has been deemed to be preferred when compared to the originally proposed 70 turbine layout, based on assessments undertaken by the specialists. As such, the reduction in the number of proposed turbines is deemed to be beneficial from an environmental perspective.
- With regards to access to the proposed site, it was deemed that Option 3 would be the preferred option according to the Traffic Assessment.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.

The date on which the activity will commence cannot be determined at this stage as they are based on the timeframes dictated by the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) bid windows. The date of the next round of bid submissions has not yet been announced. The construction of the !Xha Boom Wind Farm and associated infrastructure is dependent on being selected as a preferred bidder. The project will therefore require an environmental authorisation of at least 5 years.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

# SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

# PROPOSED CONSTRUCTION OF THE !XHA BOOM WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

# DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

**Contents** **Page**

## List of Tables

## List of Figures

## List of Appendices

**Appendix 1:** IFC Handbook
**Appendix 2:** Expertise of the EAP and Project Team
**Appendix 3:** Declaration of Interest Forms and the EAP Affirmation
**Appendix 4:** Authority Consultation
**Appendix 5:** Maps
**Appendix 6:** Specialist Studies (including specialist comment letters on final 47 turbine layout)
- Appendix 6A: Biodiversity Assessment
- Appendix 6B: Avifauna Assessment (including addendum report)
- Appendix 6C: Bat Assessment (including amendment letter)
- Appendix 6D: Surface Water
- Appendix 6E: Soils and Agricultural Potential Assessment
- Appendix 6F: Noise Assessment
- Appendix 6G: Visual Assessment
- Appendix 6H: Heritage Assessment
- Appendix 6I: Socio-Economic Assessment

**Appendix 7:** Public Participation
- Appendix 7A: Proof of site notices
- Appendix 7B: Written Notices
- Appendix 7C: Proof of advertisements
- Appendix 7D: Correspondence
- Appendix 7E: Comments and Response Report (C&RR)
- Appendix 7F: I&AP Database
- Appendix 7G: Minutes of Meetings – To be included in the FEIAr
- Appendix 7H: Landowner Notifications and Consent
- Appendix 7I: Distribution to Organs of State

**Appendix 8:** Draft Environmental Management Programme (EMPr)
**Appendix 9:** Additional Information
- Appendix 9A: Project Coordinates
- Appendix 9B: Title Deeds – To be included in the FEIAr
- Appendix 9C: SKA Assessments (Path Loss and Risk Assessment)
- Appendix 9D: Preliminary Engineering Services Report - Engineering services, transportation and geotechnical
- Appendix 9E: Preliminary Engineering Services Report – Transportation

## Glossary of Terms

**Alluvial:** Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc.

**Biodiversity:** The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

**Cultural Significance:** This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

**Cumulative Impact:** In relation to an activity, cumulative impact means 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.

**Equator Principles:** A financial industry benchmark for determining, assessing and managing social & environmental risk in project financing.

**Environmental Impact Assessment:** 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 the application.

**Environmental Impact Report:** In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

**Environmental Management Programme:** A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.

**Heritage Significance Grades:**
a) Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
(c) Grade III: Other heritage resources worthy of conservation.

**Heritage Resources:** This means any place or object of cultural significance. See also archaeological resources above.

**Iron Age:** Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. These people, according to archaeological evidence, spoke

early variations of the Bantu Language. Because they produced their own iron tools, archaeologists call this the Iron Age.
Early Iron Age AD 200 - AD 900
Middle Iron Age AD 900 - AD 1300
Late Iron Age AD 1300 - AD 1830

**Kilovolt (kV):** a unit of electric potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

**Precipitation:** Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

**Red Data Species:** All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

**Riparian:** The area of land adjacent to a stream or river that is influenced by stream induced or related processes.

**Scoping Report:** An “issues-based” report which forms the first phase of an Environmental Impact Assessment process.

**Stone Age:** The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.
Early Stone Age 2 000 000 - 150 000 Before Present
Middle Stone Age 150 000 - 30 000 BP
Late Stone Age 30 000 - until c. AD 200

## List of Abbreviations

| | |
|---|---|
| AP | - Action Plan |
| ATNS | - Air Traffic and Navigation Services Company Limited |
| AIA | - Archaeological Impact Assessment |
| ADT | - Average Daily Traffic |
| ADTT | - Average Daily Truck Traffic |
| BA | - Basic Assessment |
| BID | - Background Information Document |
| CARA | - Conservation of Agricultural Resources Act |
| CBA | - Critical Biodiversity Area |
| CISPR | - International Special Committee of Radio Interferences |
| CSW | - Continuous Surface Wave |
| DEA | - Department of Environmental Affairs |
| DDD | - Data Deficient |
| DDT | - Taxonomically uncertain |
| DM | - District Municipality |
| DEIAr | - Draft Environmental Impact Assessment Report |
| DSR | - Draft Scoping Report |
| DoE | - Department of Energy |
| DM | - District Municipality |
| DWS | - Department of Water and Sanitation |
| EAP | - Environmental Assessment Practitioner |
| ECA | - Environmental Conservation Act No 73 of 1989 |
| ECO | - Environmental Control Officer |
| ED | - Economic Development |
| EHS | - Environmental, Health, and Safety |
| EIA | - Environmental Impact Assessment |
| EIR | - Environmental Impact Report |
| EMPr | - Environmental Management Programme |
| EMI | - Electromagnetic Interference |
| EP | - Equator Principles |
| EPFI | - Equator Principles Financial Institutions |
| ERA | - The Electricity Regulation Act No. 4 of 2006 |
| ESA | - Ecological Support Area |
| EAS | - Early Stone Ages |
| ESMP | - Environmental and Social Management Plan |
| ESMS | - Environmental and Social Management System |
| FEIAr | - Final Environmental Impact Assessment Report |
| EHS | - Environmental, Health, and Safety |
| FGM | - Focus Group Meeting |
| FSR | - Final Scoping Report |

| | |
|---|---|
| GDP | - Gross Domestic Product |
| GHG | - Green House Gases |
| GIIP | - Good International Industry Practice |
| GIS | - Geographic Information System |
| GW | - Gigawatts |
| HIA | - Heritage Impact Assessment |
| HSR | - Heritage Scoping Report |
| I&AP(s) | - Interested and Affected Parties |
| IBA(s) | - Important Bird Area(s) |
| IDP | - Integrated Development Plan |
| IEP | - Integrated Energy Plan |
| IFC | - International Finance Corporation |
| IPP(s) | - Independent Power Producers |
| IRP | - Integrated Resource Plan |
| IUCN | - International Union for the Conservation of Nature and Natural Resources |
| KSW | - Key Stakeholder Workshop |
| kV | - Kilo Volt |
| LM | - Local Municipality |
| LED | -Local Economic Development |
| LSA | - Late Stone Age |
| LWEF | - Leeuwberg Wind Energy Facility |
| MSA | - Middle Stone Age |
| MTS | - Main Transmission Substation |
| MLL | - Minimum Living Level |
| MW | - Megawatt |
| NC DENC | - Northern Cape Department of Environment and Nature Conservation |
| NC PGDS | - Northern Cape Provincial Growth and Development Strategy |
| NEA | - The National Energy Act No. 34 of 2008 |
| NEMA | - National Environmental Management Act No. 107 of 1998 |
| NEMBA | - National Environmental Management: Biodiversity Act No. 10 of 2004 |
| NFA | - The National Forest Act No. 84 of 1998 |
| NHRA | - National Heritage Resources Act No. 25 of 1999 |
| NSBA | - National Spatial Biodiversity Assessment |
| NWA | - National Water Act No. 36 of 1998 |
| NEMAA | - National Environmental Management: Air Quality Act of 2004 |
| NPAES | - National Parks Area Expansion Strategy |
| NRTA | - The National Road Traffic Act No. 93 of 1996 |
| OHL | - Overhead Line |
| OHSA | - Occupational Health and Safety Act No. 85 of 1993 |
| PoS | - Plan of Study |
| PM | - Public Meeting |
| PPA | - Power Purchase Agreement |

| | |
|---|---|
| PPP | - Public Participation Process |
| PV | - Photovoltaic |
| RBS | - Revised Balanced Scenario |
| REIPPP | - Renewable Energy Independent Power Producer Procurement Programme |
| RE | - Renewable Energy |
| RFI | - Radio Frequency Interference |
| RFP | - Request for Proposals |
| RFQ | - Request for Qualifications |
| SA | - South Africa |
| SAHRA | - South African Heritage Resources Agency |
| SALT | - Southern African Large Telescope |
| SANBI | - South African National Biodiversity Institute |
| SDF | - Spatial Development Framework |
| SKA | - Square Kilometre Array |
| SPVs | - Special Purpose Vehicles |
| TL | - Terrain Loss |
| WEF | - Wind Energy Facility |
| WETFEPA | - Wetland Freshwater Ecosystem Priority Areas |
| WF | - Wind Farm |
| WMA | - Water Management Area |
| WTG | - Wind Turbine Generator |
| WUL | - Water Use License |
| WULA | - Water Use License Application |

# SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

# PROPOSED CONSTRUCTION OF THE !XHA BOOM WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

# DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

## 1 INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a wind farm and associated infrastructure near Loeriesfontein in the Northern Cape Province of South Africa (hereafter referred to as the ‘proposed development’) (**Figure 1**). The proposed development will consist of a 235MW maximum export capacity wind farm referred to as !Xha Boom Wind Farm. The overall objective of the proposed development is to generate electricity to feed into the National Grid. SiVEST Environmental Division has subsequently been appointed by Mainstream as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed construction of the !Xha Boom Wind Farm and associated infrastructure.

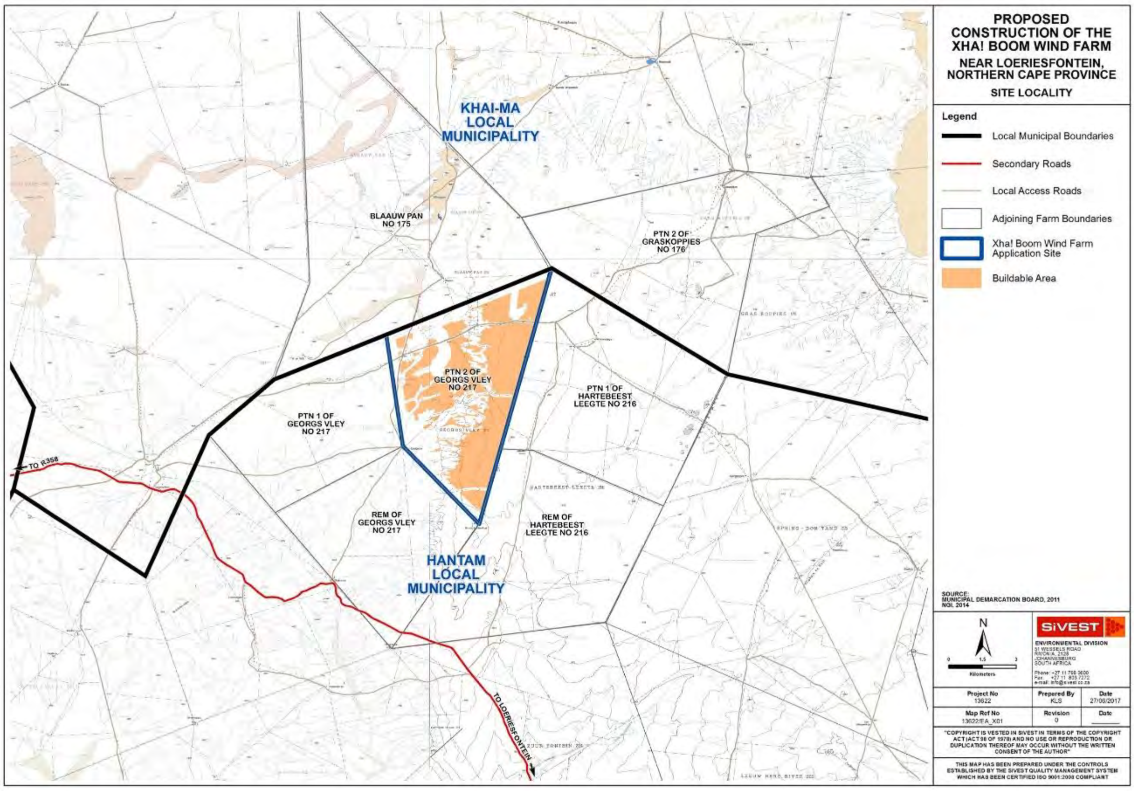



**Figure 1:** Site locality for the proposed !Xha Boom Wind Farm

Additionally, Mainstream are proposing to develop the associated on-site !Xha Boom IPP substation and power line to Helios transmission substation, both with a capacity of up to 132kV. This additional associated electrical infrastructure will however require a separate Environmental Authorisation (EA) and is being conducted as a part of a separate Basic Assessment (BA) process. The 132kV !Xha Boom power line has been included in the wind farm EIA for background information but will be authorised under a separate BA to allow for handover to Eskom. The proposed 132kV on-site !Xha Boom substation will include an Eskom portion and an Independent Power Producer (IPP) portion, hence the on-site substation has been included in the wind farm EIA and in the on-site substation and power line BA to allow for handover to Eskom. Although the wind farm and associated electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider both of the proposed developments. The potential environmental impacts associated with both developments will be assessed as part of the cumulative impact assessment. The DEA reference number allocated for the proposed 132kV on-site !Xha Boom substation and associated 132kV power line has not yet been allocated by the DEA. This will be provided in the Final Environmental Impact Assessment Report (FEIAr) or as soon as they are received from the Department of Environmental Affairs (DEA).

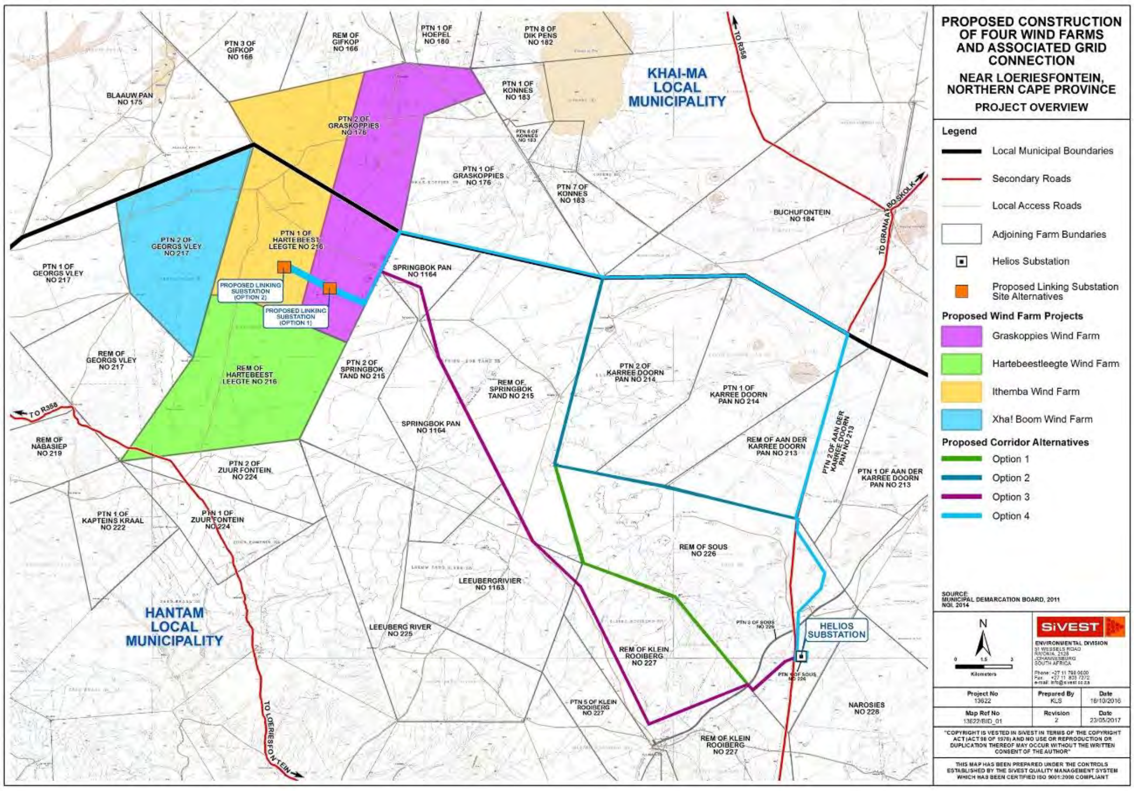



**Figure 2:** Combined layout map showing all of the proposed Mainstream Wind Farm developments as part of recent applications, well as the proposed on-site IPP substations and associated 132kV power lines which are part of separate BA processes

The proposed development requires EA from the DEA. However, the provincial authority will also be consulted (i.e. Northern Cape Department of Environment and Nature Conservation (NC DENC)). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998) which came into effect on 8 December 2014, and as amended on 7 April 2017. In terms of these regulations, a full EIA is required for the proposed development. All relevant legislations and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times.

This report has been compiled in accordance with World Bank standards and the Equator Principles (EP). The EP is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing (Equator Principles, 2013). This wind farm development is considered a Category B project. Category B Projects are those with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures (Equator Principles, 2013). The project will also comply with the International Finance Corporation's (IFC) Social and Environmental Performance Standards (2012) and General Environmental Health and Safety (EHS) Guidelines (2007).

## 1.1 Structure of this Report

This DEIAr is structured as follows:

- **Section 1** introduces the project and discusses the experience of the Environmental Assessment Practitioners (EAP), including specialists, who have contributed to the report. It expands on the relevant legal ramifications applicable to the project and describes the Equator Principles, IFC Performance Standards and the relevant development strategies and guidelines.
- **Section 2** details the approach used to undertake the study i.e. the scoping study, authority consultation and the DEIAr.
- **Section 3** elaborates on the assumptions and limitations pertaining to the EIA process for the proposed development.
- **Section 4** provides explanation to the need and desirability of the proposed development by highlighting issues such as security of power supply; the appropriateness of the selected site; local employment as well as the regional and local income profile.
- **Section 5** gives detailed technical descriptions of the proposed wind farm as well as the alternatives involved.
- **Section 6** provides a description of the region in which the proposed development is intended to be located. Although the Section provides a broad overview of the region, it is also specific to the application. It contains descriptions of the site and the specialist studies conducted during the scoping and EIA phases are also summarised.
- **Section 7** describes the Public Participation Process (PPP) undertaken during the EIA Phase and tables issues and concerns raised by Interested and Affected Parties (I&APs).
- **Section 8** documents the findings of the specialist studies and associated potential impacts of the proposed wind farm and associated infrastructure.
- **Section 9** presents a rating of each environmental issue before and after mitigation measures.
- **Section 10** identifies potential cumulative impacts per environmental issue (specialist study).

- **Section 11** gives a comparative assessment of all identified alternatives based on the various environmental issues (specialist studies).
- **Section 12** identifies recommendations from the specialists that have a bearing on the layout alternatives as well as proposed mitigation measures.
- **Section 13** provides a description of the environmental monitoring and auditing process to be undertaken for the proposed wind farm.
- **Section 14** presents a checklist that ensures that the report has been compiled according to the requirements of the World Bank Standards and Equator Principles.
- **Section 15** summarises the findings and recommendations per specialist study and provides the overall conclusion.
- **Section 16** lists references indicated in the Draft Environmental Impact Assessment report (DEIAr).

## 1.2 Expertise of Environmental Assessment Practitioner

SiVEST has considerable experience in the undertaking of EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this DEIAr are detailed in **Table 1** below.

**Table 1:** Project Team

| Name and Organisation | Role |
|---|---|
| Andrea Gibb – SiVEST | EAP and Visual |
| Stephan Jacobs – SiVEST | Environmental Consultant, Visual and Public Participation Practitioner |
| Shaun Taylor – SiVEST | Environmental Consultant, Surface Water Specialist |
| Simon Todd – Simon Todd Consulting | Biodiversity (fauna and flora) |
| Chris van Rooyen – Chris van Rooyen Consulting | Avifauna |
| Werner Marais – Animalia | Bats |
| Johann Lanz | Agricultural Potential |
| Morné De Jager – Enviro Acoustic Research (EAR) | Noise |
| Wouter Fourie – PGS | Heritage |
| Elena Broughton – Urban-Econ Development Economists | Socio-economic |
| Zimkita Nkata – Urban-Econ Development Economists | Socio-economic |
| Nicolene Venter – Imaginative Africa | Senior Public Participation Practitioner |
| Kerry Schwartz – SiVEST | GIS, Mapping and Visual |
| Cobus Hendriksz – SMEC South Africa | Geotechnical and Traffic |
| Callie Fouché - Interference Testing and Consultancy Services (ITC) | Path Loss and Risk Assessment to the SKA |

As per the requirements of the EIA Regulations (2014), as amended, the details and level of expertise of the persons who prepared the DEIAr are provided in **Table 2** below.

**Table 2:** Expertise of the EAP

| | |
|---|---|
| **Environmental Practitioner** | SiVEST South Africa (Pty) Ltd – Andrea Gibb |
| **Contact Details** | andreag@sivest.co.za |
| **Qualifications** | BSc Landscape Architecture and BSc (Hons) Environmental Management |
| **Expertise to carry out the EMPr** | Andrea has 8.5 years' work experience and specialises in undertaking and managing Environmental Impact Assessments (EIAs) and Basic Assessment (BAs), primarily related to energy generation and electrical distribution projects. She also specialises in undertaking visual impact and landscape assessments, by making use of ArcGIS technology and field surveys. She has extensive experience in overseeing public participation and stakeholder engagement processes and has been involved in environmental baseline assessments, fatal flaw / feasibility assessments and environmental negative mapping / sensitivity analyses. From a business and administrative side, Andrea is actively involved in maintaining good client relationships, mentoring junior staff and maintaining financial performance of the projects she leads. |
| **Environmental Consultant** | SiVEST South Africa (Pty) Ltd – Stephan Jacobs |
| **Contact Details** | stephanj@sivest.co.za |
| **Qualifications** | BSc Environmental Sciences and BSc (Hons) Environmental Management and Analysis |
| **Expertise to carry out the EMPr** | Stephan joined SiVEST in May 2015 and holds the position of Graduate Environmental Consultant in the Johannesburg office. Stephan specialises in the field of Environmental Management and has been involved in the compilation of Environmental Impact Assessments (EIAs) and Basic Assessments (BAs). Stephan has also assisted extensively in the undertaking of field work and the compilation of reports for specialist studies such as surface water and visual impact assessments. Stephan also has experience in Environmental Compliance and Auditing and has acted as an Environmental Control Officer (ECO) for several infrastructure projects. |
| **Environmental Consultant** | SiVEST South Africa (Pty) Ltd – Shaun Taylor |
| **Contact Details** | shaunt@sivest.co.za |
| **Qualifications** | BA Geography and Environmental Science, BSc (Hons) Geography and Environmental Studies, MSc Aquatic Health |
| **Expertise to carry out the EMPr** | Shaun joined SiVEST in October 2010 and is based in the Johannesburg office in the capacity of an Environmental Scientist. Shaun has eight and a half (8.5) years of expericne in the environmental industry. More specifically, Shaun has a passion for working in the environmental and water (wetlands) field. From an environmental management perspective, Shaun has completed a number of environmental impact assessments, basic assessments, strategic environmental assessments, environmental management programmes/plans, various exemption and amendment applications, and |

| | |
|---|---|
| | conducted environmental auditing. Within the water field, Shaun has undertaken water use licensing (WUL) and WUL compliance monitoring for various developments. In terms of specialist work, Shaun has completed numerous surface water (including wetlands and riparian) assessments for renewable energy projects, linear projects as well as site specific projects. |

Please refer to attached CV's for more information in **Appendix 2**. Declarations of Independence of each specialist are contained in **Appendix 3**.

## 1.3 Key Legal and Administrative Requirements Relating to the Proposed Development

### *1.3.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) – NEMA EIA Requirements*

The National Environmental Management Act, 1998 (Act No. 107 of 1998) was promulgated in 1998. This Act replaces parts of the Environment Conservation Act (Act No 73 of 1989) with exception to certain parts pertaining to Integrated Environmental Management. The act intends to provide for:

- co-operative environmental governance by establishing principles for decision-making on matters affecting the environment;
- institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state;
- to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment; and
- to provide for matters connected therewith.

NEMA now governs the EIA process with the recent promulgation of the new EIA regulations in April 2017 (Government Gazette No. 40772 of the 7th of April 2017), as amended. However, as per correspondence received from the determining authority (DEA) on the 22nd of June 2017 (see **Appendix 4**), the proposed project will be assessed in accordance with the former relevant EIA Regulations (2014) promulgated on the 4th December 2014 (Government Gazette No. 38282 of the 4th of December 2014).

In terms of the NEMA read with the EIA Regulations (2014), activities that may significantly affect the environment must be considered, investigated and assessed prior to implementation.

Therefore, in terms of the EIA Regulations (2014) promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on 8th December 2014, as amended, a full EIA is required for the proposed project.

### *1.3.2 NEMA & EIA Requirements*

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation. As mentioned earlier, the result being that NEMA governs the EIA process with the said promulgation of EIA Regulations in December 2014 (Government Gazette No. 38282 of 04 December 2014), as amended. This EIA has therefore been undertaken in accordance with the NEMA and EIA 2014 Regulations which are contained in four Government Notices (GN R 982, 983, 984, and 985) which came into effect on the 4th of December 2014, as amended.

In terms of these Regulations, a full EIA is required for the proposed project based on triggered activities. However, several activities which trigger a Basic Assessment (BA) were also identified and need to also be specified. Ultimately, these activities will not form a separate assessment, but will fall into the greater EIA.

The following Schedules of the Government Notice No. R. 983 – 985 of 4 December 2014, as amended, are of relevance to the project in question. All of the Listed Activities identified in terms of Sections 24(2) and 24D include:

**Table 3:** Listed activities in terms of the NEMA Regulations

| Activity number of the relevant notice: | Listed activity as described in GNR 983, 984 and 985 | Description of Listed Activity |
|---|---|---|
| **GN R. 983 Item 11** | *The development of facilities or infrastructure for the transmission and distribution of electricity-*<br><br>*(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts* | **An on-site IPP substation will be constructed as part of the proposed wind farm. The proposed on-site IPP substation will be located outside an urban area and will have a capacity of 132kV.** |
| **GN R. 983 Item 12** | *The development of :*<br>*ii) infrastructure or structures with a physical footprint of 100 square metres or more;*<br><br>*where such development occurs-*<br>*(a) within a watercourse;*<br>*(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.* | **The proposed development will entail the construction of buildings and other infrastructure exceeding 100 square metres in size. Internal access roads will be required which will need to route to the respective wind turbines locations and to the O&M building and infrastructure. The EIA Phase Surface Water Study identified two (2) depression wetlands, three (3) Major Drainage Line (drainage line with channel width >5m) and two hundred and thirty seven (237) Drainage Lines (drainage lines with channel width <5m). As a result, the layout of the proposed** |

| | | |
|---|---|---|
| | | **development will likely fall within 32m of surface water features.** |
| GN R. 983 Item 19 | *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;*<br><br>*But excluding where such infilling, depositing , dredging, excavation, removal or moving-*<br>*(a) will occur behind a development setback;*<br>*(b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or*<br>*(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.* | **The EIA Phase Surface Water Study revealed that there are surface water features located on the study site. EIA Phase Surface Water Study identified two (2) depression wetlands, three (3) Major Drainage Line (drainage line with channel width >5m) and two hundred and thirty seven (237) Drainage Lines (drainage lines with channel width <5m). Although the layout of the proposed development will be designed to avoid the identified surface water features as far as possible, some of the internal and access roads, may need to traverse the identified surface water features and during construction of these roads soil may need to be removed from the watercourses.** |
| GN R. 983 Item 24 | *The development of a road-*<br>*ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres;* | **Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6 - 8m for maintenance purposes during the operational phase.** |
| GN R. 983 Item 28 | *Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development:*<br><br>*(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;*<br><br>*excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.* | **The proposed project site is currently used for agricultural purposes, specifically commercial sheep farming, and the proposed project will result in an area greater than 1 hectare being transformed into an industrial land use.** |

| | | |
|---|---|---|
| GN R. 983 Item 56 | *The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre –*<br><br>*(ii) where no reserve exists, where the existing road is wider than 8 metres –*<br><br>*excluding where widening or lengthening occur inside urban areas.* | **It is likely that existing access roads will need to be upgraded in order to access the site. Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6 - 8m for maintenance purposes during the operational phase. The required width and length of the expansion will be confirmed during the EIA process.** |
| GN R. 984 Item 1 | *The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs –*<br><br>*(a) within an urban area.* | **It is proposed that a wind farm with an export capacity up to 235MW will be constructed.** |
| GN R. 984 Item 15 | *The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-*<br><br>*(i) the undertaking of a linear activity; or*<br>*(ii) maintenance purposes undertaken in accordance with a maintenance management plan.* | **The proposed development will transform more than 20 hectares of indigenous vegetation. Clearance will also be required for the proposed on-site substation, O&M building, internal access roads and other associated infrastructure.** |

#### *1.3.3 Environmental Impact Assessment Guideline for Renewable Energy Projects, DEA Notice 989 of 2015*

The purpose of this document is primarily to provide guidance on the environmental management legal framework applicable to renewable energy operations and all the role players in the sector. The guideline is principally intended for use by the following stakeholder groups:

- Public Sector Authorities (as regulator and/or competent authority);
- Joint public sector authorities and project funders, e.g., Eskom, IDC, etc.
- Private Sector Entities (as project funder/developer/consultant); and
- Other interested and affected parties (as determined by the project location and/or scope).

This guideline seeks to identify activities requiring authorisation prior to commencement of that activity, and provide an interface between national EIA regulations and other legislative requirements of various authorities.

The guidelines are applicable for the construction, installation and/or development of the following renewable energy projects:

- Concentrating Solar Power Energy facility;
- Wind Farm;
- Hydropower Station; and
- Photovoltaic Power Facility.

As the proposed development is for a wind farm, it is subject to the recommendations proposed in the guidelines.

### *1.3.4 National Energy Act No. 34 of 2008*

The National Energy Act (Act no, 34 of 2008), promulgated in 2008, has, as one of its key objectives, the promotion of diversity of supply of energy and its sources. From this standpoint, the Act directly references the importance of the renewable energy (RE) sector, with a mention of the wind energy sector included. The aim is to ensure that the South African economy is able to grow and develop, fast tracking poverty alleviation, through the availability of a sustainable, diverse energy mix. Moreover, the goal is to provide for the increased generation and consumption of RE (Republic of South Africa, 2008).

### *1.3.5 National Heritage Resources Act No. 25 of 1999*

This Act requires all developers to undertake archaeological impact studies whenever any type of development activity is undertaken. Preliminary archaeological impact studies will consequently become a common procedure for all development activities, even if such development may be exempted in terms of the National Environmental Management Act (Act No 107 of 1998).

The law ensures community participation in the protection of national heritage resources and will involve all three levels of government in the management of the country's national heritage. The South African Heritage Resources Agency (SAHRA) will establish and maintain a national policy, strategy plans and standards for heritage resources management and will monitor the system as a whole.

Heritage authorities will assist and co-operate with individuals and organisations concerned with the study, the conservation, promotion and utilisation of national heritage resources. A newly established National Heritage Resources Fund will provide financial assistance for heritage projects.

A heritage assessment has been conducted to explore how the proposed development may impact on heritage resources as protected by the Act.

### 1.3.6 National Water Act No. 36 of 1998, as amended

The National Water Act (NWA) No 36 of 1998 was promulgated on the 20th of August 1998. This Act is important in that it provides a framework to protect water resources against over exploitation and to ensure that there is water for socio-economic and economic development, human needs and to meet the needs of the aquatic environment. The Act also recognises that water belongs to the whole nation for the benefit of all people.

It is important to note that water resources are protected under the Act. Under the act, water resources as defined include a watercourse, surface water, estuary or aquifer. A watercourse is defined as a river or spring, a natural channel in which water flows regularly or intermittently, or a wetland, lake or dam into which, or from which water flows.

One of the main aims of the Act is the protection of water resources. 'Protection' in relation to a water resource entails:

- Maintenance of the quality of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- The rehabilitation of the water resource.

In the context of the proposed development and any potential impact on water resources, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

This definition of pollution is quite wide ranging, and it applies to all types of water resource. Activities which cause alteration of the biological properties of a watercourse (i.e. the fauna and flora contained within that watercourse are also considered pollution).

In terms of section 19 of the Act owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include (inter alia):

- measures to cease, modify, or control any act or process causing the pollution;
- comply with any prescribed waste standard or management practice;
- contain or prevent the movement of pollutants;
- remedy the effects of the pollution; and
- remedy the effects of any disturbance to the bed and banks of a watercourse.

A surface water assessment has been conducted to explore how the proposed development may impact on water resources as protected by the Act.

### *1.3.7 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004 as amended)*

The overarching aim of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004, within the framework of NEMA, is to provide for:

- The management and conservation of biological diversity within South Africa, and of the components of such biological diversity;
- The use of indigenous biological resources in a sustainable manner; and
- The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources.

The South African National Biodiversity Institute (SANBI) was established by the NEMBA, its purpose being (*inter alia*) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems.

NEMBA provides for a range of measures to protect ecosystems and for the protection of species that are threatened or in need of protection to ensure their survival in the wild, including a prohibition on carrying out a "restricted activity" involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. Lists of critically endangered, endangered, vulnerable and protected species have been published and a permit system for listed species has been established.

It is also appropriate to undertake a Faunal and Botanical Impact Assessment where proposed developments, in an area that is considered ecologically sensitive, require an environmental authorisation in terms of NEMA, with such Assessment taking place during the basic assessment or EIA. These two studies will be undertaken during the project.

The NEMBA is relevant to the proposed project as the construction of the wind energy facility may impact negatively on biodiversity. The project proponent is therefore required to take appropriate reasonable measures to limit the impacts on biodiversity, to obtain permits if required and to also invite SANBI to provide commentary on any documentation resulting from the proposed development.

### *1.3.8 National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003 as amended)*

The overarching aim of the National Environmental Management: Protected Areas Act (NEMPAA) No. 57 of 2003, within the framework of NEMA, is to provide for:

- provide for the declaration and management of protected areas;
- provide for co-operative governance in the declaration and management of protected areas;

- effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity;
- provide for a representative network of protected areas on state land, private land and communal land;
- promote sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas;
- promote participation of local communities in the management of protected areas, where appropriate; and
- provide for the continued existence of South African National Parks.

### *1.3.9 National Forests Act, 1998 (Act No. 84 of 1998)*

The National Forest Act (NFA) was enacted to:

- Provide for the protection, management and utilisation of forests;
- The protection of certain plant and animal life;
- The regulation of trade in forest produce;
- The control and management of a national hiking way system and National Botanic Gardens.

The NFA enforces the necessity for a license to be obtained prior to destroying any indigenous tree in a natural forest and, subject to certain exemptions, cutting, disturbing, damaging, destroying or removing any protected tree. The list of protected trees is currently contained in GN 908 of 21 November 2014. Licenses are issued by the Minister and are subject to periods and conditions as may be stipulated.

The NFA is relevant to the proposed project as the removal and/or disturbance and/or clearance of indigenous vegetation may be required and a license in terms of the NFA may be required for this to be done.

### *1.3.10 Conservation of Agricultural Resources Act No. 43 of 1983*

The Conservation of Agricultural Resources Act (CARA) No. 43 of 1983 controls the utilisation of natural agricultural resources in South Africa. The Act promotes the conservation of soil, water sources and vegetation as well as the combating weeds and invader plants. The Act has been amended in part by the Abolition of Racially Based Land Measures Act, No. 108 of 1991.

The primary objective of the Act is to conserve natural agricultural resources by:

- maintaining the production potential of land;
- combating and preventing erosion and weakening or destruction of the water resources;
- protecting vegetation; and
- combating weeds and invaders plants.

The CARA is relevant to the proposed projects as the construction of the wind farm as well as other components (such as the substation) may impact on agricultural resources and vegetation on the site. The Act prohibits the spreading of weeds and prescribes control measures that need to be complied with in order to achieve this. As such, measures will need to be taken to protect agricultural resources and prevent weeds and exotic plants from invading the site as a result of the proposed development.

An agricultural potential assessment has been conducted to explore how the proposed development may impact on the agricultural production potential of the proposed site.

### *1.3.11 Subdivision of Agricultural Land Act No. 70 of 1970, as amended*

The Subdivision of Agricultural Land Act No. 70 of 1970 controls the subdivision of all agricultural land in South Africa; prohibiting certain actions pertaining to agricultural land. Under the Act the owner of agricultural land is required to obtain consent from the Minister of Agriculture in order to subdivide agricultural land.

The purpose of the Act is to prevent uneconomic farming units from being created and degradation of prime agricultural land. To achieve this purpose the act also regulates leasing and selling of agricultural land as well as registration of servitudes.

The Act is of relevance to the proposed development as any land within the study area that is zoned for agricultural purposes will be regulated by this Act.

Although the whole of this Act has been repealed by section 1 of the Subdivision of Agricultural Land Act Repeal Act 64 of 1998, this Repeal Act has not been implemented and no date of coming into operation has been proclaimed.

It is important to note that the implementation of this act is problematic as the Act defines 'Agricultural Land' as being any land, except land situated in the area of jurisdiction of a municipality or town council, and subsequent to the promulgation of this Act uninterrupted Municipalities have been established throughout South Africa.

### *1.3.12 National Road Traffic Act No. 93 of 1996, as amended*

The National Road Traffic Act (NRTA) No. 93 of 1996 provides for all road traffic matters and is applied uniformly throughout South Africa. The Act enforces the necessity of registering and licensing motor vehicles. It also stipulates requirements regarding fitness of drivers and vehicles as well as making provision for the transportation of dangerous goods.

All the requirements stipulated in the NRTA will need to be complied with during the construction and operational phases of the proposed project.

### 1.3.13 Civil Aviation Act No. 13 of 2009

The Civil Aviation Act No. 13 of 2009 controls and regulates aviation within South Africa. It provides for the establishment of a South African Civil Aviation Authority (CAA) and independent Aviation Safety Investigation Board in compliance with Annexure 13 of the Chicago Convention. It gives effect to various conventions related to aircraft offences, civil aviation safety and security, and provides for additional measures directed at more effective control of the safety and security of aircrafts, airports and matters connected thereto.

Although the Act is not directly relevant to the proposed development, it should be considered as the establishment of a wind farm may impact on aviation and air traffic safety if located directly within aircraft flight paths.

Air Traffic and Navigation Services Company Limited (ATNS) and the CAA will be consulted and the required approvals will be obtained prior to construction.

### 1.3.14 Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009)

These are developed to protect both animal and plant species within the various provinces of the country which warrant protection. These may be species which are under threat or which are already considered to be endangered. The provincial environmental authorities are responsible for the issuing of permits in terms of this legislation. The Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009) and the Nature and Environmental Conservation Ordinance 19 of 1974 are of relevance to the Northern Cape Province.

A biodiversity assessment has been conducted to explore how the proposed development may impact on biodiversity as protected by the Act.

### 1.3.15 Astronomy Geographic Advantage Act No. 21 of 2007

The Astronomy Geographic Advantage Act No. 21 of 2007 provides for:

- The preservation and protection of areas that are uniquely suited for optical and radio astronomy;
- Intergovernmental cooperation and public consultation on matters concerning nationally significant astronomy advantage areas and matters connected therewith.

In terms of section 7(1) and 7(2) of this Act, the Minister declared core astronomy advantage areas on 20 August 2010 under Regulation No. 723 of Government Notice No. 33462. As such, all land within a 3 Kilometre radius of the centre of the Southern African large Telescope (SALT) dome located in the Northern Cape Province, falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope.

Under Section 22(1) of the Act the Minister has the authority to protect the radio frequency spectrum for astronomy observations within a core or central astronomy advantage area. As such, the Minister may still under section 23(1) of the Act, declare that no person may undertake certain activities within a core or central astronomy advantage area. These activities include the construction, expansion or operation; of any fixed radio frequency interference source, facilities for the generation, transmission or distribution of electricity, or any activity capable of causing radio frequency interference or which may detrimentally influence the astronomy and scientific endeavours.

Mainstream appointed ITC to conduct a Path Loss and Risk Assessment based on the turbine layout for the proposed !Xha Boom Wind Farm. This risk assessment was based from measurements taken at the Gouda Wind farm. This initial high level risk assessment was conducted to enable one to estimate the maximum permissible radiated emissions from the equipment installed within the !Xha Boom Wind Farm, compared to known radiated emission data from the Acciona AW125/3000 Wind Turbine Generator (WTG). Acciona AW125/3000 WTG is a large turbine type and was used to show the typical impacts of a similar technology and sized turbine. The report concluded that due to natural terrain barriers and the 52.6km distance between !Xha Boom and Rem-opt 7, the closest SKA unit, no degradation of performance is expected when the mitigated AW 125 TH100A Acciona turbines are installed. However, in order to verify overall wind farm emissions, ambient measurements should be done at the new site before construction starts. Tests points should be carefully selected based on test equipment sensitivity with the objective to observe the increase in ambient emissions as construction progresses. In addition, final site tests will be done on completion of the project to confirm the radiated emission levels. Although not anticipated, proper mitigation measures on identified emitters will be studied and implemented if final test shows emissions exceeding the SKA threshold.

The cumulative impact assessment concluded that due to the sensitivity of the telescope receivers, there is a risk that unintentional emissions from the systems and associated equipment associated with renewable energy projects will desensitize or saturate the SKA receivers resulting in interference to celestial observations and/or data loss. Such interference is typically referred to as ‘Radio Frequency Interference’ (or ‘RFI’). The NITIA TM-89-139 calculation of 17.9dB (REM OPT 7 location) and 18.4dB (SKA ID 2377 location) to be added to the emissions from a single unit to allow for the cumulative effect of 500 units appears to be conservative when compare to general man-made noise data (<10dB increase measured at various locations). The >60 degree beamwidth assumed during the NITIA TM-89-139 calculations will result in over estimation of the cumulative effect due to a higher number of emitters in the beamwidth. The 40dB mitigation is a borderline figure when considering all the adjacent projects resulting in a relatively high emitter density.

The SKA has provided initial comments and were also provided with the opportunity to comment on the Draft Scoping Report (DSR), Final Scoping Report (FSR) and on the ITC report. SKA comments on the ITC reports, the DSR and the FSR have been included in the updated C&RR which is included in this Draft Environmental Impact Assessment Report (DEIAr). In addition, proof of correspondence undertaken with the SKA is included in **Appendix 7B**, **7D** and **7I**. The Topographical Analysis Assessment and the Path Loss and Risk Assessment Reports are included in **Appendix 9C** [4].

### *1.3.16 Additional Relevant Legislation*

- Occupational Health and Safety Act (Act No. 85 of 1993)
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008 as amended)
- Development Facilitation (Act No. 67 of 1995)
- The Hazardous Substances Act (Act No. 15 of 1973)
- Water Services Act (Act No. 108 of 1998)
- Electricity Regulation Act (Act No. 4 of 2006 as amended)
- Municipal Systems Act (Act No. 32 of 2000)
- Mineral and Petroleum Resource Development Act (Act No. 28 of 2002 as amended)
- Northern Cape Planning and Development Act, 1998 (Act No. 7 of 1998)

## 1.4 Key Development Strategies and Guidelines

### *1.4.1 Integrated Development Plans*

An Integrated Development Plan (IDP) is defined in the Local Government: Municipal Systems Act No. 32 of 2000), as an inclusive and strategic plan that:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan
- Forms the policy framework on which annual budgets must be based; and
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation.

The main purpose of the IDP is considered the enhancement of service delivery and fighting poverty through an integrated and aligned approach between different role-players and stakeholders.

Each municipality is required to produce an IDP which would address pertinent issues relevant to their municipality. However, common concerns include municipal transformation and development, and service delivery and infrastructural development.

[4] Please note that the EMI and RFI studies were based on the currently available worst case scenario turbines. Due to technology improvements a different turbine will be used for the proposed development. The chosen turbine would have to be subjected to the same EMI and RFI studies. As previously mentioned, these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, it is recommended that the DEA include a condition that final modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process as has been done to date.

The proposed !Xha Boom Wind Farm is situated within the Hantam Local Municipality (LM), which is located within the greater Namakwa District Municipality (DM). The Namakwa Integrated Development Plan (IDP) sets out to utilise natural resources in the Province by optimally utilising and managing resources in each sector; this includes the growing realisation of investing in more renewable energy based development. The Namakwa DM has a competitive advantage in the energy sector as wind, solar, wave, nuclear and natural gas energy plants have all been identified as suitable investments in the area. Amongst other sectors such as agriculture and tourism, renewable energy is thus prioritised. Several large-scale renewable energy projects have already been included in the IDP of the district. The district also recognises the importance of the agriculture and tourism industries in the area and promotes their development and transformation, especially eco-heritage (Namakwa DM, 2014).

Despite the fact that the proposed !Xha Boom Wind Farm is situated within the Hantam LM only, the Khai-Ma LM is also located within close proximity to the project site and is thus also expected to be impacted to a degree. As such, the IDPs for both the Hantam and Khai-Ma LMs have been assessed and included in this section. According to the Hantam LM and Khai-Ma LM Integrated Development Plans (IDPs), considering the location of the site relative to the Hantam and Khai-Ma Local Municipalities, the review of the strategic policies highlights the importance of improving the living standards of the citizens of the municipalities as being amongst the top priorities of local government. Stimulating and strengthening the economy through various sector development interventions is envisioned to be one of the means to achieve this. Based on the composition and natural resource endowment of these municipalities, particular developmental priority is given to the agriculture and tourism sectors. Although flower tourism is seasonal in the Hantam LM, eco-tourism has been recently seen as the main growth stimulant for the regional economy. At the same time, the agricultural sector provides the most employment opportunities in the municipal area; thus, making it the backbone of the Hantam LM (Hantam IDP, 2015). The above suggests that the tourism and agricultural sectors should be preserved and all effort needs to be made in order to ensure that no new development results in the loss of these activities.

In considering the spatial development pattern of the Khai-Ma LM, strengthening local economic growth is one of the focal aspects of the Khai-Ma LM Rural Spatial Development Framework (SDF). In terms of their contribution to GDP, the agriculture and tourism sector are the main contributors to the economic sector of the Khai-Ma LM as the municipality has a unique environment that needs to be exploited in a sustainable manner (Umsebe Development Planners, 2010). The Hantam LM SDF also further highlights that economic sector interventions in the area has led the municipality to seek complementary development opportunities in sectors such as agriculture, mining, tourism and renewable energy (Umsebe Development Planners, 2010; Hantam LM Spatial Development Framework (SDF)).

Upon reviewing the spatial planning component, the Namakwa DM as well as the Hantam and Khai-Ma LMs' spatial development frameworks do not suggest any potential conflicts between the planned spatial development visions and the proposed wind farm project. In addition, the site where the proposed project will be developed is not located near any settlement or tourism attraction or agricultural land that might be sensitive to the environmental effects of the proposed project. After considering the reviewed documentation, the proposed wind farm is in alignment with national, provincial and local objectives, plans and strategies relating to socio-economic development of the areas under analysis. There were no fatal flaws or contraventions identified as all spheres of government prioritise the development of renewable energy projects. The proposed project fits well with the plans to diversify the provincial, district and local economies through investment in renewable energy projects.

It can be suggested that the proposed project does not only conflict with any of the identified developmental priorities of the local governments in question but is also in alignment with the identified means to stimulate the local economy. The Hantam IDP, 2015, notes that Climate change will impact on biodiversity and with this the ability of biodiversity and ecosystems to provide ecosystem services that support human society. This is particularly important in rural areas such as the Namakwa District (ND), where the link between people and the environments that support them (and place them at risk in terms of droughts and other extreme weather events) is far more direct than in more urbanized environments (Hantam IDP, 2015). Some features in the landscape are more likely to support resilience of biodiversity to climate change than others. Such features include: riparian corridors and buffers; coastal corridors; areas with temperature, rainfall and altitudinal gradients; areas of high diversity; areas of high plant endemism; refuge sites including south-facing slopes and kloofs; and priority large unfragmented landscapes. Keeping these areas in a natural or near-natural state will help ecosystems and species to adapt naturally to climate change, thus supporting healthy landscapes and the ability of ecosystems to continue to provide ecosystem services to communities (Hantam IDP, 2015). Policy decisions taken in the next decade will largely determine the dimension of the impact of climate change. Eco-systems-based adaptation approaches, using nature and biodiversity to help people cope with, and respond to the negative impacts of climate change, will have an important role to play in Hantam. Local government is in the front line of implementation and service delivery, and thus needs to pursue adequate mitigation and adaptation strategies which should include participation from the public sector, the private sector and NGOs (Hantam IDP, 2015). Therefore, it is evident that the proposed development is aligned with the goals of the municipal IDPs in the study area.

### *1.4.2 Draft Integrated Energy Plan for the Republic of South Africa, 2013*

The Draft Integrated Energy Plan (IEP), developed by the DoE, are anchored in the National Energy Act, 2008 (Act No. 34 of 2008). The IEP was undertaken to determine the best way to meet current and future energy service needs in the most efficient and socially beneficial manner, while:

- Maintaining control over economic costs;
- Serving national imperatives such as job creation and poverty alleviation; and
- Minimising the adverse impacts of the energy sector on the environment.

The IEP takes into consideration the crucial role that energy plays in the entire economy and is informed by the output of analyses founded on a solid fact base. It is a multi-faceted, long-term energy framework which has multiple objectives, some of which include:

- To guide the development of energy policies and, where relevant, set the framework for regulations in the energy sector;
- To guide the selection of appropriate technologies to meet energy demand (i.e. the types and sizes of new power facilities and refineries to be built and the prices that should be charged for fuels);
- To guide investment in and the development of energy infrastructure in South Africa; and

- To propose alternative energy strategies which are informed by testing the potential impacts of various factors such as proposed policies, introduction of new technologies, and effects of exogenous macro-economic factors.

The IEP considers the national supply and demand balance and proposes alternative capacity expansion plans based on varying sets of assumptions and constraints. While infrastructural matters are briefly discussed, the IEP does not explicitly consider supply and demand at specific geographical locations within the country, nor does it take into account infrastructure bottlenecks at specific locations. These are, or will be, covered in detail as follows:

- Electricity infrastructure (transmission and distribution) is dealt with in other plans and the Integrated Resource Plan (IRP) should assess these in detail, taking into consideration the grid planning currently conducted by Eskom;
- Electricity supply is dealt with in the IRP;
- Liquid fuels will be dealt with in the 20-Year Liquid Fuel Infrastructure Roadmap which will cover logistical matters relating to pipelines and storage facilities for petroleum products; and
- The Gas Utilisation Master Plan (GUMP) will take into consideration the bottlenecks and capacity constraints of the current natural gas infrastructure. All the above will inform the integrated energy planning process and will enable overall enhancement through ongoing periodic iterations to ensure alignment.

### *1.4.3 Integrated Resource Plan, 2010 and updated 2016*

The Integrated Resource Plan (IRP) was created in order to plan for projected national electricity demand. The IRP 2010-30 was promulgated in March 2011, and was planned to be a “living plan”, as it needs to take into account changes in the macroeconomic environment, developments in new technologies and changes in national priorities and imperatives, amongst other factors. Since the promulgation of the (IRP) 2010-30 there have been a number of developments in the energy sector in South and Southern Africa. In addition the electricity demand outlook has changed from that expected in 2010. As a result the DoE is in the processing of updating the IDP and has recently published Assumptions and Base Cases in November 2016.

- While the IRP 2010-30 remains the official government plan for new generation capacity until it is replaced by an updated plan, there are a number of assumptions that have changed and these include: The changed landscape over the past years, in particular in electricity demand and the underlying relationship with economic growth;
- New developments in technology and fuel options (locally and globally);
- Scenarios for carbon mitigation strategies and the impact on electricity supply up to 2050; and
- The affordability of electricity and its impact on demand and supply.

The IRP 2010-30 assumed the existing Eskom fleet to have an average availability of 86%, however actual performance has in the recent past declined to less than 70% availability.

The learning rates adopted in IRP 2010-30 are maintained in the 2016 update with PV and Wind learning rates adjusted to reflect the quick fall in prices experienced in South Africa and are reflected in the table below.

| Technology | 2015 (R/kW) | 2050 (R/kW) |
|---|---|---|
| PV (fixed tilt) | 16860.6 | 13425.03408 |
| PV (tracking) | 17860.6 | 14221.26959 |
| Wind | 19208.1 | 17287.405 |
| Nuclear | 55260 | 53768.80047 |

The new generation capacities called for in the Ministerial Determinations that are not yet committed (no procurement has started) are allowed to lapse. This means that only procurement up to bid window 4.5 for renewables (expedited including smalls) and coal 900MW are considered committed. The Base Case maintains a number of policy positions imposed in the IRP 2010-30 in particular an annual build limit of new capacity for wind (1600 MW) and photovoltaic (1000 MW).

- Based on least cost and moderate emissions reduction trajectory, the model results indicates, 18GW of PV, 37GW of Wind, 20GW of Nuclear, 34GW of Gas, 2500 of Hydro, 15GW of Coal by end of the study horizon (year 2050);
- Looking at same study period used in the promulgated IRP 2010-30, the model results indicate 4.7GW of PV ,6.4GW of Wind, 12.7GW of Gas and 5.3GW of Coal by year 2030;
- The first unit of Nuclear appears around year 2037, but this is sensitive to other technology primary fuel costs and their associated emission assumptions. These will be tested as a scenario as indicated in the next section. The 2030 figures in the Base Case are different from those in the IRP 2010-30 because they exclude the capacity already procured/under procurement (6.2GW of renewable energy as well as 900MW of coal). The figures are also different because adjustment based on scenario analysis and policy has not been done.

### *1.4.4 Department of Energy White Paper on Renewable Energy, 2003*

The Department of Energy (DoE) gazetted its White Paper on Renewable Energy in 2003, and introduced it as a “policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy.” At that time the national target was fixed at 10 000GWh (0.8Mtoe) renewable energy contribution to final energy consumption by 2013. The White Paper proposed that this would be produced mainly from biomass, wind, solar and small-scale hydropower. It went on to recommend that this renewable energy should to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. Since the White Paper was gazetted, South Africa’s primary and secondary energy requirements have remained heavily fossil-fuel dependant, in terms of both indigenous coal production and use, as well as the use of imported oil resources. Alongside this, the projected electricity demand of the country has led the National utility Eskom, to embark upon an intensive build programme to secure South Africa’s longer-term energy needs, together with an adequate reserve margin.

### *1.4.5 Renewable Energy Independent Power Producer Procurement Program (REIPPPP)*

(The following information was extracted from the Eskom website: **Guide to Independent Power Producer (IPP) processes in South Africa and Eskom, June 2010** http://www.eskom.co.za/live/content.php?Item_ID=14324)

The objective of this section is to provide an overview of the processes in the country and within Eskom relating to Independent Power Producers (IPPs). It is important that certain enabling policies, rules and regulations are in place to provide certainty and transparency in the introduction of IPPs.

- **Country Process**

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

i. The National Energy Act of 2008 (No. 34 of 2008); and
ii. The Electricity Regulation Act (ERA) of 2006 (No. 4 of 2006).

In August 2009, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy.

- Formal Programmes

In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) developed by the DoE sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be executed in accordance with the specified capacities and technologies listed in the IRP. The table below highlights the energy plan that has been proposed until 2030.

**Table 4:** Government Energy Plans up until 2030 in terms of the IRP

| New Build Options | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PV** | **Wind** | **Land fill Gas** | **DR** | **Nuclear** | **OCGT** | **CCGT** | **Coal PF wFGD** | **Inga** |
| 2016 | | | | | | | | | |
| 2017 | | | | | | | | | |
| 2018 | | | | | | | | | |
| 2019 | | | | | | | | | |
| 2020 | | | | | | | | | |
| 2021 | 160 | | | | | | | | |
| 2022 | 160 | | | | | | | | |
| 2023 | 370 | 200 | | | | | | | |
| 2024 | 440 | 500 | | 1000 | | 396 | | | |
| 2025 | 650 | 1000 | 15 | 1000 | | 2376 | 732 | | |
| 2026 | 580 | 1000 | 5 | 1000 | | 264 | 1464 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2027 | 580 | 1000 | 230 | 1000 | | 264 | 2196 | | |
| 2028 | 580 | 1000 | | 500 | | 396 | 1464 | 1500 | |
| 2029 | 580 | 1100 | | 1000 | | | 1464 | 1500 | |
| 2030 | 580 | 1200 | | 1000 | | 1716 | | 2250 | 1000 |
| 2031 | 580 | 1200 | | 1000 | | 1584 | | 750 | |
| 2032 | 580 | 1200 | | 500 | | | 732 | 1500 | 1000 |
| 2033 | 580 | 100 | | | | | 1464 | 750 | 500 |
| 2034 | 580 | 1200 | | 1000 | | 1452 | | | |
| 2035 | 580 | 1600 | | 500 | | | 1464 | 1500 | |
| 2036 | 580 | 1600 | | 1000 | | | | 1500 | |
| 2037 | 580 | 1400 | | 500 | 1359 | | 732 | 2250 | |
| 2038 | 580 | 1600 | | | | 1848 | 1464 | 750 | |
| 2039 | 650 | 1500 | | | 1359 | | 2928 | | |
| 2040 | 650 | 1600 | | 1000 | | 1056 | 732 | | |
| 2041 | 650 | 1600 | | 1000 | 4077 | 792 | | 750 | |
| 2042 | 650 | 1600 | | 500 | | | 2196 | | |
| 2043 | 650 | 1600 | | 500 | | | | | |
| 2044 | 650 | 1800 | | 500 | 1359 | | | | |
| 2045 | 770 | 1600 | | | 2718 | | 2196 | | |
| 2046 | 790 | 1600 | | 500 | 1359 | 924 | | | |
| 2047 | 720 | 1800 | | 1000 | 1359 | | 732 | | |
| 2048 | 720 | 1600 | | 500 | 2718 | 264 | | | |
| 2049 | 660 | 1500 | | 500 | 1359 | | | | |
| 2050 | 720 | 1400 | | 500 | 2718 | | | | |
| Total (MW) | 17600 | 37400 | 250 | 500 | 20385 | 13332 | 21960 | 15000 | 2500 |
| | | | | | | | | | |

A decision that additional capacity be provided by an IPP must be made with the concurrence of the Minister of Finance. Once such a decision is made, a procurement process needs to be embarked upon to procure that capacity in a fair, equitable and transparent process.

The New Generation Regulations set out the procurement process. The stages within a bid programme are prescribed as follows:

i. Request for Qualifications (RFQ);
ii. Request for Proposals (RFP); and
iii. Negotiation with the preferred bidder(s).

A successful bidder will be awarded a Power Purchase Agreement (PPA) subject to approval by the Regulator.

### *1.4.6 The Northern Cape Provincial Growth and Development Strategy (NC PGDS)*

The importance of developing the renewable energy sector in the Northern Cape was first acknowledged in the Northern Cape Provincial Growth and Development Strategy (NC PGDS). The NC

PGDS refers to the need to ensure availability of affordable energy. It notes, “in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured.” At the same time, the development of new sources of energy through the promotion of the adoption of energy applications that display a synergy with the province’s natural resource endowments must be encouraged. In this regard the NC PGDS notes that, “development of energy sources such as solar energy, the natural gas fields, bio-fuels, etc., could be some of the means by which economic opportunity and activity is generated in the Northern Cape”. The NC PGDS also notes that “sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation”. In this regard, care needs to be taken to ensure that renewable energy facilities do not impact negatively on the region’s natural environment.

#### *1.4.7 The Northern Cape Provincial Spatial Development Framework (SDF)*

In the Northern Cape Provincial Spatial Development Framework (SDF) of 2011, the Northern Cape provincial government acknowledges that the major energy challenge faced by the province is finding a balance between ensuring electricity security and addressing issues around climate change. The Northern Cape Provincial SDF (2011) states that the energy sector could benefit the economy significantly through created economic spin-offs or multiplier effects. This will, however, require innovative planning to provide the necessary infrastructure and associated amenities to accommodate the industry in an efficient manner (Dennis Moss Partnership, 2012).

# 2 APPROACH TO UNDERTAKING THE STUDY

The Environmental Impact Assessment (EIA) was undertaken in accordance with the 2014 EIA Regulations listed in Government Gazette No. 10328 of 4 December 2014 (GN 982, 983, 984 and 985 of 4 December 2014, as amended), in terms of Section 24 and 44 of the National Environmental Management Act, (No 107 of 1998) (NEMA) as amended; the World Bank Standards (IFC Guidelines) and the Equator Principles, as well as with the relevant legislation and guidelines mentioned above.

## 2.1 Environmental Scoping Study

The Scoping Study identified the potential positive and negative impacts associated with the proposed development as well as the studies which were required to be undertaken as part of the EIA-phase of the project. The Draft Scoping Report (DSR) was made available for public review for a thirty (30) day period from Wednesday 21$^{st}$ of June 2017 to Friday 21$^{st}$ of July 2017. Comments received on the DSR were included in the Final Scoping Report (FSR) which was submitted to the DEA on Friday 4 August 2017. The DEA subsequently acknowledged the receipt of the FSR and EIA Plan of study on Monday 7 August 2017. In addition, The DEA accepted the FSR and EIA Plan of study on Friday 15 September 2017 and requested for additional information to be included in the DEIAr. SiVEST have responded to the DEAs request for additional information indicating how this DEIAr complies with the information required by the DEA. Refer to **Appendix 4** for FSR Acceptance Letter and SiVEST's response thereto.

The following studies were taken through into the EIA Phase:

- Biodiversity (flora and fauna);
- Avifauna;
- Bats;
- Surface Water;
- Soils and Agricultural Potential;
- Noise;
- Visual Impact;
- Heritage and Palaeontology;
- Socio-economic Impact;
- Geotechnical;
- Traffic; and
- Electromagnetic Interference Path Loss and Risk Assessment

## 2.2 Decision-Making Authority Consultation

The National Department of Environmental Affairs (DEA) are the determining authority on this application. The following consultation took place with DEA:

- An Application for EA for the proposed development was submitted to the DEA on 21 June 2017. A proof of payment, details of the EAP and declaration of interest, a project schedule, details of landowners, and locality map formed part of the application form and were submitted accordingly on the same date.
- The DSR was also submitted to the DEA on 21 June 2017.
- The DEA acknowledged receipt of the Application for EA and DSR on 22 June 2017 and the following reference number was allocated to the proposed development: **14/12/16/3/3/2/1018.**
- Comments on the DSR were received on 6 July 2017.
- The Final Scoping Report (FSR) was submitted to the DEA on 4 August 2017 and the Department confirmed receipt of the FSR on 7 August 2017.
- Acceptance of the FSR and the Plan of Study (PoS) for the EIA was received on 15 September 2017.

**As part of the letter from the DEA accepting the FSR, it was requested that additional information be included in the DEIAr. The table below provides details as to how this DEIAr fulfils the main information requested by the DEA in the FSR acceptance letter. For further details, refer to Appendix 4 for the FSR Acceptance Letter.**

**Table 5:** Compliance with the DEA requirements detailed in the FSR acceptance letter

| Additional Information Required by the DEA | Notes / Comments |
|---|---|
| All comments and recommendations made by all stakeholders and I&APs in the draft scoping report and submitted as part of the final scoping report must be taken into consideration when preparing an Environmental Impact Assessment report (EIAr) in respect of the proposed development. The concerns raised by the stakeholders and I&APs must be adequately addressed prior to submission of the final EIAr to the Department. The stakeholders and I&APs includes but is not limited to the Northern Cape Department of Nature and Conservation (DENC), the Department of Agriculture, Forestry and Fisheries (DAFF), the provincial Department of Agriculture, the South African Civil Aviation Authority (SACAA), the Department of Transport, the Local Municipality, the District Municipality, the Department of Water and Sanitation (DWS), the South African National Roads Agency Limited (SANRAL), the Square Kilometre Array (SKA), the South African Heritage Resources Agency (SAHRA), SENTEC, the Endangered Wildlife Trust (EWT), Birdlife SA, the Department of Mineral Resources, the Department of Rural Development and Land Reform, the Department of Environmental Affairs: Directorate Biodiversity and Conservation, and the South African Astronomy Observation (SAAO). | The Comments and Response Report (C&RR) details how stakeholders and I&APs comments and recommendations have been taken into consideration. The C&RR is included in **Appendix 7E**. All correspondence between authorities and I&APs is included in **Appendix 7D**. All concerns raised by the stakeholders and I&APs will be adequately addressed prior to submission of the final EIAr to the Department. |
| Ensure the following is included in the final EIAr:<br><br>▪ The comments and response report in accordance with the requirements of the EIA Regulations, 2014, as amended.<br>▪ The details of the PPP in accordance with Regulation 41 of the EIA Regulations.<br>▪ A copy of the draft EIAr must be submitted to the Department's Biodiversity Planning Directorate so that they provide comments on the draft EIAr.<br>▪ Proof of correspondence with the various stakeholders must be included in the EIAr. If the EAP is not able to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments.<br>▪ The EAP must, in order to give effect to Regulation 8, give registered I&APs access to, | ▪ The Comments and Response Report (C&RR) is included in **Appendix 7E**.<br>▪ Details of the PPP which has been undertaken to date is included in **Section 7**.<br>▪ A copy of the Draft EIAr will be submitted to the Department's Biodiversity Planning Directorate accordingly so that they can provide comments on the Draft EIAr. Proof of submission will be detailed in the FEIAr.<br>▪ All correspondence between stakeholders, authorities and I&APs is included in **Appendix 7B** and **7D**.<br>▪ The EAP will give all registered stakeholders and I&APs access to, and an opportunity to comment on the DEIAr |

| | |
|---|---|
| and an opportunity to comment on the report in writing within 30 days before submitting the FEIAr to the Department.<br>▪ It must be reiterated that, should an application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then this Department will not make nor issue a decision in terms of your application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999. Comments from SAHRA and/or the provincial department of heritage must be provided in the EIAr. | in writing for a thirty (30) day period, prior to submission of the FEIAr. See **Section 7** for a description of the PPP followed.<br>▪ The relevant officials from the SAHRA have been included on the project database, notified of the project progress and sent copies of the Scoping phase Heritage Report and FSR. Comments from SAHRA on the impact phase Heritage Report and the DEIAr will be included in the FEIAr. All comments from SAHRA and/or the provincial department of heritage are included in **Appendix 7D.** |
| Please ensure that all mitigation measures and recommendations in the specialist studies are addressed and included in the final EIAr and Environmental Management Programme (EMPr). | Specialist mitigation measures and recommendations have been addressed and included in **Sections 9** and **12**, as well as in **Section 15.1**, the summary of findings. Additionally, these have been addressed and included in the Draft EMPr which is included as **Appendix 8**. These will also be addressed and included in the Final EIAr and Final EMPr. |
| SKA-SA on their comments dated 18th of November 2016 indicated that as a result of the medium to high risk associated with the wind facilities, the SKA project office recommends that further EMI and RFI detailed studies be conducted as significant mitigation measures may be required to lower the risk of detrimental impacts to an acceptable level.<br><br>Based on the above, the applicant must conduct detailed EMI and RFI specialist studies which must be included in the EIAr. SKA-SA must be engaged to guide the drafting of the terms of reference and comments from SKA-SA must be included in the EIAr. | Initial detailed EMI and RFI specialist studies have been undertaken and are included in **Appendix 9C**. The EMI and RFI studies were based on worst case scenario turbines. Due to technology improvements a different turbine may be used for the proposed development. However this would be subject to the same EMI and RFI studies. More accurate EMI and RFI studies will thus be required and undertaken when a final turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will also be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from ICT confirming this has been included in **Appendix 9C**. It should be noted |

| | |
|---|---|
| | that these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, Mainstream have suggested that the DEA include a condition that further modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process. |
| The Path Loss and Risk Assessment report compiled by Interference Testing and Consultancy Services (ITC) is noted. However, comments regarding this report must be sought from the SKA-SA and must form part of the draft EIAr. | Comments regarding the Path Loss and Risk Assessment Report compiled by Interference Testing and Consultancy Services (ITC) were sought from the SKA-SA. All comments received from the SKA-SA to date have been included in the C&RR which is included in **Appendix 7E**. Additionally, all correspondence undertaken with the SKA-SA is included in **Appendix 7D**. A more accurate path loss and risk assessment will however be re-done once a final turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from Interference Testing and Consulting Services (Pty) Ltd (ITC) confirming this has been included in **Appendix 9C**. |
| Due to the number of similar applications in the area, all the specialist assessments must include a cumulative environmental impact statement. Identified cumulative impacts must be clearly defined, and where possible the size of the identified impact must be quantified and indicated i.e. hectares of cumulatively transformed land. | All the specialist assessments have included a cumulative environmental impact statement. The identified cumulative impacts were assessed as requested by the DEA. **Section 10** provides a detailed summary of all of the cumulative impacts potentially associated with the proposed project. |
| Detailed cumulative impact assessments must be provided in the EIAr for all specialist studies conducted. The specialist studies must provide proof that other specialist reports that were conducted for renewable energy projects in the area were reviewed and indicate how the recommendations, mitigation measures and conclusions have been taken into | Detailed cumulative impact assessments have been provided in the DEIAr for all the specialist studies conducted. The cumulative impact assessments were conducted to include all the information which was requested by the DEA. **Section 10** provides a detailed summary of all of the cumulative |

| | |
|---|---|
| consideration when the conclusion and mitigation measures were drafted for this project. | impacts potentially associated with the proposed project. |
| The Bat and Avifaunal specialist assessments must assess and make recommendations for the definite measurements for the preferred hub heights and rotor diameter. | The Bat and Avifaunal specialist assessments have assessed and made recommendations for the definite measurements for the preferred hub heights and rotor diameter. The Bat and Avifaunal specialist assessments are included in **Appendix 6B** and **6C** respectively. In addition, specialist recommendations are detailed in **Section 12** of the DEIAr. |
| The 12 months Bird and Bat Monitoring must be conducted in line with the latest guidelines. It is noted that monitoring was done from 31 July 2004 to 13 September 2004. As such, this must be amended to include the updated requirements. A copy of the latest guidelines can be found on the Birdlife South Africa and SABAAP's website. | The Department's comment that the 12 month Bird and Bat Monitoring studies were conducted from 31 July 2004 to 13 September 2004 is incorrect. These studies were rather undertaken from 10 November 2015 to 02 December 2016. In addition, the 12 month Bird and Bat Monitoring studies have been conducted in line with the latest guidelines. The Bird monitoring protocol for the site is 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 Bat monitoring has been undertaken to comply with the latest version (2016) of: Sowler, S., Stoffberg, S., MacEwan, K., Aronson, J., Ramalho, R., Potgieter, K., Lötter, C. 2016. South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: 4th Edition. South African Bat Assessment Association. |
| DEA requires submission of an avifauna and bat pre-construction monitoring report together with the draft EIAr. Baseline monitoring must be undertaken for a period of 12 months. The avifauna and bat preconstruction monitoring must be conducted in accordance with the minimum requirements guidelines produced by Bird Life South Africa and the South African Bat Advisory Panel. The baseline monitoring programme for avifuana and bats must | Impact phase avifauna and bat pre-construction monitoring reports are included in **Appendix 6B** and **6C** of the DEIAr respectively. Baseline monitoring was undertaken for a period of 12 months. The avifauna and bat pre-construction monitoring was also conducted in accordance with the minimum requirements guidelines produced by Bird Life South Africa and the South |

| | |
|---|---|
| cover the entire site as well as the height of the entire facility, i.e., you may be required to install more monitoring masts at height. | African Bat Advisory Panel. The baseline monitoring programme for avifuana and bats covered the entire site as well as the height of the entire facility. |
| The DEIAr must provide a detailed description of the need and desirability, not only providing motivation on the need for clean energy in South Africa of the proposed activity. The need and desirability must also indicate if the proposed development is needed in the region and if the current proposed location is desirable for the proposed activity compared to other sites. The need and desirability must take into account cumulative impacts of the proposed development in the area. | A detailed description of the need and desirability of the proposed activity has been provided in the DEIAr as requested. Project need and desirability is included in **Section 4**, and in the discussion of alternatives in **Section 5.2**. The desirability of the development at the proposed location compared to other sites is discussed in **Section 5.2.1**. |
| Two (2) specialist studies were undertaken by in-house specialists i.e. Surface Water Impact Assessment and Visual Impact Assessment. These studies must be peer-reviewed by external specialists. The format of each peer-review must address the following:<br>▪ A CV clearly showing expertise of the peer reviewer;<br>▪ Acceptability of the terms of reference;<br>▪ Is the methodology clearly explained and acceptable;<br>▪ Evaluate the validity of the findings (review data evidence);<br>▪ Discuss the suitability of the mitigation measures and recommendations;<br>▪ Identify any short comings and mitigation measures to address the short comings;<br>▪ Evaluate the appropriateness of the reference literature;<br>▪ Indicate whether a site-inspection was carried out as part of the peer review; and<br>▪ Indicate whether the article is well-written and easy to understand. | The two (2) specialist studies which were undertaken by in-house specialists, namely the Surface Water Impact Assessment and Visual Impact Assessment, have been peer-reviewed by external specialists as required. The format of each respective peer-review has addressed the requirements stipulated by the DEA. The peer-reviewed versions of these specialist studies (including letters supplied by the peer-reviewers) have been included in **Appendix 6D** and **6G** of the DEIAr respectively. |
| The EIAr must provide technical details for the proposed facility in a table format as well as their description and/or dimensions. A sample for the minimum information required is listed under point 2 of the EIA information required for wind energy facilities below. | The DEIAr has provided technical details for the proposed facility in a table format as well as their description and/or dimensions. See **Table 7** in **Section 5** of the DEIAr for the technical details as well as the description and/or dimensions of the wind energy facility. |
| The EIAr must provide the four corner points for the proposed development site (note that if the site has | All project co-ordinates have been included. The co-ordinates are included in the |

| | |
|---|---|
| numerous bend points, at each bend point point coordinates must be provided) as well as the start, middle and end point of all linear activities. | Executive Summary, **Section 6** and in **Appendix 9A**. |
| Details of future plans for the site and infrastructure after decommissioning in 20-30 years and the possibility of upgrading the proposed infrastructure to more advanced technologies. | The future plans for the site are detailed in the beginning section of this report before the Executive Summary. |
| Information on the services required on the site, e.g. sewage, refuse removal, water and electricity. Who will supply these services and has an agreement and confirmation of capacity been obtained? Proof of these agreements must be provided. | Generally, the final agreements with regards to the services required on the site are only concluded after the proposed project has been selected as a preferred bidder. Mainstream are however in the process of submitting the relevant applications for the services required on site to the relevant municipal departments. Copies of these applications will be included in the FEIAr. In addition, any comments received regarding the applications for the services required on the site will also be included in the FEIAr accordingly. |
| Should a Water Use License be required, proof of application for a license must be submitted. | Should a Water Use License be required, proof of application for a license will be submitted as required. |
| This Department requires that wind resource data be submitted as part of the EIAr. The wind resource data must be a summary of the wind resource available in the study area and motivation that the site has a good wind resource to sustain the Ithemba Wind Farm must also be provided. In addition, whilst the information may be deemed to be confidential, your attention is drawn to Regulation 10 of the EIA Regulations 2014, as amended, which states that "*An applicant must provide the competent authority with all information that reasonably has or may have the potential of influencing any decision with regard to an application*." | The wind resource data for the site is detailed in the beginning section of this report before the Executive Summary. |
| It has been noted that there are wetland and drainage lines on the sensitivity layout plan prepared by KLS on 02 February 2017 and revised on 19 June 2017 (Map Ref No 13622/SCO-X10), therefore, a sensitivity layout plan overlaid by the sensitive features and buffer zones i.e. rocky outcrops, wetland, drainage lines, etc, and also the existing structure (roads, power lines etc.) in the vicinity of the preferred site, the location of the turbines, substation, | A sensitivity layout plan overlaid by the sensitive features and buffer zones and also the existing structure in the vicinity of the preferred site, the location of the turbines, substation, permanent laydown area footprint, buildings, including accommodation and all "no-go" areas has been submitted as part of the final report for analysis. This is included in **Section 5.2**, |

| | |
|---|---|
| permanent laydown area footprint, buildings, including accommodation and all "no-go" areas must be submitted as part of the final report for analysis of the effect of the proposed project on the environment. Please ensure all features are clearly indicated on the legend of the sensitivity layout plan. | Error! Reference source not found. and **ppendix 5** of the DEIAr. All features have been clearly indicated on the legend of the sensitivity layout plan. |
| A shapefile of the preferred development layout/ footprint must be submitted to this Department. The shapefile must be created using the Hartebeesthoek 94 Datum and the data should be in Decimal Degree Format using the WGS 84 Spheroid. The shapefile must include at a minimum the following extensions i.e. .shp; .shx; .dbf; .prj; and .xml (Metadata file). If specific symbology was assigned to the file, then the .avl and/or the .lyr file must also be included. Data must be mapped at a scale of 1:10 000 (please specify if an alternative scale was used). The metadata must include a description of the base data used for digitizing. The shapefile must be submitted in a zip file using EIA application reference number as the title.<br><br>The shape file must be submitted to:<br><br>Postal Address:<br>Department of Environmental Affairs<br>Private Bag X447<br>Pretoria<br>0001<br><br>Physical Address:<br>Environment House<br>473 Steve Biko Road<br>Pretoria<br><br>For Attention: Muhammad Essop<br>Integrated Environmental Authorisations<br>Strategic Infrastructure Developments<br>Telephone Number: (012) 399 9406<br>Email Address: MEssop@environment.gov.za | The shapefiles will be provided according to the specifications in the FSR acceptance letter and submitted to the DEA with the FEIAr. |
| Ensure the assessment is undertaken as per the EIA Regulations 2014 (as amended), Appendix 3. In addition, please ensure the following is addressed in the final EIAr: | The EAP has ensured that the assessment is being undertaken as per the EIA Regulations 2014 (as amended), Appendix 3. In addition, the EAP will ensure that the requirements stipulated in the FSR acceptance letter are |

| | |
|---|---|
| ▪ An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.<br>▪ A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase.<br>▪ A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction.<br>▪ A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.<br>▪ An open space management plan to be implemented during the construction and operation of the facility.<br>▪ A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimise impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.<br>▪ A transportation plan for the transport of components, main assembly cranes and other large pieces of equipment. | addressed in the FEIAr. Should this be required, the EAP will provide detailed motivation if any of the requirements in the FSR acceptance letter is not required by the proposed development and not included in the EMPr. |

| | |
|---|---|
| ▪ A stormwater management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and sub-surface flows. Drainage measures must promote the dissipation of storm water run-off.<br>▪ A fire management plan to be implemented during the construction and operation of the facility.<br>▪ An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.<br>▪ An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.<br>▪ Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct and indirect spillage or pollutants.<br><br>The EAP must provide detailed motivation if any of the above requirements is not required by the proposed development and not included in the EMPr. | |
| Ensure the content of the EMPr complies with the requirements of Appendix 4 of the EIA Regulations, 2014 as amended. | The EAP has ensured that the content of the EMPr complies with the requirements of Appendix 4 of the EIA Regulations, 2014 as amended. A Draft EMPr is included in **Appendix 8**. |

| | |
|---|---|
| The EAP is reminded that should the EIAr fail to comply with the requirements of this acceptance letter, the proposed WEF development will be refused in terms of the EIA Regulations 2014, as amended. | The comment is noted. The DEIAr will comply with the requirements of the FSR acceptance letter, as detailed in this table. |
| The applicant is reminded to comply with the requirements of Regulation 45 with regard to the time period allowed for complying with the requirements of the Regulations, and Regulations 43 and 44 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the competent authority for decision-making. The reports referred to are listed in Regulation 43 (1). | All regulated timeframes will be complied with. A description of the public participation process to be followed is included in **Section 7**. |
| The Department will undertake a site inspection prior to or upon receipt of the draft EIAr for comment. | The comment is noted. |
| The DEA has requested that two (2) electronic copies (CD/DVD) and two (2) hard copies of the DEIAr and FEIAr must be submitted to the DEA. | Two (2) electronic copies (CD/DVD) and two (2) hard copies of the DEIAr and FEIAr will be submitted to the DEA as requested. |
| The DEA attached information to the FSR acceptance letter which must be used in the preparation of the DEIAr. This will enable the Department to speedily review the DEIAr and make a decision on the application. | The information attached to the FSR acceptance letter will be used in the preparation of the DEIAr. |
| The EAP is reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, which stipulates that no activity may commence prior to an Environmental Authorisation being granted by the DEA. | The comment is noted, and no activity will commence prior to the Environmental Authorisation (EA) being granted by the DEA. |

A record of all authority consultation is included within **Appendix 4**.

Consultation with other relevant authorities was and is also being undertaken via meetings and telephonic consultation in order to actively engage them and provide them with information and gain their feedback.

Authorities and key stakeholders consulted include the following:

- National Authorities;
- Provincial Authorities;
- Namakwa District Municipality;
- Hantam Local Municipality;
- Khai-Ma Local Municipality;
- Government Structures such as SAHRA, SANRAL, Eskom Telkom, etc.;
- Agriculture Associations;

- Regional and local media (advertisements and public documents e.g. BID);
- Business and commerce;
- Environmental bodies / NGOs;
- Department of Environmental Affairs: Biodiversity Section;
- Department of Water and Sanitation;
- Community representatives, CBOs, development bodies;
- Landowners;
- Square Kilometre Array (SKA);
- Civil Aviation Authority (CAA); and
- Air Traffic and Navigation Services (ATNS).

The full list of authorities and key stakeholders that have been consulted is included in **Appendix 7F**.

## 2.3 Environmental Impact Assessment Report

The EIA phase of the project has focused on consulting with Interested and / or Affected Parties (I&APs) as well as conducting specialist studies to address the potential impacts identified during the scoping phase.

The NEMA EIA Regulations (GN. R. 982), as amended, state that the objective of the environmental impact assessment process is to, through a consultative process:

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
(b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
(d) determine the--
    (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    (ii) degree to which these impacts-
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources, and
        (cc) can be avoided, managed or mitigated;
(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
(g) identify suitable measures to avoid, manage or mitigate identified impacts; and
(h) identify residual risks that need to be managed and monitored.

The content requirements for an Environmental Impact Assessment (EIA) Report, as well as details of which section of the report fulfils these requirements, are shown in **Table 6** below.

**Table 6:** Content requirements for an Environmental Impact Assessment Report

| Content Requirements | Applicable Section |
|---|---|
| (a) details of-<br>(i) the EAP who prepared the report; and<br>(ii) the expertise of the EAP, including a curriculum vitae; | Details of the EAP and full project team are included in **Section 1.2**. The expertise (including curriculum vitae) of the EAP and full project team are include in **Appendix 2**. |
| (b) the location of the activity, including-<br>(i) the 21 digit Surveyor General code of each cadastral land parcel;<br>(ii) where available, the physical address and farm name;<br>(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties; | The location (including 21 digit Surveyor General codes) of the proposed project is detailed in on **page *iii*** of the report, as well as in **section 6.1**. |
| (c) a plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is-<br>(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or<br>(ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken; | A map of the regional locality is shown in **Section 6.1**, and the site locality is shown in **Section 5.1**. Additionally, all project maps are included in **Appendix 5**. Coordinates are shown on **page *iii*** of the report, as well as in **Section 6.1**. Additionally, all coordinates are included in **Appendix 9A**. |
| (d) a description of the scope of the proposed activity, including-<br>(i) all listed and specified activities triggered;<br>(ii) a description of the activities to be undertaken, including associated structures and infrastructure; | The listed and specified activities triggered as per NEMA are detailed in **Section 1.3.2**. The technical project description is included in **Section 5**. This includes a description of activities to be undertaken, including associated structures and infrastructure. |
| (e) a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context; | A description of all key legal and administrative requirements is provided in **Section 1.3**, this includes an explanation of how the proposed development complies with the requirements. Key development strategies and guidelines and their applicability to the proposed project are detailed in **Section 1.4**. |

| | |
|---|---|
| (f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location; | The need and desirability of the proposed project is discussed in **Section 4**, including the need and desirability of the activity at the location as proposed. |
| (g) a motivation for the preferred development footprint within the approved site; | The site specific suitability is discussed in **Section 4.4**. |
| (h) a full description of the process followed to reach the proposed development footprint within the approved site, including:<br>(i) details of the development footprint alternatives considered;<br>(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;<br>(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;<br>(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;<br>(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts-<br>(aa) can be reversed;<br>(bb) may cause irreplaceable loss of resources; and<br>(cc) can be avoided, managed or mitigated;<br>(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;<br>(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;<br>(viii) the possible mitigation measures that could be applied and level of residual risk;<br>(ix) if no alternative development locations for the activity were investigated, the motivation for not considering such; and<br>(x) a concluding statement indicating the preferred alternative development location within the approved site; | A description of the alternatives considered in terms of the Regulations is included in **Section 5.2** and a full description and comparative assessment of the alternatives considered is included in **Section 11**. The public participation process followed is detailed in **Section 7**. Additionally, all public participation documents are included in **Appendix 7**. This includes a summary of issues raised by I&APs, and the responses to their comments. A full description of the environmental attributes within the application site is included in **Section 6** and **8**. The impacts and risks associated with each alternative are assessed in **Section 9.2**. The methodology used in identifying the impacts and risks associated with each alternative is included in **Section 9.1**. The positive and negative impacts that the proposed activity will have on the environment are discussed in **9.2**. Potential mitigation measures are included in **section 12**. The inclusion of alternatives is discussed in **section 5.2** and in **section 11**. A concluding statement indicating the preferred alternatives is contained in **section 11**. |

| | |
|---|---|
| (i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including<br>(i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and<br>(ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures; | The process undertaken to assess the impacts as well as the assessment of impacts by each specialist are shown in **Section 9**. Each environmental issue and risk is tabulated in **section 9.2** and an assessment of the significance of each issue before and after mitigation measures is included. |
| (j) an assessment of each identified potentially significant impact and risk, including-<br>(i) cumulative impacts;<br>(ii) the nature, significance and consequences of the impact and risk;<br>(iii) the extent and duration of the impact and risk;<br>(iv) the probability of the impact and risk occurring;<br>(v) the degree to which the impact and risk can be reversed;<br>(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and<br>(vii) the degree to which the impact and risk can be avoided, managed or mitigated; | The impact rating system contained in **Section 9.1.2** details the methodology for determining the significance of an impact. This includes the points (j) (i to vii) of **Appendix 3**. The assessment of each risk identified by the specialists is contained in **Section 9.2**. |
| (k) where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report; | All relevant specialist findings are included in **Section 8**, with all recommended mitigation measures detailed in **Section 12**. The mitigation measures have been incorporated into the EMPr which is contained in **Appendix 8**. The tabulated summary of key specialist findings and recommendations is included in **Section 15.1** and in the executive summary. |
| (l) an environmental impact statement which contains-<br>(i) a summary of the key findings of the environmental impact assessment:<br>(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and | **Section 15** contains a tabulated summary of the key findings in each specialist assessment and the positive and negative impacts associated with the activity, which were identified by each specialist, are also summarised in table form in the section. **Section** Error! eference source not found. also |

| | |
|---|---|
| (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives; | contains a map showing the final preferred layout superimposed with sensitive and no-go areas and buffers where required. |
| (m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation; | The recommended mitigation measures associated with each impact are included in section 9, and overall specialist recommendations and mitigation measures are included in **Section 12**. These measures are contained in the EMPr which can be found in **Appendix 8**. |
| (n) the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment; | The final proposed alternatives are included in **Section 11**, including a comparative assessment by the specialists. |
| (o) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation; | Any aspects identified by specialists or the EAP that should be included as conditions of the authorisation are identified in **Section 15** and in the executive summary. |
| (p) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed; | All assumptions and limitations are highlighted in **Section 3**. |
| (q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation; | A reasoned opinion as to whether or not the proposed activity should be authorised, including conditions if required, is included in **Section 15** and in the executive summary. |
| (r) where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised; | The period required for the environmental authorisation, as well as the date on which the activity and post construction monitoring will be concluded is discussed in **Section 15** and the executive summary. |
| (s) an undertaking under oath or affirmation by the EAP in relation to-<br>(i) the correctness of the information provided in the reports;<br>(ii) the inclusion of comments and inputs from stakeholders and I&APs; | The EAP affirmation is included in **Appendix 3**. |

| | |
|---|---|
| (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and<br>(iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties; | |
| (t) where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts; | If applicable, details of any financial provisions for the management of negative environmental impacts are included in **Section 12**, **Section 15** and the executive summary. |
| (u) an indication of any deviation from the approved scoping report, including the plan of study, including-<br>(i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and<br>(ii) a motivation for the deviation; | If required, the details of, and motivation for, any deviation from the FSR plan of study will be detailed in **Section 2.1**. At this stage, no deviation from the approved scoping report and plan of study is anticipated. |
| (v) any specific information that may be required by the competent authority; and | As part of the letter of acceptance for the FSR the DEA detailed specific information requirements. These requirements are tabulated in **Section 2.2**, along with an explanation of how the requirements are met. All correspondence from the DEA is included in **Appendix 4**. |
| (w) any other matter required in terms of section 24(4)(a) and (b) of the Act. | All requirements in terms of section 24(4)(a) and (b) of the Act have been met in this report. |

# 3 ASSUMPTIONS AND LIMITATIONS

- It is assumed that all information provided by the Applicant to the Environmental Team was correct and valid at the time it was provided.
- It is not always possible to involve all Interested and / or Affected Parties (I&APs) individually, however, every effort has / is been made to involve as many interested parties as possible. It is also assumed that individuals representing various associations or parties convey the necessary information to these associations / parties.
- It is assumed that the information provided by the various specialists is unbiased and accurate.
- The following assumptions, uncertainties and gaps in knowledge were encountered by the various specialists:

- **Biodiversity:**
  - The current study is based on a number of site visits as well as an associated desktop study.
  - Although it was not very wet at the time of the site visits, conditions were nevertheless suitable for the assessment and there are no significant limitations associated with the timing of the field assessment.
  - The presence of some fauna is difficult to verify in the field as these may be shy or rare and their potential presence at the site must be evaluated based on the literature and available databases. In many cases, these databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna and flora present at the site. This is acknowledged as a limitation of the study, however it is substantially reduced by the fact that the consultant has sampled the adjacent properties on multiple occasions across different seasons. In order to further reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site.

- **Avifauna:**
  - A total of 21 full protocol lists have been completed to date for the 9 pentads where the study area is located (i.e. listing surveys lasting a minimum of two hours each). This is a fairly comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, SABAP1 records (Harrison *et al*. 1997) and the results of the 12-months pre-construction monitoring.
  - Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
  - To date, few comprehensive studies (other than a number of environmental impact reports), and no peer-reviewed scientific papers, are available on the impacts wind farms have 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. 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."
  - Even in the international arena predicted mortality rates are often significantly off the mark, 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).

- Priority species were taken from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).
- The study area was defined as the area which comprises the four application sites for the Mainstream WEFs and immediate environs. The development area refers to the proposed !Xha Boom WEF.
- No comparative assessment was undertaken of the various power line connection alternatives. This will form part of a separate Basic Assessment (BA).

**Cumulative Impacts:**

- The information on the other renewable energy projects in the study area was received from SiVEST and independently sourced from various websites, but the accuracy of these sources cannot be guaranteed.
- The assessment takes into account the potential impact of the associated grid connections as well.

- **<u>Bats:</u>**
  - Distribution maps of South African bat species still require further refinement such that the bat species proposed to occur on the site (that were not detected) are assumed accurate. If a species has a distribution marginal to the site, it was assumed to occur in the area. The literature based table of species probability of occurrence may include a higher number of bat species than actually present.
  - The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large scale effect on migratory species. Attempts to overcome this limitation, however, will be made during this long-term sensitivity assessment.
  - The satellite imagery partly used to develop the sensitivity map may be slightly imprecise due to land changes occurring since the imagery was taken.
  - 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.
  - 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 as well as a measure of relative abundance.
  - 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 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.

- **<u>Surface Water:</u>**
  - This short term once-off surface water assessment has only focused on the identification and delineation of surface water resources within the proposed development area. Identification and delineation of surface water resources in the wider area outside of the proposed development area has not been undertaken.

- Given the short term once-off nature of the assessment, the assessment should not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence within the surface water resources.
- Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (NFEPA, 2011) database. This database is a national level database and some smaller surface water resources may not be identified if the database. Additionally, mainly wetlands with permanent inundation are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles may not be included. The fieldwork component was included in the assessment to verify the desktop database information in order to address these shortcomings.
- Surface water resources were initially identified and delineated at a desktop level. These were then groundtruthed and verified in the fieldwork phase. The initial delineations undertaken at a desktop level were refined following findings made in the fieldwork phase.
- A Global Positioning System (GPS) device was used to groundtruth surface water resources as well as for delineation purposes. The GPS is expected to be accurate from 5m up to 15m depending on meteorological conditions.
- Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor have water quality, hydrological or groundwater studies been included.
- Wetland or river health, present ecological status (PES), ecosystem services and the ecological importance (EI)/ecological sensitivity (ES) categories have not been assessed for identified surface water resources. Only desktop information in terms of PES/EI/ES (where available) from the databases were provided as per the scoping assessment information.
- Application of the DWAF (2005 and 2008) delineation guidelines are limited for the delineation of drainage lines and pan wetlands in arid and semi-arid regions due to the intermittent nature of flow which is poorly accommodated in the methodology, and application thereof.
- Avi-fauna in general are known to frequent surface water resources regularly, or in some cases can live in these habitats on a longer more permanent basis. Impacts to avi-fauna therefore may fall within the scope of a surface water assessment from an ecological perspective. However, as a separate independent avifaunal assessment has been undertaken for the proposed development, the assessment of potential impacts as related to avi-fauna have not been included in this assessment. It is therefore assumed that all avi-faunal impacts (including that related to waterfowl associated with wetlands and other surface water resources) will have been adequately covered in the avi-faunal impact assessment.

- **<u>Soils and Agricultural Potential:</u>**
  - The field investigation for this assessment is considered more than adequate for the purposes of this study (see section 3.1 of the Soils and Agricultural Potential Report) and is therefore not seen as a limitation.
  - The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

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

- **Noise:**

**Measurement of Ambient Sound Levels:**

- The selection of measurement locations is critical to provide information on the soundscape. Sound levels closer to dwellings are generally significantly higher than the sounds away from these dwellings. This is due to residents of the dwellings significant altering the surrounding dwelling sound environment, develop infrastructure and alter vegetation (that also attracts other animals) that also changes the sound character. Activities associated with the dwelling (agricultural, equipment operating, etc.) would also increase the noise levels. Factors that need to be considered include:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. 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. It is assumed that the measurement locations represents other residential dwellings 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 closest trees, number and type of trees as well as the height of trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwelling, type of equipment used at dwelling (compressors, air-cons);
    - general maintenance condition of house (especially during windy conditions); and
    - a number and type of animals kept in the vicinity of the measurement locations.
- Measurement locations for this project were selected to be in a relative quiet area, away from the residential dwelling to minimize the potential of extraneous noises impacting on the ambient sound levels,
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation and external noise sources will influence measurements. It may determine whether one is measuring anthropogenic sounds from a receptors dwelling, or environmental ambient soundscape contributors of significance (faunal, roads traffic, railway line movement etc.). At times there are extraneous noises that cannot be heard during deployment, or not operational, that can significantly impact on readings (such as water pumps, transformers, faunal communication, etc.);

- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.) – when close to any busy or significant roads. Traffic however is highly dependent on the time of day as well as general agricultural activities taking place during the site investigation. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. This study found that traffic in the area was very low, yet it cannot be assumed that it is always low.
- 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. The site visit unfortunately coincided with a relatively windy period;
- Ambient sound levels are depended not only time of day and meteorological conditions, but also change 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. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronization, magnifying noise levels they produce from their tymbals;
- 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. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and in various cases sought after and pleasing;
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as LAMin, LAIeq, LAFeq, LCeq, LAMax, LA10, LA90 and spectral analysis forms part of the many variables that can be considered; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

**Adequacy of Underlying Assumptions:**

  - Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds are also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.
  - As previously mentioned, 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.

**Uncertainties Associated with Mitigation Measures:**

  - Any noise impact can be mitigated to have a low significance, however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of a NSD), or the mitigation may result in the project not being economically viable. These mitigation measures may be engineered, technological or due to management commitment.

- For the purpose of this report (determination of the significance of the noise impact) mitigation measures will be selected that is feasible, mainly focusing on management of noise impacts using rules, policy and require a management commitment. This however does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management).
- It will be assumed the mitigation measures proposed for the construction phase will be implemented and continued during the operational phase. If mitigation proposed in this report will be adequate to manage the significance of the noise impact to low, no further noise studies will be recommended in the EIA phase.

**Uncertainties of Information Provided and Sound Propagation Modelling:**

- It is important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms in Noise Impact Assessment Report). Sound or noise levels generally refers to a sound pressure level as measured using an instrument, whereas the noise rating level refers to a calculated noise level to which various corrections and adjustments was added.
- These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In this project it illustrates the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time. It is used to define potential issues of concern and not to predict a noise level at a potential noise-sensitive receptor. For this the selected model is internationally recognised and considered adequate.
- While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is as 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. Assumptions include:
    - The octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of this processes/equipment. The determination of these 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 change depending on the load the process and equipment is subject too. 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. Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worst-case scenario;
    - As it is unknown which processes and equipment will be operational (and when operational and for how long), modelling considers a scenario where all processes and equipment are under full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely over-estimate noise levels;
    - Ambient sound levels vary over time of day, season and largely depend on the complexity and development character of the surrounding environment. To allow the

calculation of change in ambient sound levels, a potential ambient sound level of 35 dBA is assumed. This level represents a quiet environment;

- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- Topography impacts on sound propagation as it can allow the reflection of sound from the surface and result in refraction effects due to wind gradients. Studies in this regard indicated that it is difficult to model noise levels accurately when facing complex topography challenges (especially deep valleys and canyons);
- 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. 75% hard ground conditions will be modelled even though the area is where the facility will be located is relatively well vegetated and uneven. This will allow a more precautious worst-case scenario.

- **Visual:**
  - The identification of visual receptors has been based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential receptors within the study area. Thereafter a site visit was undertaken from 05 to 09 December 2016 in order to verify the sensitive visual receptors within the study area and assess the visual impact of the development from these receptor locations. Due to the extensive area covered by the study area, 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 in an area potentially affected by the proposed development does not thus necessarily mean that a visual impact will be experienced.
  - Wind turbines are very large structures by nature and could impact on receptors that are located relatively far away, particularly in areas with very flat terrain. 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 wind farm – i.e. an area of 8km from the boundary of the wind farm application site. This 8km limit on the visual assessment zone was applied because distance is a critical factor when assessing visual impacts and although the wind farm may still be visible beyond 8km, the degree of visual impact would diminish considerably. As such the need to assess the impact on potential receptors beyond this distance would not be warranted. This is demonstrated in **Figure 3** below, which provides a visual simulation of how a wind farm could potentially appear from a distances of approximately 8km away. It should be noted that **Figure 3** was sourced from a previous VIA which SiVEST undertook for another proposed wind farm and does not represent the study area / visual assessment zone for the proposed !Xha Boom Wind Farm. As indicated, from this distance haze may impede views toward the structures,

making them appear to blend with the horizon and reducing the visual contrast between the turbines and the landscape.

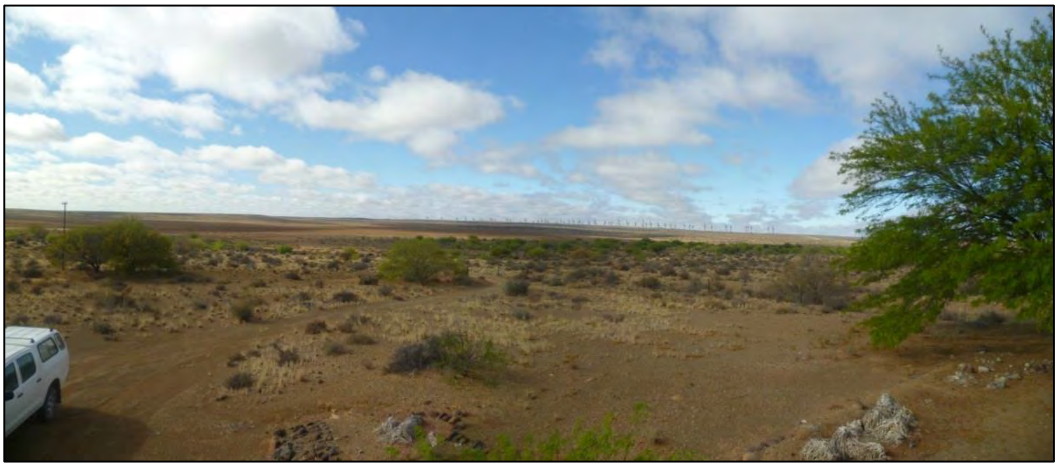


**Figure 3:** Visually modelled view of a wind farm development from a distance of approximately 8km away. This image was sourced from a previous VIA which SiVEST undertook for another proposed wind farm and does not represent the study area / visual assessment zone for the proposed !Xha Boom Wind Farm.

- During the site visit, it was observed that a few of the farmsteads / residential dwellings identified via desktop means (i.e. Google Earth) during the scoping phase of this study have been abandoned. No further assessment was therefore undertaken from these abandoned farmsteads / residential dwellings and they were eliminated from the list of potentially sensitive receptor locations for the purpose of this EIA phase study.
- The Noise Specialist (with the Public Participation Practitioner's advice) has identified several receptors which the initial VIA did not identify (De Jager, 2017). As such, some of the receptors identified by the noise specialist have been included in the VIA in order to ensure consistency with the findings of the noise report. It should however be noted that some of the receptors identified by the noise specialist have been excluded for the purpose of the VIA as they were deemed not be impacted on from a visual perspective due to the fact that they are not permanently occupied by residents or have been abandoned. In addition, some of the identified noise receptors were found to be occupied by shepherds who are employed by the owners of the farmsteads / homesteads.
- Due to access limitations during the site visit, the impact rating assessment of the proposed development on some of the potentially sensitive visual receptor locations was undertaken via desktop means. Although the use of these farmsteads / residential dwellings could not be established during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed wind farm and were assessed as part of the VIA.
- Due to the varying scales and sources of information as well as the fact that only 20m contours were available to establish the Digital Terrain Model (DTM); 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 DTM.

- A matrix has been developed to assist in the assessment of the potential visual impact at each 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 five 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 receptor location by the proposed wind energy facility. The matrix should therefore be seen as a representation of the likely visual impact at a receptor location. The results of the matrix should be viewed in conjunction with the visualisation modelling to gain a full understanding of the likely visual impacts associated with the proposed development.
- Some feedback regarding the visual environment has been received from the public participation process. This feedback will be incorporated into further drafts of this report.
- No viewsheds were generated during this visual study, as the topography within the study area is relatively flat. Within this context, minor topographical features, vegetative screening, or man-made structures would be important factors which would influence the degree of visibility and which would not be factored in by the viewsheds.
- As previously mentioned, ground-truthing was undertaken during the scoping phase of this study. The visual sensitivity of each receptor location was therefore investigated and explored during the scoping phase of the study. The visual sensitivity of each receptor location was however investigated and explored further in this phase of the study.
- Operational and security lighting will be required for the proposed wind farm 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 nighttime environment in the study area was not characterised. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have however been provided.
- At the time of undertaking the visual study no specific information was available regarding the design and layout of services and infrastructure associated with the proposed development. The potential visual impact of the typical infrastructure associated with a wind farm has been assessed.
- The assessment of receptor-based impacts has been based on the turbine layout provided by the proponent. 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 receptor locations.
- A cumulative impact assessment has been undertaken to provide a representation of the number of proposed renewable energy facilities likely to be visible from each potentially sensitive receptor location, if they were all constructed. Factors affecting visibility, such as localised screening from trees or topographical undulations have not been factored into the cumulative impact assessment.
- No layout information could be sourced for each proposed renewable energy facility planned in close proximity to the proposed !Xha Boom Wind Farm. The distance of the potentially sensitive receptor locations from the actual layout could therefore not be utilised to determine whether the receptor is likely to be visually exposed to the development. As

such, the distance from the farm on which each development is proposed was used to calculate the cumulative visual impact.

- Visualisation modelling from all potential 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 wind energy facility. The visual models represent a visual environment that assumes all vegetative clearing will be restored to its current state after the construction phase. This is however, 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 early planning stages. Therefore, the turbine layouts, as provided by Mainstream, may change and the infrastructure associated with the facility has not be included in the models.
- Most rainfall within the area occurs from February to March, during the late summer months. It should be noted that the fieldwork was undertaken at the beginning of December 2016, during early summer. During winter months up until early summer, the visual impact of the proposed development may be greater, particularly from farmhouses surrounded by tall deciduous trees. As such, the surrounding vegetation is expected to provide less potential screening than in the late summer months.
- The 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 early summer months which are characterised by clear weather conditions. It should be noted that clear conditions would make the wind turbines appear to contrast more from 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 the impact rating for each identified potentially sensitive receptor location (section 6.1 of the Visual Impact Assessment Report).

- **<u>Heritage:</u>**
  - Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the development area. Various factors account for this, including the subterranean nature of some archaeological sites. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

- **<u>Palaeontology:</u>**
  - The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:
    - Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South

    - Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist
    - The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
    - Impact studies and other reports (e.g. of commercial mining companies) - is not readily available for desktop studies.
  - Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on the possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a Palaeontological Impact Assessment may be significantly improved through field-survey by a professional palaeontologist.

- **<u>Socio-Economic:</u>**
  - 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.
  - The study was done with the information available to the specialist within the timeframes and specified budget.
  - 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 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.
  - It is assumed that the project description and infrastructure components as discussed above, are reasonably accurate. These details were used to assess the potential impacts.
  - Regarding the interviews undertaken, the following assumptions were made:
    - Questions asked during the interviews were answered accurately.
    - The degree of the perceived possible significance of concerns raised by the respondents were truthfully rated by the respondents.
    - The attitude of the respondents towards the project will remain reasonably stable over the short- to medium- terms.
  - It is also assumed that the general concerns and opinions raised by all land owners interviewed, such as security concerns, would also apply to the land owners not consulted with for whatever reason.
  - Considering the information obtained through primary as well as secondary sources, it can be concluded that the level of risk to the project associated with this knowledge gap is low.

- **<u>Geotechnical</u>**

- The research report has been a desktop study and as such, surveys were limited to on-site observations together with a field trip of the two (2) wind farm projects currently under construction. It is therefore recommended that the findings of this report be verified either through more detailed studies once the project moves into the preliminary and detail design stages of the engineering life cycle;
- It is assumed that each wind farm has a power export capacity of 235MW (total of 940MW for four projects);
- The grid connection shall not be N-1 compliant (export redundancy) as set out in the SA Network Code, due to economic considerations. As such, the cheapest connection costs is considered;
- The grid connection is based on the latest site development plans. Any changes to these plans would require a rework of this report;
- Any competing connections not mentioned in Chapter 10 of the Geotechnical Report should be made known to SMEC in order to update the report;
- The technical performance of the connection shall not be assessed, as this is a preliminary desktop assessment only; and
- Technical studies (steady state, fault, contingency studies, etc.) are not included at this stage.

- **Traffic:**
  - The assessment has been based on the traffic information available at this stage of the project. Information was sourced from the Department of Transport for the Northern Cape. In order to predict the likely staffing requirements the nearby Loeriesfontein 2 and Khobab wind farms were used as a guidance, although it is accepted that these values could vary substantially and are project specific. Caution is therefore advised when quoting the staff numbers.
  - The research report has been a desktop study and as such, surveys were limited to on-site observations together with a field trip of the two (2) wind farm projects currently under construction. It is therefore recommended that the findings of this report be verified either through more detailed studies once the project moves into the preliminary and detail design stages of the engineering life cycle;
  - The report assumes that Abnormal and some Heavy Goods Vehicles (HGV's) are unable to navigate the Vanrhynsdorp Pass or the Piketberg Pass due to sharp horizontal curves and steep slopes along particular sections;
  - The wind turbine components could be either manufactured locally (i.e. Gestamp in Atlantis) or imported using one of the cargo ports available in South Africa. All planning therefore recognises that logistical plans must ensure a suitable corridor is available for both alternatives;
  - The report only considered two possible ports for the importation of turbine components; namely Saldahna and Coega. The ports of Walvisbaai and Cape Town have been excluded on the basis that they are primarily container ports rather than ports servicing the oil and gas industry. As a consequence they appear ill equipped to deal with large items such as wind turbine cells and blades;
  - It is assumed that each wind farm has a power export capacity of 140MW (total of 560MW for four projects);

- The grid connection shall not be N-1 compliant (export redundancy) as set out in the SA Network Code, due to economic considerations. As such, the cheapest connection costs is considered;
- The grid connection is based on the latest site development plans. Any changes to these plans would require a rework of this report;
- Any competing connections not mentioned in Chapter 10 of the Traffic Impact Assessment Report should be made known to SMEC in order to update the report; and
- The technical performance of the connection shall not be assessed, as this is a preliminary desktop assessment only.

# 4 PROJECT NEED AND DESIRABILITY

## 4.1 National Renewable Energy Requirement

In 2010 South Africa (SA) had 44,157MW of power generation capacity installed. Current forecasts indicate that by 2025, the expected growth in demand will require the current installed power generation capacity to be almost doubled to approximately 74,000MW (SAWEA: 2010).

This growing demand, fuelled by increasing economic growth and social development within Southern Africa, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmental impact, climate change and the need for sustainable development. Despite the worldwide concern regarding GHG emissions and climate change, South Africa continues to rely heavily on coal as its primary source of energy, while most of the countries renewable energy resources remain largely untapped (DME, 2003). There is therefore an increasing need to establish a new source of generating power in SA within the next decade.

The use of renewable energy technologies, as one of a mix of technologies needed to meet future energy consumption requirements is being investigated as part of Eskom's long-term strategic planning and research process. It must be remembered that wind energy is plentiful, renewable, widely distributed, clean and reduces greenhouse gas emissions when it displaces fossil-fuel derived from electricity. In this light, renewable wind energy can be seen as desirable.

The REIPPP programme and the competitiveness nature of the bidding process has resulted in significant lowering of solar and wind tariff prices since 2011. Solar PV, for example, was bid with tariffs of R2.80/kWh at the inception of the REIPPPP in 2011, to 60c/kWh at present. Further projects will increase the competitive nature of the REIPPP program and further result in cost savings to South African consumers.

## 4.2 National Renewable Energy Commitment

In support of the need to find solutions for the current electricity shortages, the increasing demand for energy, as well as the need to find more sustainable and environmentally friendly energy resources, South Africa has embarked on an infrastructure growth programme supported by various government initiatives. These include the National Development Plan (NDP), the Presidential Infrastructure Coordinating Commission (PICC), the Department of Energy's Integrated Resource Plan, the National Strategy for Sustainable Development, the National Climate Change Response White Paper, the Presidency of the Republic of South Africa's Medium-Term Framework, and the National Treasury's Carbon Tax Policy Paper.

The Government's commitment to growing the renewable energy industry in South Africa is also supported by the *White Paper on Renewable Energy* (2003) which sets out the Government's principals, goals and objectives for promoting and implementing renewable energy in South Africa. In order to achieve the long term goal of achieving a sustainable renewable energy industry, the Department of Energy has set a target of contributing 17,8*GW* of renewable energy to the final energy consumption by 2030. This target is to be produced mainly through, wind and solar; but also through biomass and small scale hydro (DME, 2003; IRP, 2010). Further renewable energy targets have been proposed within the latest IRP, which is scheduled to be released for Gazetting in the first quarter of 2018.

## 4.3 Wind Power Potential in South Africa and Internationally

Onshore wind energy technology is the most commonly used and commercially developed renewable energy technology in South Africa, wind is abundant and inexhaustible (DEA Guideline for Renewable Energy, 2015). Wind energy is one of the lowest-priced renewable energy sources and is economically competitive (www.wasaproject.info).

## 4.4 Site Specific Suitability

The selection of a potential wind farm project site included several key aspects including wind resource, grid connection suitability as well as environmental, competition, topography and access.

Wind resource is one (1) of the main drivers of project viability across South Africa. This specific project site has been identified by Mainstream through a pre-feasibility desktop analysis based on the estimation of the wind energy resource. This region of the Northern Cape Province in South Africa has above average wind resource potentials. Following 12 months of wind resources measuring, initial results confirmed average wind speeds between 6 and 8m/s, which is considered highly suitable for a wind farm development. This high resource ensures the best value for money is gained for the economy of South Africa. The general area would experience a similar resource, but as resource is only one driver of site selection, the other aspects should be considered when holistically evaluating a project. Although wind resource information is considered to be confidential (by the developer) because of its commercial sensitivity, the following on-site wind parameter measurement related information can be provided:

- The project site was chosen based on an in-house study on the wind resource in the broader area;

- The findings of this study were supported by historic data from a local weather station, as well as from the Loeriesfontein and Khobab Met Masts, which have been measuring since 2012;
- Together this research provided a comprehensive macro wind model of the area, which clearly illustrated the preferred site as an optimal site for a wind farm;
- A met mast which was subsequently installed on site has confirmed the expected wind resource to be between 6 and 8m/s; and
- In addition to the wind resource, other key factors which indicated that the site is potentially suitable for a wind farm included but were not limited to proximity to and availability of Eskom grid, site access and constructability, and potential environmental and social sensitivities.

Grid connection suitability is the next element which drives the project location. Long connection lines have increased environmental impacts as well as add increased costs to the project development. The !Xha Boom project site has good grid connection potential as the project is likely to connect to the existing regional Helios Substation, the !Xha Boom facility is located approximately 32km from the substation, thereby minimising the need for an extensive grid network upgrade or long power line.

Environmental is a key aspect that Mainstream considers when evaluating a wind project. The project should be developed in a sustainable and ecologically friendly manner ensuring its development has the least possible impact on the land on which it will be built. The regional farms have been evaluated before the selection of these specific farms and it was concluded that the development on these farms would result in the least impact of regional fauna and flora. Certain farms in the region, which are located in the lower areas have increased biodiversity which are deemed sensitive and other farms show increased biodiversity.

The site is not located within any Critical Biodiversity Area (CBA), Protected Area, Important Bird Area (IBA) or Nature Reserve. There are however surface water resources (drainage lines and wetlands) located within the project site. It should be noted that buffers have been applied to these areas so that they will be avoided as far as practically possible.

Other key criteria which refines the site selection on a micro level include competition, topography and access. The project site has a flat arid topography which is suitable for the development of a wind project. The region does have several ongoing EIA developments, with two (2) 140MW projects currently under construction. The project site can be accessed easily via the N7 towards Kliprand via the R358 regional road or via the N1 to Loeriesfontein. Upgrade of the district gravel road will be done by the current preferred bidder projects to allow for direct access to site.

The proposed wind farm is situated on the entire portion of Portion 2 of the Farm Georg's Vley No. 217. The farm is currently used for agricultural purposes, specifically commercial sheep farming. The proposed development is not envisioned to impact farming activities after the construction phase has been completed. With regards to competing land uses in the area, it was found that while sheep farming is the dominant activity grazing can still continue within the wind farm development area. The arid nature of the climate has restricted stocking densities which has resulted in relatively large farms across the area which are ideal for wind farm developments. The wider area is therefore sparsely populated, and human-related infrastructure is largely restricted to isolated farmsteads and gravel access roads. The area is regarded as largely uninhabited and the closest built up area is the small town of Loeriesfontein approximately 68km to the south of the proposed wind farm application site. It should also be noted that quarrying activities are present in the wider area, on the eastern edge of Konnes se Pan which is located to the north-east of the proposed wind farm application site. These quarrying activities are however isolated to this part of the area and are also expected reduce the impact of the proposed development from a visual perspective as these activities have reduced the natural/scenic character of the wider area to some degree. Due to the extreme aridity constraints as well as the poor soils, agricultural land use in the area is restricted to low intensity grazing only. As such, the area is not valued for its agricultural potential and the proposed development will only impact agricultural land which is of extremely low agricultural potential and is unsuitable for cultivation. In addition, several renewable energy developments (both wind and solar) are being proposed and/or constructed in the area. Such developments, could cumulatively have positive or negative impacts which needs to be taken into consideration when determining the desirability of the project at the current location. The construction of these renewable energy developments is expected to result in the loss of agricultural land. The impact is however low because of the extremely limited agricultural potential of all land in the area, predominantly as a result of climatic limitations, and the fact that there is no particular scarcity of such land in South Africa. Furthermore 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. In light of the above, it can be concluded that the land use in the area appears to be shifting more towards the use of renewable energy developments and the proposed site is therefore considered to be suitable from a land use perspective.

Additionally, cumulative impact assessments of similar developments in the area were undertaken by the specialists during the impact phase for this proposed development. The cumulative impact assessments rated the significance of the cumulative impacts using the significance rating methodology. Based on the findings of the cumulative impact assessments which were undertaken by the specialists, the cumulative impacts associated with the proposed development were found to range from medium to low. In addition, the cumulative impact of the proposed !Xha Boom Wind Farm on priority avifauna within a 40km radius around the Helios MTS, should range from minor to insignificant, if appropriate mitigation is implemented. From a surface water perspective, the potential cumulative impact on the surrounding renewable energy developments is negligible. It should however be noted that the impact phase bat monitoring study found that the significance of the cumulative bat mortalities due to direct blade impact or barotrauma during foraging would be very high. Nevertheless, the significance of this cumulative impact could be reduced to medium after the implementation of mitigation measures. Despite the fact that there are a number of few similar projects in the area, the medium to low cumulative impacts associated with the proposed development will result in the site location being considered ideal for the proposed development of the wind farm.

It should be noted that it is possible for the proposed wind farm to be decomissioned and/or potentially upgraded after it has reached its lifespan. The initial lifespan of the wind farm is proposed to be approximately 20 years, based primarily on the DoE PPA terms. Technically, however, through suitable maintenance and upgrade activities, the proposed wind farm could run for another 10 to 20 years, should Eskom or the DoE see a need for the continued need for the electricity being generated. The proposed project could also be paired with energy storage systems and potentially contribute to baseload capacity in the country. Should the proposed wind farm be decommissioned, the wind farm site / property would be restored to its original state, and as detailed by the EMPr, whereafter it could be returned to use as agricultural land. Given the limited on-ground footprint of the wind farm infrastructure, the wind farm site / property could essentially be re-used in various forms, be it upgrading the installed technology or reverting to a new land use.

## 4.5 Local Need

The Northern Cape Province faces numerous socio-economic and developmental challenges, which are not unique to the Province and are observed throughout the country. Reducing poverty through social development and achieving a sustainable economic growth in the Province through diversification and transformation of its economy are at the forefront of the provincial government's developmental objectives (Northern Cape Government, 2008; Office of the Premier of the Northern Cape, 2012).

The Northern Cape Province is endowed with biological diversity, mineral resources, and renewable energy sources such as solar and wind. Therefore, the achievement of its developmental objectives is envisaged to be done by capitalising on the local resources and specifically, the development of the agriculture and agro-processing, mineral extraction and mineral beneficiation, fishing and aquaculture, manufacturing, and tourism industries (Northern Cape Government, 2008; Office of the Premier of the Northern Cape, 2012).

Ensuring availability of inexpensive energy is seen to be fundamental to growing competitive industries in the Province (Northern Cape Government, 2008). However, provincial government advocates the development of the energy sector in the Province through "the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments" (Northern Cape Government, 2008). This implies the use of renewable energy sources and natural gas fields that the Province enjoys (Northern Cape Government, 2008). Provincial strategic documents specifically promote the development of large-scale renewable energy projects, similar to the one under analysis, which among others, would contribute to renewable energy targets set by national government and allow to secure supply, tackle climate change and address the needs of the Province (Office of the Premier of the Northern Cape, 2012).

Harnessing renewables is also seen to contribute towards alleviation and reduction of poverty in the Province. One of the interventions that underpins the provincial approach to poverty eradication is "utilisation of natural resources in a sustainable manner", which in turn implies the transition to greater exploitation of renewables, including wind (Northern Cape Government, 2008).

Considering the above, it can be concluded that the development of the proposed project follows the provincial priorities and developmental objectives. From a spatial perspective, the project also does not appear to raise any red flags.

Similar to the Province, the district and local municipalities where the proposed project is to be established, also face challenges of poverty, unemployment, and income inequality. Therefore, the municipalities' developmental priorities largely coincide. Although much of the focus within district and local municipalities relates to the development and delivery of basic services, infrastructure, agriculture and tourism, the development of a green economy remains to be seen as an additional fundamental pillar of growth. Thus, in like any manner with the national and provincial policies, the district and local municipalities have placed considerable emphasis on the prioritisation and promotion of renewable energy resources within their boundaries. As previously mentioned, the Namakwa DM has a competitive advantage in the energy sector as wind, solar, wave, nuclear and natural gas energy plants have all been identified as suitable investments in the area. Amongst other sectors such as agriculture and tourism, renewable energy is thus prioritised. Several large-scale renewable energy projects have already been included in the IDP of the district. The district also recognises the importance of the agriculture and tourism industries in the area and promotes their development and transformation, especially eco-heritage (Namakwa DM, 2014). This is explained in more detail below.

#### *4.5.1 Namakwa District Municipality views in Renewable Energy*

Renewable Energy projects have been prioritised in strategies at various municipal scales in the area. The Northern Cape Province aims to provide a “home” for Renewable Energy. The Namakwa DM aims to “enable development around the construction of the 100MW wind farm16”. This would suggest that the site for !Xha Boom Wind Farm would be supported by the DM. In the 2016-2017 IDP, renewable energy is identified as a focus area within their programme of action, specifically in relation to economic development and the “optimal utilisation of natural resources in a sectoral manner”.

The Namakwa SDF identifies a number of major infrastructure projects, which includes “the promotion of domestic and large scale solar energy usage and projects such as wind and solar farms subject to appropriate guidelines and siting principles”. The plan specifically lists wind and solar farm siting principles based on slope, geology, soils, surface hydrology, ground water and vegetation.

#### *4.5.2 Hantam Local Municipality*

The Hantam LM has identified the need to speed up economic growth and transform the economy in a sustainable manner and to provide a programme to build economic and social infrastructure. In the next five years (2015-2020) the LM aims to raise public awareness on green energy and energy saving.

The Loeriesfontein ward region is a very arid region of the Northern Cape where agricultural potential is very low. Sheep farming forms the predominant land use and large expanses of land are required for grazing. Large farms (exemplified by those on which this project is proposed) hold little to no economic opportunity for the farmers with little access to water. During an interview with one of the affected landowners, the socio-economic specialist identified that many of the farmers are unable to employ farm workers permanently, and generally only employ seasonal workers for sheep shearing.

The proposed !Xha Boom WEF would therefore directly benefit the local community. Firstly, it would be a source of income to the landowner and would improve the economic viability of the landowner’s current farming operations. Secondly, it would also create direct and indirect job opportunities for the local community, with associated skills development.

Secondary economic benefits may include an increase in service amenities through an increase in contractors and associated demand for accommodation and other services.

A percentage of the operational revenue of the WEF will be utilised to support local economic development initiatives, via the community trust to be created for the WEF. The local municipality will play a strong role in guiding how the funds in the community trust are utilised, thus ensuring that relevant and pressing needs in the community will be addressed.

#### *4.5.3 Loeriesfontein*

The Khobab and Loeriesfontein Wind Farms are nearing end of construction on neighbouring farms. The services provided and development of unskilled labour for these construction phases will be complementary to the proposed !Xha Boom Wind Farm. The area is currently being designed to be an area of excellence for renewable energy (provided the projects are implemented). This is well suited given the need for clean energy in South Africa, and the low agricultural potential of the land on which this project is proposed.

The land proposed is currently zoned as agricultural land. The respective landowners have signed an option for a long-term lease agreement with the Proponent. The leased land has very low agricultural potential and grazing could continue below the turbines and as such it would not negatively affect the economic viability of the farm. Participating landowners would receive a percentage of the revenue from the wind farm and this additional income would safeguard the economic sustainability of the farms.

#### *4.5.4 Suitability of Services*

The services required for the development of the proposed !Xha Boom Wind Farm would include appropriate road access to the site; an appropriate connection to the national grid; access to water and disposal of different waste streams for the construction period; as well as associated services supplied from the local towns (accommodation, etc.).

The construction of the Loeriesfontein and Khobab Wind Farms has led to the upgrade of the roads in the area to facilitate the movement of abnormal loads. These construction periods will have also increased the demand from secondary services from the local towns.

The capacity of the municipal water and waste streams will need to be determined prior to construction. It is unfeasible to consider this during the EIA process as construction of this project may only begin in more than two years, if the project is granted all authorisations and selected as a preferred bidder in terms of REIPPPP. Appropriate waste disposal site/s with sufficient capacity to accept the project's waste will be identified closer to the time of construction. The applicant (or their appointed construction contractor) will be responsible for securing the necessary service agreements with the Municipality or private service providers prior to construction.

Based on the above reviewed IDPs, SDF's and other site specific information, it is evident that the site is suitable for the development of a renewable energy facility and that the proposed project fits well with the plans to diversify the provincial, district and local economies through investment in renewable energy projects.

# 5 TECHNICAL PROJECT DESCRIPTION

## 5.1 Project Description

The proposed development will encompass the installation of wind turbines and associated infrastructure, in order to generate electricity that is to be fed into the Eskom grid. The facility will have a maximum export capacity of up to 235MW and will be referred to as the !Xha Boom Wind Farm. The wind farm will consist of up to 47 turbines, each with a generation capacity between 4 and 8MW. The generated electricity will be fed into the national grid at the Helios Substation via a 132kV power line. It should however be noted that this 132kV power line will require a separate Environmental Authorisation and is being conducted as a part of a separate Basic Assessment (BA) process. The 132kV power line has been mentioned for background information but will be authorised under a separate BA to allow for handover to Eskom. The total extent of the development area is approximately 3804 hectares (ha). The total environmental buildable area for the proposed Wind Farm is however 1988.5 ha. It should be noted that the above-mentioned environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's proposed buildable area for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildable area. The operation and maintenance buildings will have a total combined footprint that will not exceed 5 000$m^2$. In addition, the 132kV on-site !Xha Boom IPP Substation will occupy a footprint area of approximately 15ha. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

### *5.1.1 Wind Farm Components*

Mainstream is proposing the establishment of a wind farm (namely the !Xha Boom Wind Farm) on the development site near Loeriesfontein in the Northern Cape Province (**Figure 4**). As mentioned, the objective of the proposed development is to generate electricity to feed into the national grid at the Helios MTS. The proposed wind farm will have a maximum export capacity of up to 235MW.

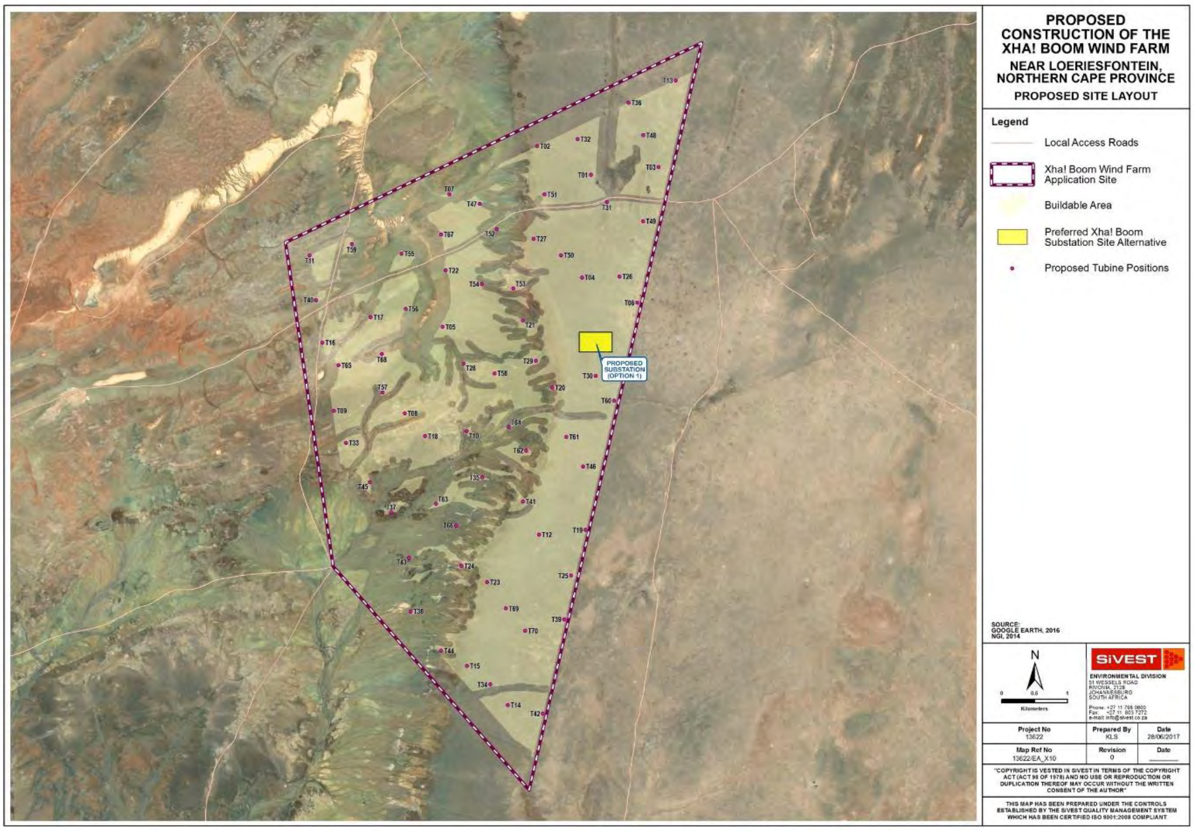



**Figure 4:** Proposed !Xha Boom Layout

The key technical details and infrastructure required is presented in the table below (**Table 7**).

**Table 7:** !Xha Boom Wind Farm technical summary

| Project Name | DEA Reference | Farm name and area | Technical details and infrastructure necessary for the proposed project |
|---|---|---|---|
| !Xha Boom Wind Farm | 14/12/16/3/3/2/1018 | ▪ Entire part of Portion 2 of the Farm Georg's Vley No.217.<br><br><u>Development Area</u>: **3804 ha** | ▪ Up to **47 wind turbines**, between 4MW and 8MW, with a maximum export capacity up to 235MW.<br>▪ Wind turbines will have a hub height of up to 160m and a rotor diameter of up to 160m[5]. |

[5] The AW125/3000 wind turbine generator which has a hub height of 100m, a rotor diameter of 125m and an output of 3MW was used to assess the EMI and RFI. Forty seven (47) turbines with a hub height of 150m was used during the calculations as requested by Mainstream. It should be noted that a more suitable turbine with different specifications may be available once the proposed wind farm is ready for construction. As such, turbines with a hub height of up to 160m and a rotor diameter of up to 160m will need to be authorised. A more accurate path loss and risk assessment cannot be re-done until the turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from ICT confirming this has been included in this Draft Environmental Impact Assessment Report (DEIAr) in **Appendix 8C**.

| | | | |
|---|---|---|---|
| | | Total Environmental Buildable Area: **1988.5 ha** | ▪ **132kV on-site !Xha Boom IPP Substation**<br>▪ The turbines will be connected via **medium voltage cables** to the proposed 132kV on-site !Xha Boom IPP Substation**.**<br>▪ Internal **access roads** are proposed to be up to 20 m wide. This would however only be for the construction phase as the width of the internal access roads will be reduced to 6 - 8m during the operational phase.<br>▪ A temporary construction **lay down area.**<br>▪ A **hard standing area / platform** per turbine.<br>▪ The **operations and maintenance buildings**, including an on-site spares storage building, a workshop and an operations building.<br>▪ **Fencing** (if required) will be up to 5m where required and will be either mesh or palisade. |

As previously mentioned, Mainstream is also proposing to develop the associated on-site !Xha Boom IPP Substation and power line, both with a capacity of up to 132kV. This associated electrical infrastructure will require a separate Environmental Authorisation (EA) and is being conducted as a part of a separate BA process. The 132kV !Xha Boom power line has been mentioned for background information but will be authorised under a separate BA to allow for handover to Eskom. The proposed 132kV on-site !Xha Boom IPP Substation will include an Eskom portion and an Independent Power Producer (IPP) portion, hence the substation has been included in the wind farm EIA and in the substation and power line BA to allow for handover to Eskom. Although the wind farm and the electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider both of the proposed developments. The potential environmental impacts associated with both developments will be assessed as part of the cumulative impact assessment. The DEA reference number allocated for the proposed 132kV on-site !Xha Boom IPP Substation and 132kV power line development has not yet been allocated by the DEA. The Application for EA for the substation and power line development will only be submitted after the proposed wind farm development Final Environmental Impact Assessment report (FEIAr) has been submitted to the DEA.

### *5.1.2 Turbines*

The total amount of developable area is approximately 3804 ha. The total environmental buildable area for the proposed wind farm is 1988.5 ha. As previously mentioned, the environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's proposed buildable area for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildable area. The wind turbines and all other project infrastructure will be placed strategically within the development area based on environmental constraints. The size of the wind turbines will depend on the development area and the total generation capacity that can be produced as a result. The wind turbines will therefore likely have a hub height of up to 160m and a rotor diameter of up to 160m[5] (Figure 5). Each wind turbine will have a foundation diameter of up to 25m and will be approximately 3m deep, however, these dimensions may be larger if geotechnical conditions dictate as such. The hardstand area occupied by each wind turbine will be up to 0.5 hectares (85m x 60m). The excavation area will be approximately 1 000m² in sandy soils due to access requirements and safe slope stability requirements. A hard standing area / platform of approximately 2 400m² (60m x 40m) per turbine will be required for turbine crane usage. There will be up to 47 wind turbines constructed with a capacity up to 235MW. The electrical generation capacity for each turbine will range between 4 and 8MW, depending on the final wind turbine selected for the proposed development. It must be noted that the final selection for the turbine type will be conducted after the project has been selected as a Preferred Bidder project under the DoE REIPPPP. This is as a result of technology constantly changing as time progresses[6].

[6] Further SKA studies would be required at a later stage once a final turbine type has been confirmed and final modelling has been undertaken.

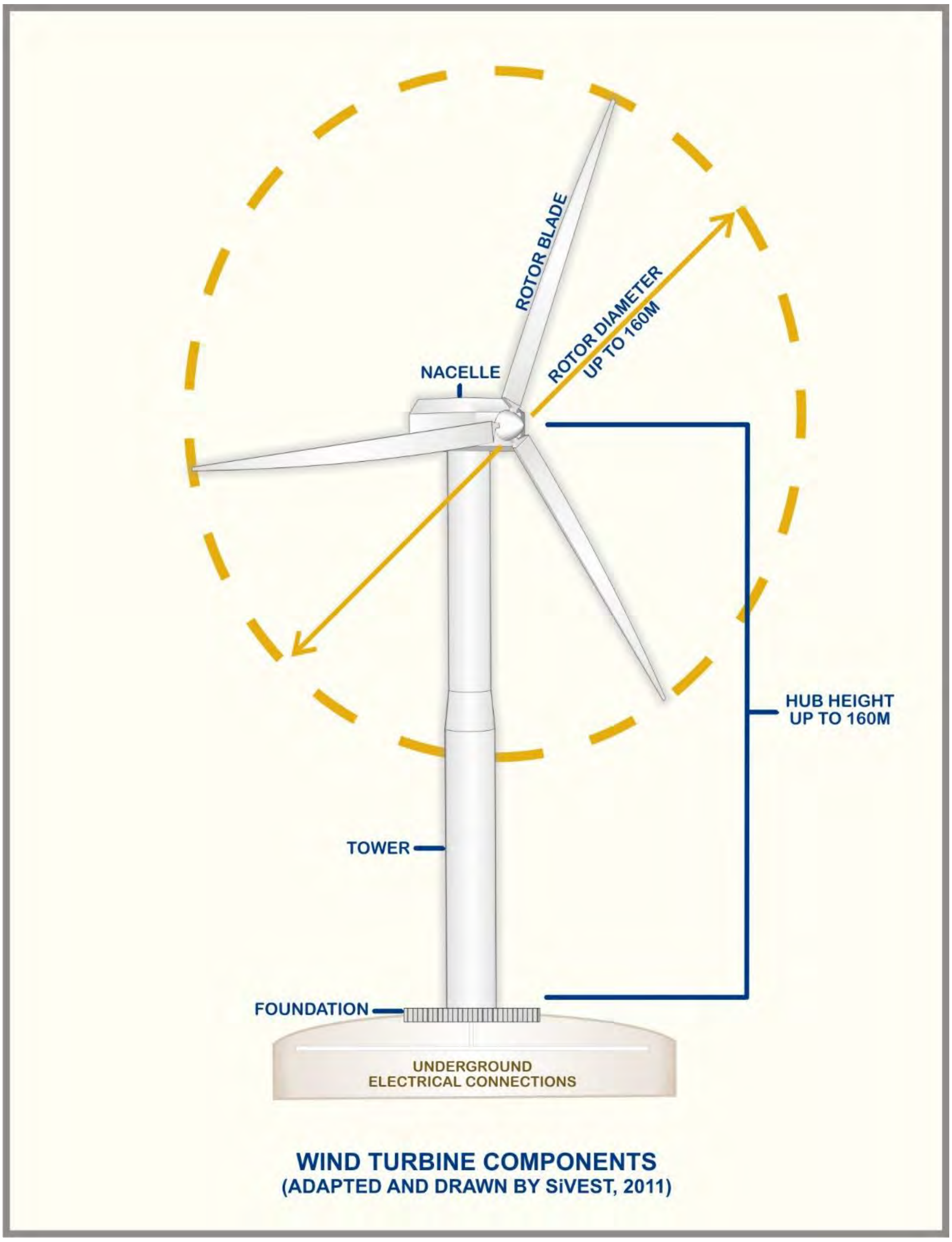



**Figure 5:** Typical Connections of a Wind Turbine

### *5.1.3 Electrical Connections*

The wind turbines will be connected (**Figure 6**) to the proposed 132kV on-site !Xha Boom IPP Substation using buried (up to a 1.5m depth) medium voltage cables except where a technical assessment of the proposed design suggests that overhead lines are more appropriate such as over rivers, gullies and long runs. Where overhead power lines are to be constructed, self-supported or H-pole tower types will be used. The height will vary based on the terrain, but will ensure minimum Overhead Line (OHL) clearances with buildings, roads and surrounding infrastructure will be maintained. The dimensions of the specific OHL structure types will depend on electricity safety requirements. The exact location of the towers, the selection of the final OHL structure types and the final designs will comply with the best practice and SANS requirements.

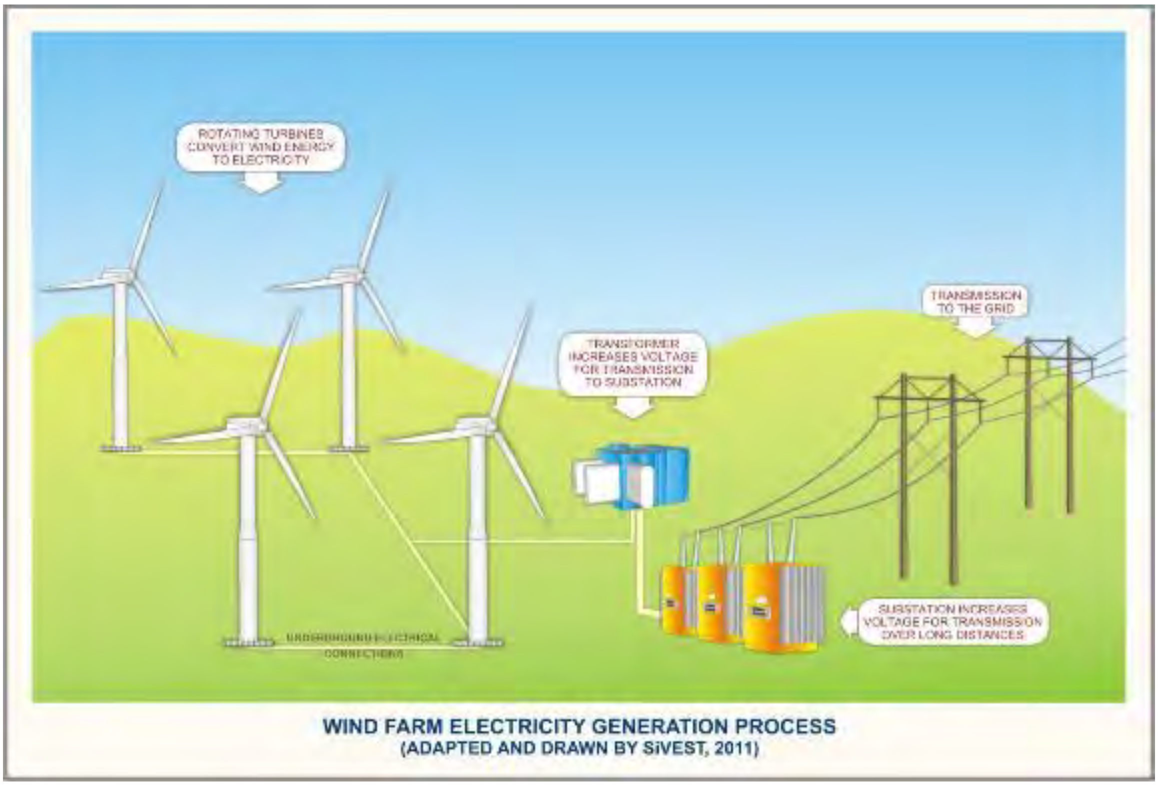



**Figure 6:** Conceptual Wind Farm Electricity Generation Process showing Electrical Connections

### *5.1.4 Roads*

Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6 - 8m for maintenance purposes during the operational phase. The proposed internal access roads will include the net load carrying surface excluding any V drains that might be required.

### *5.1.5 Temporary Construction Lay Down Area*

The temporary construction lay down area will be approximately 10 000m² (100m x 100m) and will include an access road and contractor's site office area of up to 5 000m². A hard standing area / platform of approximately 2 400m² (60m x 40m) per turbine will be required for turbine crane usage.

### *5.1.6 Operation and Maintenance (O&M) Buildings*

The operation and maintenance buildings will include an on-site spares storage building, a workshop and operations building with a total combined footprint that will not exceed 5 000m$^2$. The operation and maintenance buildings will be situated in proximity to the wind farm substation due to requirements for power, water and access.

### *5.1.7 Other Associated Infrastructure*

Other associated infrastructure includes the following:

- Fencing (if required) will be up to 5m where required and will be either mesh or palisade.

## 5.2 Alternatives

As per Chapter 1 of the EIA regulations (2014), as amended, feasible and reasonable alternatives are required to be considered during the EIA process. Alternatives are defined at “different means of meeting the general purpose and requirements of the activity” These alternatives may include:

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

Each of these alternatives are discussed in relation to the proposed project in the sections below.

### *5.2.1 The property on which or location where it is proposed to undertake the activity*

Prior to the initiation of the EIA, alternative properties were considered for the location of the proposed development. The selection of a potential wind project includes several key aspects including wind resource, environmental, grid connection suitability as well as competition, topography and access. This site was selected by Mainstream based on the above criteria ahead of other regional farms due to the cumulative assessment of all criteria. This internal process takes several weeks to complete and ensures that the least environmentally sensitive farm is selected in the specific region of development.

No site alternatives for this project are being considered during the EIA. The placement of wind energy installations is dependent on the factors discussed above, all of which are favourable at the proposed site location The project site has access to the national grid via the existing Helios Substation. The project site has a relatively flat topography which is suitable for the development of a wind farm. The project site is easily accessible via the N7 towards Kliprand via R358 or the N1 to Loeriesfontein. The site is therefore considered highly suitable for the proposed development and no other locations are being considered.

### 5.2.2 The type of activity to be undertaken

No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view. While solar PV projects were considered, wind energy installations are more suitable for the site because of the high wind resource.

### 5.2.3 The design or layout of the activity

**Design and layout alternatives are being considered** in the EIA process. Prior to the submission of the DEIAr, Mainstream intended to construct 70 turbines on the proposed !Xha Boom Wind Farm site. This number of turbines provided flexibility in that turbines between 3MW and 5MW could be considered. Various environmental specialists assessed the site during the scoping phase. Their assessments encompassed the entire proposed development site and included the identification of sensitive areas. These sensitive areas were used during the Scoping Phase to perform a preliminary comparison of layout alternatives. These layouts were then extensively investigated in the EIA phase of the project.

Two (2) alternative locations for the proposed 132kV on-site IPP Substation[7] were comparatively assessed by the specialists during the scoping phase. However, based on the findings from the various specialist scoping phase assessments it was recommended within the approved Plan of Study for the EIA phase that only on-site IPP Substation Option 1 be taken through to the EIA phase. As such, only on-site IPP Substation Option 1 was assessed by the various specialists during the EIA phase and a comparative assessment of alternatives for the on-site IPP substation site was thus subsequently not undertaken during the EIA phase.

The 70 turbine layout alternatives which has taken the scoping phase environmental sensitives into account is provided in **Figure 7** below.

[7] The O&M buildings and laydown areas will also fall within the proposed on-site substation sites and have therefore been assessed

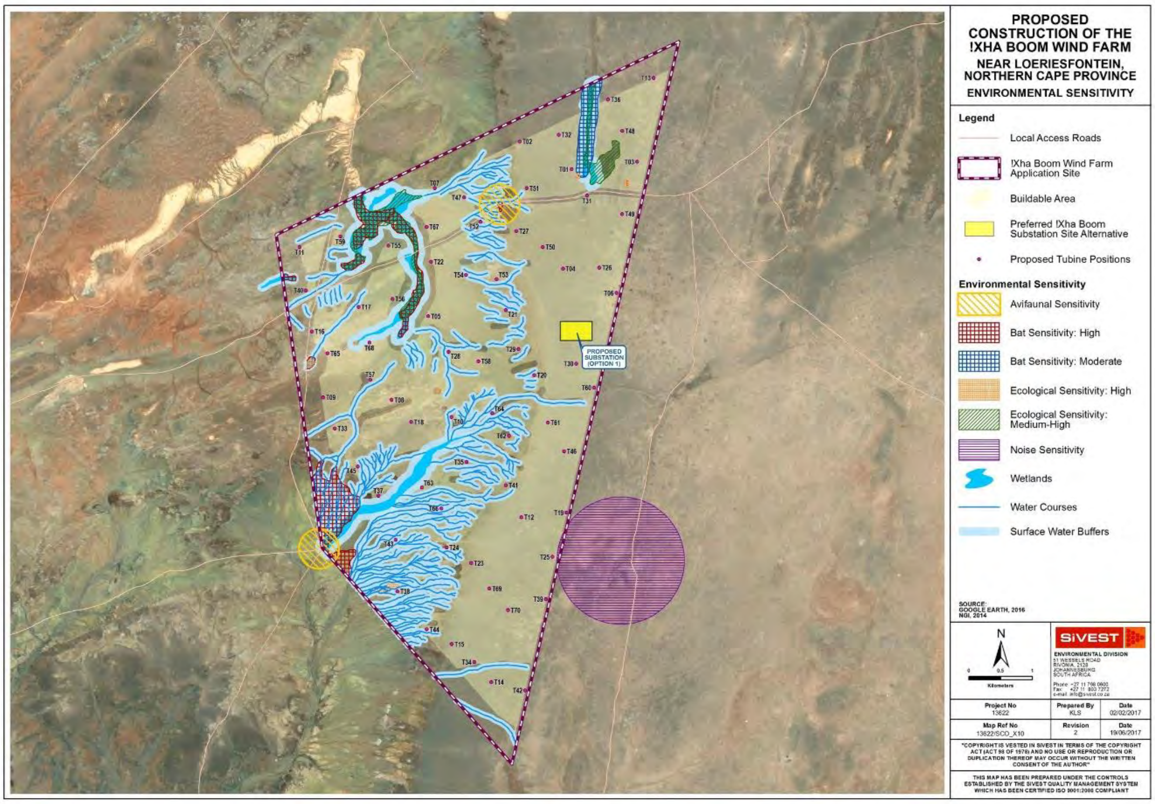



**Figure 7:** Proposed !Xha Boom 70 Turbine Layout Alternatives and Scoping Phase Environmental Sensitivity

However, in order to ensure that the proposed wind farm development avoids the EIA phase sensitive areas and does not result in significant environmental impacts, an alternative turbine layout was put forward for assessment with the total number of turbines being reduced to 47. In light of the above, the range of the proposed turbines has been amended to range between 4MW and 8MW. This is deemed to be acceptable considering the fact that Mainstream will not be changing any of the assessed turbine parameters. The proposed hub height, rotor diameter and max MW will remain the same. This design amendment was done taking the environmental considerations into account. In an attempt to show that the new proposed 47 turbine layout will result in lower / fewer environmental impacts and will ultimately be preferred to the 70 turbine layout from an environmental perspective, the new proposed 47 turbine layout was compared to the previously assessed 70 turbine layout by the specialists during the EIA phase (prior to the submission of the DEIAr) and assessed as a design alternative. As such, the new 47 turbine layout and the previously assessed 70 turbine layout were included as design alternatives and comparatively assessed in the EIA phase. In light of the above, the specialists were requested to compile letters commenting on the environmental impact of the final proposed 47 turbine layout. The specialist comment letters included the following information:

- Comparative assessment of the new 47 turbine layout verses the previously assessed 70 turbine layout;
- Indication of whether or not the 47 turbine layout avoids all sensitive areas;
- Indication of whether or not the reduction in turbines is favourable (in terms of impacts etc.);

- Any additional recommendations and/or mitigations measures which need to be implemented as a result of the new turbine layout,
- Any recommendations and/or mitigation measures provided in the impact phase specialist reports which are no longer applicable and can be excluded / removed and state as such); and
- A final environmental impact statement.

The specialist comment letters on the final proposed 47 turbine layout are included along with the respective impact phase specialist reports in **Appendix 6.**

Based on the sensitivity mapping and revisions to the layout, the preferred layout for the wind farm and associated infrastructure has avoided the sensitive features identified by the specialists. The area that excludes these sensitive features is considered to be the buildable area for this project and ideally no development should occur outside this envelope, apart from internal access roads where they traverse sensitive areas. The internal access roads have however at the same time been designed to remain within the buildable area as far as possible. Based on the boundaries of the buildable area, a site layout was determined for this project (i.e. the placement of the wind turbines within the buildable area). These EIA phase layout alternatives have been extensively investigated. The EIA phase layout alternatives, including maps, are presented in **Section 11**. The selected preferred layout alternative will be based on both environmental constraints and design factors.

#### *5.2.4 The technology to be used in the activity*

The technology selected for the !Xha Boom Wind Farm facility was based on environmental constraints, technical and economic considerations. The size of the wind turbines will depend on the development area and the total generation capacity that can be produced as a result. Therefore no technology alternatives will be considered during the EIA. The choice of technology used will ultimately be determined by technological and economic factors at a later stage.

#### *5.2.5 The operational aspects of the activity*

No operational alternatives were assessed in the EIA.

#### *5.2.6 The option of not implementing the activity*

The option of not implementing the activity, or the **'no-go'** alternative, is considered in the EIA. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although wind energy is not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind farm would be detrimental to the mandate that the government has set to promote the implementation of renewable energy. It is a suitable sustainable solution to the energy crisis and this project could contribute to addressing the problem. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

# 6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

A general description of the study area is outlined in the section below. The receiving environment in relation to each specialist study is also provided.

## 6.1 Regional Locality

The proposed development will be located approximately 68km north of Loeriesfontein, within the Hantam Local Municipality in the Northern Cape Province (**Figure 8**). The proposed wind farm will be accessed by the N7 towards Kliprand via R358 regional road or via the N1 to Loeriesfontein which lies south of the site. The corner point co-ordinates for the development area, as well as the centre point co-ordinates for the development area and associated infrastructure are included in **Table 8, Table 9** and **Table 10** respectively.

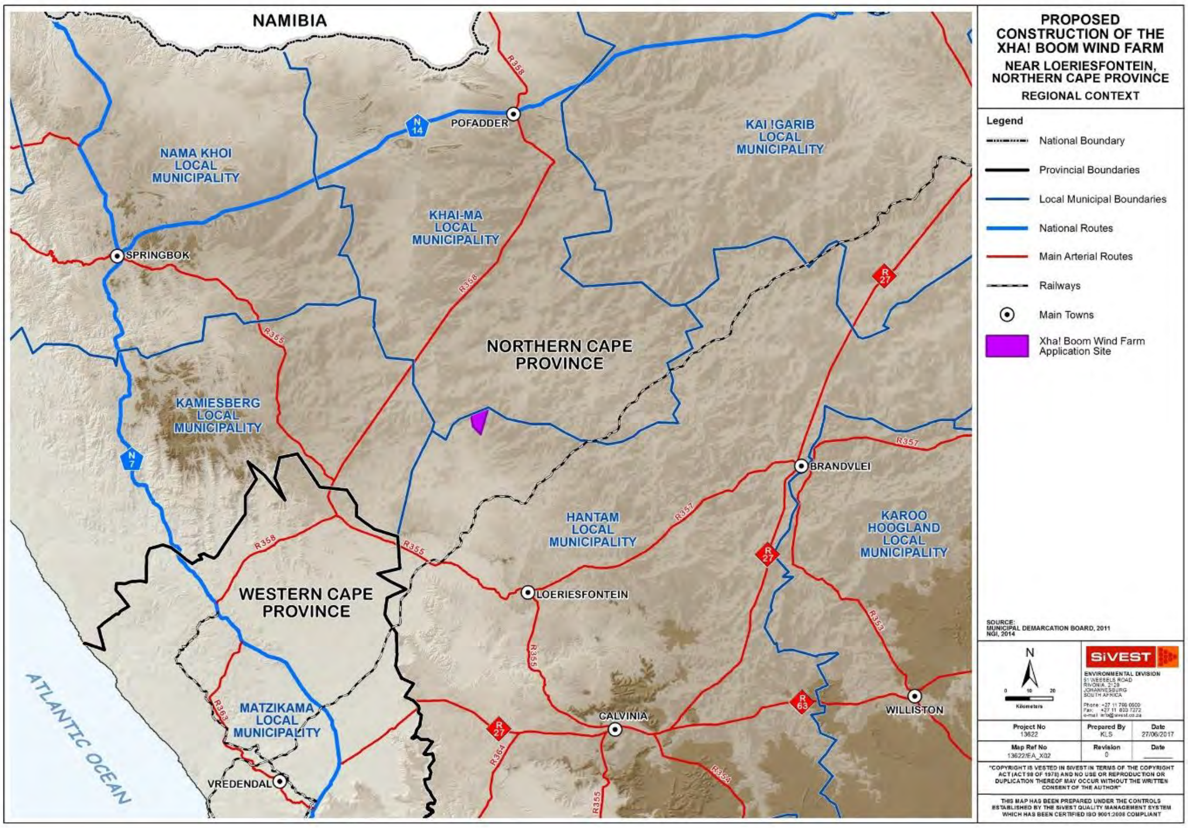



**Figure 8:** Regional Study Area.

## 6.2 Study Site Description

The site that is proposed for the !Xha Boom Wind Farm is located on the following properties:

- Entire part of Portion 2 of the Farm Georg's Vley No. 217, cadastral number: C01500000000021700002.

**Table 8:** Application Site Corner Points

| !XHA BOOM WIND FARM: APPLICATION SITE | | |
|---|---|---|
| **CORNER POINT COORDINATES** | | |
| **POINT** | **SOUTH** | **EAST** |
| XW_01 (NW) | S30° 16' 50.056" | E19° 13' 55.084" |
| XW_02 (NE) | S30° 15' 14.650" | E19° 17' 53.313" |
| XW_03 (SE) | S30° 21' 22.040" | E19° 16' 8.738" |
| XW_04 (SW) | S30° 19' 30.216" | E19° 14' 19.283" |
| **CENTRE POINT COORDINATES** | | |
| **POINT** | **SOUTH** | **EAST** |
| XW_05 | S30° 18' 2.587" | E19° 15' 47.612" |

**Table 9:** Buildable Area Centre Points

| ENVIRONMENTAL BUILDABLE AREA | | | |
|---|---|---|---|
| **PHASE** | **AREA (HECTARES)** | **CENTRE POINT COORDINATES** | |
| | | **SOUTH** | **EAST** |
| !XHA BOOM WIND DEVELOPMENT AREA | 1988.5 | S30° 18' 1765" | E19° 16' 5.680" |

The above-mentioned environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's buildable area proposed for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildbale area.

**Table 10:** Associated Infrastructure Centre Points

| !XHA BOOM WIND: COMPONENTS | |
|---|---|
| **CENTRE POINT COORDINATES (DD MM SS.sss)** | |
| **COMPONENT** | **OPTION 1** |
| SUBSTATION | S30° 17' 41.614" |
| | E19° 16' 50.509" |

The application site as shown on the locality map below comprises the entire part of Portion 2 of the Farm Georg's Vley No. 217. The total area of the application site is approximately 3804 hectares. Within the application site the !Xha Boom Wind Farm development area has a total environmental buildable area of approximately 1988.5 hectares (**Figure 9**). As previously mentioned, the environmental buildable area includes areas proposed for infrastructure development, something which was not included in Mainstream's buildable area proposed for turbine siting. As such, the environmental buildable area is slightly larger than the turbine buildbale area. The Farm Georg's Vley No. 217 is currently used for agricultural purposes, specifically commercial sheep farming. There are no farmsteads / homesteads which can be found within the proposed application site. In addition, no other buildings can be found within the proposed application site.

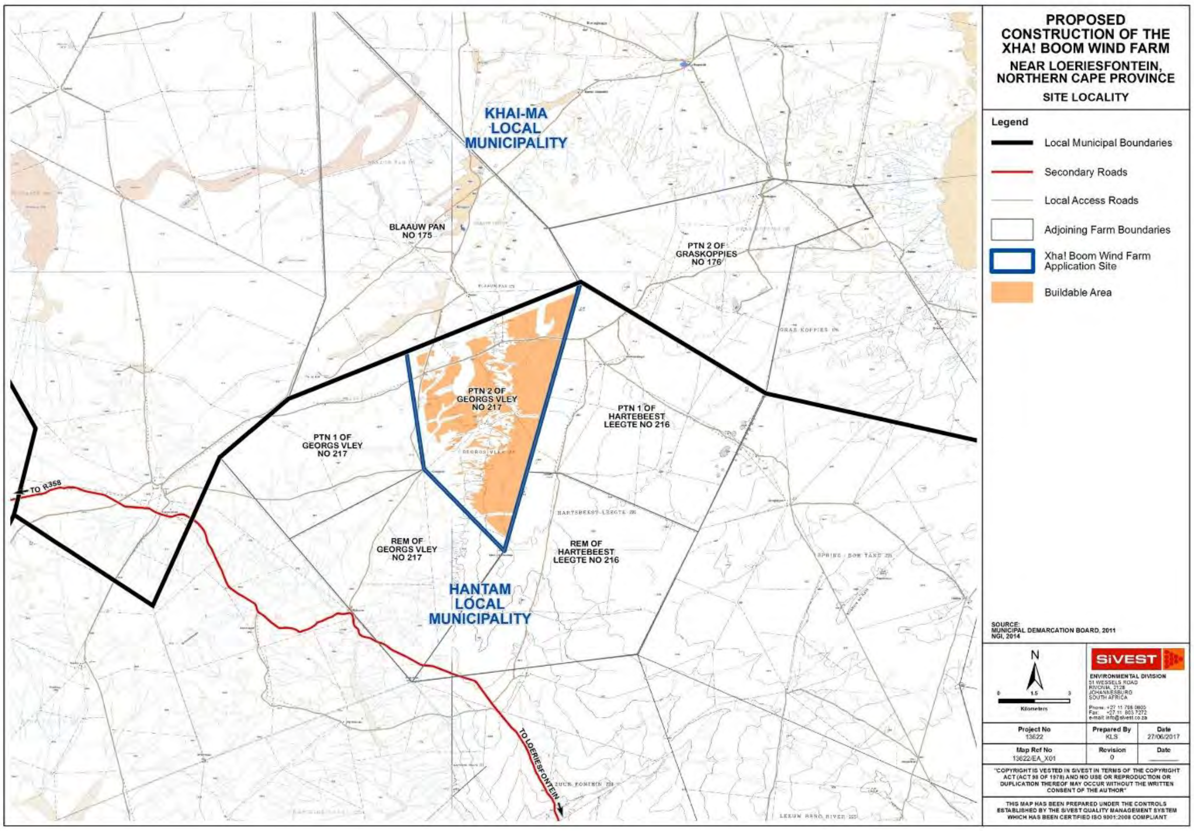



**Figure 9:** Site Locality

Please note that all maps within the report are included in **Appendix 5** and are in A3 format.

## 6.3 Land Use

Much of the land use in the wider study area is classified as bare (non-vegetated) although the north-western and western sectors of the visual assessment zone are characterised by grassland and low shrubland (**Figure 10**). Sheep farming (**Figure 11**) is the dominant activity in the study area although the arid nature of the climate restricts stocking densities which has resulted in relatively large the farms across the area. The study area is therefore sparsely populated, and human-related infrastructure is largely restricted to isolated farmsteads and gravel access roads. The area is regarded as largely uninhabited and the closest built up area is the small town of Loeriesfontein approximately 68km to the south of the site.

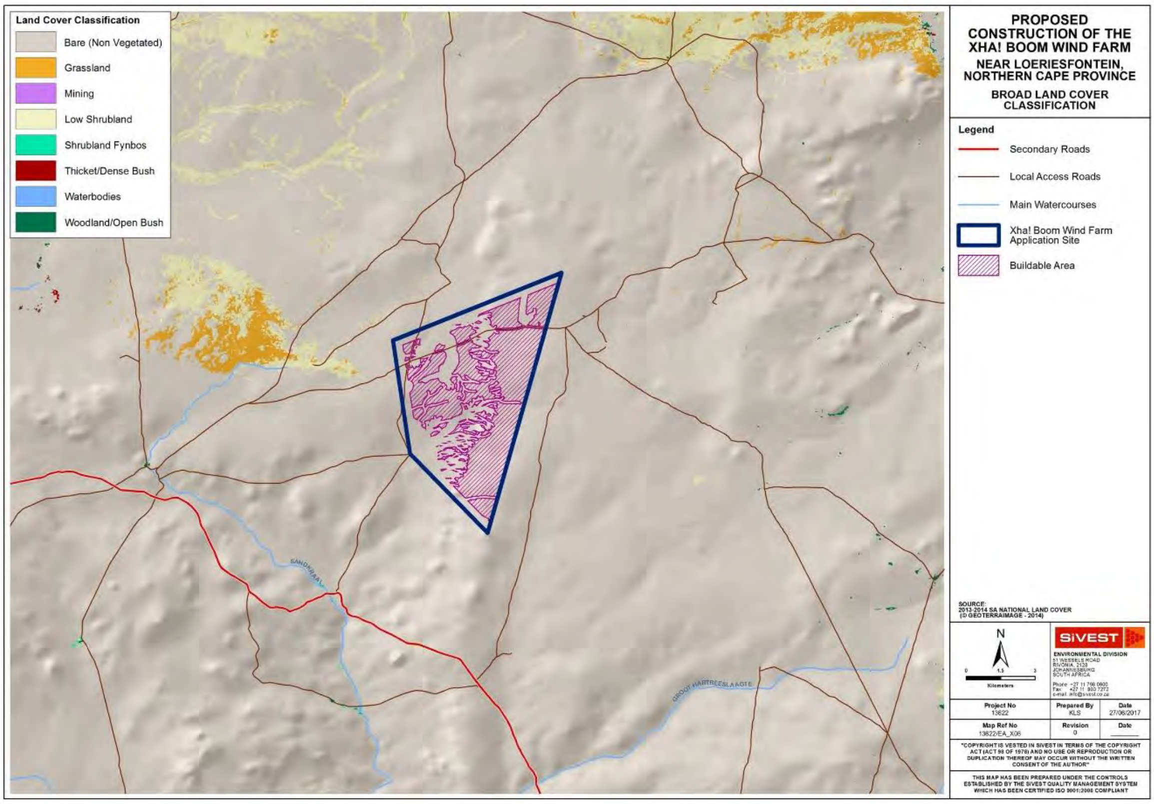



**Figure 10:** Land Use of the Application Site and Surrounding Area

**Figure 11:** Typical natural undeveloped grazing land found within the surrounding area

It should be noted that the study area is also characterised by the presence of certain pastoral elements (**Figure 12**). These elements can be found throughout the study area and are typically present in areas where sheep farming is taking place.

**Figure 12:** Example of typical pastoral elements which can be found within parts of the study area, especially in areas where sheep farming is taking place.

It should also be noted that quarrying activities are taking place on the eastern edge of ‘Konnes se Pan’, which is located to the north-east  of the proposed !Xha Boom Wind Farm application site. This pan is however located outside of the study area. In addition, these quarrying activities are isolated to this part of the study area. As such, the quarrying activities are taking place outside of the study area and therefore there is no significant instance of transformation in the study area.

## 6.4 Topography and Slope

The topography of the study site and surrounds is shown below (**Figure 13**). The area lies at a height of approximately 900 to 950 metres above sea level. The topography in the immediate vicinity of the site proposed for the wind farm is characterised by a flat to gently undulating landscape with gentle slopes (typical of much of the Karoo). Immediately north and north-east of the site the presence of a number of large pans signals that the topography is very flat and thus very poorly drained. Within the proposed wind farm site the topography is characterised by relatively flat terrain that slopes down gradually from a slight ridge in the southern half of the site.

It should also be noted that the topography in certain parts of the wider study area is characterised by the presence of localised hills / ridges / koppies which create areas of localised hilly topography. In addition, the Klein and Groot Rooiberg and Leeuwberg koppies can also be found within the wider area and form an area of localised hilly topography to the south-east of the proposed !Xha Boom Wind Farm application site.

The degree of slope of the site and surrounding area are shown in **Figure 14**.

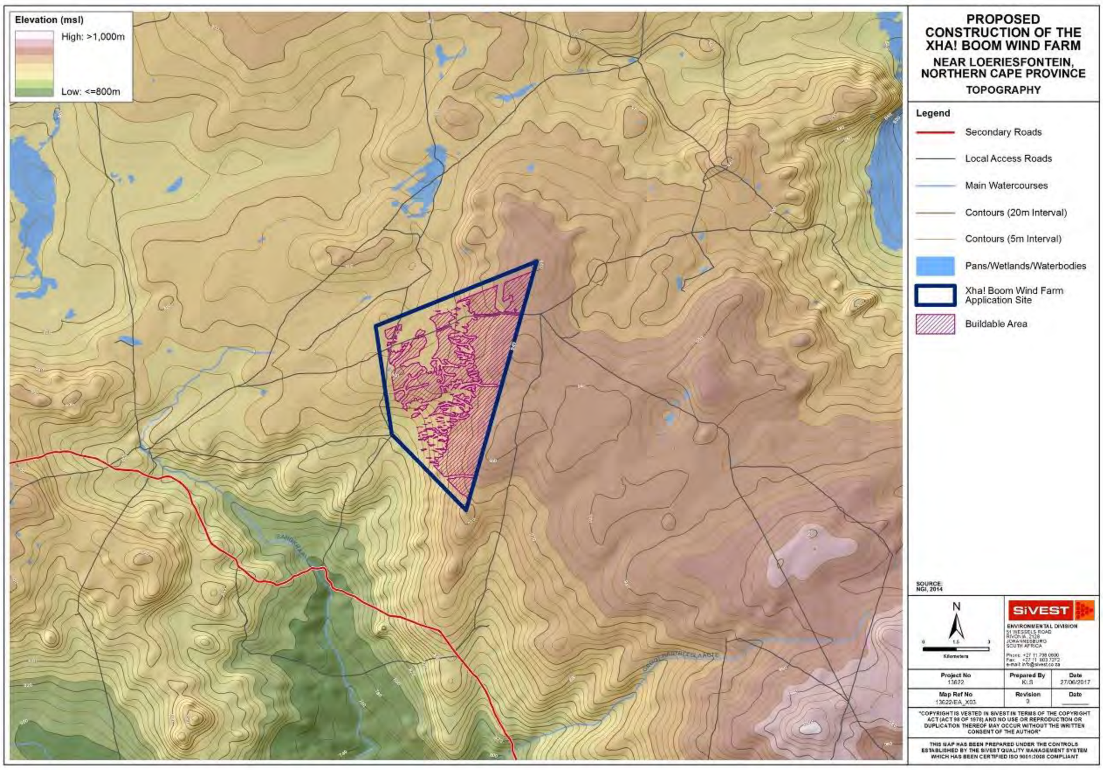



**Figure 13:** Topography of the study area.

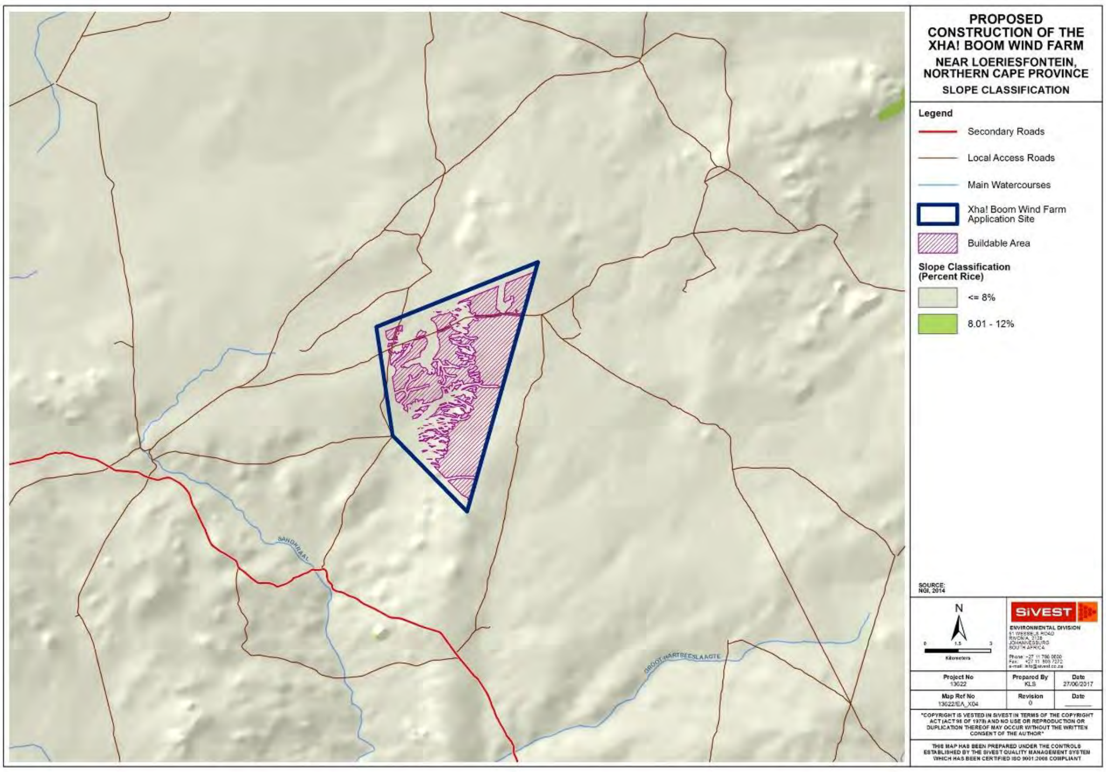



**Figure 14:** Degree of slope in region of the study area.

## 6.5 Climate

The area is dominated by the Cape Winter Season (cold fronts, resulting in soft, misty showers) and is characterised by semi-arid climatic conditions, with most of the rain falling at the start of autumn and during the winter. Rainfall for the site is given as a very low 130 mm per annum (The World Bank Climate Change Knowledge Portal, undated). The average monthly distribution of rainfall is shown in **Figure 15**. One of the most important climate parameters for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. This parameter largely controls what rain fed agriculture (including grazing) is possible within a given environment. Moisture availability is classified into 6 categories across the country (see **Table 11**). The site falls into the driest 6th category, which is labelled as a very severe limitation to agriculture.

Temperatures are moderate, with hot summers and cool winters. The average maximum daily temperatures vary from 32ºC in February to 17ºC in July, but temperatures can drop to 2ºC.

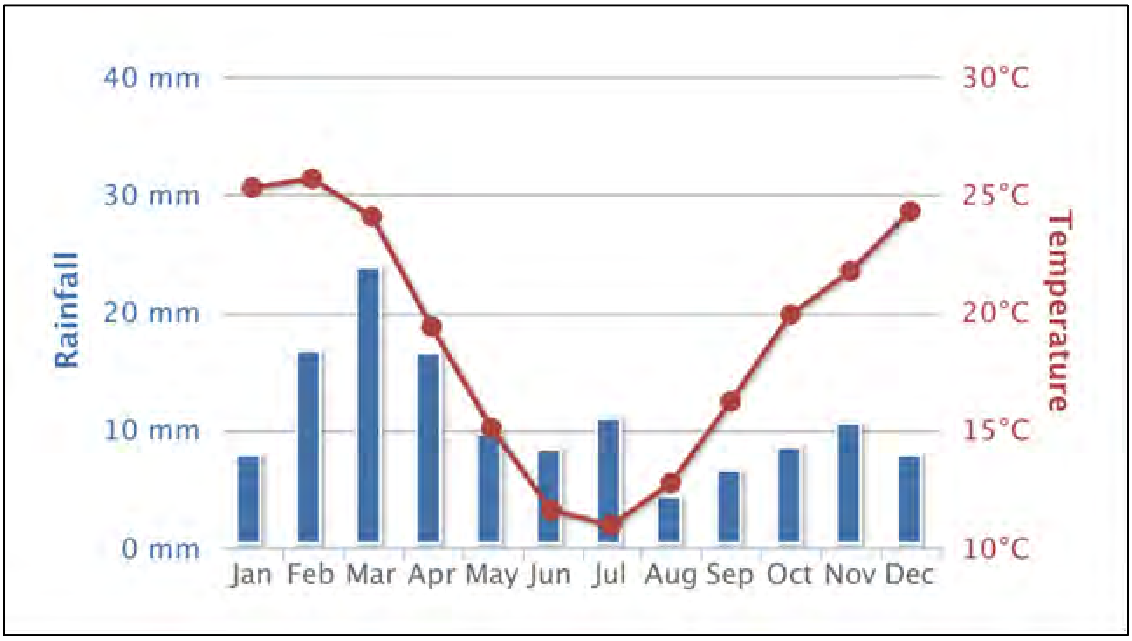



**Figure 15:** Average monthly temperature and rainfall for the site from 1990-2012 (The World Bank Climate Change Knowledge Portal, undated).

**Table 11:** The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

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

## 6.6 Geology

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

According to the Geological Map of Loeriesfontein 3018 (scale 1:250 000, 2011) the site is mainly underlain by dolerite, which intruded into and crystallised as a sill within the brown and grey shale of the Prince Albert and Whitehill Formation. Significant alluvial sand deposits, associated with the local streams, partly cover the southern part of the site.

The Loeriesfontein 3018 Geological Map is shown in **Figure 16**.

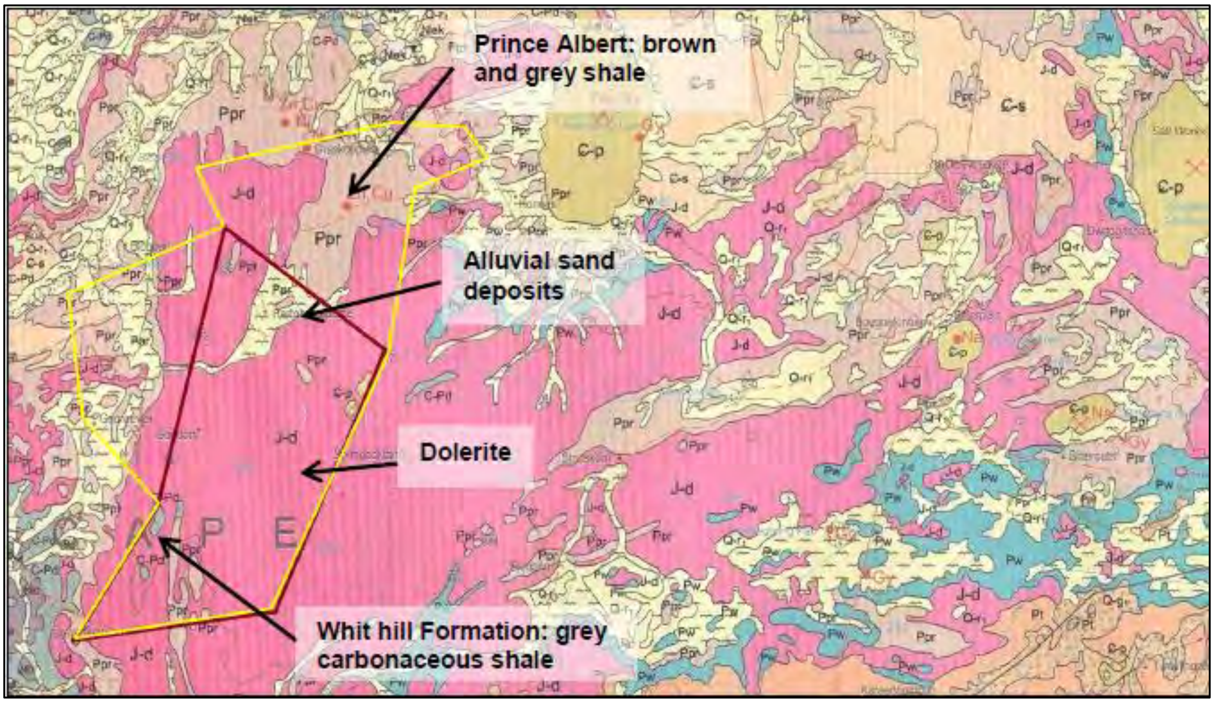



**Figure 16:** Loeriesfontein 3018 Geological Map for the study area

Breccia Pipes, associated with hydrothermal activity, caused by the dolerite intrusions, are found within the area, especially within the southern portion of the site. These pipes comprise baked and dislocated shale and mudstone, locally with breccia (shattered re-cemented blocks). Gas vugs and fractures are often filled with minerals like calcite, chlorite, fluorite, apophyllite, barite and quartz.

Economical zinc and copper deposits are found on Erf 176 (Graskoppies) in the north, but with the exception of a couple of borrow pits within the dolerite sill, no mining has occurred on site.

## 6.7 Biodiversity (Flora and Fauna)

The Biodiversity Assessment was conducted by Simon Todd and is included as **Appendix 6A**. The environmental baseline from a biodiversity perspective is presented below. The purpose of the Terrestrial Biodiversity EIA 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 impacts associated with the development of the site as a wind energy facility.

### *6.7.1 Broad-scale vegetation patterns*

The national vegetation map (Mucina & Rutherford 2006) for the study area is depicted below in **Figure 17.** The whole site is mapped as falling within the Bushmanland Basin Shrubland vegetation type. The majority of the !Xha Boom site is mapped as falling within the Western Bushmanland Klipveld vegetation type, with a small proportion of Bushmanland Basin Shrubland along the eastern boundary of the site. However, the site visit revealed that the majority of the areas classified as Bushmanland Basin Shrubland are in fact Bushmanland Arid Grassland. Although the dominant and characteristic species associated with each of these vegetation types is described in Mucina & Rutherford, these lists are not repeated here as the actual vegetation as observed at the site is described in the next section.

The south western margin of the site consists of Western Bushmanland Klipveld, which forms part of the Succulent Karoo Biome and occurs on the north-western plains of Bushmanland east of the Namaqualand Klipkoppe, north and south of Kliprand and west of Stofvlei. It consists of sparse plains of desert character supporting dwarf succulent shrubs and drought-tolerant grasses. This vegetation type has an extent of 2297km$^2$, of which 99% is still intact, with no major transformation, although erosion is extensive with as much as 70% considered to be suffering from significant erosion. Eight endemic species are reported for this vegetation type by Mucina & Rutherford, which is significant given the low extent of this vegetation type.

Bushmanland Arid Grassland is an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km$^2$. It extends from around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type.

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

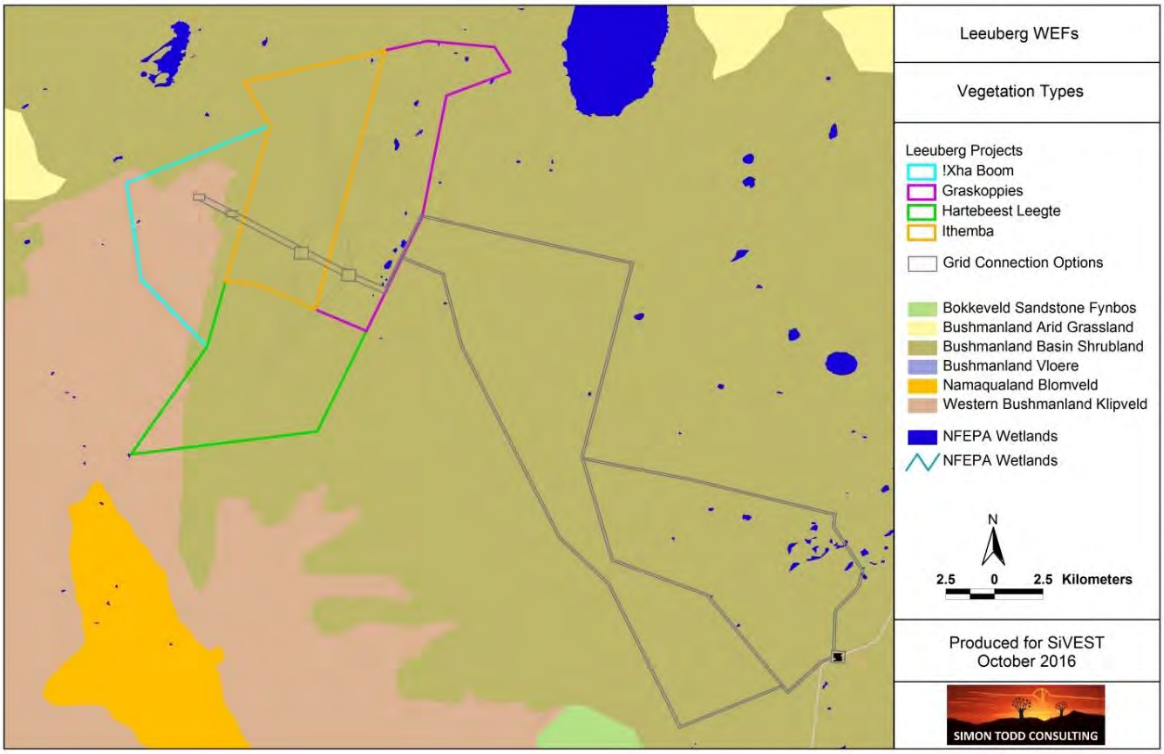



**Figure 17:** The national vegetation map (Mucina & Rutherford, 2006) for the study area. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel *et al.* 2011) are also depicted.

### *6.7.2 Fine-scale vegetation patterns*

The site visit revealed that the site consists of two clear parts, the Western Bushmanland Klipveld section in the lower-lying areas in the west and then a much smaller strip of Bushmanland Arid Grassland along the eastern boundary of the !Xha Boom site boundary. These two broad units are seprated by a broken ridge system with sporadic rocky outcrops. The Western Bushmanland Klipveld and the Bushmanland Arid Grassland are generally considered low sensitivity, but the ridge that divides them is considered relatively sensitive and disturbance to this area should be minimised.

The areas mapped as Bushmanland Basin Shrubland by Mucina & Rutherford (2006) are consistently dominated by grasses with low shrub cover and are clearly more closely allied with Bushmanland Arid Grassland. This discrepancy with the vegetation map can be ascribed to the coarse nature of the national vegetation map and associated uncertainty along the boundaries of the vegetation units. In addition, boundaries between units have been mapped largely from aerial or satellite imagery and these boundaries are not always clearly visible. The main driver of vegetation pattern in the area is substrate. On the gravels and stony soils which characterise the western part of the site, the vegetation consists of open shrub-dominated vegetation of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by various *Stipagrostis* species and is typical of Bushmanland Arid Grassland. There are also some areas on shallow soils, which consist of grassy shrublands and are transitional areas.

**Figure 18:** Typical vegetation of the !Xha Boom site, which consist of Western Bushmanland Klipveld has very low cover and consists of bare, open areas alternating with shrubby or grassy areas with deeper soils or which accumulate more soil moisture.

The majority of the !Xha Boom site consists of Western Bushmanland Klipveld. These areas are dominated by shrub species such as *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Zygophyllum retrofractum*, *Zygophyllum flexuosum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Hermannia spinosa*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia glomerata*, *Pteronia sordida*, *Thesium hystrix, Euphorbia decussata* and *Salsola tuberculata*; succulent shrubs including *Aridaria noctiflora*, *Ruschia intricate*, *Prenia tetragonia* and *Sarcocaulon patersonii*; annual grasses such as *Aristida congesta*, *Stipagrostis anomala* and *Enneapogon desvauxii*. Taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. There are also a number of forbs and annuals present including *Sesamum capense*, *Galenia sarcophylla*, *Gazania lichtensteinii*, *Leysera tenella*, *Osteospermum pinnatum* and *Tribulis terrestris*. Cover across most of this area is very low and while this can be partly attributed to the aridity of the area, livestock grazing also appears to have played a significant role in leading to the degradation of the area and further loss in the plant cover.

The areas of Bushmanland Arid Grassland tend to be very homogenous with little species turnover and are usually dominated by *Stipagrostis ciliata*, *S.brevifolia* and *s.obtusa* with low shrubs such as *Lebeckia spinescens*, *Monechma incanum*, *Asparagus capensis*, *Asparagus retrofractus*, *Eriocephalus microphyllus var. pubescens*, *Zygophyllum retrofactum* with occasional larger *Lycium pumilum* shrubs or small *Parkinsonia africana* trees. Protected or listed species are rare in this habitat and only an occasional *Hoodia gordonii* was observed within this vegetation type. The rocky outcrops which occur along the western boundary of this unit in the transional area with Western Bushmanland Klipveld contain a number of species not observed elsewhere including *Aloe falcata*, *Dyerophytum africanum*, *Asparagus africanus*, *Thesium lineatum*, *Pteronia incana* and *Searsia burchellii*.

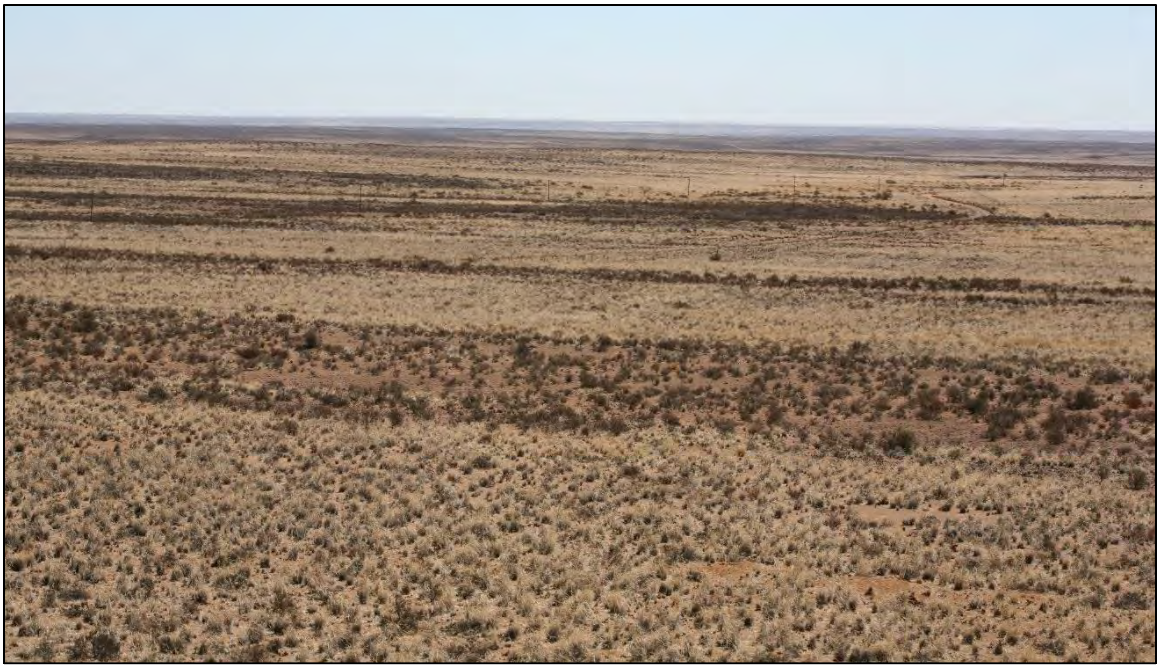


**Figure 19:** The eastern margin of the !Xha Boom site consists of open plains of Bushmandland Arid Grassland, interspersed with more shrubby areas of Bushmanland Basin Shrubland. These areas are not considered sensitive as the diversity is low and there are few species of concern present.

**Figure 20:** The transional areas between the grassy plains in the east of the !Xha Boom site and the Western Bushmanland Klipveld consists of a low ridge with sporadic rocky outcrops. Such features are not common in the area and are important habitats for fauna and flora.

### *6.7.3 Listed plant species*

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. Listed and protected species observed in the area include the provincially protected species *Aloe falcata*, *A.claviflora* and *Hoodia gordonii* and *Aloinopsis luckhoffii* and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

### *6.7.4 Critical biodiversity areas & broad-scale processes*

The site lies within the planning domain of the Namakwa Biodiversity Sector Plan (Desmet & Marsh 2007). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. There are no CBAs within the wind farm site or along the power line corridors, with the nearest CBA being northeast of the site on one of the large pans of the area. Although it is not yet published, the Northern Cape Conservation Plan (Oosthuysen & Holness, 2016) defines CBAs for the whole Northern Cape and will be shortly published. The site does not fall within any CBAs defined within this map either (**Figure 21**), suggesting that no significant biodiversity features have been identified in this area. Although there are some CBAs along the grid connection route, the presence of a power line will generate a low terrestrial impact and this would not compromise the functioning of these CBAs which are corridors associated with larger drainage lines. In addition, the site does not lie within a National Protected Area Expansion Strategy (NPAES) focus area and has therefore not been identified as an important area for future conservation area expansion.

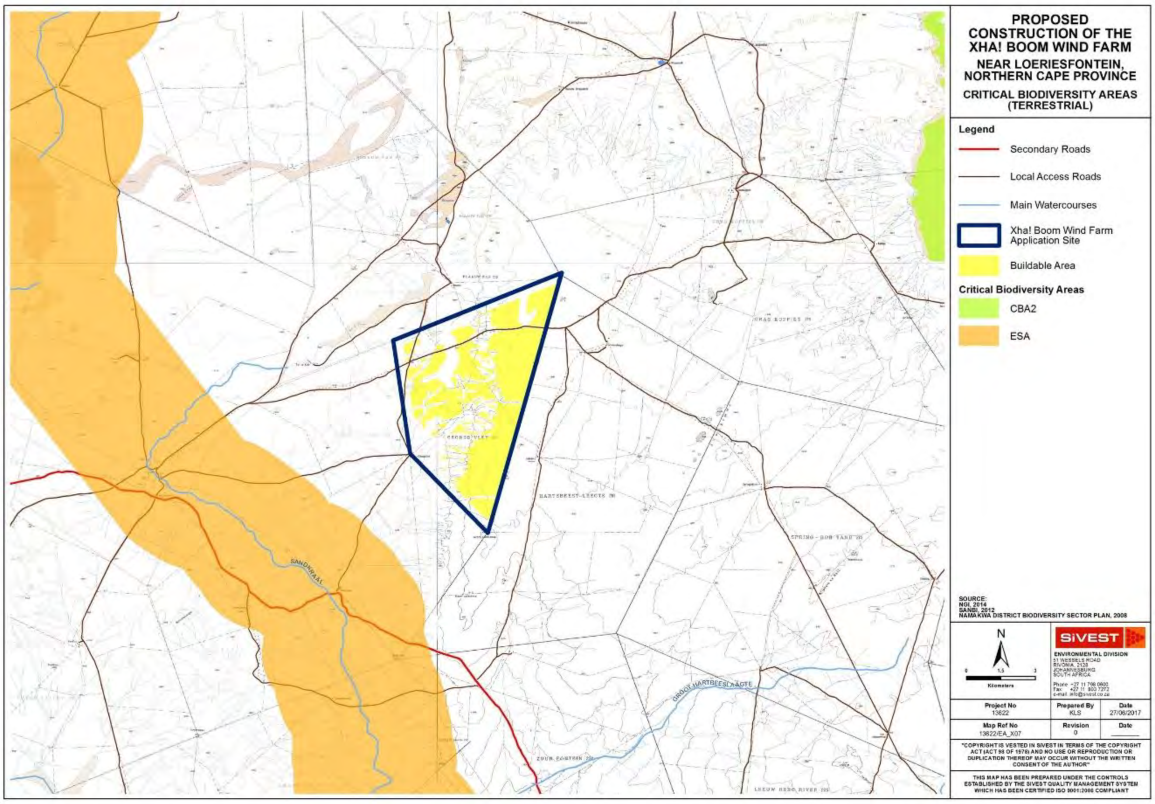



**Figure 21:** Extract of the Northern Cape Conservation Plan for the study area, showing that there are no CBAs within the !Xha Boom site.

## 6.8 Avifauna

The Avifauna Assessment was conducted by Chris van Rooyen and is included as **Appendix 6B**. The environmental baseline from an avifaunal perspective is presented below.

### *6.8.1 Description of the Affected Environment*

#### *6.8.1.1 Natural Environment*

The development area is located on a vast, arid, topographically uniform plain. The habitat is very uniform, and consists mainly of Western Bushmanland Klipveld and a small section of Bushmanland Basin Shrubland in the east and the north of the development area. Western Bushmanland Klipveld is characterized by succulent dwarf shrubs (*Aciduria, Drosanthemum, Eberlanzia, Phyllobolus, Psilocaulon, Ruschia*), with microphyllous nonsucculent shrubs (*Aptosimum, Pentzia*) and drought-tolerant grasses, with occasional mass display of annual spring flora. Bushmanland Basin Shrubland consists of dwarf shrubland dominated by a mixture of low, sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also abundant annual flowering plants such as species of *Gazania* and *Leysera* (Mucina & Rutherford 2006).

A number of ephemeral drainage lines flow though the development area, but they only hold water for brief periods after exceptional rainfall events, which are rare events. The study area is extremely arid with a mean annual rainfall of 170.5mm, with peak rainfall between March and July. The temperatures are highest on average in January, at around 22.8 °C. The lowest average temperatures in the year occur in July, when it is around 9.9 °C.). The development area is situated in an ecological transitional zone between the Nama Karoo and Succulent Karoo biomes (Harrison et al. 1997). In comparison with Succulent Karoo, the Nama Karoo has higher proportions of grass and tree cover. The ecotonal nature of the study area is apparent from the presence of typical avifauna of both Succulent and Nama Karoo e.g. Karoo Eremomela Eremomela gregalis (Succulent Karoo) and Red Lark Calendulauda burra (Nama Karoo). The two Karoo vegetation types support a particularly high diversity of bird species endemic to Southern Africa, particularly in the family Alaudidae (Larks). Its avifauna typically comprises ground-dwelling species of open habitats (Harrison et al. 1997). Because rainfall in the Nama Karoo falls mainly in summer, while peak rainfall in the Succulent Karoo occurs mainly in winter, it provides opportunities for birds to migrate between the Succulent and Nama Karoo, to exploit the enhanced conditions associated with rainfall. Many typical karroid species are nomads, able to use resources that are patchy in time and space (Barnes 1998).

A feature of the arid landscape where the development area is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are typical of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison *et al*. 1997). Although the development area itself does not contain any significant pans, there is a major pan, known as Konnes se Pan, situated approximately 18km north-east of the development area, and a series of small pans, known as Die Soutkomme, approximately 4km north-east of the development area. When these pans hold water (which is only likely after exceptional rainfall events which may occur only once a decade or more), waterbird movement to and from these pans is possible, including Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoenicopterus* minor. It is possible that nocturnal flamingo movement might take place over the proposed wind farm sites between the coast and the abovementioned pans, although this should be sporadic rather than regularly.

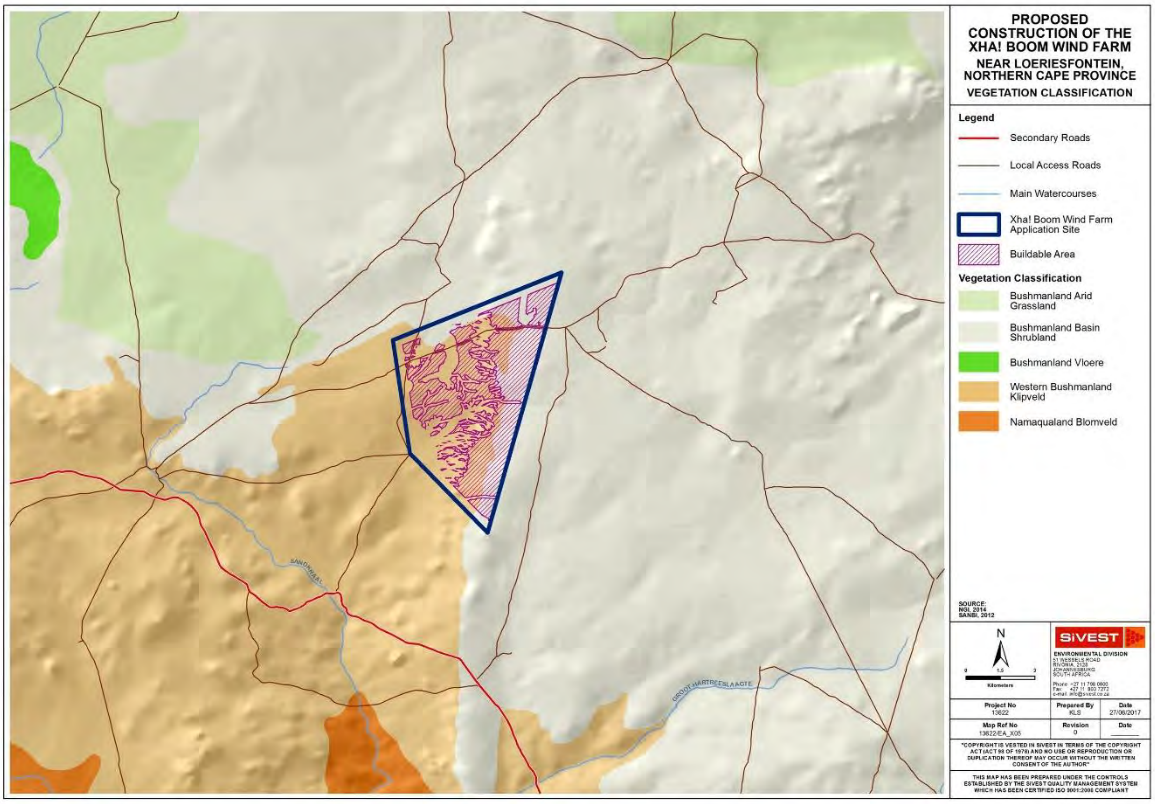



**Figure 22**: Vegetation types in the greater study area, indicating the homogenous character of the habitat at the proposed !Xha Boom Wind Farm (Mucina & Rutherford 2006).

#### *6.8.1.2 Modified Environment*

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

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the broader development area:

- **Water points:** The land use in the broader development area is mostly small stock farming. The entire area is divided into grazing camps, with several boreholes with associated water reservoirs and drinking troughs. In this arid environment, open water is a big draw card for several bird species, including priority species such as Martial Eagle, Verreaux's Eagle and Sclater's Lark that use the open water troughs to bath and drink.
- **Transmission lines:** The Aries - Helios 400kV transmission line runs approximately 25km east of the proposed WEF areas. The transmission towers are used by raptors for perching and roosting, and also for breeding. Three Martial Eagle nests were recorded on the Aries - Helios 400kV transmission line east of the proposed sites, two of which were active during the monitoring period. The study area contains many fence-lines which are used by several priority species for perching.

**Appendix B** of the Avifauna Specialist Report provides a photographic record of the habitat in the study area. A map of the study area, indicating the location of water points, raptor nests and HV lines is shown in **Figure 23**.

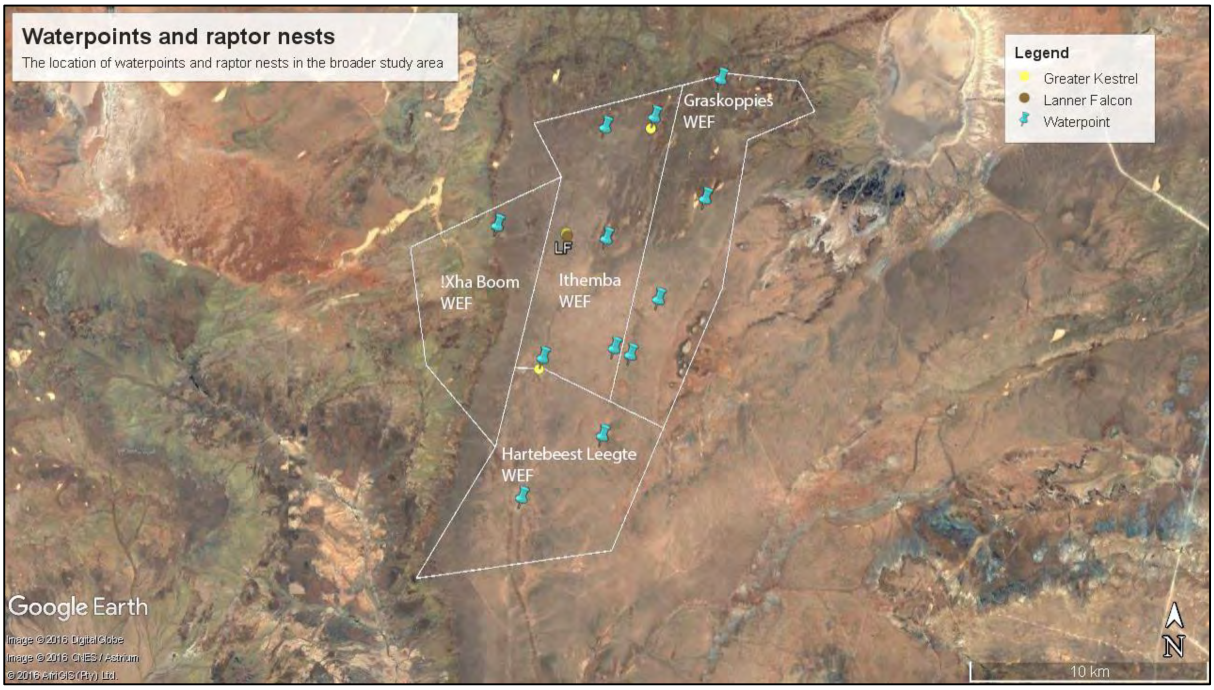



**Figure 23:** Location of water points and raptor nests in the greater area.

## 6.9 Bats

The Bat Assessment was conducted by Daleen Burger, Monika Moir and Werner Marais of Animalia Zoological & Ecological Consultation. The full report is included in **Appendix 6C**. The environmental baseline from a bat perspective is presented below.

### *6.9.1 Land Use, Vegetation, Climate and Topography*

The site is located over two different vegetation units, namely Bushmanland Basin Shrubland and Western Bushmanland Klipveld. The folowing vegetation units are found in the surrounding area: Namaqualand Blomveld, Bushmanland Arid Grassland and Bushmanland Vloere (**Figure 22**).

The site mostly falls in the Bushmanland Basin Shrubland vegetation unit which consists of slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny shrubs as well as 'white' grasses and abundant annuals in years of high rainfall. This unit is found at an altitude of 800 m – 1200 m. Mudstones and shales of Ecca Group and Dwyka tillites, both of early Karoo age, dominate the unit. About 20% of rock outcrop is formed by Jurassic intrusive dolerite sheets and dykes. Soils are shallow Glenrosa and Mispah forms with lime generally present in the entire landscape. To a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually less than 15% clay are also found. These soils have a high salt content. Rainfall occurs mainly in late summer and early autumn with MAP ranging from 100 mm - 200 mm. Mean maximum and minimum temperatures are 39.6°C and -2.2°C for January and July, respectively. This biome is Least Threatened with a target of 21%. None of the unit is statutorily conserved and is without signs of serious transformation. Erosion is moderate (56%) and low (34%) (Mucina and Rutherford 2006).

The Western Bushmanland Klipveld vegetation unit is mostly present in the western parts of the site. The unit consists of very sparsely populated plains with a desert appearance supporting succulent dwarf shrubs with microphyllous non succulent shrubs and draught tolerant grasses. There are occasional mass displays of spring flora. Geology consists of Hutton and Mispah soils over Karoo Sequence sediments. The rocky pavement of rounded boulders, which characterise this area, are palaeo-river terraces of the palaeo-Orange river, which is presumed to have flowed south through this area (approximately 22 mya). Rainfall shows slight peak in winter, hardly any rain falls in December and January, thus this unit is in winter-rainfall regime. Mean maximum and minimum temperatures are 36°C and -2°C for January and July, respectively. Incidence of frost is relatively high due to its land-locked position and high altitude. The biome is Least threatened with a target of 18%. No portion of the vegetation unit is statutorily conserved. There are no signs of serious large scale transformation or invasion of alien species (Mucina and Rutherford 2006).

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 12** below.

**Table 12:** Potential of the vegetation to serve as suitable roosting and foraging spaces for bats.

| Vegetation Unit | Roosting Potential | Foraging Potential | Comments |
|---|---|---|---|
| Namaqualand Blomveld | Low - Moderate | Moderate - High | Scattered and few rocky outcrops as well as little to no large flora result in low roosting potential. The flowering flora results in higher concentrations of insects and thus increasing foraging. |
| Bushmanland Arid Grassland | Low - Moderate | Low - Moderate | Roosting potential is almost entirely determined by sparse rocky outcrops resulting in low roosting potential. The lack of diverse flora results in a lower diversity of insect species resulting in lowered foraging potential. |
| Bushmanland Basin Shrubland | Low - Moderate | Moderate | Rocky outcrops provide roosting areas and scrubland provides potential foraging space. |

| | | | |
|---|---|---|---|
| Western Bushmanland Klipveld | Moderate - High | Moderate - High | The presence of large boulders and rock outcrops provide roost sites. The presence of drought tolerant grasses as well as a variety of shrubs make for adequate foraging area. |
| Bushmanland Vloere | Low | Moderate -High | This biome possesses salt pans and dry riverbeds which does not provide adequate roosting place. The sprouting of flora may infer a higher foraging capacity for the unit. |

Refer to **Figure 22** above for vegetation units present on the study area (Mucina and Rutherford 2006).

### *6.9.2 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. The probability of occurrence is described by a percentage indicative of the expected numbers of individuals present on site and the frequency with which the site will be visited by the species (in other words the likelihood of encountering the bat species).

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 and Stoffberg (2014) based on species distributions, altitudes at which they fly and distances they travel; and assumes a 100% probability of occurrence. The ecology of most applicable bat species recorded in the vicinity of the site is discussed below.

**Table 13:** Table of species that may be roosting or foraging on the study area, the possible site specific roosts, and their probability of occurrence based on literature (Monadjem *et al.* 2010).

| Species name | Common name | Probability of Occurrence (%) | Conservation Status | Possible roosting sites occupied on site | Foraging habits (indicative of possible foraging areas on site) | Likely Risk of Impact (Sowler & Stoffberg 2014) |
|---|---|---|---|---|---|---|
| *Miniopterus natalensis* | Natal long-fingered bat | 10 - 20 | Near Threatened | Cave-dependent. No known caves in vicinity of site, however mountainous terrain within the larger area can possibly provide caves. Also being observed to forage singly or in small groups in small hollows and culverts or bridges. | Clutter-edge forager. Feeds on a variety of aerial prey including *Diptera*, *Hemiptera*, *Coleoptera*, *Lepidoptera* and *Isoptera*. | Medium - High |
| *Neoromicia capensis* | Cape serotine | 90 - 100 | Least Concern | Possibly large trees around farm buildings livestock kraal and shade areas. Limited farm building roofs | Clutter-edge forager feeding mainly on *Coleoptera*, *Hemiptera*, *Lepidoptera* and *Neuroptera*. | Medium - High |
| *Tadarida aegyptiaca* | Egyptian free-tailed bat | 90 - 100 | Least concern | Limited farm buildings and tall farm structures. Crevice dweller that will take refuge in almost any suitably sized crevice raised above ground. | Open-air forager with a diet consisting mainly of *Diptera*, Hemiptera, Coleoptera and to some extent Lepidoptera. Vegetation below has little influence on foraging habitat, and can forage large distances. | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Eptesicus hottentotus* | Long-tailed serotine | 90 - 100 | Least Concern | It is a crevice dweller roosting in rock crevices, expansion joints in bridges and road culverts | It seems to prefer woodland habitats, and has been caught in granitic hills and near rocky outcrops | Medium |

### *6.9.3 Ecology of bat species that may be largely impacted by the proposed !Xha Boom Wind Farm*

There are three (3) bat species recorded in the vicinity of the site that occurs commonly in the area due to their probably of occurrence and widespread distribution. These species are of importance based on their likelihood of being impacted by the proposed wind farm, which is a combination of abundance and behaviour. The relevant species are discussed below.

- ***Miniopterus natalenis***

*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 and is listed as Near Threatened (Monadjem *et al*. 2010).

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 *Miniopterus natalensis* in South Africa with migration distances exceeding 150 kilometres. If the site is located within a migratory path the bat detection systems should detect high numbers and activity of the Natal long-fingered bat.

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 and co-workers (2016) advise that *Miniopterus natalensis* faces a medium to high risk of fatality due to wind turbines. This evaluation was based on broad ecological features and excluded migratory information.

- ***Neoromicia capensis***

*Neoromicia capensis* is commonly called the Cape serotine and has a conservation status of Least Concern as 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 *Neoromicia 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.,* 2016).

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 & Lynch 1989).

- ***Tadarida aegyptiaca***

The Egyptian Free-tailed bat, *Tadarida aegyptiaca*, is a Least Concern species as it has a wide distribution and high abundance throughout South Africa. 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 rock crevices, under exfoliating rocks, caves, 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).

The Egyptian Free-tailed bat 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 by wind turbines (Sowler *et al*., 2016). Due to the high abundance and widespread distribution of this species, high mortality rates by wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species. The sensitivity maps are strongly informed by the areas that may be used by this species.

After a gestation of four months, a single pup 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 (Bernard and Tsita 1995). Maternity colonies are apparently established by females in November (Herselman 1980).

Several North American studies indicate the impact of wind turbines to be highest on migratory bats, however there is evidence to the impact on resident species. Fatalities from turbines increase during natural changes in the behaviour of bats leading to increased activity in the vicinity of turbines. Increases in non-migrating bat mortalities around wind turbines in North America corresponded with when bats engage in mating activity (Cryan and Barclay 2009). This long term assessment will also be able to indicate seasonal peaks in species activity and bat presence.

## 6.10 Surface Water

The Surface Water Assessment was conducted by Shaun Taylor of SiVEST (**Appendix 6D**) and the environmental findings from a Surface Water perspective are presented below.

### *6.10.1 Surface Water Database Information*

In terms of the National ENPAT (2002) database, the proposed wind farm study site is completely within the Berg Olifants Water Management Area (WMA) (**Figure 24**). Moreover, the proposed development is therefore also within the Olifants – Cape Primary Catchment. At a finer level of detail, the !Xha Boom Wind Farm site traverses two (2) quaternary catchments including E31A and E31C.

In terms of the NFEPA (2011) database, there is only one (1) natural depression wetland. This wetland is not considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). A WETFEPA is a wetland that is earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy.

Two (2) non-perennial watercourses were identified in the Northern Cape ENPAT (2000) database. No other watercourses were identified from the NFEPA (2011) database. Drainage lines were identified on the 1:50 000 topographical maps however.

No new database information was identified that could be of relevance to the proposed development. Previous scoping level findings were therefore unchanged and used for the in-field assessment.

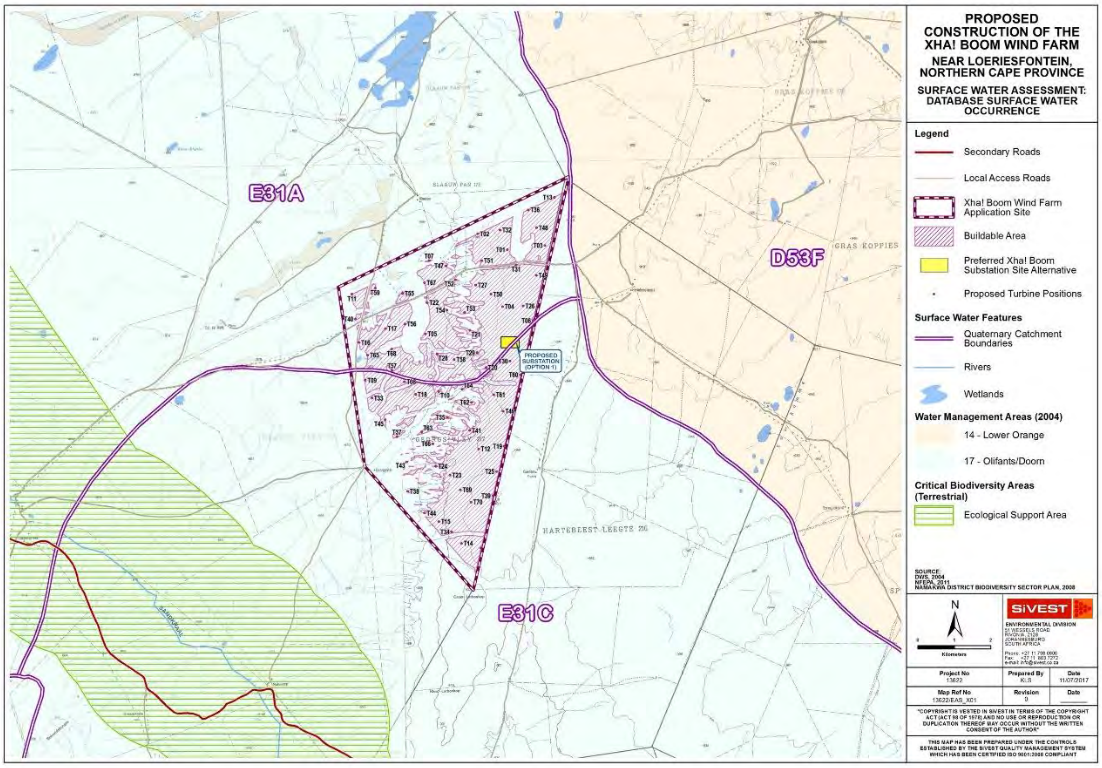



**Figure 24:** Database Surface Water Occurrence Map

## 6.11 Soils and Agricultural Potential

The Soils and Agricultural Potential Assessment was conducted by Johann Lanz. The full report is included in **Appendix 6E**. The environmental baseline from a soils and agricultural perspective is presented below.

### *6.11.1 Soils*

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There are three land types across the study area, mainly Fc457, with small areas of Ah25 and Fc422 (**Figure 25**). Soils on these land types are similar and are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. The soils would fall into the Lithic and Calcic soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in the Appendix of the Soils and Agricultural Report in **Table A1**. The field investigation confirmed the occurrence of shallow, sandy soils on underlying rock or hard-pan carbonate across the entire site. The predominant soil forms are Coega, Mispah, Glenrosa and Askham.

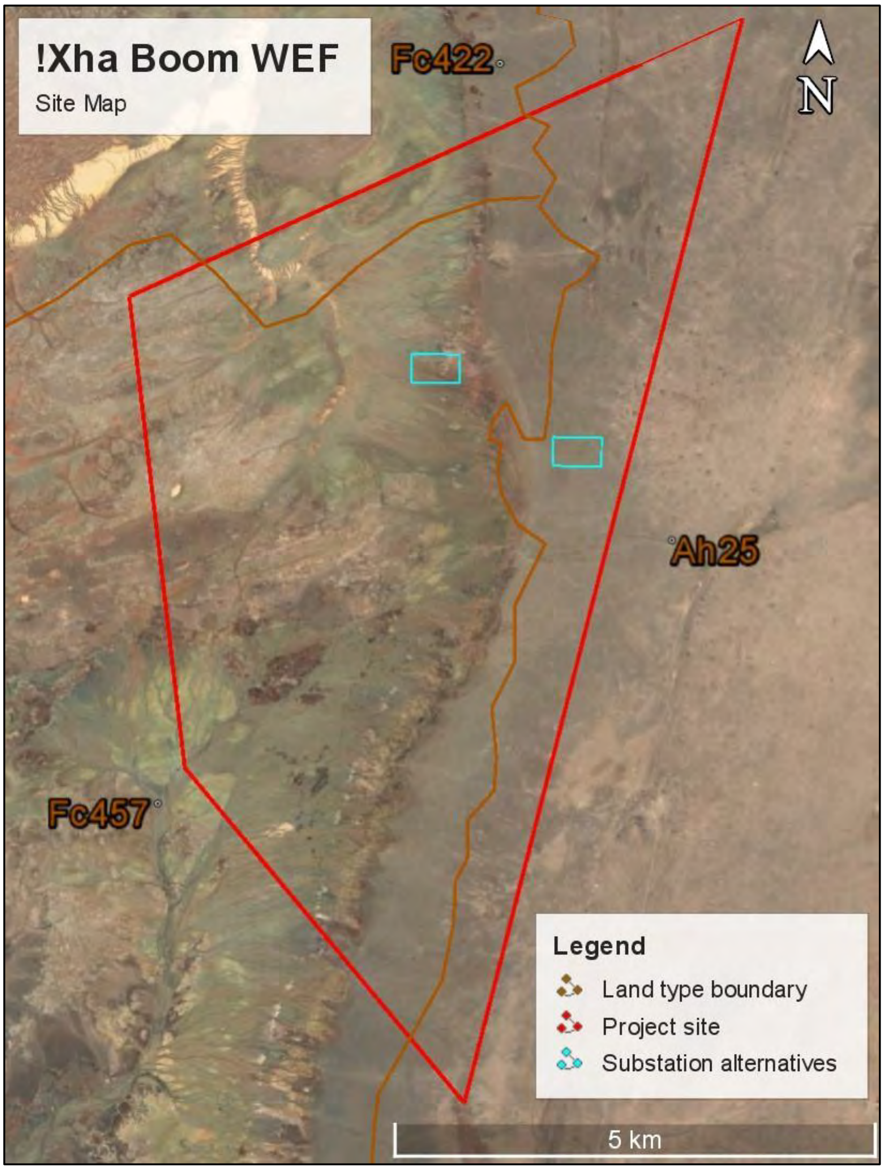



**Figure 25:** Satellite image map of the site showing the development area.

**Figure 26:** Photograph showing typical landscape and veld conditions on the site.

**Figure 27:** Photograph showing typical landscape and veld conditions on the site.

**Figure 28:** Photograph showing site conditions with example of dolerite outcrops that occur on site.

## 6.12 Noise

The Noise Assessment was conducted by Morné De Jager of Enviro-Acoustic Research (EAR). The full report is included in **Appendix 6F**. The environmental baseline from a noise perspective is presented below.

### *6.12.1 Study Area*

The development is situated in the Hantam Local Municipality which falls within the Namakwa District Council Municipal area in the Northern Cape Province. This is of relevance due the fact that this province has not yet promulgated Provincial Noise Control Regulations. The study area is further described in terms of environmental components that may contribute to or change the sound character in the area.

- **<u>Topography</u>**

The topography in the vicinity of the development is generally flat plains. There are no topographical features that will assist in the blocking of sound propagation. The larger area is classified by the Environmental Potential Atlas of South Africa as plains. Due to the height of the wind turbines, topographical features will not significantly limit the propagation of sound from the wind turbines.

- **<u>Roads and rail roads</u>**

There are a few small gravel roads in the area, mainly used by the local land owners. Traffic volumes on these roads are very low and sporadic and will not be of any significance in terms of calculable noise.

- **Land use**

Land use in the area is mostly vacant natural and agricultural activities (sheep and game).

- **Residential areas**

Excluding structures identified (Section 1.4 of the Noise Impact Assessmnt Report) that may be occupied, either permanently or temporary, there are no residential areas within 5,000m from the proposed wind farm.

- **Ground conditions and vegetation**

The area falls within the arid Karoo and desert false grassveld vegetation regions within the Nama Karoo biome. The area consists mostly of low growing shrubs and grasses with hard ground conditions typical of an arid area. Ground conditions are unlikely to assist in the attenuation of noise (fraction of sound waves hitting and being reflected from the ground)

- **Existing Ambient Sound Levels**

Ambient sound levels were previously measured in the area for the Loeriesfontein and Kokerboom Wind Farms.

Excluding the measurements collected near construction activities of the Loeriesfontein Wind Farm, ambient sound levels are very low in the area. Sound levels are higher at the dwellings in the area, mainly due to the modified environment around the residential dwellings.

### *6.12.2 Noise-Sensitive Developments*

An assessment of the area was done using the Google Earth® as well as available topographical maps to identify potential Noise-sensitive Developments in the area (within area proposed, as well as potential NSD's within around 2km from the boundary of the proposed WF).

A desktop assessment identified seven (7) potential noise-sensitive developments in the area (**Figure 29** and **Table 14**. The statuses of these structures were confirmed by Mrs. Nicolene Venter of Imaginative Africa (Pty) Ltd after discussions with landowners.

**Table 14:** Status of identified potential noise-sensitive developments

| Potential receptor | Status of the developments identified in Figure 29 and comments |
|---|---|
| NSD01 | Owner – Mr. Christo van der Merwe. Status unknown. |

| | |
|---|---|
| NSD02 | Owner – Mr. Herman Nel. Single room with carport, loading platform and kraal occupied up to 4 months per year by a shepherd. |
| NSD03 | Owner – Mr. Herman Nel. Single room with carport, loading platform and kraal occupied up to 4 months per year by a shepherd. |
| NSD04 | Owner - Mr. Albi Louw. House being used on a temporary basis by Albi's shepherds during sheering time. |
| NSD05 | Owner – Mr. Gys Lombaard. The house is occupied in the summer time, usually from January to June. |
| NSD06 | Owner - Mr. Nico Louw. Occupied only in summer time (lambing period) and for a weekend at a time. He commented that noise will not be an issue for them. |
| NSD07 | Owner – Mr. Kallie van Zyl. The house is not occupied. The owner lives in town. |


**Figure 29:** Aerial Image indicating identified potential Noise-sensitive developments identified during scoping

### *6.12.3 Onsite Ambient Sound Level Measurements*

Ambient sound levels were measured in the area for the Loeriesfontein and Kokerboom WEF's. The sound levels are discussed in the following sections.

- **<u>Loeriesfontein Measurements</u>**

Measurements were collected at seven (7) locations during the day and night of 13th June 2011. The results are presented in **Table 15** below.

**Table 15:** Results of ambient sound level monitoring (Datum type: WGS 84, Decimal Degrees)

| Point name | Location, Latitude | Location, Longitude | $L_{Aeq,T}$ (dBA) | $L_{A, max}$ (dBA) | $L_{A, min}$ (dBA) | $L_{A, 90}$ (dBA) | Wind speed Ave. (m/s) |
|---|---|---|---|---|---|---|---|
| LBN01 (N) | -30.336740° | 19.584582° | 25.7 | 32.1 | 16.3 | 18.8 | 1.1 |
| LBN02 (N) | -30.420516° | 19.561455° | 23.6 | 36.6 | 16.1 | 16.9 | 0.9 |
| LBN03 (N) | -30.485515° | 19.557087° | 29.7 | 43.1 | 17 | 19.4 | 0.9 |
| LBN04 (D) | -30.497410° | 19.557970° | 54.3 | 64.2 | 48.9 | 50.8 | 4.2 |
| LBN05 (D) | -30.498541° | 19.559391° | 74.1 | 74.5 | 72.7 | 73.5 | 3.2 |
| LBN06 (D) | -30.476170° | 19.563890° | 30.6 | 38.9 | 18.3 | 23.3 | 0.4 |
| LBN07 (D) | -30.428747° | 19.605808° | 42.2 | 55.7 | 25.4 | 33.5 | 3.4 |
| LBN07 (D)(T) | -30.428747° | 19.605808° | 51.3 | 61.2 | 28.4 | 33.1 | 3.2 |

Notes:

- The Sound Level Meter was fitted with the WS-03 all-weather windshield during times when the average wind speed exceeded 3 m/s
- (D) = Day, (N) = Night, (R) = Road, (T) = Train moving slowly through station
- The Rion Sound Level Meter NL 32 minimum limit is at 18 dBA.
- LBN05 taken approximately 1m from Transformer inside the substation perimeter.

Measurements indicated an area with very low ambient sound levels (away from dwellings and industrial activities - the Eskom substation). During the period that measurements were collected sound levels in the area ranged from less than 18 dBA ($L_{A90}$) upwards, indicating that this area is very quiet (with no wind blowing and away from anthropogenic activities). All samples illustrate the rural character of the area during periods with light winds, with mainly natural sounds defining the acoustic character. Measurements closer to one dwelling and the Eskom substation indicated significantly increased sound levels.

- **<u>Kokerboom Measurements</u>**

A number of additional measurements were collected during the day and night of 17 June 2016, with the site visit confirming the very low ambient sound levels in the area. Sound levels closer to construction activities and the substation (where the Loeriesfontein WEF contractor's camp are located) are significantly elevated.

The data collected and information about the measurement locations are presented in Table 16. All the 10-minute measurements indicated an area with a potential to be quiet, although traffic on the roads as well as natural (birds, insects and wind-induced noises) did increase the noise levels.

#### *6.12.4 Ambient Sound Levels – Summary*

Daytime measured data indicate an area with elevated noise levels, but, considering the spectral data and sounds heard, these sounds are mainly due to natural activities (wind-induced). Night-time measurements indicated a very quiet environment, even with low winds (around 0 – 2 m/s). Considering the measurements, and measurements conducted in the last few years at similar areas, acceptable rating levels for the area would be typical of a rural noise district.

There is a high confidence in the ambient sound levels measured and the subsequent Rating Levels determined. For the purpose of this assessment the strictest rating level (rural) will be used as defined in SANS 10103:2008 (35 dBA at night, 45 dBA during the day) for all the receptors living in the area.

#### *6.12.5 Current Sound Levels*

Considering the location of the project site in relation to roads or industrial activities, the current low developmental character and measurements done in the area indicates very low ambient sound levels. There is very high confidence that the ambient sound levels will also be very low on the project site.

Agricultural and other anthropogenic activities may raise ambient sound levels in the vicinity of the dwellings and agricultural structures in the area, but, as the night-time soundscape is of interest, these activities are unlikely to influence night-time sound levels.

**Table 16:** Summary of singular noise measurement

| Measurement location | $L_{Aeq,i}$ level (dBA) | $L_{Aeq,f}$ level (dBA) | $L_{A90}$ Level (dBA 90) | Comments |
|---|---|---|---|---|
| **Daytime data** | | | | |
| MKWEFSTASL101 (-30.314288°, 19.590754°) | 37 | 36 | 30 | Very quiet with wind induced noises dominating. Aeolian noises from fence wires just audible at times. Wind speed ranging between 4 and 8 m/s at 2m height. |
| | 39 | 37 | 26 | |
| MKWEFSTASL102 (-30.328244°, 19.497512°) | 37 | 35 | 31 | Wind induced noises, grass rustling. Very quiet environment. 3 m/s average wind with a few gusts. |
| | 41 | 39 | 27 | |
| MKWEFSTASL103 (-30.392800°, 19.569415°) | 41 | 38 | 30 | Quiet location. Wind induced noises with 6 to 8 m/s wind. Truck in distance barely audible 2nd measurement. Bird call second measurement was audible. Wind noise dominant. |
| | 45 | 40 | 29 | |
| MKWEFSTASL104 (-30.431132°, 19.558799°) | 72 | 68 | 41 | Construction area. Excavator in distance barely audible. Other trucks passing measurement location. Reverse alarms audible in area. 4 - 6 m/s wind. 4 Cars, 4 trucks first measurement, 2 cars and 3 trucks second measurement. |
| | 68 | 64 | 37 | |
| MKWEFSTASL105 (-30.524433°, 19.517243°) | 36 | 34 | 17 | Wind induced noises dominant. Crows flying in area, squawking audible first measurement. 3 - 5 m/s wind. |
| | 35 | 32 | 25 | |
| MKWEFSTASL106 (-30.498437°, 19.557166°) | 55 | 53 | 49 | Sounds from construction camp. Vehicle idling at sub-station. Voices. Running engine and impulsive sounds (material dropping) dominant sound. Reverse alarms. Vehicles entering contractor’s area. Frequently. Vehicles travelling between camp and sub-station. 3 - 5 m/s wind. 3 cars and 4 cars first and second measurement. |
| | 59 | 56 | 49 | |
| MKWEFSTASL107 (-30.554480°, 19.550756°) | 60 | 58 | 26 | Some wind-induced noises. Very quiet with bird calls. End of shift and passing vehicles generate significant noises. 4 cars, 1 trucks first measurement, 3 cars and 1 truck second measurement. Vehicles driving fast. |
| | 61 | 59 | 26 | |
| MKWEFSTASL108 | 20 | 17 | 15 | Extremely quiet. No sounds observable. No wind. |

| | | | | |
|---|---|---|---|---|
| (-30.668283°, 19.526764°) | 21 | 18 | 15 | |
| **Night-time data** | | | | |
| MKWEFSTASL101 (-30.314288°, 19.590754°) | 18 | 16 | 15 | Possible corona discharge type sound from somewhere, source unknown (just audible). Crickets just audible. Bird in distance at times. Very quiet. |
| | 20 | 18 | 16 | |
| MKWEFSTASL107 (-30.554480°, 19.550756°) | 16 | 15 | 14 | Very quiet location. No audible sounds. |
| | 19 | 15 | 14 | |

Note:

- $L_{Aeq,i}$ - Equivalent (average) A-weighted impulse-time-weighted noise level
- $L_{Aeq,f}$ - Equivalent (average) A-weighted fast-time-weighted noise level
- $L_{A90}$ - Noise level that is exceeded 90% or more of the time, A-weighted fast-time-weighted noise level

## 6.13 Visual

The Visual Assessment was conducted by Stephan Jacobs and Andrea Gibb of SiVEST. The full report is included in **Appendix 6G**. The environmental baseline from a visual perspective is presented below.

The physical and land use related characteristics are outlined below as they are important factors contributing to the visibility of a development and visual character of the study area. Defining the visual character is an important part of assessing visual impacts as it establishes the visual baseline or existing visual environment in which the development would be constructed. The visual impact of a development is measured according to this visual baseline by establishing the degree to which the development would contrast with or conform to the visual character of the surrounding area. The inherent sensitivity of the area to visual impacts or visual sensitivity is thereafter determined, based on the visual character, the economic importance of the scenic quality of the area, inherent cultural value of the area and the presence of visual receptors.

### *6.13.1 Topography*

The flat terrain that occurs over most of the site results in generally wide-ranging vistas throughout the study area (**Figure 30**), and the horizon is usually visible across an entire 360$^{o}$ arc of the viewer. The only exception to this flat topography is the presence of the localised hills / ridges / koppies which can be found within certain parts of the wider visual assessment zone and as the range of hills located some distance to the south and south-west of the site, which will constrain the viewshed. Bearing in mind that wind turbines are very large structures (over 160m in height when the rotor blades are taken into account), these could be visible from a very wide radius around the site, except from areas to the south-east of the site where koppies and localised hilly topography will shield the proposed development. These above-mentioned areas are however located outside of the visual assessment zone and thus the visibility of the wind turbines from these areas is likely to be minimal. It should be noted that the areas of localised hilly topography which are found within certain parts of the wider study area are also expected to shield the proposed development to a degree. In general however, there would be very little shielding to lessen the visual impact of the wind turbines from any locally-occurring receptor locations.

**Figure 30:** Generally wide-ranging vistas found throughout the study area as a result of the flat terrain that occurs over most of the site.

### *6.13.2 Vegetation*

The natural short vegetation cover will offer no visual screening. Parts of the visual assessment zone are however characterised by the presence of some tree species (some relatively large and some low). These trees occur naturally in certain areas of the visual assessment zone and are expected to contribute to the overall natural character of the study area as well as provide some form of screening from the proposed development. In addition, tall exotic trees may effectively screen the proposed development from farmhouses, where these trees occur in close proximity to the farmhouse and are located directly in the way of views to the site.

### *6.13.3 Land Use*

The general lack of human habitation and associated human infrastructure, has an obvious impact on the sense of place, giving the area a largely natural, rural feel (**Figure 31**). The pastoral elements which are present in parts of the study area, especially where sheep farming is taking place, are however expected to give the surrounding area a more pastoral feel.

**Figure 31:** Typical natural or rural visual character found within the study area

The influence of the level of human transformation on the visual character of the area is described in more detail below.

*6.13.4 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 including buildings, roads and other objects such as telephone or electrical infrastructure.

The majority of the study area is considered to have a natural (almost vacant) visual character as natural shrub land prevails throughout the site and there is minimal human habitation and associated infrastructure. In addition, the predominant land use (sheep farming) has not transformed the natural landscape and the area has thus largely retained its natural rural character. It should however be noted that the study area is also characterised by the presence of certain pastoral elements, which are expected to give the surrounding area a more pastoral feel. As mentioned above, built infrastructure within the proposed site is limited to isolated farmhouses, gravel farm roads and farm boundary fences. In addition, quarrying activities are taking place on the eastern edge of 'Konnes se Pan', which is located to the north-east of the proposed !Xha Boom Wind Farm application site. This pan is however located outside of the visual assessment zone and as such, the quarrying activities are also taking place outside of the visual assessment zone. There is therefore there no significant instance of transformation in the study area.

The relatively low density of human transformation throughout the surrounding area is an important component contributing to the largely natural visual character of the study area. This is important in the context of potential visual impacts associated with the proposed development of a wind farm as introducing this type of development could be considered to be a degrading factor in this context.

It should however be noted that several renewable energy facilities (solar and wind) are proposed within relatively close proximity to the proposed wind farm. These facilities and their associated infrastructure typically consist of very large structures which are highly visible. As such, these facilities 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. The Loeriesfontein Wind Farm can be found approximately 29km to the east of the proposed !Xha Boom Wind Farm application site and is currently operational (**Figure 32**). This wind farm is however located outside of the visual assessment zone and is therefore not expected to alter the visual character of the study area.

**Figure 32:** View of the Loeriesfontein Wind Farm which has been constructed approximately 29km to the east of the proposed !Xha Boom Wind Farm application site. This wind farm is however located outside of

the visual assessment zone and is shown here as a representation of what the visual character of the proposed Wind Farm will look like once construction is completed.

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, and the promotion of tourism in this little visited, but large part of South Africa. 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). Although the small town of Loeriesfontein may be used by tourists as a stop-over destination, the proposed wind farm is located approximately 68km to the north of the town and would therefore not influence these visitors. None of the roads passing near the proposed development are considered to be tourism routes.

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):

- "a landscape designed and created intentionally by man";
- an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
- 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 Karoo towns, such as Loeriesfontein, 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.

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 proposed development of a wind farm 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.

### *6.13.5 Visual Sensitivity*

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 receptors, and the likely value judgements of these receptors 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 17**), the visual sensitivity of the area is broken up into a number of categories, as described below:

i) **High** - The introduction of a new development such as a wind farm would be likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptors
- **Moderate** - Presence of receptors, but due to the nature of the existing visual character of the area and likely value judgements of receptors, 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 17:** 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 receptors | | | | | | | | | | |
| 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' for this specific aspect 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 due to the relatively uninhabited character of the area. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. As described below, very few potentially sensitive receptors are present in the study area. Although no formal protected areas or leisure / nature-based tourism activities exist within the study area, the area would still be valued as a typical Karoo cultural landscape.

As previously mentioned, the Loeriesfontein Wind Farm can be found approximately 22km to the south-east of the proposed Graskoppies Wind Farm application site and is currently operational. This wind farm is however located outside of the visual assessment zone and is not expected to alter the visual character of the study area. Other renewable energy facilities (solar and wind) are however proposed and/or being constructed within relatively close proximity to the proposed project. As such, an assessment of the cumulative impact that will be experienced from each potentially sensitive receptor has been undertaken (**Section 7** of the Visual Impact Assessment Report).

### *6.13.6 Visually Sensitive Areas on the Site*

During the scoping phase, all project specialists were requested to indicate environmentally sensitive areas within the application site. This exercise was undertaken to assist with determining the final placement and micro-siting the turbine layout within the site.

The aim of the assessment was to identify those parts of the application site where the establishment of wind turbines or other associated infrastructure would result in the greatest probability of visual impacts on potentially sensitive visual receptors, and should be precluded from the proposed development i.e. areas within the application site that should be avoided.

Different spatial characteristics were utilised to identify the visually sensitive areas within the proposed application site. In order to reduce the direct visual impact of the proposed turbines (especially those impacts related to shadow flicker), a buffer of 500m was recommended around all farmsteads located on or near the proposed development site. These buffers should be treated as exclusion zones in which no infrastructure, in particular turbines, should be allowed to be developed. This is done in order to prevent the impact of shadow flicker on people residing at the farmsteads. For more details regarding this impact refer to **Section 4.1.1** of the Visual Impact Assessment Report.

It should be noted that a 500m buffer zone will typically be applied to any sensitive or potentially sensitive visual receptors identified within the proposed wind farm development area. However, it must be noted that Mainstream applies a 1km buffer which is preferable. Within this part of the development area the establishment of wind turbines or other associated infrastructure would result in the greatest probability of visual impacts (especially the impact of shadow flicker) on potentially sensitive visual receptors. These areas within the proposed development area should therefore be avoided. However, based on the findings of the field-based investigation, no sensitive or potentially sensitive visual receptors were identified within or within close enough proximity to the proposed !Xha Boom Wind Farm development area or application site. As such, the 1km buffer zone was not applied for the proposed !Xha Boom Wind Farm and thus the proposed development is not expected to have any on-site visually sensitive areas.

#### *6.13.7 Sensitive Visual Receptors*

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 wind farm into a 'view', which may affect the 'sense of place'. The identification of sensitive receptors 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 receptor location and a sensitive receptor location. A 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. Receptor locations include 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 residential dwellings in natural settings.

Distance bands were used to assign zones of visual impact from the proposed development site, as the visibility of the development would diminish exponentially over distance (refer to section 2.4 above). As such, the proposed development would be more visible to receptors located within a short distance and these would experience a higher adverse visual impact than those located at a moderate or long distance from the proposed development.

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)

A total number of four (4) scattered farmsteads / homesteads which house the local farmers as well as their farm workers were identified within the study area. 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. The degree of visual impact experienced will vary from one inhabitant 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).
- Degree to which the viewer will accept a change in the typical Karoo character of the surrounding area.

As far as possible, each potentially sensitive visual receptor that was identified via desktop means was visited to determine the current use of the facility and rate the impact of the proposed development from the location. As mentioned above, four (4) potentially sensitive visual receptors were identified within the study area. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area.

**Table 18** below provides details of the potentially sensitive places that have cultural and symbolic importance that were identified within the study area.

It should be noted that a few of the farmsteads / homesteads identified during the scoping phase were excluded as potentially sensitive receptor locations for the purposes of this EIA phase study as it was discovered during the time of the site visit that these were uninhabited and/or abandoned. No further assessment was thus undertaken from these abandoned farmsteads / homesteads as no visual impact will be experienced from these locations. However, the Noise Specialist (with the Public Participation Practitioner's advice) has identified several receptors which the initial VIA did not identify (De Jager, 2017). As such, the applicable noise receptors have been included in this VIA in order to ensure consistency with the findings of the noise report.

**Table 18:** Visual receptor locations potentially sensitive to the proposed !Xha Boom Wind Farm

| Name | | Distance from the proposed !Xha Boom Wind Farm buildable area | Visual Impact Zone |
|---|---|---|---|
| *VR5 | Farmstead/Homestead | Approximately 7.7km | Low |
| ** VR 13 | Farmstead/Homestead | Approximately 0.9km | High |
| ***VR 18 | Farmstead/Homestead | Approximately 1.6km | High |
| ****VR 44 | Farmstead/Homestead | Approximately 5.7km | Low |

**According to the Noise Specialist, it was confirmed that this farmstead / homestead is only occupied by the owner (Mr. Nico Louw) in summer time (lambing period) and for a weekend at a time (De Jager, 2017).*

***This farmstead / homestead was identified by the Noise Specialist as a noise receptor which will be affected by the proposed development. This farmstead / homestead was however initially eliminated as a potentially sensitive visual receptor for this VIA as this receptor appeared to be unoccupied during the time of the site visit. According to the Noise Specialist, this receptor was confirmed as a house which is only used sporadically and usually only for one night. There is also single room present for a shepherd (De Jager, 2017). As such, this receptor has been included in this VIA in order to ensure consistency with the findings of the noise report.*

*****This farmstead / homestead was identified by the Noise Specialist as a noise receptor which will be affected by the proposed development. This farmstead/homestead was however initially eliminated as a potentially sensitive visual receptor for this VIA as it did not appear to be a farmstead / homestead during the time of the site visit. According to the Noise Specialist, this receptor was confirmed as a farmstead / homestead which is owned by a Mr Kallie van Zyl (De Jager, 2017). No further information was however provided with regards to this receptor. As such, this receptor has been included in this VIA in order to ensure consistency with the findings of the noise report.*

*****This farmstead / homestead was identified by the Noise Specialist as a noise receptor which will be affected by the proposed development. This farmstead / homestead was however not identified as a potentially sensitive visual receptor for this VIA as it was accidentally overlooked. According to the Noise Specialist, this receptor was confirmed as a farmstead / homestead which is owned by a Mr Christo van der Merwe. The status of this farmstead / homestead is however unknown (De Jager, 2017). As such, this receptor has been included in this VIA in order to ensure consistency with the findings of the noise report.*

There are no main or arterial roads in close enough proximity to the proposed development to be visually impacted by it. The district road that connects the town of Loeriesfontein with Granaatboskolk to the north, is some 4kms north-east of the study area and therefore well outside the visual impact zone (**Figure 33**). As such, there are no visually sensitive roads within the study area. However, the district road that connects the town of Loeriesfontein with the R358 Regional Road to the west of the site, traverses the south-western section of the visual assessment zone and is therefore found within the visual impact zone. Despite the presence of this district road, there are no visually sensitive roads within the study area.

**Figure 33:** View of the district road that connects the town of Loeriesfontein with Granaatboskolk to the north. This district road is however found well outside the visual impact zone.

The potentially sensitive visual receptor locations in relation to the zones of visual impact are indicated in **Figure 34** below.

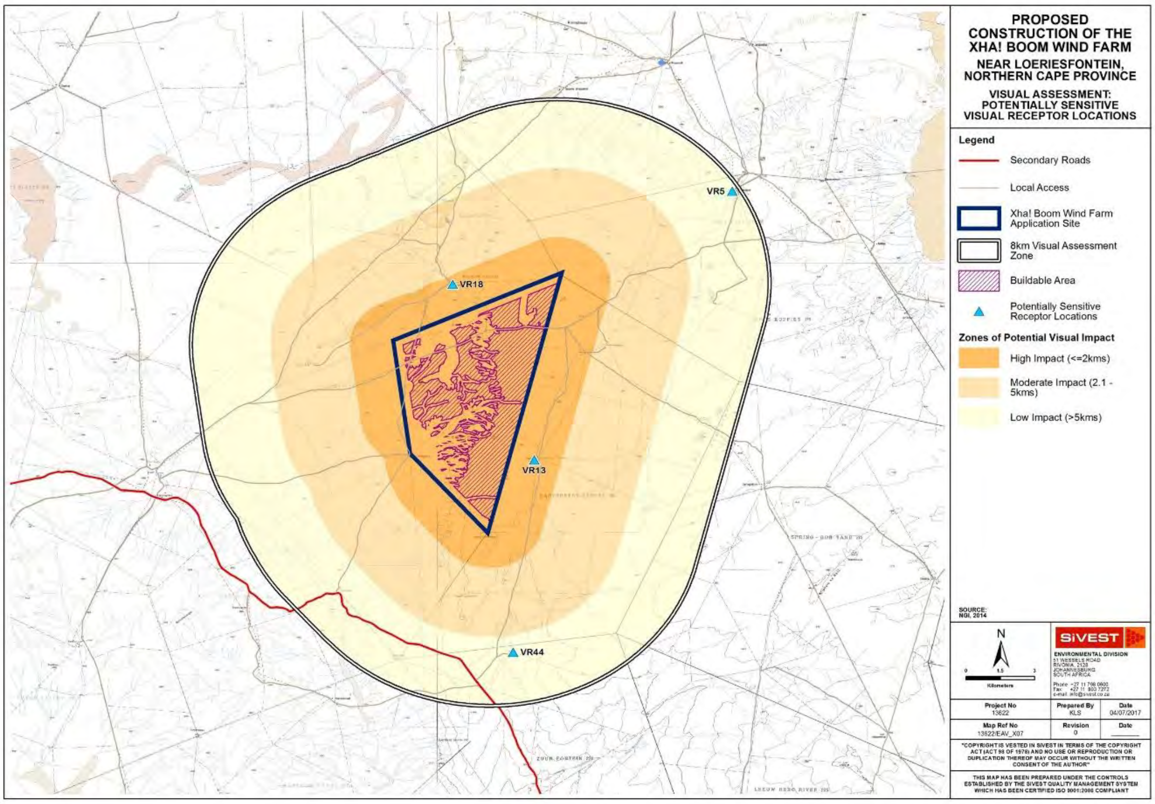



**Figure 34:** Potentially Sensitive Visual Receptors within the study area

## 6.14 Heritage and Palaeontology

The Heritage Assessment was conducted by Wouter Fourie of PGS Heritage. The full report is included in **Appendix 6H**. The environmental baseline from a heritage perspective is presented below.

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an Internet literature search was conducted and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

Researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that a number of other archaeological or historical studies have been performed within the wider vicinity of the study area.

### *6.14.1 Findings from the studies*

- **<u>Palaeontology</u>**

The following section has been compiled by Elize Butler for PGS Heritage. The full report can be viewed in **Appendix D** of the Heritage Specialist Report.

The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian basinal rocks of the lower part of the Ecca Group (Karoo Supergroup). They are assigned to the Prince Albert Formation, Whitehill Formation and Tierberg Formation in order of decreasing age. The Ecca Group were laid down within the marine to freshwater Ecca Sea.

These mudrocks are generally weathered, and creates landscapes of low relief. The Ecca Group sediments, particularly the Whitehill Formation, are intruded by Early Jurassic (183 ± 2 Million years old) igneous intrusions of the Karoo Dolerite Suite (Duncan & Marsh 2006). The basic sills thermally metamorphosed or baked the adjacent Ecca country rocks. In many areas the Permian and Jurassic bedrocks are mantled with a variety of superficial deposits, most of which is probably of Late Caenozoic (Quaternary to Recent) age. This include doleritic surface rubble, gravelly to silty river alluvium and pan sediments and small patches of aeolian (i.e. wind-blown) sands. The intrusive Karoo dolerites are of no direct palaeontological significance and the Late Caenozoic superficial deposits are generally of very low palaeontological sensitivity.

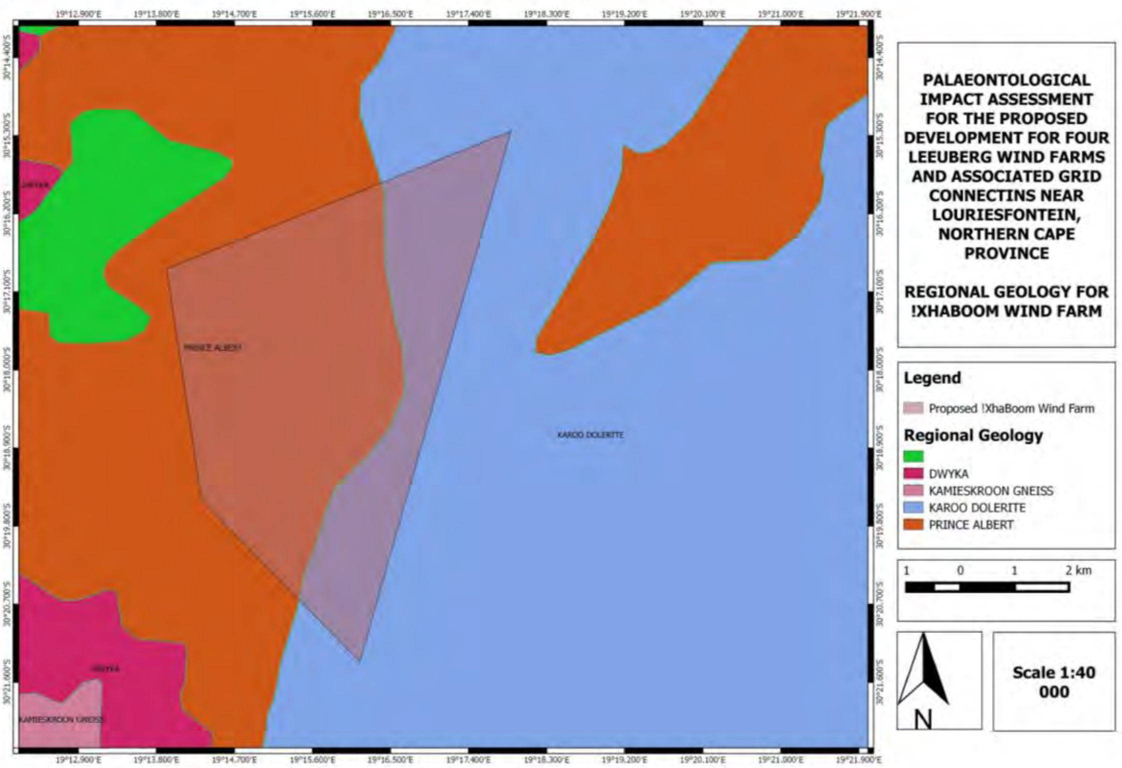



**Figure 35:** The surface geology of the proposed !Xha Boom Wind Farm near Loeriesfontein in the Northern Cape Province. The development footprint is underlain by Karoo Dolerite as well as the Prince Albert and Whitehill Formations of the Ecca Group.

- **Archaeology**

Although a study conducted by Morris (2007) have indicated minimal finds of archaeological sites in the vicinity of the upgrade of Loop 7A of the Sishen-Saldanha ore line to the north of the study area, discussions with local framers have indicated the occurrence of some archaeological sites.

Morris (2010) notes that previous studies have indicated that substantial MSA scatters is fairly uncommon in the Bushmanland/Namaqualand areas. While herder sites where more limited to sheltered and dune areas close to water sources such as pans and rivers.

The HIA's (Fourie, 2011; Van Schalkwyk, 2011; Webley & Halkett, 2012 and Orton, 2014) and the AIA's (Morris, 2007; Van der Walt, 2012 and Morris, 2013), have added to the body of work conducted in the area since the observations of Beaumont et al. (1995), that "thousands of square kilometres of Bushmanland area covered by a low density lithic scatter".

Orton (2014) notes that previous studies in the vicinity of the current study area, have found and assessed archaeological material dating to the early (ESA), Middel (MSA) and Later (LSA) Stone Ages.

### *6.14.2 Historical structures and history*

The farm Georg's Vley 217 was surveyed and proclaimed in 1880. No structures are indicated on the original survey diagrams.

### *6.14.3 Heritage sensitivities*

The evaluation of the possible heritage resource finds and their heritage significance linked to mitigation requirements was linked to types of landscape. The heritage sensitivity rating does not indicate no-go areas but the possibility of finding heritage significant site that could require mitigation work.

### *6.14.4 Possible finds*

Evaluation of aerial photography has indicated that certain areas may be sensitive from an archaeological perspective. The analysis of the studies conducted in the area assisted in the development of the following landform type to heritage find matrix in **Table 19**.

**Table 19:** Landform to heritage matrix

| LAND FROM TYPE | HERITAGE TYPE |
|---|---|
| Crest and foot hill | LSA and MSA scatters |
| Crest of small hills | Small LSA sites – scatters of stone artefacts, ostrich eggshell, pottery and beads |
| Pans | Dense LSA sites |
| Outcrops | Occupation sites dating to LSA |
| Farmsteads | Historical archaeological material |

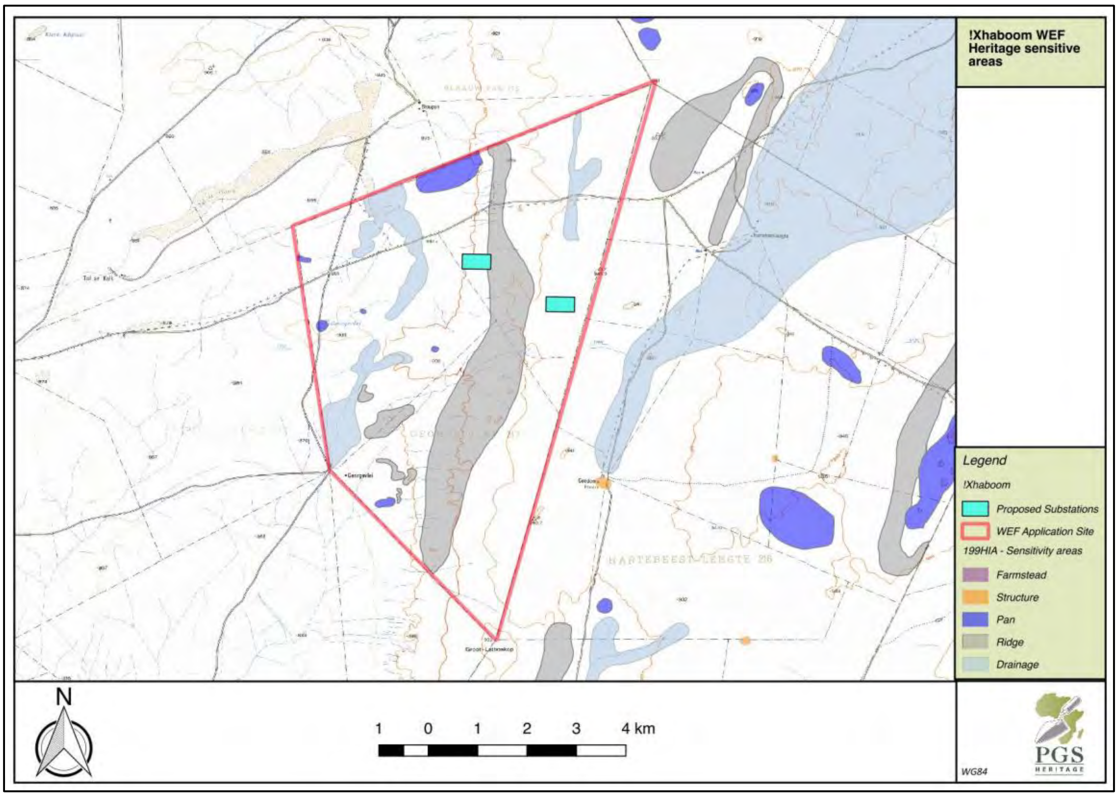



**Figure 36:** Possible heritage sensitive areas

## 6.15 Socio-economic Environment

The Socio-economic Assessment was conducted by Zimkita Nkata and Elena Broughton of Urban-Econ Development Economists. The full report is included in **Appendix 6I**. The environmental baseline from a socio-economic perspective is presented below.

### *6.15.1 Baseline Information*

This chapter examines key socio-economic characteristics of the study area, as per delineation provided in the previous chapter. This is essential as it provides both qualitative and quantitative data related to the communities and economies under observation, creating a baseline against which the impacts can be assessed. As previously mentioned, the proposed wind farm project is located in within the Hantam LM and in close proximity to the border of Khai-Ma LM which both fall under the Namakwa DM.

- **Spatial Context and Regional Linkages**

Geographically, the **Northern Cape** is the largest province located within South Africa with an area of 372 889km$^2$ equating to approximately 30.6% of South Africa's spatial composition. Despite having the largest surface area, the Northern Cape is the least populated province in South Africa with a population of 1.1 million people equating to 2.2% of the national population (Stats SA, 2011). This province is a dry and hot region classified as a semi-desert as it also experiences scarce rainfall patterns. The Northern Cape Province consists of five districts, namely Frances Baard, Pixley ka Seme, Namakwa, ZF Mgcawu (previously known as Siyanda) and John Taolo Gaetsewe.

The proposed project falls within the **Namakwa DM** which is situated on the western part of the Northern Cape Province and is the largest municipality of the five main municipal districts of the Province covering an area of 126 900km$^2$ (34%) of the total provincial landmass. The Namakwa DM is bordered by the Western Cape province on the southern side, Namibia towards the northern side and two districts (ZF Mgcawu and Pixley ka Seme) on the north-east and east side respectively. Although it is the largest district geographically, the Namakwa DM is sparsely populated with a population of 115 842 people, which comprise 10.11% of the total province population (Stats SA, 2011).

In the Namakwa DM, the project lies within the borders of the Hantam LM and the Khai-Ma LM. The **Hantam LM** is an inland municipality which lies on the west of the Namakwa DM and is located 140km from Springbok. The Hantam LM covers an area of 36 128km$^2$ and has a population of 21 581 people (Stats SA, 2011). The municipality is known for its wide open space, striking mountain ranges and nature reserves filled with a vast array of indigenous plants and bulbs (Hantam IDP, 2015). The main attractions of the area are therefore, the floral displays, hiking and the natural environment. Hantam municipality is also furnished with four conservation areas, namely Oorlogskloof Nature Reserve, Hantam National Botanical Gardens, Tankwa Karoo National Park and the Akkerdam Nature Reserve (Umsebe Development Planners, 2010).

With a total surface area of 16 627km$^2$, the **Khai-Ma LM** is situated along the north-western part of the Namakwa DM and is a sparsely populated region with 12 466 people. The Khai-Ma LM is bordered by Namibia on the north, the ZF Mgcawu LM on the east and, the Nama-Khoi LM on the west. Urban nodes surrounding the local municipality include Pofadder as the main centre, Aggeneys, Pella, Witbank and Onseepkans. Although the surrounding area of the region has a low grazing potential, vast amounts of extensive land in Khai-Ma is predominantly used for livestock farming (Umsebe Development Planners, 2010).

#### *6.15.2 Sense of Place, History and Cultural Aspects*

**Loeriesfontein** is a small rural service centre town that lies within a basin surrounded by mountains and is situated to the north-west of the town of Calvinia. Loeriesfontein was built around a general store in the year 1894 by a British bible salesman, Frederick Turner (Hantam IDP, 2015). Loeriesfontein has a population of 2 746 people which has grown by 12.4% since the year 2001. The town covers a total surface area of 34.45km$^2$ and has a population density of 80 people/km2 (Stats SA, 2011).

The south-western part of Loeriesfontein forms part of Namaqualand which is a region popular for its spring flowers and its wide variety of diverse vegetation (Hantam IDP, 2015). Loeriesfontein town also houses the Gannabos (Quiver) Forest, which is home to the worlds' largest colony of the *Aloe Dichotoma* species (Umsebe Development Planners, 2010). During spring, the town is flooded by tourists attracted by the spring flowers. The town also boasts of its' Windmill museum, which is one of only two in the world. Sheep farming and salt mining are the predominant activities within and around Loeriesfontein town (Umsebe Development Planners, 2010).

### *6.15.3 Demographic Profile*

- **Population demographics**

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

As previously noted, the **Hantam LM** has a population of 21 581 individuals, this accounts for 18.6% of the total population of Namakwa DM. In comparison to the year 2001, the Hantam LM has increased by 6.6%. Within the local municipality, 80% of the people reside in urban areas whilst the rest occupy farms. In total, the Hantam LM has 6 341 households with a household density of 0.14km$^2$ (Stats SA, 2011). The majority of the people in the Hantam LM reside in the city centre, which is Calvinia town; thus, only a small percentage of people reside in other smaller surrounding towns such as Loeriesfontein (13%) (Stats SA, 2011). Over 90% of the residents in the municipality as well as the nearby towns (Loeriesfontein and Brandvlei) speak Afrikaans as a first language, with the dominant race being coloured people (82%) and white people lagging behind at 11%. The Hantam LM's population consists of 50.1% males and 49.9% females. The largest group of people fall under those aged between 35 and 64 years of age. In this LM, the youth (15-34 years) encompass about 29.1% of the total population. Only 28% of Hantam residents are married, whilst 54% have never been married (Stats SA, 2011).

Loeriesfontein, the closest town to the project site, only has 806 households in total resulting in a household density of 23.3 km$^2$. The majority (94.3%) of people have access to formal housing whilst the rest either live in houses or flats in a backyard (0.87%) or in informal dwellings (4.12%). A huge portion of people living in Loeriesfontein are coloured (86%), followed by white people at 11.54% whilst Black people equate to 1.9% of the total population. Afrikaans is the main language spoken as more than 90% of the people cited it as their first language, only 0.4% residents speak English whilst 0.5% speak Setswana (Stats SA, 2011). Only 26.5% residents are married, whilst 56.9% have never married.

Although Loeriesfontein is a relatively small town, residents and farm owners stated that since the establishment of similar projects in the area, namely Khobab and Loeriesfontein 2, the town has experienced and influx of people either in an attempt to find employment or to seize economic opportunities brought by the wind farms.

The **Khai-Ma LM** on the other hand, has a smaller population of 12 466 people; this accounts for 10.7% of the total population of the Namakwa DM. Although the population has increased by 6.2% from 11 692 people in 2001, it is still only almost two thirds of the Hantam population (Stats SA, 2011). Most residents within Khai-Ma LM reside in the urban areas (81%) whilst some reside in farms (17%). The total number of households in the Khai-Ma LM is 3 796 resulting in a household density of 0.22km$^2$. Just over 80% of the residents speak Afrikaans in the municipality (Stats SA, 2011). Coloured people equate to three quarters of the total population with black people (18%) being the second dominant race. Only 24% of the Khai-Ma

LM residents are married whilst 64% have never been married. In like manner with the Hantam LM, the Khai-Ma LM has more males (52.6%) than females (47.4%) with the largest population also falling within 35 and 64 years of age. Although this is the case, this local municipality however, has a youth population (15-34 years) that is just over a third (36.8%) of the total population (Stats SA, 2011).

- **Health Demographics**

The process of assessing and monitoring the level of health in a particular area is beneficial as it provides useful information on the development as well as human welfare of an area. Over the last 15 years, in comparison to the rest of South Africa and the Northern Cape Province, the effect of HIV has been less severe on the DM and LM's. AIDS related deaths have also been following a similar pattern.

In the year 2015, the **Hantam LM** reported a total of 956 people to be living with HIV, which equates to 4.5% of the total LM population. Although the number of HIV-positive people for the Namakwa DM (4.9%) is close to that of the LM (4.5%), national and provincial HIV infected percentage levels are much higher, as they are at 11.4% and 7.3%, respectively.

**Table 20:** Population, HIV positive, AIDS and other deaths (2015)

| Indicator | South Africa | Northern Cape | Namakwa DM | Hantam LM | Khai-Ma LM |
|---|---|---|---|---|---|
| Population | 54 956 509 | 1 175 780 | 116 834 | 21 371 | 11 805 |
| HIV positive | 6 248 908 | 86 146 | 5 702 | 956 | 673 |
| AIDS deaths | 206 761 | 2 360 | 113 | 20 | 7 |
| Other deaths | 444 866 | 9 729 | 1 159 | 213 | 98 |

The **Khai-Ma LM** had a slightly higher percentage of people living with HIV (5.7%). AIDS related deaths at the national, provincial, regional and local context are relatively low as they range from a range of 0.1%-0.4%. In a period of 15 years (2000-2015), people living with the HIV illness in the Hantam LM had increased by 695 people whilst residents living in the Khai-Ma LM with the same illness increased by 463 within the same period.

Although the prevalence of HIV/Aids in **Loeriesfontein town** is not clear, during the site visit and interviews conducted with various stakeholders it was revealed that construction workers employed to develop wind farms in the area, namely Khobab and Loeriesfontein 2, mingle with young females and this has since resulted in a sharp increase in the rate of teenage pregnancies. The presence of construction workers in the area has also increased a number of social ills such as the use of alcohol and drug abuse. Although many of the residents agree that this has always been a norm in the town, many alluded to the fact that the social ills have exacerbated in the last few years correlating with the period of establishment of the two wind farms. One such example is the increase in the number of liquor licenses applied for, as well as an increase in the number of young school girls who interact with construction workers resulting in unwanted pregnancies.

- **Crime Demographics**

In the **Hantam LM**, 816 serious crimes were reported; of these, a total amount of 760 were community reported crimes whilst 56 of them were detected by the police. Common assault was the most frequently reported crime with 207 cases, followed by property-related crime with 154 cases and assault with the intention to harm with 125 cases. The total number of serious crimes equate to 17% of the district reported crimes and 1.41% of the provincial reported crime cases. Although the use the alcohol and drugs have increased in Loeriesfontein town, crime levels have been stable and have not resulted in any criminal activities that can be directly linked to the heavy influx of people.

In 2015, the **Khai-Ma** LM had less crime-related occurrences, as only a total of 285 serious crimes were reported. The most commonly reported crimes are similar to trends noted in the Hantam LM but are at less severe rates with common assault reported to have had 69 cases, property related crime with 52 cases and assault with the intent to harm with 46 cases. Crimes reported in Khai-Ma LM equate to 6% of the cases reported at the district level and only 0.5% of the provincial reported crimes.

**Table 21:** Crimes reported by crime type (2015)

| Types of crime | South Africa | Northern Cape | Namakwa DM | Hantam LM | Khai-Ma LM |
|---|---|---|---|---|---|
| Serious crimes | 2209068 | 57817 | 4782 | 816 | 285 |
| Community reported crimes | 2068261 | 54724 | 4212 | 760 | 255 |
| Crimes dependent on police action for detection | 140807 | 3093 | 570 | 56 | 30 |

### *6.15.4 Economy*

The structure of the economy and the composition of its employment provide valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector is also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The **Hantam LM** is a relatively small economy that is valued at R1 184 million in current prices. In total, the economy of the Hantam LM equates to 11.1% of the Namakwa Districts Gross Domestic Product per Region (GDP-R) which was valued at R10 696 million in current prices (Quantec, 2016). The contribution of the LM to the Province as a whole is significantly low as it only accounts for 1.64% of the Northern Cape Province. The Hantam LM economy has been manifesting a fluctuating growth rate revealing its sensitivity to external shocks related to national and global changes. For instance, the Hantam economy was adversely affected by the 2008 global recession (Quantec, 2016). Although this was the case, the economy began slowly recovering between the 2010-2011 period. Overall, between the 1995-2011 period, the Hantam LM economy grew at a Compounded Annual Growth Rate (CAGR) of 3.19%.

The economy of the **Khai-Ma LM** lags behind the Hantam economy with a total size of R939 million in current prices (Quantec, 2016). This contribution accounts for 8.8% of the districts economy and 1.3% of the Province economy. The Khai-Ma LM experienced similar growth patterns with Hantam, as it experienced stagnation in the year 2009 after the global recession and began recovering shortly after. At current prices, the 20-year period (1995-2011) CAGR for Khai-Ma LM equates to 2.44%.

According to the Hantam LED Framework (2011), economic development ought to be sustainable. Ensuring that it is sustainable entails strengthening and diversifying the economy through a range of sectors such as the primary, secondary and tertiary sector which should cater for all consumer and business needs. Due to the fact that 72% of the GDP-R of the **Hantam LM** is generated by the tertiary sector, this LM is a service economy with prominent sub-sectors such as general government (13%), transport and communication (16%) as well as wholesale, retail and trade (25%). A contributing factor to this is mostly likely the numerous government departments that are situated in Calvinia town as it serves as the main seat and administrative town of the Hantam LM (Hantam IDP, 2015). On the other end of the spectrum, within the primary sector, agriculture is the main contributor to GDP-R as it equates to 18% of the Hantam economy.

Although the mining industry currently has a very low contribution to the economy, 80% of the worlds' gypsum reserves lie just outside Loeriesfontein town; thus, an opportunity exists for salt and gypsum mining in the region as salt pans at Dwaggas Pit also employ 30 permanent workers (Umsebe Development Planners, 2010).

Since the start of the construction of Khobab and Loeriesfontein 2 wind farms, the informal hospitality industry in the town of Loeriesfontein has boomed as construction workers have been in need for accommodation in town thus majority of town. In order to meet the increased demand in accommodation, the majority of the town residents have transformed their backyards and availed their garages for rent purposes. In conjunction with the 20-year old wind museum in the town, the recently established wind farms have also added value to the tourism component of the area. Due to the influx of people in the town, the economic impact has been positive for the town as a result of this; food and fuel sales have spiraled increasing businesses' gross revenues and profits in an unprecedented manner. Further positive investments are expected to trickle down to the Loeriesfontein community when the surrounding wind farms break even (after 9 years) and 5% of the generated profits will be invested in the community.

In the **Khai-Ma LM,** the primary sector contributes the highest percentage (67%) to the municipal GDP-R. Within the primary sector, mining and quarrying is the prominent industry with a contribution of 51%, whilst the agriculture industry contributes 15% to the overall economy. The high percentage contribution of the mining industry is most likely due to the presence of various minerals within the municipal area such as zinc, copper, lead, granite and quartz (Umsebe Development Planners, 2010). Mining activity is thus exacerbated by the existence of the Black Mountain mine in Aggeneys town as well as the gypsum mine in Pofadder town. The second contributor to the GDP-R of the Khai-Ma LM is the tertiary sector with a contribution of 28%. Within the tertiary sector, the most imminent industries are general government (10%), transport and communication (6%) as well as wholesale and retail trade, catering and accommodation (6%).

### *6.15.5 Labour Force and Employment Structure*

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 profile.

- **Labour force composition**

During the year 2011, the total working population of the **Hantam LM** consisted of 13 680 people, within this figure, the total labour force only equated to 7 004 people. As outlined in **Table 22** below, a percentage of 3.4% of people are described as discouraged job seekers, which typically refers to a group of people who are capable of searching for employment but have become discouraged and are no longer looking for employment. The difference between the number of people employed (6 122) and unemployed (882) in the region results in an unemployment rate of 12.6%, which is relatively low in comparison to the national and provincial unemployment rates (29.7% and 27.4%), respectively. Within the Hantam region, Loeriesfontein town has a slightly higher unemployment rate of 14.7% (Stats SA, 2011).

Although only 100-150 local residents are currently employed by the nearby wind farms, the impact of increased employment levels in **Loeriesfontein** has been significant; this is so because in the past the town was heavily reliant on income from extensive farming. However, in the event that agricultural farms undergo expansion, employment levels usually remain the same as farming in the area largely comprises of livestock farming, which is not very labour-intensive. However, with that being said, the prevalence of drug abuse has restricted the number of locals that can be employed as the impact of the drugs is said to result in a lack of personal motivation.

In the **Khai-Ma LM**, the total working population consisted of 8 541 people with a labour force equating to 5 889 people. In 2011, about 4% of people were recorded as discouraged jobseekers. The Khai-Ma LM has a relatively higher unemployment rate of 20.9% (Stats SA, 2011).

**Table 22:** National, Provincial & Regional Labour Force Profile

| **Town / settlement** | **Working age** | **Labour force** | | | **Discouraged job seekers** | **Unemployment rate** |
|---|---|---|---|---|---|---|
| | | Employed | Unemployed | Total | | |
| South Africa | 33928806 | 13254829 | 5586624 | 18841453 | 1848720 | 29,7% |
| Northern Cape | 736205 | 284202 | 107379 | 391581 | 40170 | 27,4% |
| Namakwa DM | 76579 | 33713 | 8455 | 42168 | 4258 | 20,1% |
| Hantam LM | 13860 | 6122 | 882 | 7004 | 475 | 12,6% |
| Loeriesfontein | 1767 | 680 | 117 | 797 | 33 | 14,7% |
| Khai-Ma LM | 8541 | 4660 | 1229 | 5889 | 327 | 20,9% |

- **Employment structure**

Within the working age population (15-64 years) of the **Hantam LM**, about 60% of the individuals are employed in the formal sector whilst 21% are employed in the informal sector (Stats SA, 2011). Employment opportunities provided by private households equate to approximately 17% of the Hantam working population. Within the Hantam LM, Loeriesfontein town employed the least people in the formal sector resulting in it being the dominant job creator in the informal sector. In the **Khai-Ma LM**, more employment is offered in the formal sector whilst only a minority of people work in the informal sector. Similar patterns can be observed for the provision of employment by private households within the LM as well as the towns.

Within the formal sector, only 14% of people of the Hantam LM's working population are considered to be skilled, whilst majority (30%) of the people either occupy jobs that require semi-skilled or low-skilled individuals. The rest of the working population (27%) are employed in the informal sector. In the Khai-Ma LM, very few individuals (10%) within the working population are considered skilled. Instead, similar to the Hantam LM, majority of people are semi-skilled and lowly-skilled (Quantec, 2016). Twenty percent (20%) of the people within the LM are occupied in the informal sector. As it can be noted in **Table 23** below, employment percentages by skill level for the Local Municipalities (Hantam and Khai-Ma) are relatively similar to the districts skill level percentages.

**Table 23:** Employment sector and compensation by skill level (2015)

| **Skills** | **Employment sector & compensation by skill level** | | | | | |
|---|---|---|---|---|---|---|
| | **Namakwa DM** | | **Hantam LM** | | **Khai-Ma LM** | |
| | Employment | % | Employment | % | Employment | % |
| Formal: skilled | 5092 | 14% | 987 | 14% | 446 | 10% |
| Formal: Semi-skilled | 11151 | 32% | 2004 | 29% | 1613 | 36% |
| Formal: Low-skilled | 9917 | 28% | 2077 | 30% | 1536 | 34% |
| Informal | 8962 | 26% | 1849 | 27% | 879 | 20% |

**(Quantec, 2016)**

In the Hantam LM, the tertiary sector is the largest contributor to formal and informal employment with 60% share of all employment provided in the municipality. As depicted in **Table 24** below, such employment consists of opportunities working in wholesale and trade (18%), finance and business services (7%), general government (17%) as well as community, social and personal services with 15%. Although the Hantam LM is dominated by the services sector, within the primary sector, agriculture employs the largest number of people (29%). The secondary sector makes very little contribution to employment services as it only accounts for 10% of the Hantam working population.

In contrast, the Khai-Ma LM is dominated by the primary sector, equating to 54% of municipal working age population. Within this sector, half of the total employment within the municipality is provided by the agriculture industry. The tertiary sector is the second largest contributor to job creation in the Khai-Ma LM; within this sector, prominent industries include general government (12%) and wholesale and retail trade (12%). The secondary sector lags with a contribution of 10% to the working population.

**Table 24:** Employment by economic services (2015)

| **Economic sector** | **Employment by area** | | | | | |
|---|---|---|---|---|---|---|
| | **Namakwa DM** | | **Hantam LM** | | **Khai-Ma LM** | |
| | **Employment** | **%** | **Employment** | **%** | **Employment** | **%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Agriculture, Forestry & Fishing** | 7948 | 23% | 1972 | 29% | 2220 | 50% |
| **Mining and Quarrying** | 783 | 2% | 2 | 0% | 175 | 4% |
| **Manufacturing** | 1384 | 4% | 140 | 2% | 335 | 7% |
| **Electricity, gas & water** | 152 | 0% | 20 | 0% | 4 | 0% |
| **Construction** | 2760 | 8% | 564 | 8% | 114 | 3% |
| **Wholesale and retail trade, catering and accommodation** | 7016 | 20% | 1253 | 18% | 517 | 12% |
| **Transport, storage and communication** | 1138 | 3% | 218 | 3% | 64 | 1% |
| **Finance, insurance, real estate and business services** | 2689 | 8% | 493 | 7% | 178 | 4% |
| **General government** | 6269 | 18% | 1200 | 17% | 557 | 12% |
| **Community, social and personal services** | 4983 | 14% | 1055 | 15% | 310 | 7% |
| **Industry employment total** | **35122** | **100%** | **6917** | **100%** | **4474** | **100%** |

### *6.15.6 Income*

In order to improve the living standards of residents in terms of to the Minimum Living Level (MLL), which broadly refers to the minimum monthly income needed to sustain a household, the Khai-Ma SDF stipulates that a greater disposable income per household is required. Linked to this point, economic development is thus seen as an essential pathway to raising the living standards and general wellbeing of residents (Umsebe Development Planners, 2010).

The average household annual income in the **Hantam LM** is R116 276 in 2016 prices; this implies an average household monthly income of R9 690. The monthly income for Loeriesfontein is R10 620; these figures are relatively higher than the provincial average income, which is R8 521 per month. As highlighted in **Table 25** below, 9% of households do not have a regular amount of income in both the Hantam LM and Loeriesfontein town which in on par with the national and provincial levels, where the proportion of people who do not receive any form of income equated to 9% and 7% respectively. In the Hantam LM, 54% of people fell within the poverty line as they earned less than R3 200 per month.

The main source of income in the municipality is the agricultural sector; predominantly sheep farming and rooibos tea. The second largest income contributor is the community employment sector; particularly the social and personal services industry.

Subsequent to the establishment of wind farms in the area, new economic opportunities in **Loeriesfontein** town have emerged. Public transport has benefitted as a result of the increased demand for the transportation of workers to and from construction sites. Cleaning services have also provided work opportunities for unemployed individuals whilst informal trading amongst residents has also increased and has stimulated further income and job creation in the town. Wind farm construction companies either pay their workers once a month or every fortnight; this has resulted in more money in circulation as the purchasing power of local residents also increased. This is important as it may assist in reducing the number of people living below the poverty line. Upon consultation, one farmer went to the extent of sharing that poverty levels have been slightly alleviated in the Loeriesfontein town.

The average household annual income in the **Khai-Ma LM** was R99 144 in 2016 prices; this equated to an average household monthly income of R8 262. The main source of income in Khai-Ma is the Black Mountain Mine situated in Aggeneys town, as well as several government departments. Commercial farmers depend on incomes generated from their farms. The rest of the residents are either dependent on the government grant or they earn a living by providing housekeeping and gardening services (Umsebe Development Planners, 2010).

**Table 25:** Household per monthly income groups (2011)

| Indicator | Namakwa DM | Hantam LM | Loeriesfontein | Khai-Ma LM |
|---|---|---|---|---|
| No income | 8% | 9% | 9% | 5% |
| R1 – R3 200 | 54% | 57% | 61% | 62% |
| R3 201 – R6 400 | 14% | 12% | 12% | 10% |
| R6 401– R12 800 | 12% | 11% | 10% | 13% |
| R12 801– R25 600 | 7% | 6% | 4% | 6% |
| R25 601– R51 200 | 2% | 2% | 2% | 1% |
| >R51 200 | 4% | 3% | 3% | 2% |

**(Stats SA 2011)**

*6.15.7 Education*

The key characteristics of the education profile of the population in the analysed municipalities are presented below.

In terms of education levels in the **Hantam LM**, during the year 2011, 13.8% people living in the municipality did not have any form of schooling. This is worse than the provincial and national level, which were 6.3% and 11.1%, respectively. Thirty percent (30%) of the population acquired some form of secondary schooling but had not completed the full course. Only 7.7% of people continued on to further their studies by pursuing higher education. Amongst the nearby towns, in Loeriesfontein 15.2% people indicated that they had never been exposed to a school environment whilst 23.3% failed to complete primary school resulting in an even lower portion (15.4%) of people completing secondary school (Stats SA, 2011).

In the **Khai-Ma LM**, only 3.8% of the people did not have any form of schooling. Although the proportion of people without any form of schooling was relatively low in comparison to the Hantam LM, only 5.1% people furthered their studies in the form of higher education (Stats SA, 2011). This can be possibly be ascribed to the fact that there is no university in the Namakwa DM as well as the Northern Province, it is also highly unlikely for individuals who have obtained further education elsewhere to return to the region (Umsebe Development Planners, 2010). Another contributing factor to the low higher education levels in Khai-Ma could be due to the fact that 45% of the residents indicated that they had not completed their secondary studies which reduce the chances of being admitted in a higher institution of learning. The low percentage of individuals who have completed their studies in both municipalities also coincides with the abundance of semi- and low-skilled individuals working in the formal sector.

### *6.15.8 Access to Services and State of Local Built Environment*

Access to shelter, water, electricity, sanitation, and other services are indicators that assist to determine the standard of living of the people in the area under investigation. Infrastructure and the state of local infrastructure is another indicator to contemplate when considering living standards. The availability of social and economic infrastructure including roads, educational facilities, and health facilities further indicates the nature of the study area, which is valuable in developing a complete profile of the circumstances in which communities are living. These measurements create a baseline against, which the potential impacts of the proposed project can be assessed.

- **Settlement profile**

In comparison to the national population density (42 people/km$^2$), the Hantam LM is characterised by a low density of people per square km. It is also relatively lower than the district (0.91 people/ km$^2$) and provincial (3.07 people/ km$^2$) density. Although population densities for the LM are significantly low (0.59 people/ km$^2$), as outlined in **Table 26** below, Loeriesfontein town has a higher population density of 79.69 people/km$^2$ making it the most densely populated area between the three areas under analysis.

**Table 26:** Population density of Hantam and Khai Ma LM (2011)

| Indicator | Towns in the Hantam & Khai-Ma LM's | | |
|---|---|---|---|
| | **Hantam LM** | **Loeriesfontein** | **Khai-Ma LM** |
| Population total | 21581 | 2746 | 12466 |
| Area (Sq. Km) | 36128.07 | 34.45 | 16627.9 |
| Population density | 0.59 | 79.69 | 0.74 |

The Khai-Ma LM also has a relatively low population density with only 0.74 people/km$^2$, making it a sparsely populated region. Most people in the Khai-Ma LM are situated in the urban areas or in agricultural clusters along the Orange River, which also provides opportunities for water sport and recreation as well as resort development (Umsebe Development Planners, 2010).

- **Access to Housing and Basic Services**

With respect to basic service provision and housing, the Namakwa DM is responsible for assisting and ensuring that local municipalities provide adequate housing to inhabitants in their jurisdiction such. The current level of access to various basic services in the municipality are as follows:

- **Housing:** During the year 2011, housing shortages in the **Hantam LM** were an acute problem. In Hantam LM, 94% of houses had access to formal housing (i.e., a house made of brick or a concrete structure on a separate yard). Towns of the Hantam LM followed a similar path with Loeriesfontein having 94% access to formal housing (Stats SA, 2011). Amongst other pressing developments of the municipality, new housing unit developments have been identified by the Hantam SDF (Umsebe Development Planners, 2010). In comparison to the Hantam LM, the **Khai-Ma LM** residents had less access to formal housing as only 74% of inhabitants resided in formal housing structures (Stats SA, 2011).
- **Access to piped water**: In the **Hantam LM,** more than 90% of the households have access to piped water either inside their dwellings or yards. This includes residents living in Loeriesfontein town. More than 95% of water for the Hantam LM as well as for nearby towns is supplied by a regional or local water scheme operated by the municipality. In the **Khai-Ma LM**, more than 90% of households have access to piped water either in their dwellings or yards. A very low percentage of people do not have any type of access to piped water in the Khai-Ma LM.
- **Access to sanitation**: Although the Spatial Development Framework suggests that almost all households in the **Hantam LM** had access to flush toilets in 2011 (Umsebe Development Planners, 2010), statistics show that just over three quarters (76%) of households in Hantam LM have access to flush toilets either connected to the sewerage or to a septic tank. Whilst the Hantam LM believes to have eradicated the bucket system (Umsebe Development Planners, 2010), 3.1% of residents rely on the bucket latrine system whilst 0.9% do not have any form of access to any form of sanitation (Stats SA, 2011). Just over half of Loeriesfontein residents utilise flush toilets. The **Khai-Ma LM** has the same proportion of people who have access to flush toilets as the Hantam LM, with 6% of people who have no access to any type of sanitation.
- **Access to electricity:** In the **Hantam LM**, only urban areas are provided with electricity whilst the rural areas depend on other sources (Umsebe Development Planners, 2010). Slightly more than three quarters (77%) of households in the municipality have access to electricity for lighting whilst only 15% and 7% of people use candles and solar for lighting, respectively (Stats SA, 2011). Similar trends can be noted when assessing the towns of the municipality as more than 90% of Loeriesfontein town residents have access to electricity. One of the objectives of the municipality is to improve the living standards of its residents by implementing opportunities for bulk infrastructure development (Urban-Econ Development Economists, 2011). Although the SDF highlights electricity as one of the sectors experiencing backlogs in the **Khai-Ma LM**, 90% of households in the municipality use electricity for lighting whilst the rest use 7% candles and 2% use solar. Development objectives premised on the optimisation of resources relating to bulk infrastructure such as electricity remains a goal for the municipality (Umsebe Development Planners, 2010).

- **Transport Infrastructure**

The transport sector plays a vital role in meeting the objectives of economic development, access to employment opportunities and social infrastructure (Dennis Moss Partnership, 2012). As a result of this, industrial development ought to take the mode of transport utilised by the labour force of a particular region into consideration. This means that new economic developments should not be situated far from the pick-up or drop-off points of various means of transport (Urban-Econ Development Economists, 2011). In 2001, just over a third 36.8% of people in the Hantam LM travelled to work or school by foot. The rest of the people used public transport (4.92%) whilst others made use of bicycles (1.39%) and their own transport facilities (5.12%) (Stats SA, 2001). Using the R55 gravel road, the distance between Calvinia and Loeriesfontein is 86km, whilst travelling from Calvinia to Brandvlei requires the utilisation of the R27 tar surface road for approximately 2 hours and 30 minutes.

The **Hantam LM** is traversed by a number of regional roads and encompasses two transport corridors (Umsebe Development Planners, 2010):

- Nieuwoudtville – Calvinia - Williston corridor consisting of the R63 tar road and railway link among Calvinia, Williston and Carnarvon, which links Gauteng and the Western Cape
- Nieuwoudtville – Calvinia – Brandvlei -Kenhardt corridor consisting of the R27 tar road leading from Cape Town to Upington, which provides a shortcut alternative to the route via Springbok and is often used by trucks particularly during the grape season. Considering that this is the main route in the region, it is essential that this road is maintained as it is of economic importance to the area.

The **Khai-Ma** IDP places emphasis on the need for local communities to have adequate accessibility to services through the provision of sufficient transport infrastructure. Although the Khai-Ma LM recognises the need for sufficient transport facilities, about 30% of people walked home and either to and from work or school. The second most-utilised mode of transport is public transport in the form of buses, trains and taxis (Umsebe Development Planners, 2010).

- **<u>Social and Recreational Infrastructure</u>**

The **Hantam LM** has the following social and recreational infrastructure available:

- Three libraries in Calvinia, Loeriesfontein and Nieuwoudtville
- Five secondary schools in Calvinia, Loeriesfontein, Nieuwoudtville and Brandvlei
- Three hospitals in Calvinia, Loeriesfontein and Brandvlei
- Seven sport facilities in Calvinia and Loeriesfontein
- Nine religious centres in Loeriesfontein and Brandvlei

The **Khai-Ma LM** has the following social and recreational infrastructure available:

- Four primary and schools in Pofadder and Aggeneys
- Two clinics in Pofadder and Aggeneys
- Three police stations in Pofadder and Aggeneys

#### *6.15.9 Site Related Information*

- **<u>Land-use profile</u>**

The land earmarked for the potential development of the wind farm is currently used for agricultural purposes, specifically commercial sheep farming. In order to gain an understanding of the impact of the proposed development on the immediate zone of influence, in-person as well as telephonic interviews were conducted with farm owners to on understanding day to day farm operations, general demography of the affected farms as well as economical information based on the agricultural processes. The site is located approximately 75km away from the closest urban area and will be developed across the following farm portions (presented in **Table 27** below):

**Table 27:** Directly and indirectly affected farm portions across zone of influence

| Farm Portion | Farm Name | Farm no | Type |
|---|---|---|---|
| 2 | Georg's Vley | 217 | Directly affected |
| 1 | Hartebeest Leegte | 216 | Adjacent |
| Rem | Hartebeest Leegte | 216 | Adjacent |

Information obtained during in-person and well as telephonic interviews with the affected landowners is summarised below:

- <u>Portion 1 of Hartesbeest Leegte Farm No.216 (adjacent)</u>
  - **General information**
    - 5 100 hectares are used for commercial livestock (sheep) farming which is the main source of income
    - Type of sheep: Dorpers
    - Average annual revenue: ± R500 000
    - No workers currently live on the farm
  - **Concerns raised for construction phase:**
    - The farm is almost only grass; this however, is not a concern because grass grows very quickly but the destruction of the veld and shrubs are a concern because they recover at much slower rates than the grass and they are the primary source of food for the sheep
    - During the building process, the sheep will have to be moved to another farm which will be rented and there is not much farmland available to rent in the area thus farm owner will have to be adequately compensated for this
    - Water is a very scarce commodity in the area so there is great concern related to where the water for the project will be sourced from during the construction phase
  - **Concerns raised for operational phase:**
    - Farm owner is not concerned about the visual impact as he jokingly added that the sheep will most probably enjoy the shade of the wind turbines
    - Economic benefits and opportunities for the farm and the town
    - Concerns related to the rising population as Loeriesfontein is a relatively small town
    - Water scarcity in the area

- <u>Remainder of Hartebeest Leegte Farm No.216 (adjacent)</u>
  - **General information**
    - 5 400-6000 hectares used for commercial farming however main source of income derived from date farming
    - Type of sheep: Wit Dorpers and Merino's
    - Average annual revenue: ± R183 333
    - Currently, no-workers are employed by the farm however workers periodically live on the farm during the sheering season

- **Concerns raised:**
    - The farm owner mentioned that any operational losses incurred will require compensation
    - Incurred losses will be proportionate to the forfeited rental income (in the event that the sheep are relocated elsewhere during the construction phase)
    - The construction company must ensure that minimal damage is done to the veld and that roads are built without infringing on existing infrastructure (farms, farm gates, water pipes, water installations, windmills etc.)
    - All construction roads that will potentially be built across the farm to be communicated with farm owner in time
    - The construction workers must ensure that they are careful during the construction phase and none of the project activities cause unnecessary damage to the existing infrastructure and veld Farm
    - Dust needs to be controlled as the Merino sheep are especially affected by this

▪ **P**<u>ortion 2 of Georg's Vley Farm no.217 (directly affected)</u>

- **General information**
    - ± 13000 hectares are used for commercial sheep farming which is the main source of income
    - Type of sheep: Mainly Dorpers
    - Average annual revenue: ± R1 400 000
    - Family permanently resides on the farm during summer rainfall time
    - Two permanent workers live on the farm (one of which is a long term employee who lives with his wife and two children
- **Concerns raised during construction phase: short term**
    - The farm owner expressed his concerns about the destruction of the bossie veld (shrubs) as once it is destroyed, it recovers very slowly and it is the primary source of food for the sheep.
    - The construction will be situated 14km away from our main house; therefore, we are not concerned about any disturbances during the construction phase
    - During the construction phase, 200 sheep will need to be relocated to another rented farm and compensation for this is necessary. There is also concern there will be limited grazing land if all the farm owners have to move their sheep
    - No jobs will be lost on farm during the construction phase
    - Not concerned about the developments that are occurring in the area as long as they do not affect the farms daily operations
    - Not concerned about construction workers as most of them prefer to reside in town
    - Water is a very scarce commodity in the area so there is great concern related to where the water for the project will be sourced from during the construction phase
- **Concerns raised during construction phase: long term**
    - An average of 200 sheep is lost to jackals every year; thus, the farm owner had hope that the wind turbines would drive the jackals away; however, jackals quickly get used to the turbines

## 6.16 Preliminary Geotechnical Assessment

The Preliminary Geotechnical Assessment was conducted by Glen Randall and reviewed by Cobus Hendriksz from SMEC. Glen Randall subsequently no longer works at SMEC, but Cobus Hendriksz will be responsible for the study going forward. The full report is included in **Appendix 9D**. The environmental baseline from a socio-economic perspective is presented below.

This chapter discusses the geotechnical conditions present over the area in which the site is situated. An evaluation of the impact of the expected geotechnical characteristics on the development are discussed below.

### *6.16.1 Existing Conditions*

Topographical maps show the site to be relatively flat with local ridges associated with dolerite intrusions. The only prominent hill is Groot Rooiberg, on the southern site boundary.

Farms within the region are generally undeveloped and used for grazing. The surface of the region is generally characterised by a gravelly crust that becomes sandier in the vicinity of the stream floodplains and pans. The southern part of the site is drained by generally south west flowing, non-perennial Klein Sandkraal River tributaries. Within the northern part of the site, water typically flows in the form of sheet wash, with some small stream tributaries draining towards Konnes se Pan in the far north.

According to Acock's field types of South Africa, the area is located within the western Mountain Karoo that has a desert appearance with its sparsely populated succulent dwarf shrub species, particularly of the Vygie Family, with Bushmanland grass.

The general appearance of the area, in which the site is situated, is shown on the photographs below.

**Figure 37:** General aerial view (During dry season)

### *6.16.2 Seismicity*

The Northern Cape can generally be considered a region with a low hazard (peak ground acceleration of 0 – 0.2m/s2). According to the Seismic Hazard Map of South Africa contained in the new South African Loading Code - SANS 10160 the peak ground acceleration (g) with a 10% probability of being exceeded in a 50 year period for the site is in the order of 0.08 – 0.12g. An extract of this map indicating the position of the site is as **Figure 38** below.

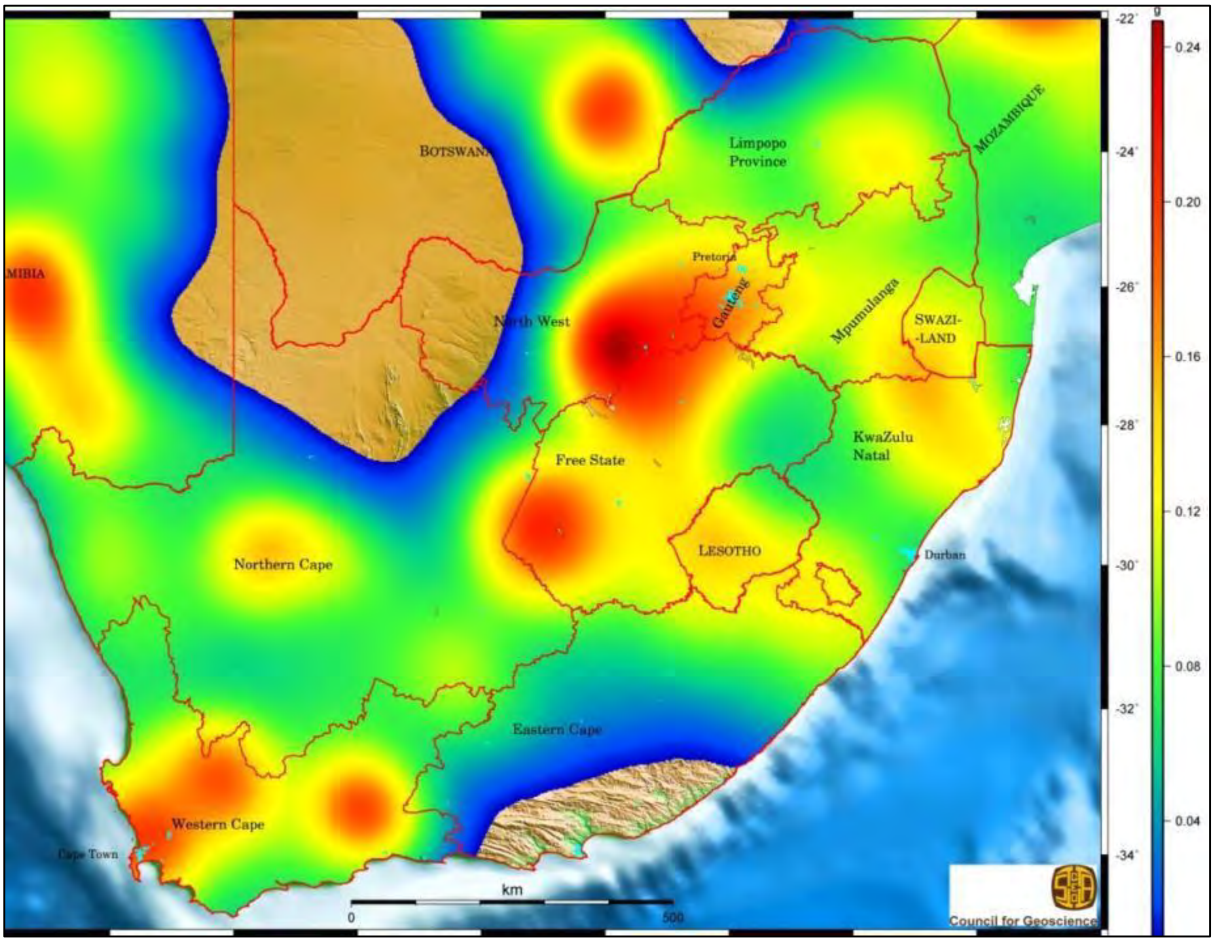



**Figure 38:** Seismic Hazard map of South Africa

### *6.16.3 Geology*

According to the Geological Map of Loeriesfontein 3018 (scale 1:250 000, 2011) the site is mainly underlain by dolerite, which intruded into and crystallised as a sill within the brown and grey shale of the Prince Albert and Whitehill Formation. Significant alluvial sand deposits, associated with the local streams, partly cover the southern part of the site as shown on **Figure 39** below:

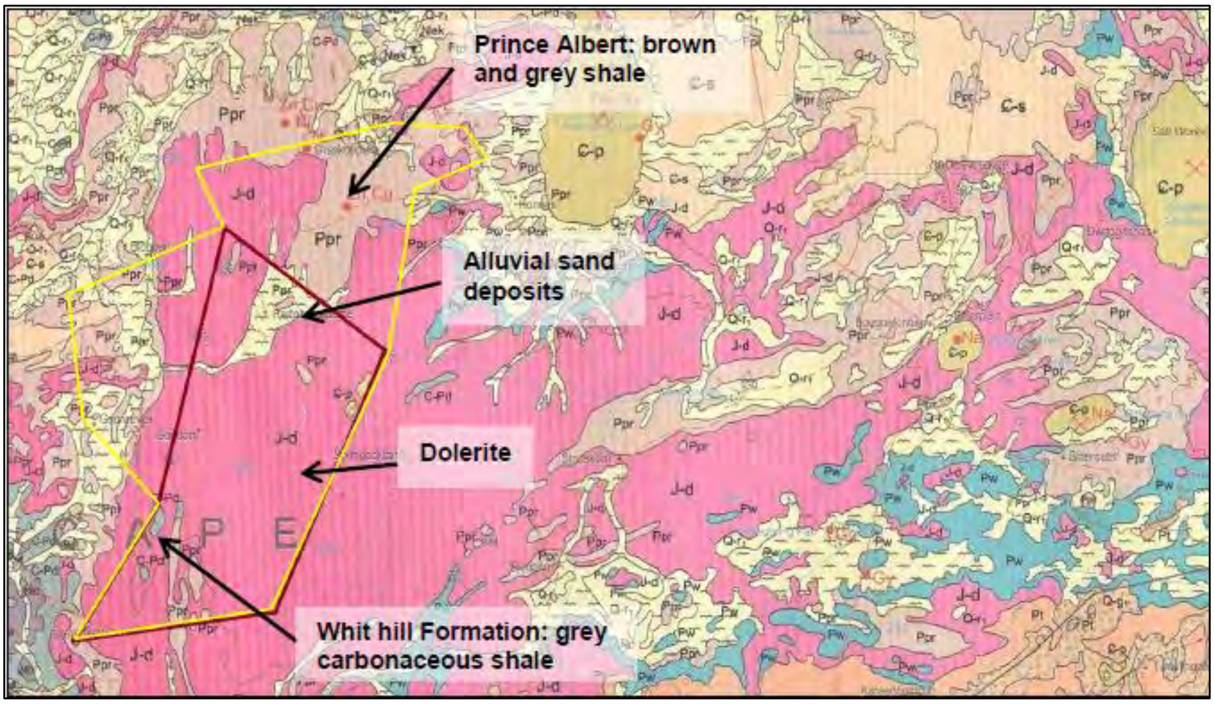



**Figure 39:** Extract from Loeriesfontein 3018 Geological Map

Breccia Pipes, associated with hydrothermal activity, caused by the dolerite intrusions, are found within the area, especially within the southern portion of the site. These pipes comprise baked and dislocated shale and mudstone, locally with breccia (shattered re-cemented blocks). Gas vugs and fractures are often filled with minerals like calcite, chlorite, fluorite, apophyllite, barite and quartz.

Economical zinc and copper deposits are found on Erf 176 (Graskoppies) in the north, but with the exception of a couple of borrow pits within the dolerite sill, no mining has occurred on site.

### *6.16.4 General Ground Conditions*

Previous investigations on neighbouring farms show the area is generally underlain by shallow bedrock found between 0 – 1.9m below surface. General profiles for the geological units mapped in **Figure 39** above, are summarised in **Table 28** below:

**Table 28:** General Subsurface Profiles

| UNIT | GEOLOGY | APPROXIMATE PROPORTION OF SITE (%) | GENERAL PROFILE DESCRIPTION |
|---|---|---|---|
|  | Alluvial Sand | 8 | |
|   | Whitehill Formation Shale | 2 | The area is underlain by shale, covered by silty sand with gravel and calcrete nodules (generally between 0.1-2.0m thick), occasionally with weakly |

| | | | |
|---|---|---|---|
| | | | cemented to cemented calcrete towards the base. The shale tends to be fractured within the upper 2m below surface and within the vicinity of dolerite sills.<br><br>Weathered dolerite sills (up to 1.5m thick), may be occasionally encountered within the upper 5m below surface, with thick hard to very hard rock dolerite sills at depth.<br><br>Refusal of the excavator is generally expected between 0.3-1.5m below surface. |
| J-d | Dolerite | 75 | This area comprises a dolerite sill covered by silty sand with gravel and calcrete nodules (generally between 0.1-1.2m thick), occasionally with cemented calcrete towards the base. Sill thickness varies, generally between 5 - >10m, but may be locally absent. Here the subsurface is characterised by fractured shale. Weathering of the sill is also variable, with completely weathered dolerite grading into hard rock from 1.5- >10m below surface, with hard rock generally within 6m.<br><br>Refusal of the excavator is generally expected between 0.3-3.5m below surface. |
| Pt | Prince Albert Shale | 15 | The area is underlain by shale, locally with surface outcrops and covered by silty sand with gravel and calcrete nodules (generally between 0.1-2m thick), occasionally with weakly cemented to cemented calcrete towards the base. The shale tends to be fractured within the upper 2m below surface and within the vicinity of dolerite sills.<br><br>Weathered dolerite sills (up to 1.5m thick), may be occasionally encountered within the upper 5m below surface, with thick hard to very hard rock dolerite sills at depth.<br><br>Refusal of the excavator is generally expected between 0.3-1.5m below surface. |

## 6.17 Traffic Impact Assessment

The Traffic Impact Assessment was conducted by Glen Randall and reviewed by Cobus Hendriksz from SMEC. Glen Randall subsequently no longer works at SMEC, but Cobus Hendriksz will be responsible for the study going forward. The full report is included in **Appendix 9E**. The environmental baseline from a traffic perspective is presented below.

This Chapter provides a summary of a separate report entitled "Leeuwberg Farm Preliminary Transportation Study" which attempts to address all transport related issues. Both the abnormal and legal vehicles were reviewed in terms of their type of activity; i.e. construction traffic, traffic associated with the transportation of the wind turbine components, or traffic associated with the transportation of materials, equipment and people. The key issues associated with the construction and operational phases of the project that will be assessed as part of the transport study are:

- Increase in traffic generation throughout the lifetime of the project;
- Increase in road maintenance required; and
- Ability to transport wind turbine components to site safely and efficiently.

### *6.17.1 Existing Traffic Conditions*

**Table 29** below shows a summary of the roads and road segments affected by the LWEF project.

**Table 29:** Road Segments Affected by LWEF

| Road Segment | Segment Name | Chainage Start | Chainage End | Distance (km) |
|---|---|---|---|---|
| **Atlantis to R358** | | | | |
| R304 | Dr1134 | Km1 | Km0 | 1 |
| N7 | Segment 1 | Km36 (Atlantis) | Km52 (Malmesbury) | 16 |
| | Segment 2 | Km0 (Malmesbury) | Km34 (Moorreesburg) | 34 |
| | Segment 3 | Km0 (Moorreesburg) | Km31 (Piketberg) | 31 |
| R366 | MR023/MR531 | Km0 (Piketberg) | Km38 | 38 |
| R365 | MR538 | Km86 | Km0 | 86 |
| R364 | TR5501 | Km61 | Km0 | 61 |
| N7 | Segment 5 | Km0 | Km75 (Vanrhynsdorp) | 75 |
| | Segment 6 | Km0 | Km75 (Bitterfontein) | 83 |
| | Segment 7 | Km0 | Km4 (R358 intersection) | 4 |
| | | | **Total** | 429 |
| **R358 to P2948** | | | | |

| | | | | |
|---|---|---|---|---|
| R358 | MR736 | Km0 | Km61 (R355 intersection) | 61 |
| | MR736 | Km61 | Km105 (P2948 intersection) | 44 |
| | | | Total | 105 |
| **P2948 to LWEF Boundary** | | | | |
| P2948 | | Km0 | Km29 | 29 |
| Private Access Road | | Km0 | Km12 (LWEF Boundary) | 12 |
| | | | **Total** | 41 |
| **Loeriesfontein to R358** | | | | |
| | R355 | Km0 (Loeriesfontein) | Km84 (R358 intersection) | 84 |

**Table 30** shows that the Average Daily Traffic (ADT) for the N7 between Vanrhynsdorp and Nuwerus is in the order of 1100 vehicles of which the Average Daily Truck Traffic (ADTT) consist of 300 vehicles. The N7 is only one lane in each direction and is capable of carrying 2000vph. It is furthermore reasonable to assume that this portion of the N7 carries significantly lower volumes of traffic than elsewhere along its length. SMEC are still awaiting additional traffic data from the provincial DoT.

**Table 30:** Existing Traffic Volumes (2013)

| **Historic Trip Generation of N7 (2013)** | |
|---|---|
| Section | Between Vanrhynsdorp and Nuwerus |
| Average Daily traffic (ADT) | 1038 vehicles |
| Average Daily Truck Traffic (ADTT) | 290 vehicles (27.9% of total) |

## 6.18 Path Loss and Risk Assessment

The Path Loss and Risk Assessment was conducted by Callie Fouché of Interference Testing and Consultancy Services (Pty) Ltd (ITC). The full report is included in **Appendix 9C**. The environmental baseline from a socio-economic perspective is presented below.

The SKA is a stakeholder listed in the Interested and Affected parties of the proposed development. In order to determine whether the planned wind farm development could have any influence on the SKA, Mainstream requested a risk evaluation of the planned development to SKA activities. The frequency band of concern for SKA mid-band is 200MHz to 20GHz.This assessment does not consider any potential telecommunication services or networks that are to be established as part of the operational plan.

This risk assessment assumes the use of 47 Acciona AW 125 TH100A turbines within the !Xha Boom development and will be compared to known radiated emission data from the AW125 TH100A Acciona WTG as presented in the Acciona Control Plan.

The Acciona AW 125 TH 100A is the model within the AW 3000 platform that will be evaluated for this project. This assessment will be updated based on additional measurement results and design information as it becomes available.

The intent of this evaluation is to ensure that the !Xha Boom facility poses a low risk of detrimental impact on the SKA by using known radiated emission amplitudes of the Acciona AW3000/125 TH100 50Hz wind turbine. Specific mitigation measures to be implemented on the AW3000/125 TH100 50Hz wind turbine in order to achieve 40 dB of attenuation has been reviewed and agreed by SKA South Africa as described in the Emission Control Plan for the AW125 TH100A WTG.

*6.18.1 EMC Analysis*

- **<u>Site Location</u>**

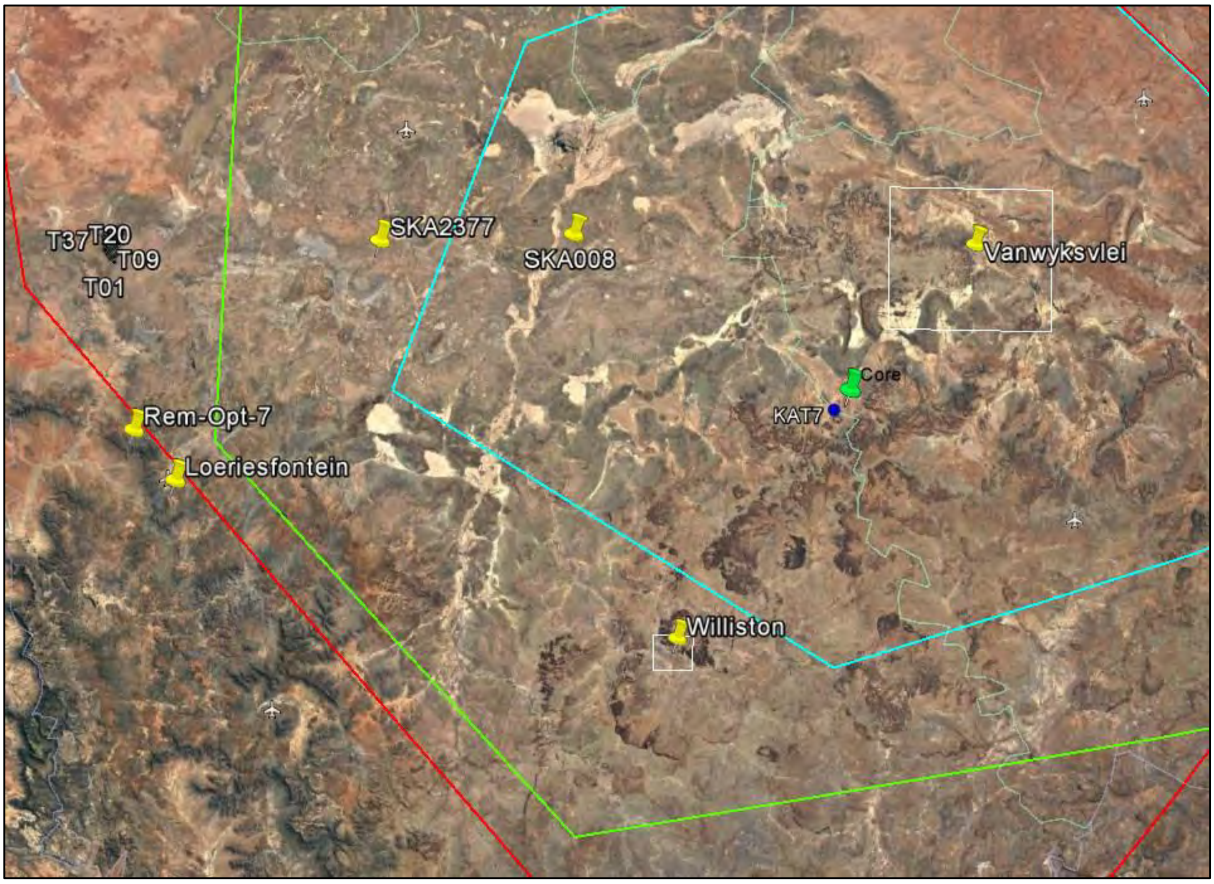



**Figure 40:** Area Map showing !Xha Boom locations relative to SKA

Two (2) WTG locations (WTG 1 and WTG 36) and two (2) SKA installations (Rem Opt 7 and SKA 2377) were used for the evaluation.


**Figure 41:** Local map showing nearest two SKA locations

# 7 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA Regulations govern the EIA process, including public participation. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment, and ensuring the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors; firstly, ongoing interaction with the environmental specialists and the technical teams in order to achieve integration of technical assessment and public participation throughout. Secondly, to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification that their issues have been captured and for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process. Registration on the project can take place at any time during the EIA process up until the final EIA report is submitted to DEA. There are however set periods in which comments are required from Interested and / or Affected Parties (I&APs) in order to ensure that these are captured in time for the submission of the various reports. The comment periods during the Scoping Phase were implemented according to NEMA EIA Regulations. The comment periods during the Scoping Phase (as set out by EIA Regulations 2014) are as follows:

- Background Information Document (BID): 4 Calendar weeks, but also as and when an I&AP registers.
- Comment period for the Draft / Final Scoping Report (DSR/FSR): 4 Calendar weeks (30 days).
- Any public participation process must be conducted for a period of at least 30 days.

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered interested and/or affected parties –

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes as stipulated by the EIA Regulations;
- must send a copy of any comments to the applicant or Environmental Assessment Practitioner (EAP) if the comments were submitted directly to the competent authority; and
- must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

Further, in terms of the EIA regulations, the EAP:

- manages the application process;
- must be independent;
- must undertake the work objectively – even if this results in views and findings that are not favourable to the applicant;
- must disclose material information that may influence the decision; and
- must conduct a public participation process.

The following actions were taken upon receiving comments/queries/issues:

- The contact details provided were entered into the project database for use in future notifications.
- Confirmation of receipt of comments.
- Addressed comments in the Comments and Response Report (C&RR).

## 7.1 Objectives of the Public Participation

An understanding of what the public participation is, and is what it is not, needs to be explored and must be clarified.

- Public Participation is:
    - A communication mechanism to inform I&APs regarding a proposed project.

- A communication mechanism to record comments and/or concerns raised during the relevant phase of the EIA by I&APs regarding a proposed project.

- What Public Participation is not:
  - A marketing exercise.
  - A process to address grievances but rather to record comments raised.
  - One-on-one consultation with each I&AP during the EIA process (not relevant to possibly affected landowners identified).

The primary aims of the PPP are:

- To inform interested and affected parties (I&APs) and key stakeholders of the proposed development.
- To initiate meaningful and timeous participation of I&APs.
- To identify issues and concerns of key stakeholders and I&APs with regards to the proposed development
- To promote transparency and an understanding of the proposed project and its potential environmental impacts.
- To provide information used for decision-making.
- To provide a structure for liaison and communication with I&APs and key stakeholders.
- To assist in identifying potential environmental impacts associated with the proposed development.
- To ensure inclusivity (the views, needs, interests and values of I&APs must be considered in the decision-making process).
- To focus on issues relevant to the project and issues considered important by I&APs and key stakeholders.
- To provide responses to I&AP queries.
- To encourage co-regulation, shared responsibility and a sense of ownership.

In addition to the guidance of the PPP in the EIA Regulations, every effort was also made to conform to the requirements of the Promotion of Administrative Justice Act 2000 (Act 3 of 2000).

## 7.2 Overview of the Public Participation Process to date

The public participation process for the EIA was initiated in October 2016 with the issuing of the BID and initial landowner consultation. Site notices (as per regulations) were placed near the study area during a site visit between Wednesday 26 October 2016 and Friday 28 Otober 2016. The DSR was made available for public review for a thirty (30) day period from Wednesday 21 June 2017 to Friday 21 July 2017. Comments received on the DSR were included in the FSR which was submitted to the DEA on Friday 4 August 2017. The FSR was made available public review and comment for a period of thirty (30) calendar days, from Friday 4 August 2017 to Tuesday 5 September 2017. The DEA subsequently acknowledged the receipt of the FSR and EIA Plan of study on Monday 7 August 2017. In addition, The DEA accepted the FSR and EIA Plan of study on Friday 15 September 2017 and requested for additional information to be included in the DEIAr. During the DEIAr comment period, the public and focus group meetings will be held.

On-going consultation with key stakeholders (e.g. provincial, district and local authorities, relevant government departments, local business, affected and adjacent landowners etc.) and identified I&APs will ensure that I&APs are kept informed regarding the EIA phase (the full stakeholder database list is included in **Appendix 7F**). Networking with I&APs will effectively continue throughout the Impact Phase of the project until the FEIAr and EIA Plan of Study are submitted to DEA. Where required, stakeholders and I&APs were engaged on an individual basis.

During the environmental studies, consultations were held with individuals, businesses, institutions and organisations, and the following sectors of society have been identified and were afforded the opportunity to comment (the full stakeholder database list is included in **Appendix 7F**):

- National Authorities;
- Provincial Authorities;
- Namakwa District Municipality
- Hantam Local Municipality
- Khai-Ma Local Municipality
- Government Structures such as SAHRA, SANRAL, Eskom Telkom, etc.;
- Agriculture Associations;
- Regional and local media (advertisements and public documents e.g. BID);
- Business and commerce;
- Environmental bodies / NGOs;
- Department of Environmental Affairs: Biodiversity Section;
- Department of Water and Sanitation;
- Community representatives, CBOs, development bodies;
- Landowners;
- Square Kilometre Array (SKA);
- Civil Aviation Authority (CAA); and
- Air Traffic and Navigation Services (ATNS).

The stages that typically form part of the public participation process during the EIA phase are reflected in **Figure 42** below.

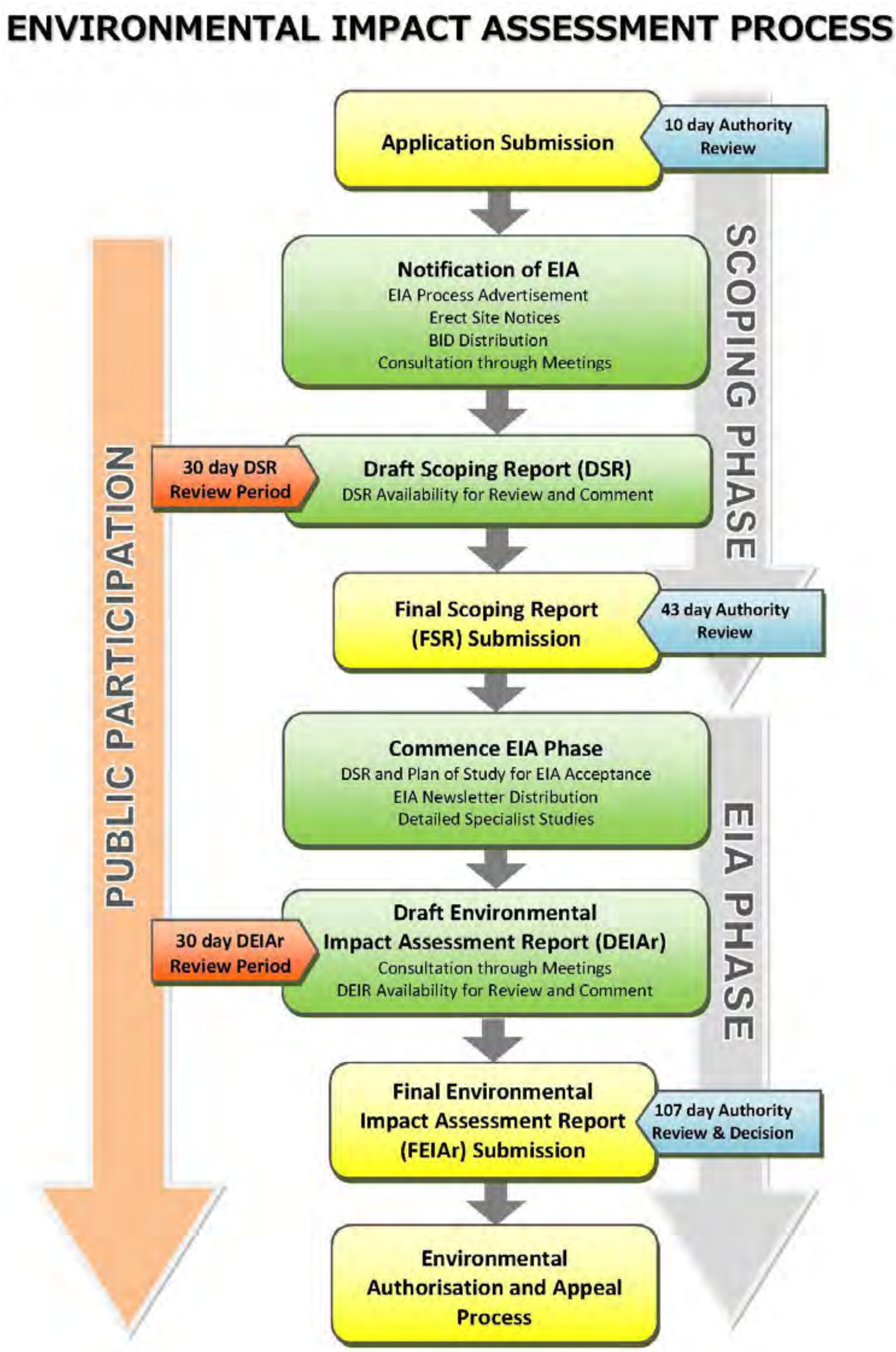



**Figure 42:** EIA and Public Participation Process

## 7.3 Consultation and Public Involvement

Through the consultation process, issues for inclusion within the DEIAr were identified and confirmed. Telephonic discussions and one-on-one consultation were undertaken where relevant. Meetings with landowners took place prior to the release of the DEIAr in order to identify key issues, needs and priorities for input into the proposed project. Special attention was paid to the consultation with possibly affected landowners and communities within the study area to try and address their main concerns.

It should be noted that Municipal and Landowner Focus Group Meetings (FGMs) will be held during the Draft Environmental Impact Assessment Report (DEIAr) comment period.

Notifications will be sent via email, sms, fax and post to inform I&APs of the availability of the DEIAr.

## 7.4 Comments Received during the Scoping Phase

All comments and recommendations made by stakeholders and I&APs during the scoping phase and submitted as part of the FSR have been taken into consideration when preparing the DEIAr.

All comments received during the scoping phase are addressed and included in **Appendix 7E**.

## 7.5 Proof of Notification

**Appendix 7** includes all proof of notification to I&APs which includes;

- Proof of process advertisements in the newspapers (**Appendix 7C**)
- EIA Newsletter (**Appendix 7B**)
- Correspondence to registered I&APs and key stakeholders (**Appendix 7B** and **7D**)

## 7.6 Notification of the Potential Interested and Affected Parties

Communication with I&APs were conducted by means of telephone, faxes and email in order to obtain the necessary background information to compile this report. The advertising process was followed in terms of regulation 41 of the EIA Regulations published in R982 in Government Gazette No. 38282 of 4 December 2015, as amended.

An advertisement was placed in the Noordwester newspaper on 16 June 2017.

In addition, many site notices (as per regulations) were placed near the study area during a site visit in October 2016 (**Appendix 7A**).

As stakeholders respond to these advertisements, they will be registered on the project database and sent letters of invitation to participate as well as the BID.

## 7.7 Focus Group Meetings

Focus Group Meetings (FGMs) are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project.

It must be noted that FGMs have not yet taken place. Two (2) FGMs are however scheduled to take place during the review period of the DEIAr. Affected landowners and authorities will be invited to the respective FGMs, as follows:

| DATE | TIME | MEETING TYPE | VENUE |
|---|---|---|---|
| 31 October 2017 | 14:30 – 16:00 | Authorities FGM | Boardroom, Hantam LM Offices, Hope Street, Calvinia |
| 01 November 2017 | 09:00 – 10:30 | Landowners FGM | NG Church Hall, Loeriesfontein |

Minutes of the FGMs will be compiled and forwarded to all attendees for their review and comment. The primary aim of the meetings are to:

- Disseminate information regarding the proposed development to I&APs.
- Provide I&APs with an opportunity to interact with the EIA team and the Mainstream representatives present.
- Supply more information regarding the EIA process.
- Answer questions regarding the project and the EIA process.
- Receive input regarding the public participation process and the proposed development.
- Present I&APs with an overview of EIA phase specialist findings.

Draft minutes of the FGMs will be included in **Appendix 7G** in the FEIAr.

## 7.8 Public Meeting / Open Day

A Public Meeting or Open Day will be held during the review of the DEIAr as follows:

| DATE | TIME | MEETING TYPE | VENUE |
|---|---|---|---|
| 01 November 2017 | 11:30 – 13:00 | Public Meeting / Open Day | Loeriesfontein Communty Hall |

Invitation letters were sent out via post and e-mail to all registered I&APs on the project's database.

The Public Meeting will be held in order to provide I&APs with information regarding the proposed development, present the EIA phase environmental findings and invite I&APs to raise any further comments and/or concerns that they may have.

Draft minutes of the PM will be compiled and forwarded to all attendees for their review and comment. Minutes of the meetings will be included in **Appendix 7G** in the FEIAr.

## 7.9 Public Review of Draft Environmental Impact Assessment Report

The DEIAr will be made available for review at the following venue for a period of 30 calendar days, excluding public holidays and the December closure period:

**Table 31:** Venues where the DEIAr will be publically available

| VENUE | STREET ADDRESS | HOURS | CONTACT NO |
|---|---|---|---|
| Loeriesfontein Library | Main Street, Loeriesfontein | Mondays – Fridays<br>14h00 – 17h00 | 027 662 8607 |

All comments received on this report will be incorporated into the Comments and Response Report (C&RR), which will be attached to the FEIAr as **Appendix 7E**.

## 7.10 Comments and Response Report (C&RR)

Issues, comments and concerns raised during the public participation process to date are captured in the Comments and Response Report (C&RR) – **Appendix 7E**. This C&RR provides a summary of the issues raised, as well as responses provided to I&APs. This information will be used to feed into the evaluation of environmental and social impacts. All comments received during the review period of the FSR have been included in the C&RR.

## 7.11 Comments on the Final Scoping Report

The Final Scoping Report (FSR) was made available for public review after submission to DEA, the competent authority.

The report was out for public review and comment for a period of thirty (30) calendar days, from 4 August 2017 to 5 September 2017. Written notice was given to all registered I&APs as well as all key stakeholders on the database that the FSR was available for public review.

Electronic copies (CD) of the report were also made available and were distributed on written request.

# 8 SPECIALIST STUDIES

The following specialist studies were undertaken as per the Plan of Study for EIA:

- Biodiversity (flora and fauna)
- Avifauna
- Bat
- Surface Water
- Soils and Agricultural Potential
- Noise
- Visual Impact
- Heritage and Palaeontology (Desktop)
- Socio-economic Impact
- Preliminary Engineering Services- Engineering services, transportation and geotechnical
- Traffic
- Path Loss and Risk Assessment (SKA)

Each specialist assessed the impact of the proposed !Xha Boom and associated infrastructure that BioTherm are proposing to develop near Copperton and the results are presented below.

## 8.1 Biodiversity

### *8.1.1 Faunal communities*

**<u>Mammals</u>**

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

The only mammal species of conservation concern which may occur at the site is the Black-footed cat *Felis nigripes* (Vulnerable). As this species has a broad distribution across South Africa, the relatively limited footprint of the development is not likely to compromise the local or regional populations of this species. In addition, the majority of the wind farm would still be accessible to such fauna and it is likely that most predators will continue to use the site.

**<u>Reptiles</u>**

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3 of the Biodiversity Specialist Report), comprising 5 tortoises, 12 snakes, 15 lizards and skinks, 8 geckos and 1 chameleon. This is a comparatively low total, suggesting that reptile diversity at the site is likely to be low. There are no listed species which are likely to occur at the site. Species which were observed in the area include the Karoo Girdled Lizard Karusasaurus polyzonus / Namaqua Sand Lizard *Pedioplanis namaquensis*, Spotted Desert Lizard *Meroles suborbitalis*, Western Sandveld Lizard *Nucras tessellata*, Southern Rock Agama *Agama atra*, Ground Agama *Agama aculeata subsp. aculeata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii*. The most important habitats for reptiles at the site are the rocky outcrops as well as drainage lines with a higher vegetation cover. The development footprint in these areas would however be low and a significant impact on important reptile habitats is not likely.

In terms of the likely impacts of the development on reptiles, habitat loss is not likely to be highly significant as the direct footprint of the development is not likely to exceed a few hundred hectares and this would not be significant in context of the relatively homogenous and intact surrounding landscape. In some situations, the loss of vegetation cover associated with roads and other cleared areas can generate significant impact on reptiles as they may be vulnerable to predation while crossing such cleared areas, but as the site is arid, plant cover is already low and the reptile species present are mostly well adapted to low-cover environments.

**Figure 43:** The Karoo Girdled Lizard is common on small rocky outcrops which occur scattered throughout the !Xha Boom site.

**Amphibians**

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

### *8.1.2 !Xha Boom Sensitivity Assessment*

The draft sensitivity map for the study area is depicted below in **Figure 44**. The majority of the site consists of arid grasslands or low open shrublands on open plains that are not considered highly sensitive. The abundance of species of conservation concern at the site is very low and no significant impacts in this regard are likely to occur.The transition area between the arid grasslands of the east and the Klipveld of the west is considered a sensitive area and the rocky outcrops in particular should be avoided. There are also numerous washes and minor drainage features running off the ridge towards the west and while these are not well developed and do not have significant riparian vegetation, they should still be avoided as much as possible. Overall, apart from these features which occupy a small proportion of the site, the site is considered low sensitivity and the impact of the development would be local in nature and there are no highly significant impacts that cannot be reduced to a low level.

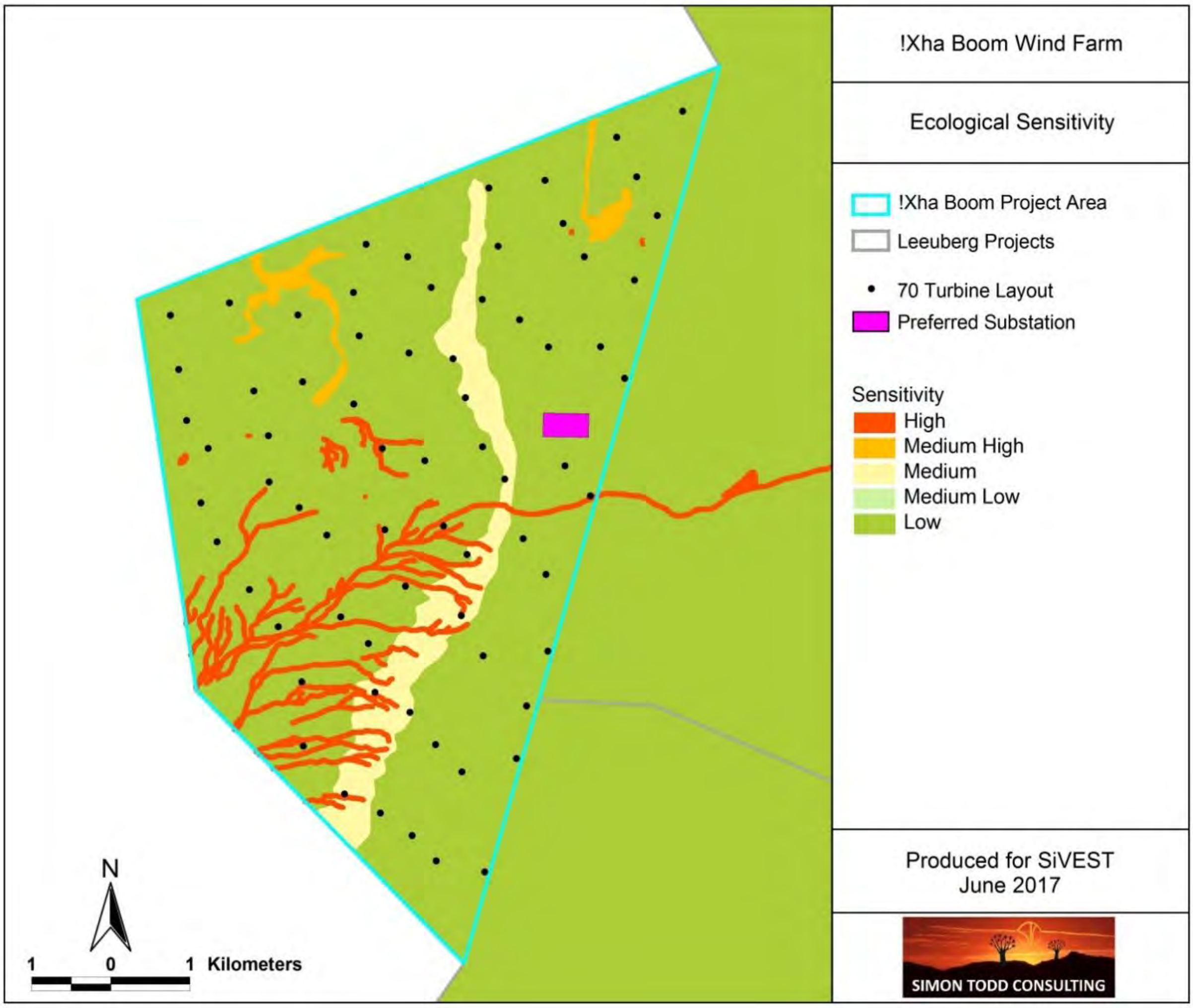



**Figure 44:** Draft sensitivity map for the !Xha Boom study area and the larger Leeuwberg site. The majority of the site is arid grassland or low open shrublands of low sensitivity.

### *8.1.5 Impacts and Issues Identification*

The development of the !Xha Boom Wind Farm, is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as turbine foundations and service areas, roads, operations buildings etc. The following impacts are identified as the major impacts that are likely to be associated with the development and which are assessed for the !Xha Boom wind farm, for the preconstruction, construction and operational phases of the development.

#### *8.1.5.1 Identification of Potential Impacts*

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

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

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

- **Impact 2. Direct Faunal Impacts**

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed if proper management and monitoring is not in place. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity was high. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. During the operational phase, noise generated by the operation of the turbines is likely to negatively affect at least some fauna. Faunal impacts will therefore be assessed during the construction and operational phase of the facility.

- **Impact 3. Increased Erosion Risk**

The large amount of disturbance created during construction would leave the site vulnerable to wind and water erosion. Soil disturbance associated with the development will render the impacted areas vulnerable to erosion and measures to limit erosion will need to be implemented. This impact is likely to manifest during construction and would persist into the operational phase and should therefore be assessed for both phases.

- **Impact 4. Alien Plant Invasion**

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Some woody aliens are already present and additional alien plant invasion is inevitable and regular alien plant clearing activities would be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, the site will be less vulnerable to alien plant invasion, however, the roadsides and turbine service areas are likely to remain foci of alien plant invasion for years. This impact would manifest during the operational phase, although some of the required measures to reduce this impact are required during construction.

- **Impact 5. Cumulative Impact 1 - Impacts on broad-scale ecological processes and cumulative habitat loss**

The development will contribute to cumulative impacts on habitat loss in the area and potentially the ability o meet future conservation targets. In addition, the presence of the wind turbines and daily operational activities at the site may deter certain species from the area, resulting in a loss in broad-scale landscape connectivity. This impact would persist for the life of the facility and is thus assessed for the operational phase of the wind farm.

## 8.2 Avifauna

A total of 56 species were recorded in the broader study area (i.e. the WEF sites, control area and immediate surroundings) during the pre-construction monitoring from all data sources (drive transects, walk transects, VP watches, focal point counts and incidental sightings), of which 12 (21.4%) are priority species. See Table 32 for a list of all priority species that were recorded by SABAP1 and 2 in the broader study area, as well as those that could potentially occur in the development area itself. Table 33 lists all species (priority and non-priority) recorded during pre-construction monitoring in the broader study area and table 7-3 lists only the priority species recorded at the development areas, and method through which they were recorded.

### *8.2.1 Listed plant species*

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. Listed and protected species observed in the area include the provincially protected species *Aloe falcata*, *A.claviflora* and *Hoodia gordonii* and Aloinopsis luckhoffii and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

### *8.2.2 Transect counts*

The **drive** transects were surveyed three times per seasonal survey. A total of 8 059 individual birds were recorded during drive transect counts at the development areas, of which 354 were priority species and 7 705 were non-priority species, belonging to 52 species (12 priority species and 40 non-priority species). At the control area, a total of 844 birds were recorded during drive transect counts, of which 31 were priority species and 813 non-priority species, belonging to 47 species (7 priority species and 40 non-priority species).

The **walk** transects were counted 32 times, i.e. 8 times per season. A total of 10 920 individual birds were recorded at the development areas, of which 173 were priority species and 10 747 non-priority species, belonging to 44 species (8 priority species and 36 non-priority species). At the control area, a total of 1 307 birds were recorded, of which 54 were priority species and 2 0153 non-priority species, belonging to 43 species (4 priority species and 39 non-priority species).

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species, and also for all priority species combined recorded during transect counts. This was done separately for drive transects and walk transects. Figure 45 and Figure 46 show the relative abundance of priority species recorded during the pre-construction monitoring through drive and walk transects.

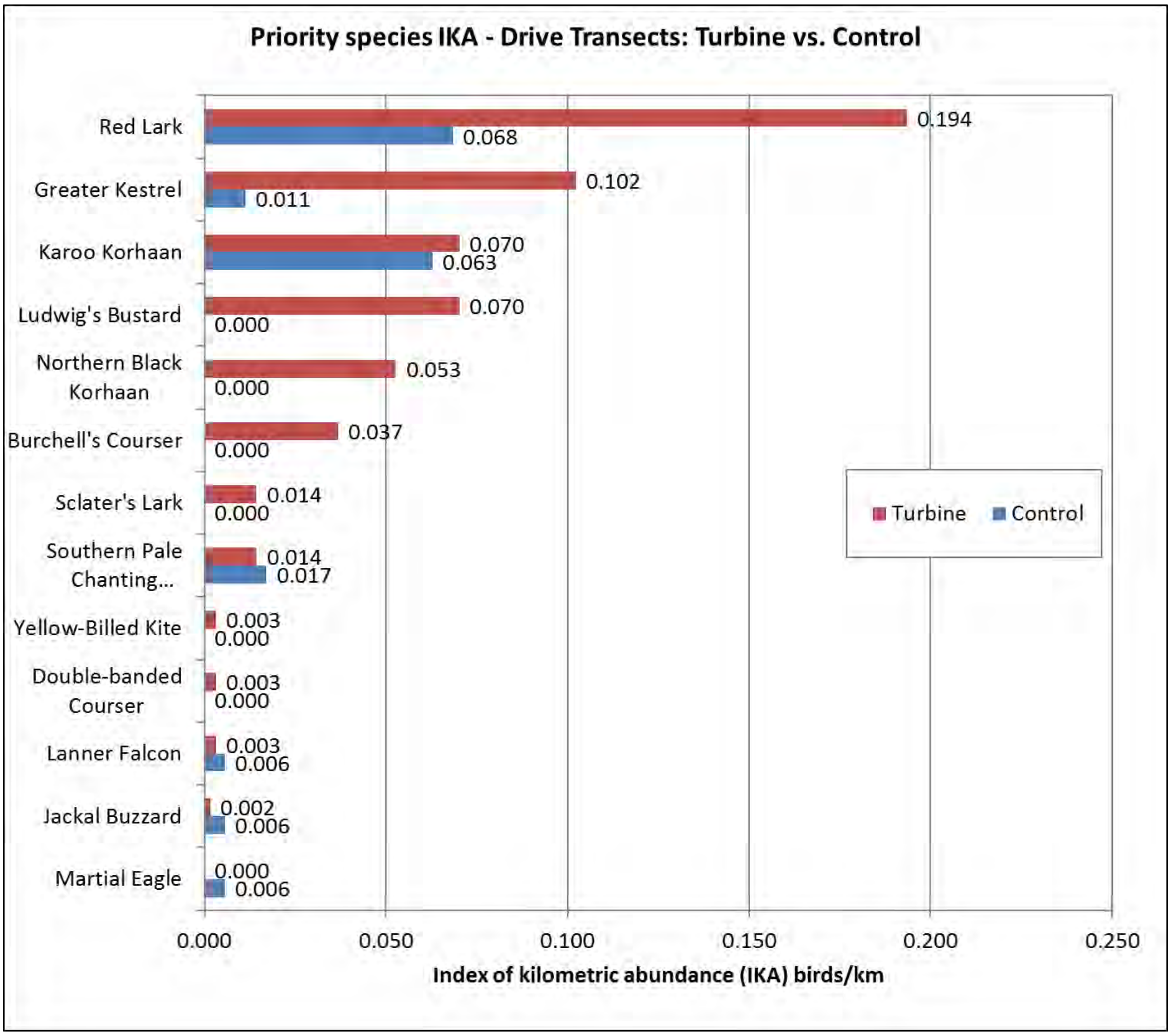



**Figure 45:** Priority species recorded at the WEF sites and control site through drive transect surveys

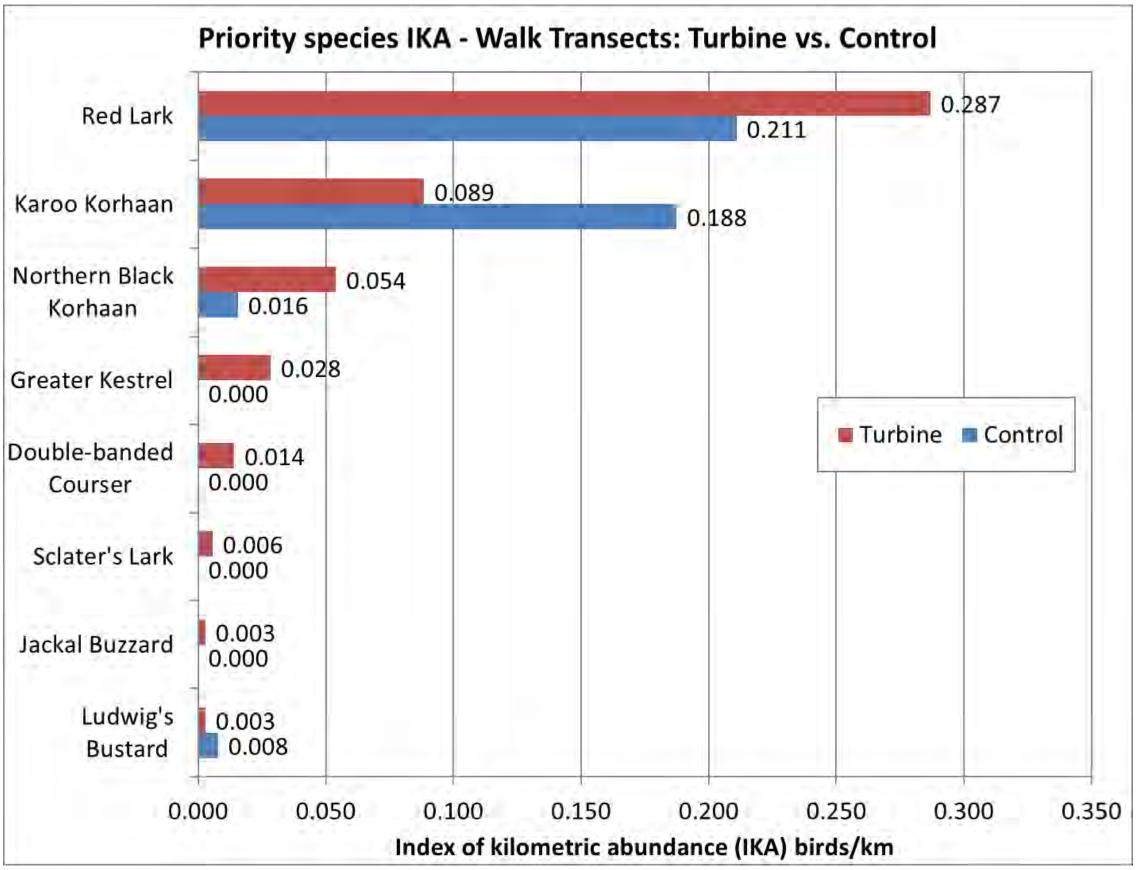



**Figure 46:** Priority species recorded at the WEF sites and control site through walk transect surveys

- **Overall species composition**

The broader study area supports a relatively low diversity and abundance of avifauna, which is to be expected in an arid area like Bushmanland. Based on species diversity recorded during transect surveys, the development areas and control area are essentially similar as far as priority species are concerned. The higher counts at the development areas is most likely a result of the difference in survey effort, and does not reflect any intrinsic differences in habitat quality or species diversity.

- **Abundance**

The abundance of priority species at the development areas is low, with less than one bird per kilometre recorded during transect counts - 0.743 birds/km were recorded on drive transects, and 0.905 birds/km were recorded during walk transects. Red Lark and Greater Kestrel emerged as the two most abundant priority species at the development areas during drive transect counts, and Red Lark and Karoo Korhaan were the two most abundant species during walk transects. Red Lark, Karoo Korhaan, Northern Black Korhaan and Greater Kestrel definitely breed in the study area, and Ludwig’s Bustard, Burchell’s Courser and Double-banded Courser potentially too, although no evidence of bustard display areas or nests were recorded. Raptors were generally sparse with Greater Kestrel the most frequently recorded species during both the drive and walk transects. Other raptors were recorded sporadically in very low numbers.

- **Spatial distribution of transect records and incidental sightings at the turbine site**

Figure 47 below indicates the spatial distribution of priority species recorded during transect counts and incidental sightings in the broader study area.

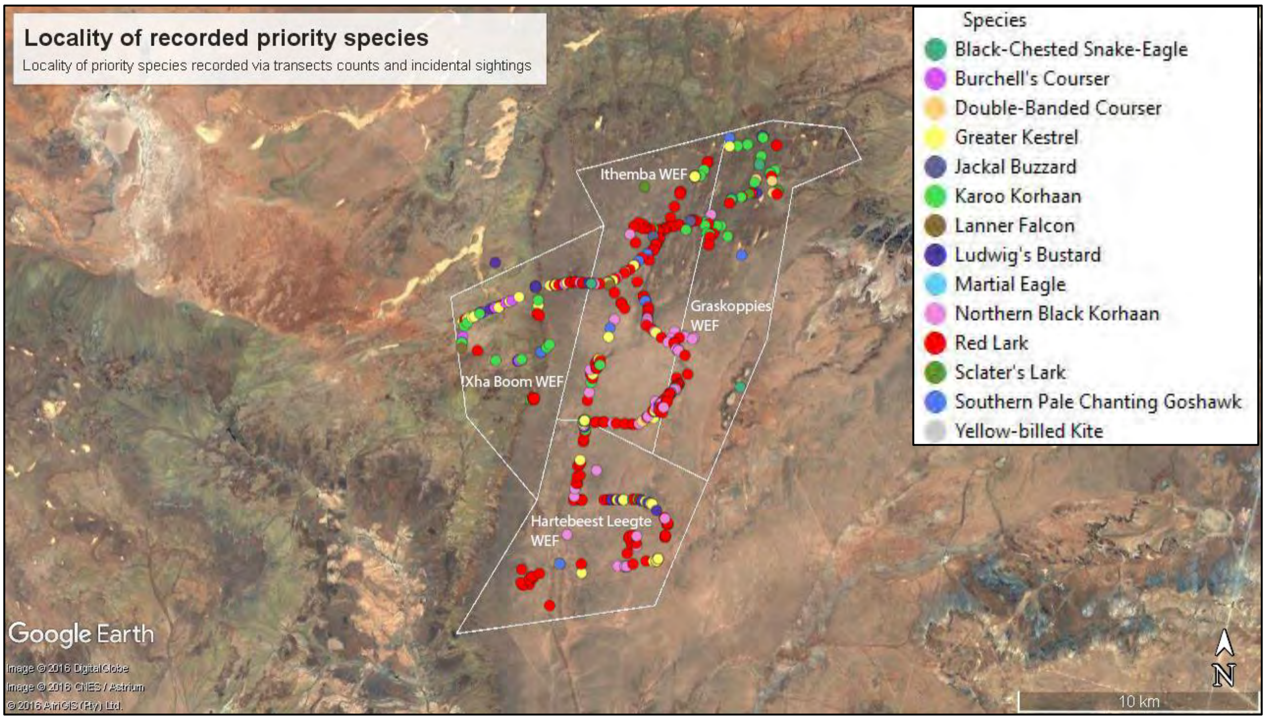



**Figure 47:** Spatial distribution of sightings of priority species recorded during transect counts. It also includes incidental counts.

Visual inspection of the distribution patterns indicates some possible trends. Burchell's Courser shows a clear preference for the gravel plains in the west, with Karoo Korhaan and Sclater's Lark similarly favouring the gravel plains in the west and north of the study area. Close inspection of Red Lark records indicates a possible preference for sandy areas, although the species was also recorded in gravel plains, although in lower numbers. Ludwig's Bustard were mostly recorded in the west and south, in both sandy and gravel areas. The rest of the priority species were generally recorded in low numbers with no clear indications of bird/habitat associations, with random sightings scattered all over the site and immediate surroundings. This is to be expected given the uniformity of the habitat in the study area (see APPENDIX B of Avifuana Report).

Table 32 below lists all the priority species that could **potentially** occur at the development area, based on SABAP1 and SABAP2 data, and the results of the pre-construction monitoring. Priority species recorded during pre-construction surveys at the development areas are shaded. The following abbreviations and acronyms are used:

| | |
|---|---|
| VU | Vulnerable |
| NT | Near threatened |
| EN | Endangered |
| SAE | Southern African endemic or near endemic |
| Ct | Collisions with turbines |
| Dd | Displacement through disturbance |

Dh Displacement habitat transformation
Ep Electrocution on the internal MV overhead powerlines

**Table 33** lists **all** the species (priority and non-priority) recorded during the pre-construction surveys and incidental counts. **Table 34** lists the manner in which the priority species were recorded.

**Table 32:**Priority species (Retief *et al.* 2012) potentially occurring at the development area. **Species recorded in the development areas are shaded.**

| **Name** | **Scientific name** | **Regional threatened status (Taylor et al. 2015)** | **Global threatene d status (IUCN 2016)** | **BLSA/EWT Priority rating (on scale of 170 – 395)** | **Terrestrial** | **Soaring** | **Likelihood of occurrence** | **Potential impact** |
|---|---|---|---|---|---|---|---|---|
| Martial Eagle | *Polemaetus bellicosus* | EN | NT | 330 | | x | Confirmed. One incidental sighting of a flying bird in the broader area, and recorded briefly flying high over the study area. Could sporadically be attracted to water troughs. | Ct, Dd, Ep |
| Ludwig's Bustard | *Neotis ludwigii* | SAE, EN | EN | 320 | x | | Confirmed. Occurrence likely to be linked to habitat conditions. The species is nomadic and a partial migrant and may occur sporadically. | Ct, Cp, Dd, |
| Secretarybird | *Sagittarius serpentarius* | VU | VU | 320 | x | x | Low. May occur sporadically | Ct, Cp, Dd, |
| Kori Bustard | *Ardeotis kori* | NT | Least concern | 280 | x | | Low. May occur sporadically. Lack of dry watercourses with trees may be an inhibiting factor. | Ct, Cp, Dd, |

| Name | Scientific name | Regional threatened status (Taylor et al. 2015) | Global threatened status (IUCN 2016) | BLSA/EWT Priority rating (on scale of 170 – 395) | Terrestrial | Soaring | Likelihood of occurrence | Potential impact |
|---|---|---|---|---|---|---|---|---|
| Lanner Falcon | *Falco biarmicus* | VU | Least concern | 280 | | x | Confirmed. Breeding resident. Most likely to perch on fence lines running through the study area, but may also be attracted to the water points where it hunts small birds. | Ct |
| Sclater's Lark | *Spizocorys sclateri* | SAE, NT | NT | 240 | x | | Confirmed. The species is nomadic and may occur sporadically. | Dd Dh |
| Steppe Buzzard | *Buteo vulpinus* | | Least concern | 210 | | x | Low. Most likely to be associated with utility lines and fence lines. May occur sporadically | Ct |
| Verreaux's Eagle | *Aquila verreauxi* | VU | Least concern | 360 | | x | Confirmed. Solitary single birds were recorded sporadically. Could sporadically be attracted to water troughs, one individual was recorded drinking at a water trough. | Ct, Ep |

| Name | Scientific name | Regional threatened status (Taylor et al. 2015) | Global threatened status (IUCN 2016) | BLSA/EWT Priority rating (on scale of 170 – 395) | Terrestrial | Soaring | Likelihood of occurrence | Potential impact |
|---|---|---|---|---|---|---|---|---|
| Black-chested Snake-Eagle | *Circaetus pectoralis* | | Least concern | 230 | | x | Confirmed. May visit water points. | Ct, Ep |
| Southern Pale Chanting Goshawk | *Melierax canorus* | SAE | Least concern | 200 | x | x | Confirmed. Habitat is very suitable for the species. | Ct, Dd |
| Karoo Korhaan | *Eupodotis vigorsii* | SAE, NT | Least concern | 190 | x | | Confirmed. One of the most commonly recorded terrestrial species. Occurs all over the study area. | Ct, Dd, Cp |
| Northern Black Korhaan | *Afrotis afraoides* | SAE | Least concern | 180 | x | | Confirmed. One of the most commonly recorded terrestrial species. Occurs all over the study area. | Ct, Dd, Cp |
| Greater Kestrel | *Falco rupicoloides* | | Least concern | 174 | | x | Confirmed. Encountered all over the study area, but most likely to be associated with utility lines and fences which are used for perching. | Ct |
| Yellow-billed Kite | *Milvus aegyptius* | | Least concern | 0 | | x | Confirmed. May visit water points sporadically. | Ct |

| Name | Scientific name | Regional threatened status (Taylor et al. 2015) | Global threatened status | BLSA/EWT Priority rating (on scale of 170 – 395) | Terrestrial | Soaring | Likelihood of occurrence | Potential impact |
|---|---|---|---|---|---|---|---|---|

| | | | (IUCN 2016) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spotted Eagle-Owl | *Bubo africanus* | Least concern | Least concern | 170 | Nocturnal raptor but flight characteristics more like terrestrial species | | High. Could be encountered anywhere in the study area. | Ct |
| Jackal Buzzard | *Buteo rufofuscus* | SAE | Least concern | 125 | | x | Confirmed. Most likely to be associated with utility lines and fence lines. May occur sporadically, particularly immature birds. | Ct |
| Burchell's Courser | *Cursorius rufus* | SAE, VU | Least concern | 140 | x | | Confirmed. Mostly recorded in the west of the study area. | Ct |
| Double-banded Courser | *Rhinoptilus africanus* | NT | Least concern | 154 | x | | Confirmed. Recorded sparsely all over the study area. | Ct |
| Booted Eagle | *Aquila pennatus* | | Least concern | 230 | | x | Confirmed. Most likely to be encountered foraging on the wing over the site, and coming down to water points to bath and drink. | Ct |
| Greater Flamingo | *Phoenicopterus roseus* | NT | LC | 290 | Waterbird which undertakes long distance, nocturnal powered flight. | | Low. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, | Ct |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | perhaps once a decade during which the pan will contain standing water for a short period. | |
| Lesser Flamingo | *Phoeniconaias minor* | NT | NT | 290 | Waterbird which undertakes long distance, nocturnal powered flight. | | Low. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, perhaps once a decade during which the pan will contain standing water for a short period. | Ct |

Table 33 lists all the priority species recorded during the pre-construction surveys, vantage point watches and incidental counts, as well as the manner in which they were recorded. Table 34 lists all the non-priority species recorded during the pre-construction surveys.

**Table 33:** Priority species recorded during pre-construction surveys, vantage point watches and incidental counts.

| Priority Species | Taxonomic Name | Development areas | Control area | Incidental sighting | VP: Development areas | VP: Control area |
|---|---|---|---|---|---|---|
| Black-Chested Snake-Eagle | *Circaetus pectoralis* | | | * | * | |
| Booted Eagle | *Aquila pennatus* | | | | * | |
| Burchell's Courser | *Cursorius rufus* | * | | * | * | |
| Double-banded Courser | *Rhinoptilus africanus* | * | | * | | |
| Greater Kestrel | *Falco rupicoloides* | * | * | * | * | * |
| Jackal Buzzard | *Buteo rufofuscus* | * | * | | | |
| Karoo Korhaan | *Eupodotis vigorsii* | * | * | * | * | |
| Lanner Falcon | *Falco biarmicus* | * | * | * | * | |
| Ludwig's Bustard | *Neotis ludwigii* | * | * | * | * | |
| Martial Eagle | *Polemaetus bellicosus* | | * | | * | |
| Northern Black Korhaan | *Afrotis afraoides* | * | * | * | * | |
| Red Lark | *Calendulauda burra* | * | * | * | * | |
| Sclater's Lark | *Spizocorys sclateri* | * | | * | * | |
| Southern Pale Chanting Goshawk | *Melierax canorus* | * | | * | * | |
| Verreaux's Eagle | *Aquila verreauxii* | | | | * | |
| Yellow-Billed Kite | *Milvus aegyptius* | * | | | | |
| **16** | **Total:** | **12** | **8** | **11** | **13** | **1** |

**Table 34:** Non-priority species recorded during pre-construction surveys.

| Non-Priority Species | Taxonomic name | Development areas | Control area |
|---|---|---|---|
| Acacia Pied Barbet | *Tricholaema leucomelas* | | * |
| African Pipit | *Anthus cinnamomeus* | * | |
| Anteating Chat | *Myrmecocichla formicivora* | * | * |
| Barn Swallow | *Hirundo rustica* | * | * |
| Black-Eared Sparrowlark | *Eremopterix australis* | * | * |
| Bokmakierie | *Telophorus zeylonus* | * | * |
| Cape Bunting | *Emberiza capensis* | | * |
| Cape Crow | *Corvus capensis* | | * |
| Cape Penduline-Tit | *Anthoscopus minutus* | * | * |
| Cape Sparrow | *Passer melanurus* | * | * |
| Cape Turtle-dove | *Streptopelia capicola* | | * |
| Capped Wheatear | *Oenanthe pileata* | * | |
| Chat Flycatcher | *Bradornis infuscatus* | * | * |
| Common Fiscal | *Lanius collaris* | * | * |
| Common Quail | *Coturnix coturnix* | * | |
| Eastern Clapper Lark | *Mirafra [apiata] fasciolata* | * | |
| Egyptian Goose | *Alopochen aegyptiaca* | * | |
| European Bee-eater | *Merops apiaster* | | * |
| Familiar Chat | *Cercomela familiaris* | * | * |
| Greater Striped Swallow | *Hirundo cucullata* | * | * |
| Grey Tit | *Parus afer* | | * |
| Grey-backed Cisticola | *Cisticola subruficapilla* | | * |
| Grey-backed Sparrowlark | *Eremopterix verticalis* | * | * |
| Karoo Chat | *Cercomela schlegelii* | * | * |
| Karoo Eremomela | *Eremomela gregalis* | * | * |
| Karoo Long-Billed Lark | *Certhilauda subcoronata* | * | * |
| Karoo Prinia | *Prinia maculosa* | * | * |
| Karoo Scrub-Robin | *Cercotrichas coryphoeus* | * | * |
| Large-Billed Lark | *Galerida magnirostris* | * | * |
| Lark-Like Bunting | *Emberiza impetuani* | * | * |
| Laughing Dove | *Streptopelia senegalensis* | | * |
| Little Swift | *Apus affinis* | | * |
| Long-billed Crombec | *Sylvietta rufescens* | | * |
| Mountain Wheatear | *Oenanthe monticola* | | * |
| Namaqua Dove | *Oena capensis* | * | * |
| Namaqua Sandgrouse | *Pterocles namaqua* | * | * |
| Pied Crow | *Corvus albus* | * | * |
| Red-Billed Teal | *Anas erythrorhyncha* | * | |
| Red-Capped Lark | *Calandrella cinerea* | * | * |
| Red-Headed Finch | *Amadina erythrocephala* | * | |
| Rock Kestrel | *Falco rupicolus* | * | * |
| Rock Martin | *Hirundo fuligula* | | * |
| Rufous-Eared Warbler | *Malcorus pectoralis* | * | * |
| Sabota Lark | *Calendulauda sabota* | * | |
| South African Shelduck | *Tadorna cana* | * | |
| Southern Masked-weaver | *Ploceus velatus* | * | * |
| Southern Pale Chanting Goshawk | *Melierax canorus* | | * |
| Speckled Pigeon | *Columba guinea* | * | * |
| Spike-Heeled Lark | *Chersomanes albofasciata* | * | * |
| Spotted Thick-Knee | *Burhinus capensis* | * | |
| Spur-Winged Goose | *Plectropterus gambensis* | * | |
| Stark's Lark | *Spizocorys starki* | * | |
| Tractrac Chat | *Cercomela tractrac* | * | * |
| White-rumped Swift | *Apus caffer* | * | * |
| White-throated Canary | *Crithagra albogularis* | * | * |
| Yellow Canary | *Crithagra flaviventris* | * | * |
| Yellow-bellied Eremomela | *Eremomela icteropygialis* | * | * |
| **57** | **Total:** | **44** | **45** |
| **Grand Total** | | **56** | **53** |

### 8.2.3 Vantage point watches

Twelve priority species were recorded during vantage point (VP) watches. A total of 528 hours of vantage point watches (12 hours per sampling period per vantage point) was completed at 11 VPs in order to record flight patterns of priority species at the development areas. In the four sampling periods, priority species were recorded flying over the development areas for a total of 2 hours and 5 minutes. A total of 114 individual flights were recorded. Of these, 1 (0.87%) flight was at high altitude (>220m = above rotor height), 11 (9.64%) were at medium altitude (approximately within rotor height i.e. between 30m and 220m) and 102 (89.47%) were at a low altitude (below rotor height <30m). The passage rate for priority species over the VP areas (all flight heights) was 0.27 birds/hour. See Figure 48 below for the duration of flights within the VP areas for each species, at each height class.

For purposes of flight analyses, priority species recorded during VP watches were classified in two classes (see also statistical analysis, Appendix C of the Avifauna Report):

- 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. At the wind farm site, korhaans, bustards and larks 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. At the wind farm site, the diurnal raptor species that were recorded during VP watches were included in this class.

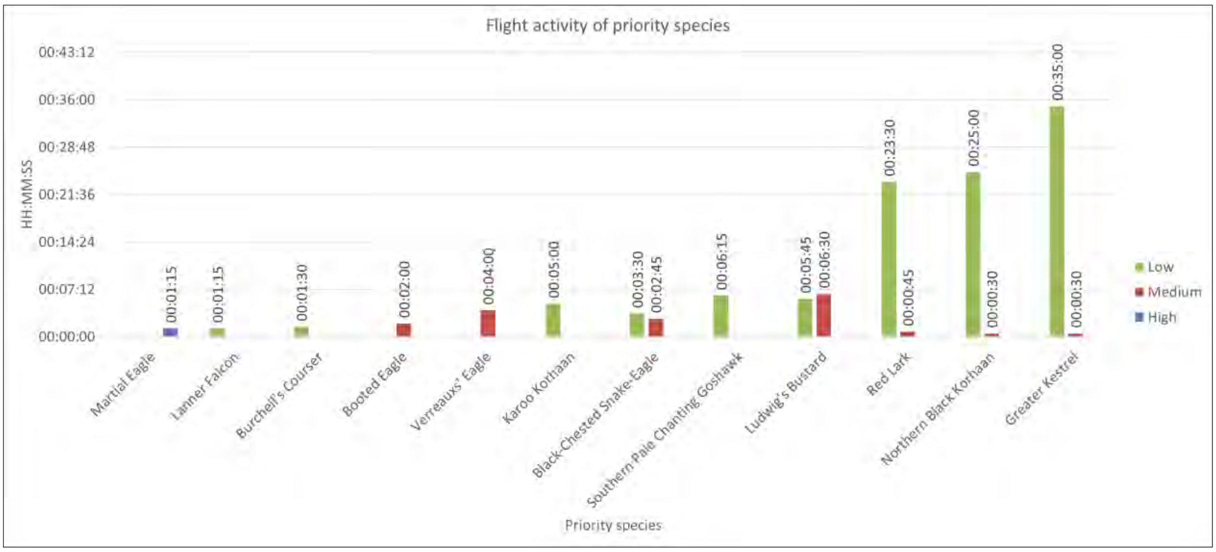



**Figure 48:** Flight duration and heights recorded for priority species (Y axis = hours: minutes: seconds). Duration (hours: minutes: seconds) are indicated on the bars. High/Blue/>220m, Medium/Red/30 to 220m, Low/Green/<30m.

- **Collision risk rating**

A site-specific collisions risk rating for each priority species recorded during VP watches was calculated to give an indication of the likelihood of an individual of the specific species to collide with the turbines. This was calculated taking into account the following factors:

- The duration of 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 planned number of turbines.

This was done in order to gain some understanding of which species are likely to be most at risk of collision at these specific sites. The formula used is as follows:

*Duration of medium height flights (decimal hours) x collision susceptibility calculated as the sum of morphology and behaviour ratings x number of planned turbines ÷100.*

The results are displayed in Table 35 and Figure 49 below.

**Table 35:** Site specific collision risk rating for all priority species recorded during VP watches at the development areas.

| Species | Duration of flights (hr) | Collision rating | No of turbines | Risk rating |
|---|---|---|---|---|
| Lanner Falcon | 0.00 | 85 | 280 | 0.00 |
| Southern Pale Chanting Goshawk | 0.00 | 65 | 280 | 0.00 |
| Martial Eagle | 0.00 | 90 | 280 | 0.00 |
| Burchell's Courser | 0.00 | 35 | 280 | 0.00 |
| Sclater's Lark | 0.00 | 45 | 280 | 0.00 |
| Karoo Korhaan | 0.00 | 60 | 280 | 0.00 |
| Greater Kestrel | 0.01 | 52 | 280 | 1.21 |
| Red Lark | 0.01 | 35 | 280 | 1.23 |
| Northern Black Korhaan | 0.01 | 55 | 280 | 1.28 |
| Booted Eagle | 0.03 | 80 | 280 | 7.47 |
| Black-Chested Snake-Eagle | 0.05 | 80 | 280 | 10.27 |
| Verreauxs' Eagle | 0.07 | 110 | 280 | 20.53 |
| Ludwig's Bustard | 0.11 | 80 | 280 | 24.27 |
| Average | 0.02 | 67.08 | 280 | 5.10 |

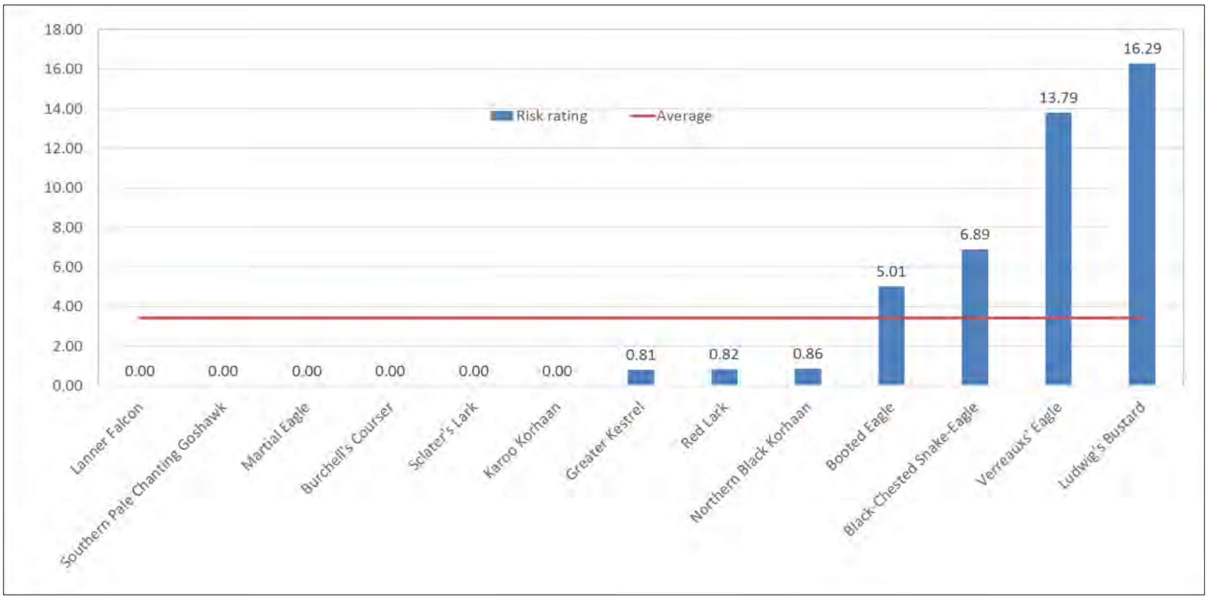


**Figure 49:** Collision risk rating for priority species.

- **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 (see Appendix C of the Avifauna Report) illustrate that the pre-construction survey may be taken to be statistically representative of the flight activity of the soaring and terrestrial priority species of birds that occur in the development areas. It has also been demonstrated that more samples would not yield a meaningful improvement in the accuracy and precision of the results.

See Appendix C of the Avifauna Report for a detailed explanation of the statistical methods.

- **Spatial distribution of flight activity**

Flight maps were prepared, indicating the spatial distribution of passages of those priority species which emerged with higher than average collision risk ratings i.e. Ludwig's Bustard, Verreaux's Eagle, Black-chested Snake-Eagle and Booted Eagle as observed from the various vantage points (see Figure 50 - Figure 53 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 i.e. the "High" category on the map for Ludwig's Bustard is not equivalent to the "High" category on the map for Booted Eagle, as the flight duration for Ludwig's Bustard is much higher than the flight duration for Booted Eagle.

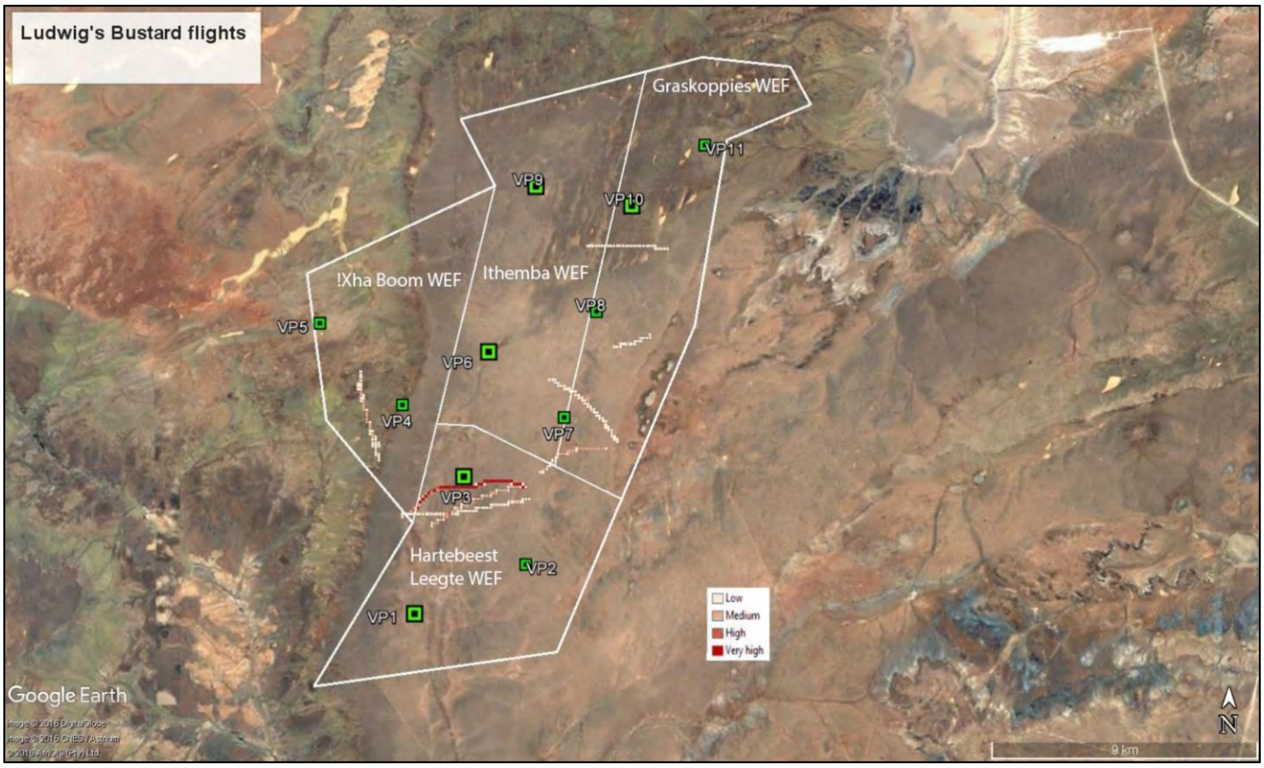



**Figure 50:** Spatial distribution and intensity of flights of Ludwig's Bustard. The green squares indicate the location of vantage points.

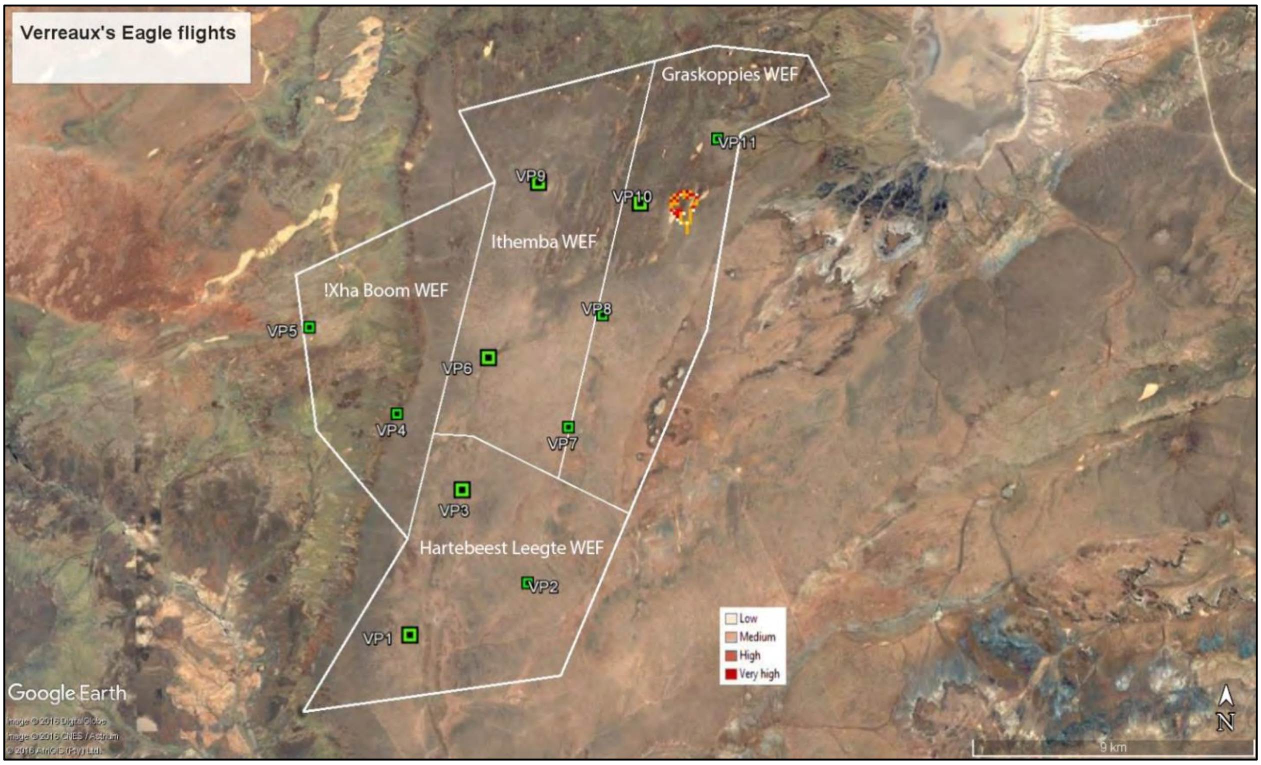



**Figure 51:** Spatial distribution and flight intensity of Verreaux's Eagle flights. The green squares indicate the location of vantage points.

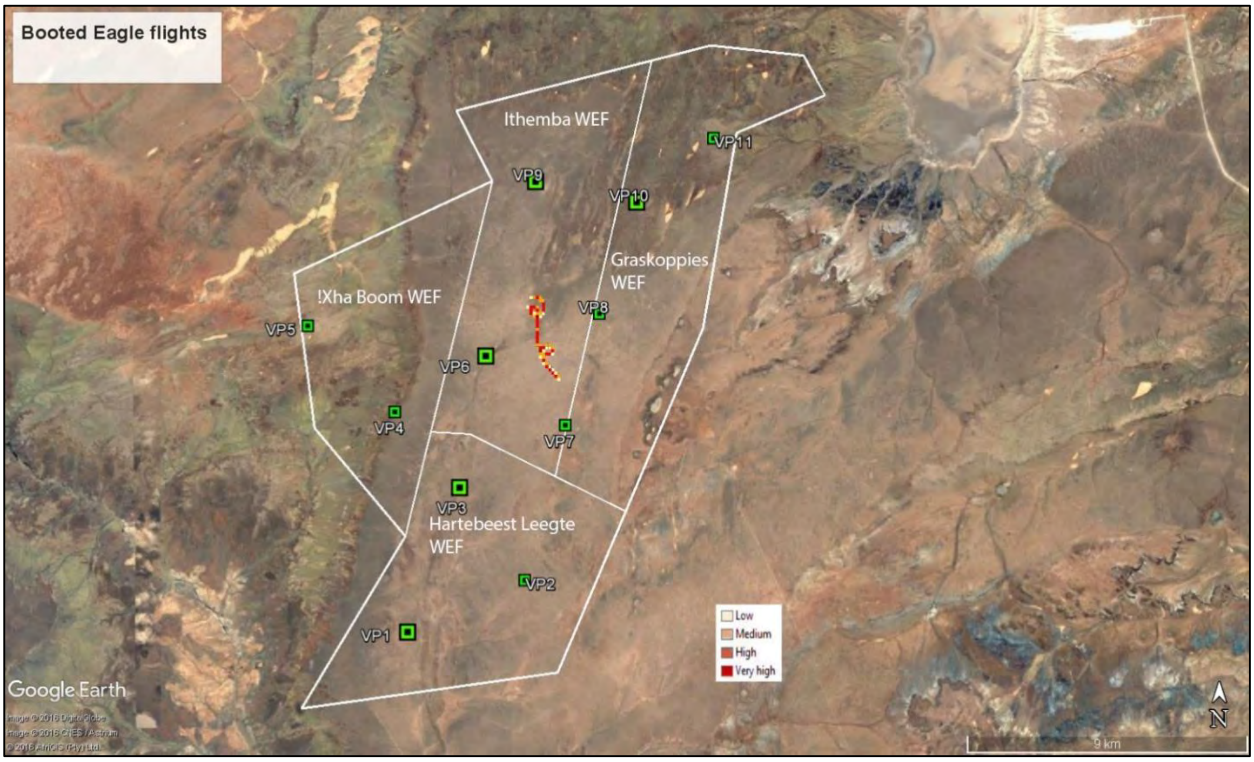



**Figure 52:** Spatial distribution and flight intensity of Booted Eagle flights. The green squares indicate the location of vantage points.

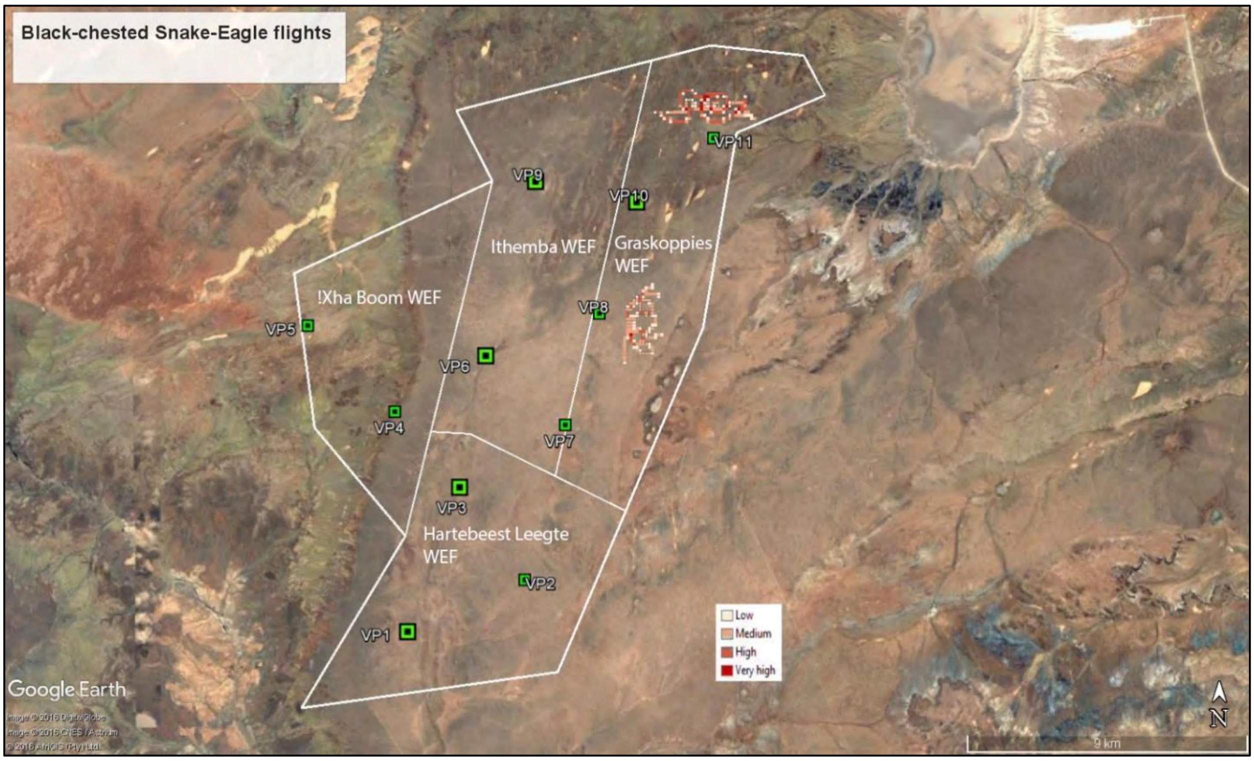



**Figure 53:** Spatial distribution and flight intensity of Black-chested Snake-Eagle flights. The green squares indicate the location of vantage points.

### 8.2.4 *Focal points*

Two (2) focal points (FP1 and FP2) of potential bird activity were monitored at the development area, and two (FP3 and FP4) outside the development area (see Appendix A of the Avifauna Report):

- FP1: A borehole. In the winter of 2016 a solitary adult Verreaux's Eagle was recorded at the borehole, confirming the importance of the water troughs to raptors.
- FP2: Die Soutkomme pans. The pans were dry for the duration of the monitoring; therefore, no priority species were observed.
- FP3: A borehole. In the winter of 2016 a pair of Greater Kestrels nested in the windmill.
- FP4: Konnes se Pan. The pan was dry for the duration of the monitoring. According to a local landowner the pan very seldom holds water, on average about once in a decade.

### 8.2.5 *Description of Expected Impacts*

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):

- Collision mortality on the wind turbines;
- Displacement due to disturbance during construction and operation of the wind farm;
- Displacement due to habitat change and loss;
- Electrocution of priority species on the internal medium voltage (MV) powerlines;
- Collision with the proposed power line grid connections; and
- Displacement due to disturbance during the construction of the power line grid connection.

It is important to note that the assessment is made on the status quo as it is currently on site. The 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.

#### 8.2.5.1 **<u>Collision mortality on wind turbines</u>**

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 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). A deep 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.

*8.2.5.1.1 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.

<u>!Xha Boom WEF</u>
Priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are Northern Black Korhaan, Karoo Korhaan, Kori Bustard and Ludwig's Bustard.

- **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).

<u>!Xha Boom WEF</u>
Many of the priority species at the proposed wind farm probably have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the bustards, korhaans and passerines. 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.

- **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).

<u>!Xha Boom WEF</u>
The priority species recorded at the site during the 12 months monitoring are mostly resident species. Exceptions are Yellow-billed Kite, which is an intra-African breeding migrant, and Booted Eagle which is a both an intra – African migrant and a Palaearctic migrant. Ludwig’s Bustard could be considered a seasonal partial migrant (Shaw 2013).

- **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).

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).

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).

<u>!Xha Boom WEF</u>
The priority species at the wind farm can be classified as either terrestrial species or soaring species, with some, e.g. Secretarybird exhibiting both types of flight behaviour.

Terrestrial species 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. At the wind farm site, korhaans, bustards and larks are included in this category. Some larger species undertake longer distance flights at higher altitudes (especially Ludwig's Bustard). Soaring species spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering and gliding at medium to high altitudes. At the wind farm site, the raptor species are included in this class. Based on the potential time spent potentially flying at rotor height, soaring species are usually at greater risk of collision.

However, specific behaviour of some terrestrial species might put them at risk of collision, e.g. display flights of Northern Black Korhaan and specifically the endemic Red Lark, might place them within the rotor swept zone.

Red Larks conduct display flights when breeding, which is opportunistic and can happen at any time following rains – most breeding activity takes place between August and May (Hockey *et al.* 2005).

Birdlife SA has recently released figures of birds killed at wind farms in South Africa. To date, a total of seven collision mortalities of Red-capped Larks *Calandrella cinerea* have been recorded at one wind farm (Ralston *in litt* 2016). These collisions most likely happened during display flights which are very similar to those performed by Red Larks. In order to get a measure of the collision risk posed to Red Larks by wind turbines, an analysis was done of display flights recorded at three potential wind farm sites during February and March 2016, following good rains (Van Rooyen & Froneman 2016). A total of 82 display flights was observed and the maximum height of the bird was visually judged and recorded. An analysis of the flights is set out below in Figure 54 and Figure 55.

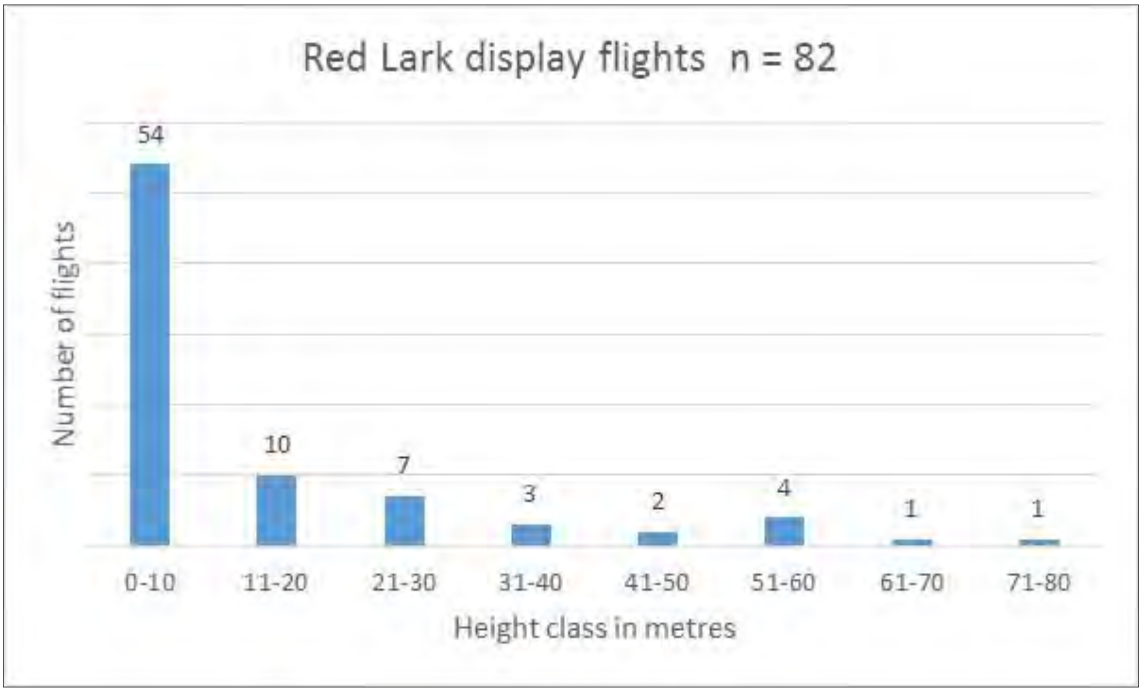



**Figure 54:** The number of Red Lark flights recorded at three proposed wind farm sites, broken down into height classes.

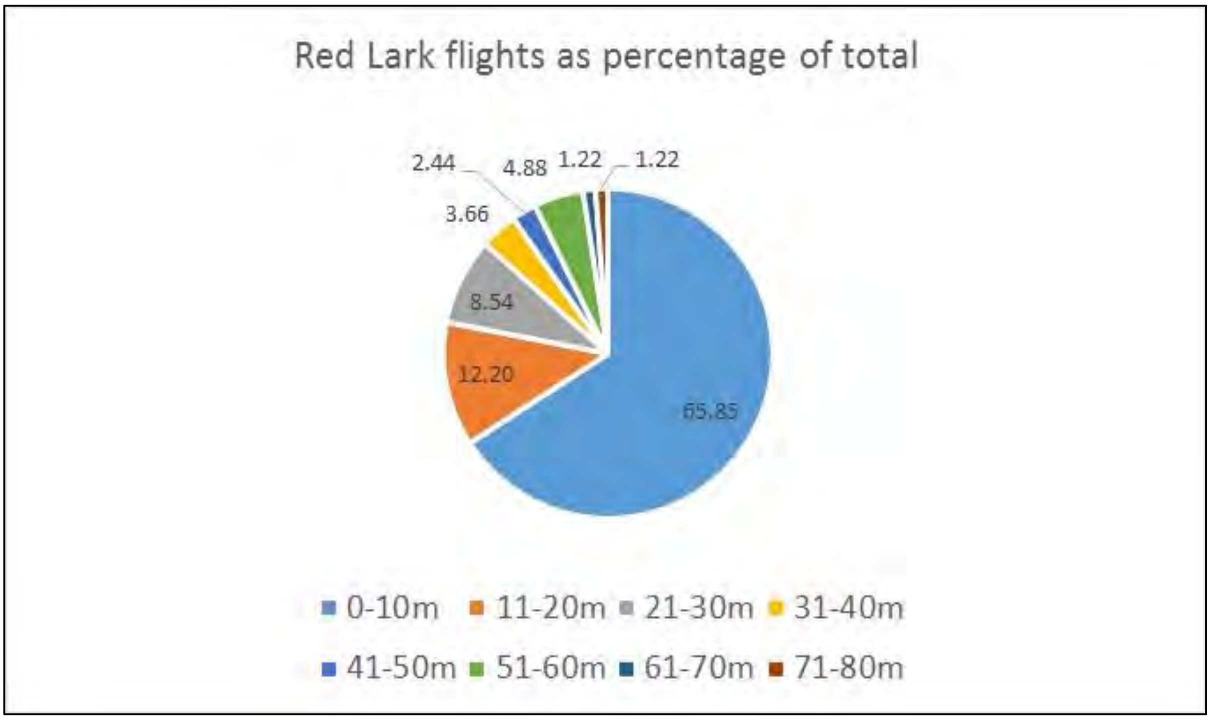



**Figure 55:** The number of Red Lark flights recorded at three proposed wind farm sites, broken down into percentages.

From the analysis of the dataset of 82 flights, the following emerged:

- 86.59% of display flights were 30m or lower,
- 90.24% were 40m or lower,
- 92.68% were 50m or lower, and
- 97.56% were 60m or lower.

The key issue as far as Red Larks is concerned is therefore the lower tip height.

The densities of the species in the study area is fairly low with a maximum density of 0.28 birds/km recorded during walk transects, compared to 2.33 birds/km in optimal habitat (Bio 3, 2013). Given the low densities of the birds at the site, it is likely that the habitat at the site i.e. a mixture of small-leaved shrubs and shrubby succulents, with drought resistant grasses, is not optimal for the species. The optimal habitat of the species is red sand dunes and sandy plains with scattered large seeded grasses, as is found in the Koa Valley about 50km to the north of the site (Hockey *et al*. 2005). Given the relatively low densities of the species at the site, mortalities at the site are not expected to significantly impact on the national population. It should also be pointed out that the assumption that Red Larks will be vulnerable to collisions is based on the behaviour of a different species. It could turn out that Red Larks for reasons as yet unknown, may not have the same vulnerability. Ideally a minimum rotor tip height of 50m should be used, and combined with rigorous post-construction monitoring and a commitment from the site operator to implement curtailment during periods of high flight activity, e.g. after good rains which triggers breeding activity, should significant mortality be recorded.

- **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 (see also section 6.2 of the Avifuana Impact Report).

<u>!Xha Boom WEF site</u>
It is anticipated that most birds at the proposed wind farm will successfully avoid the wind turbines. Possible exceptions might be raptors engaged in hunting which might serve to distract them and place them at risk of collision (e.g. Jackal Buzzard), or birds engaged in display behaviour, e.g. Red Lark (see earlier discussion). Despite being potential collision candidates based on morphology and flight behaviour, bustards do not seem to be particularly vulnerable to wind turbine collisions, indicating a high avoidance rate. Complete macro-avoidance of the wind farm is unlikely for any of the priority species.

- **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). 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).

!Xha Boom WEF

The overall density of priority species recorded at the WEF sites was low at 0.74 birds/km for drive transects and 0.9 birds/km for walk transects. However, the abundance of priority species at the proposed wind farm site could 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. In general, higher populations of priority species are likely to be present when the veld conditions are good, especially in the rainy season, which could trigger breeding activity. This could increase the risk of collisions due to heightened flight activity, especially of species such as Red Lark. Conversely, some species might be more at risk during dry conditions, e.g. Sclater's Lark which seems to increase in numbers during dry spells (Hockey *et al.* 2005).

*8.2.5.1.2 Site-specific factors*

- **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.

!Xha Boom WEF

The proposed WEF sites do not contain many landscape features as the development area is situated on a vast flat plain. There are no natural waterbodies at the sites themselves, but several boreholes with water troughs. Boreholes with open water troughs are important sources of surface water and are used by various species, including large raptors such as Martial Eagle and Verreaux's Eagle, to drink and bath. Apart from raptors, smaller species congregate in large numbers around water troughs which in turn could attract raptors such as Lanner Falcon and Southern Pale Chanting Goshawk exposing them to collisions when they are distracted and hunting. It would therefore be advisable to create a pre-cautionary no-turbine zone around all water points, including water troughs at boreholes.

- **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 5858 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.

<u>!Xha Boom WEF</u>
The proposed windfarm site is not located on any known or obvious flight paths. Visual inspection of the flight activity of the four species which had above average risk ratings, do not indicate any specific pattern for Booted Eagle and Black-chested Snake-Eagle with flights randomly distributed (see Figures 10-14 of the Avifauna Report). An area of potential denser flight activity is around water points, which could regularly attract several priority species, especially large raptors, as is possibly the case with the Verreaux's Eagle flights which were recorded in the vicinity of FP1. The Ludwig's Bustard flights show a broad east – west pattern, which could possibly be linked to the annual movement between the Nama and Succulent Karoo (Allan 1994, Shaw 2013).

- **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 availability of food (Smallie 2015).

<u>!Xha Boom WEF</u>
In 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 such as Ludwig's Bustard, Kori Bustard and various raptors (pers obs). This in turn could heighten the risk of collisions. Exceptional rain events may result in the Konnes se Pan holding water for a brief period. During such times the pan may attract waterbirds, including flamingos. Due to the very arid nature of the area, this is likely to be a very rare event, probably not more than once a decade.

- **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).

<u>!Xha Boom WEF</u>
Weather conditions at the proposed wind farm are likely to influence flight behaviour of soaring species in much the same manner as has been recorded elsewhere at wind farms. There is some indication that flight activity for all priority species (both soaring and terrestrial) is most prevalent during light to gentle breezes (see Appendix C of the Avifauna Report).

*8.2.5.1.3 Wind farm-specific factors*

- **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). Only two studies so far found a correlation between turbine hub height and mortality (De Lucas *et al.* 2008; Loss *et al.* 2013).

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.

<u>!Xha Boom WEF</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 to incorporate a wide range of models, based on feedback received from the client.

- **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.

<u>!Xha Boom WEF</u>
Motion smear is inherent to all wind turbines and will therefore also be a potential risk factor at the proposed wind farm.

- **Wind farm configuration**

Wind farm layout 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 farms 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).

<u>!Xha Boom WEF</u>
The recorded flight behaviour of priority species at the proposed wind farm provided few clues with regard to potential areas of greater risk, largely due to the low frequency of flights, and uniformity of habitat. Turbine-free buffer zones are recommended around water points with surface water, based on the potential bird activity around these focal points.

#### 8.2.5.2 <u>Displacement due to disturbance</u>

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance in effect can amount to habitat loss. Displacement may occur during both the construction and operational phases of wind farms, and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. 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 600 m 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.

<u>!Xha Boom WEF</u>

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 replacement is larger for large species such as Kori Bustard and Ludwig's Bustard, 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 pers. comm). If the wind farm follows the modern trend of fewer, larger turbines (which seems to be the case), the risk of displacement due to disturbance is also lower. However, this will only be conclusively established through a post-construction monitoring programme.

#### 8.2.5.3 <u>Displacement due to habitat loss</u>

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), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). 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 (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), 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 was 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).

<u>!Xha Boom WEF</u>

The direct habitat transformation at the proposed wind farm is likely to be fairly minimal. The indirect habitat transformation could potentially have a bigger impact on priority species. It is expected that the densities of some larger terrestrial priority species may decrease due to this impact, e.g. Ludwig's Bustard, Karoo Korhaan and Northern Back Korhaan, but complete displacement is unlikely. The degree of displacement will only become apparent through post-construction monitoring.  It is unlikely that raptors will be affected at all.

An issue that needs to be investigated is the potential of Red Lark displacement by the habitat transformation which will take place as a result of the proposed wind farms, due to the fact that the species is a range-restricted endemic. In a comprehensive study Hötker *et al.* 2006 calculated the following minimum turbine avoidance distances for several species, based on the analyses of a number of studies (see Table 36):

**Table 36:** Minimal distances (in metre) to wind farms in studies of different bird species as per Hötker *et al*. 2006

| Species | | Number of studies | Median | Mean | SD |
|---|---|---|---|---|---|
| **Breeding season** | | | | | |
| Mallard | *Anas platyrhynchos* | 8 | 113 | 103 | 56 |
| Black-tailed godwit | *Limosa limosa* | 5 | 300 | 436 | 357 |
| Oystercatcher | *Haematopus ostralegus* | 8 | 25 | 85 | 113 |
| Lapwing | *Vanellus vanellus* | 13 | 100 | 108 | 110 |
| Redshank | *Tringa totanus* | 6 | 188 | 183 | 111 |
| Skylark | *Alauda arvensis* | 20 | 100 | 93 | 71 |
| Meadow pipit | *Anthus pratensis* | 9 | 0 | 41 | 53 |
| Yellow wagtail | *Motacilla flava* | 7 | 50 | 89 | 107 |
| Blackbird | *Turdus merula* | 5 | 100 | 82 | 76 |
| Willow warbler | *Phylloscopus trochilus* | 5 | 50 | 42 | 40 |
| Chiffchaff | *Phylloscopus collybita* | 5 | 50 | 42 | 40 |
| Sedge warbler | *Acrocephalus schoenobaenus* | 7 | 0 | 14 | 24 |
| Reed warbler | *Acrocephalus scirpaceus* | 11 | 25 | 56 | 70 |
| Marsh warbler | *Acrocephalus palustris* | 9 | 25 | 56 | 68 |
| Whitethroat | *Sylvia communis* | 9 | 100 | 79 | 65 |
| Reed bunting | *Emberiza schoeniclus* | 13 | 25 | 56 | 70 |
| Linnet | *Carduelis cannabina* | 5 | 125 | 135 | 29 |
| | | | | | |
| **Non-breeding season** | | | | | |
| Grey heron | *Ardea cinerea* | 6 | 30 | 65 | 97 |
| Wigeon | *Anas penelope* | 9 | 300 | 311 | 163 |
| Swan spp. | | 8 | 125 | 150 | 139 |
| Goose spp. | | 13 | 300 | 373 | 226 |
| Mallard | *Anas platyrhynchos* | 9 | 200 | 161 | 139 |
| Diving ducks | | 12 | 213 | 219 | 122 |
| Common buzzard | *Buteo buteo* | 15 | 25 | 50 | 53 |
| Kestrel | *Falco tinnunculus* | 14 | 0 | 26 | 45 |
| Curlew | *Numenius arquata* | 24 | 190 | 212 | 176 |
| Oystercatcher | *Haematopus ostralegus* | 6 | 15 | 55 | 81 |
| Lapwing | *Vanellus vanellus* | 32 | 135 | 260 | 410 |
| Common snipe | *Gallinago gallinago* | 5 | 300 | 403 | 221 |
| Golden plover | *Pluvialis apricaria* | 22 | 135 | 175 | 167 |
| Woodpigeon | *Columba palumbus* | 5 | 100 | 160 | 195 |
| Common gull | *Larus canus* | 6 | 50 | 113 | 151 |
| Black-headed gull | *Larus ridibundus* | 15 | 0 | 97 | 211 |
| Skylark | *Alauda arvensis* | 6 | 0 | 38 | 59 |
| Starling | *Sturnus vulgaris* | 16 | 0 | 30 | 54 |
| Carrion crow | *Corvus corone* | 16 | 0 | 53 | 103 |

Based on the above figures, it seems that the mean minimum avoidance distances for breeding passerines are generally <100m from a wind turbine - see Skylark, Meadow pipit, Yellow Wagtail, Blackbird, Willow Warbler, Chiffchaff, Sedge Warbler, Reed Warbler, Marsh Warbler, Whitethroat and Reed Bunting. It is obviously not known if Red Lark will respond in a similar way to turbines, but it could probably be assumed that their reaction should not be drastically different from the passerines listed above.

There are currently 280 turbines planned for the four WEFs. If a 100m radius is drawn around each turbine and it be assumed that Red Larks will avoid this area, it means that an area of approximately 882 hectares could potentially experience reduced usage of or even complete avoidance by the species. For non-breeding skylarks and starlings, the minimum avoidance distances are considerably smaller i.e. <40m (based on 21 studies). If these are indicative of passerines in general, it would mean displacement of non-breeding Red Larks from an area of about 140 hectares. Dean *et al.* 1991 estimated the total suitable dune habitat for Red Larks at about 140 000 ha, centred around the Koa Valley. This figure is probably too conservative for the following reasons:

- Dean makes the following statement in the Red Lark SABAP 1 species account (Harrison *et al*. 1997)" …. atlas records, particularly in the eastern parts of its range, suggest it may be more common and widespread than previously thought"
- Red Larks are regularly recorded in what would be considered sub-optimal habitat e.g. at other wind farm sites near Helios MTS in Bushmanland Basin Shrubland (Van Rooyen *et al.* 2014a and b). The implication of this is that the species is in all likelihood more common outside of typical dune habitat than was previously thought. It seems that Bushmanland Basin Shrubland, of which a total of more than 3 million hectares is contained within the distribution range of the Red Lark, could potentially contain much larger numbers of the species than has been assumed up to now, especially in areas with an abundance of "white grasses".

There seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pearce 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). Of course, it cannot be assumed that Red Larks will show the same behavioural traits, but it is nonetheless interesting that seemingly conflicting evidence is emerging i.e. evidence of turbine avoidance by passerines, yet no declines at population level.

For the reasons stated above it would seem that the global population of Red Larks should be able to absorb the potential displacement impacts of the !Xha Boom WEF

#### 8.2.5.4 Electrocution of priority species on the internal MV powerlines

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design and the size of the bird. Species most at risk of electrocution are large raptors and vultures.

!Xha Boom WEF

The species most at risk of electrocution on the internal overhead MV powerline network are the large raptors, particularly Martial Eagle and Verreaux's Eagle. Although the majority of the lines will be underground, there might be small sections e.g. those crossing drainage lines, which will be overhead.

### 8.2.6 Addendum to the Avifaunal Impact Assessment

The original turbine dimensions on which the collision risk index for the four development areas was calculated were a hub height of up to 150m and a rotor diameter of up to 150m. Mainstream has however subsequently decided to change the turbine dimensions to a hub height of up to 160m and a rotor diameter of up to 160m. As such, an addendum report was compiled in order to assess whether the conclusions and recommendations of the original Bird Impact Assessment Report compiled for the Graskoppies Wind Farm in December 2016 will be affected by the proposed change in the turbine dimensions. The addendum report is included in **Appendix 6B**.

Based on this addendum report, the conclusions and recommendations of the original Bird Impact Assessment Report remains unchanged by the proposed change in turbine dimensions. The reason for that are as follows:

- While the risk rating for Martial Eagle has increased with the new turbine dimensions, it is still below the average risk rating for priority species;
- The overall risk rating for priority species has increased by only 7.45%;
- The weight of published findings indicate that rotor swept area as a stand-alone issue is not a key factor in determining collision risk.

## 8.3 Bats

### 8.3.1 Transects

- **First Site Visit**

Transects were not carried out over the first site visit due to time constraints as a result from the installation of the monitoring systems. Further transects will be carried out over the following site visits.

- **Second Site Visit**

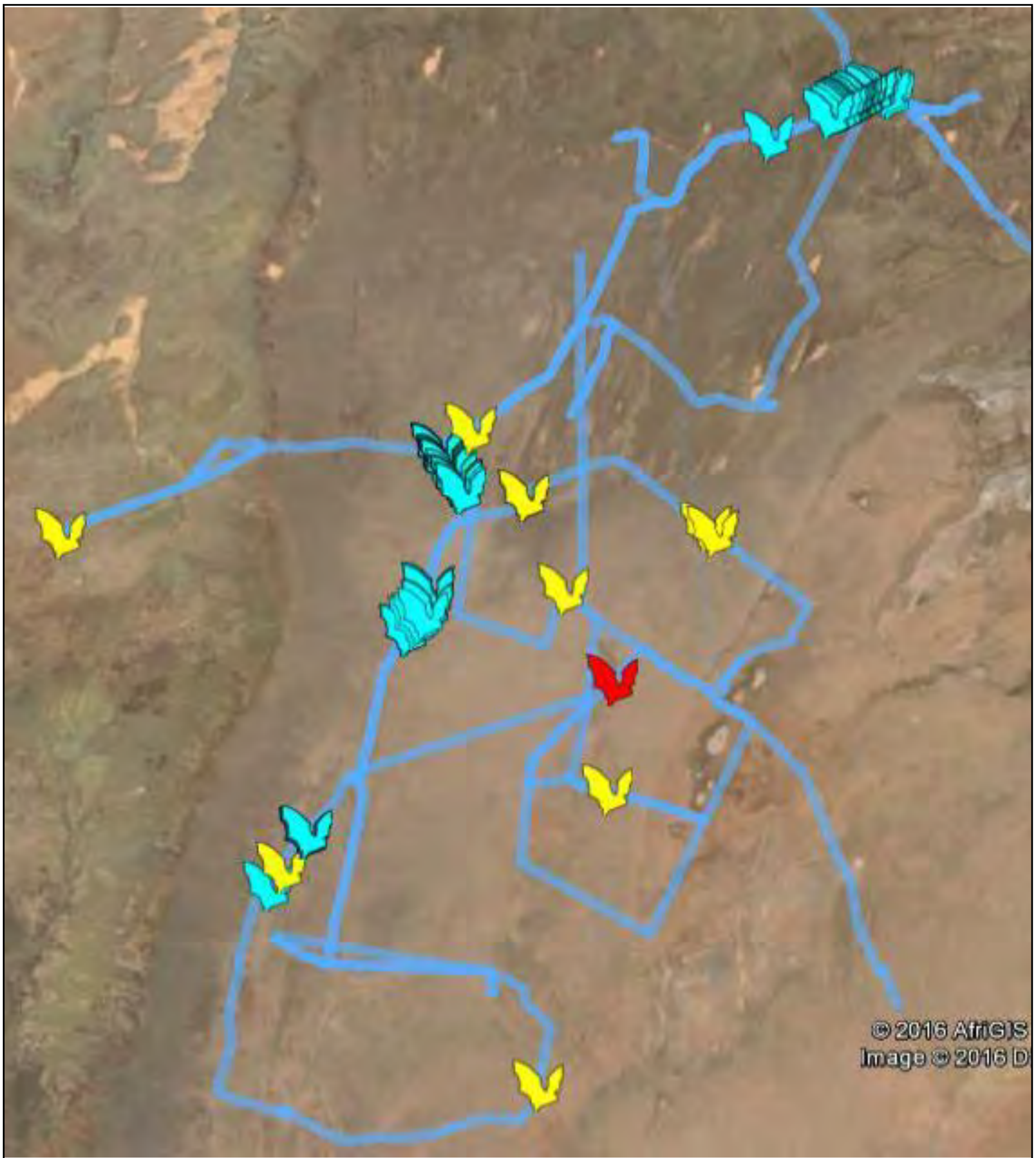
Transect data was used to analyse the accuracy of the bat sensitivity map. Large amounts of bat activity were recorded in the north and west of the site.

**Figure 56** below indicates the transect routes during the second site visit. Transect routes were not calculated and were carried out randomly based on available access to the farms and condition of the farm roads. The SM2BAT+ Real time expansion type detector was used. **Table 37** displays the sampling effort and weather conditions prevalent during transect surveys.

**Table 37:** Transect distance, duration and average weather conditions experienced during the second site visit transect

| Date | Distance (km) | Duration (hours and minutes) | Temperature (˚C) | Rain (mm) | Wind speed (km/h) |
|---|---|---|---|---|---|
| 14 February 2016 | 22.7 | 1hr 40min | 20 | 0 | 14.5 |

| | | | | | |
|---|---|---|---|---|---|
| 15 February 2016 | 28.2 | 1hr 55 min | 23 | 0 | 14.5 |
| 16 February 2016 | 24.9 | 2hr 15min | 28 | 0 | 9.7 |
| 17 February 2016 | 25.5 | 2hr 0min | 29 | 0 | 19.3 |




*Tadarida aegyptiaca* *Miniopterus natalensis* *Neoromicia capensis*

Transect track

**Figure 56:** Transect routes and bat passes detected across the site over the second site visit

- **Third Site Visit**

**Figure 57** below displays the results of the transects carried out over the April 2016 site visit. A high number of bat passes, specifically *Tadarida aegyptiaca*, was detected in the north and centre of the site. **Figure 58** displays the congregation of bats detected near the farm dams, indicating these water sources to be bat sensitive features. Only one night of transect data was collected due to problems with monitoring equipment and rain preventing site work.

**Figure 57** below indicates the transect routes during the third site visit. Transect routes were not calculated and were carried out randomly based on available access to the farms and condition of the farm roads. The SM2BAT+ Real time expansion type detector was used. **Table 38** displays the sampling effort and weather conditions prevalent during transect survey.

**Table 38:** Transect distance, duration and average weather conditions experienced during the third site visit transect

| Date | Distance (km) | Duration (hours and minutes) | Temperature (˚C) | Rain (mm) | Wind speed (km/h) |
|---|---|---|---|---|---|
| 27 April 2016 | 73.58 | 3hr 50min | 21 | 0 | 4.82 |

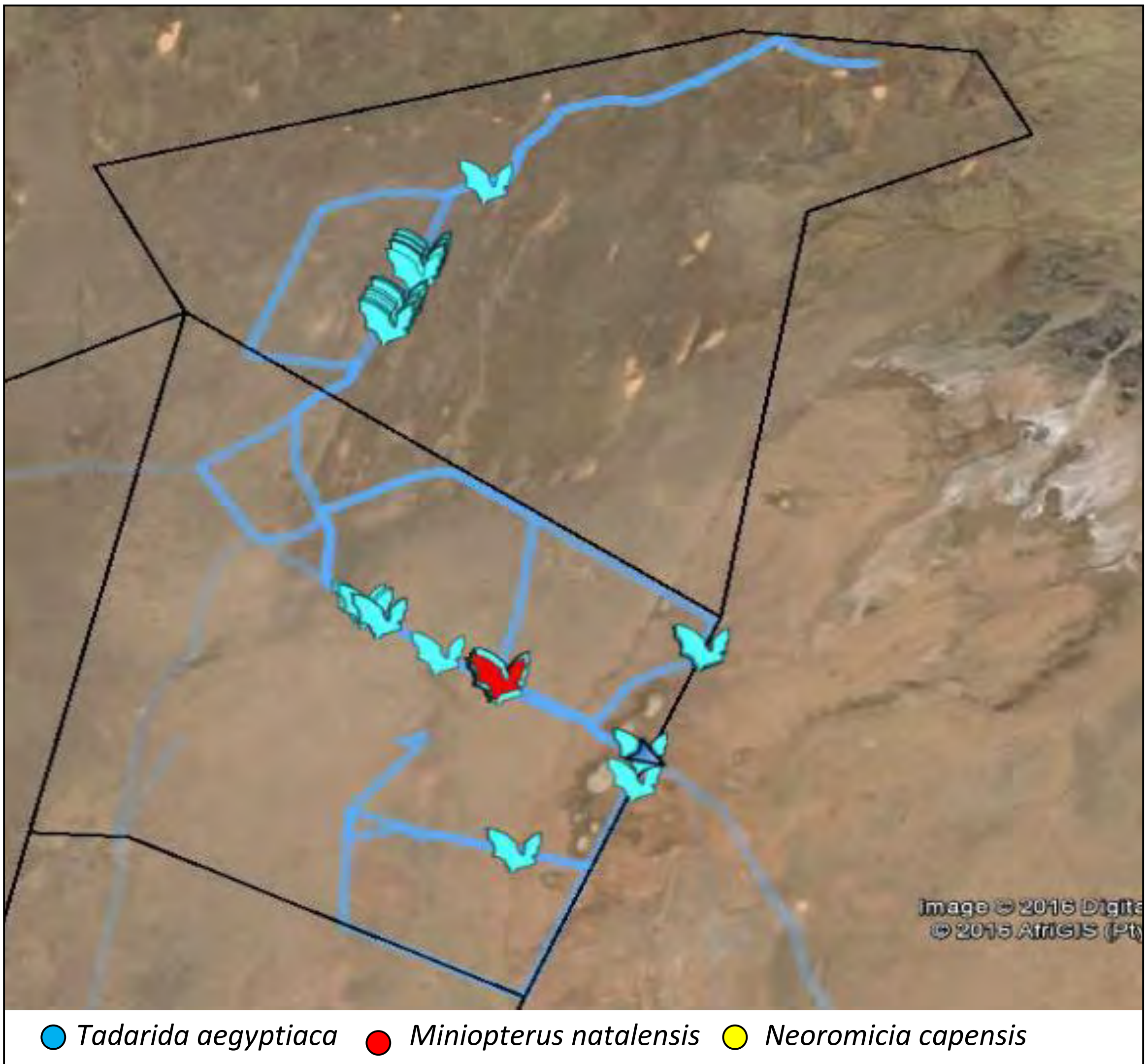



**Figure 57:** Transect routes and bat passes detected across the site over the third site visit

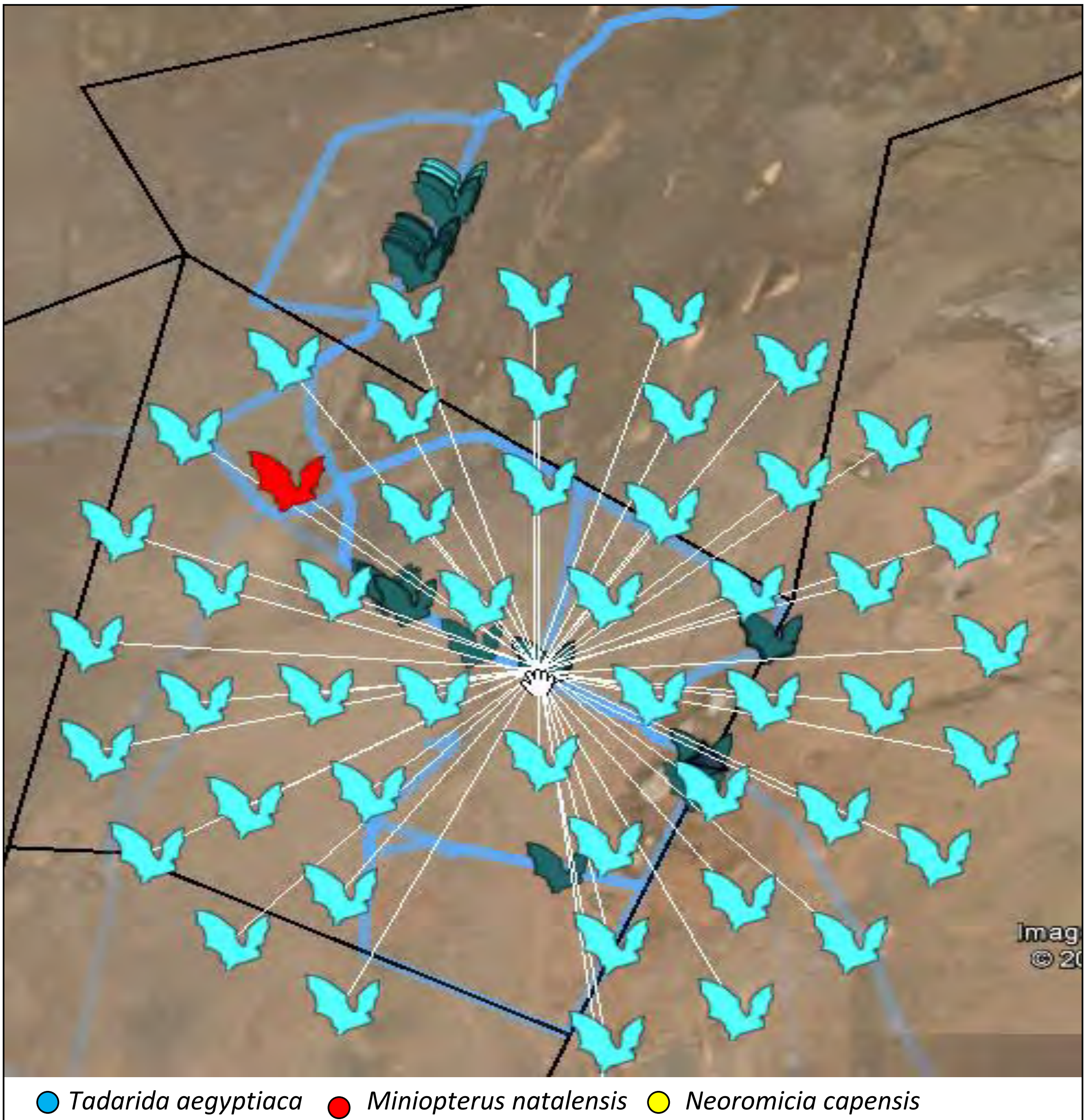



**Figure 58:** Large cluster of bats found during transects near the centre of the study area

- **Fourth Site Visit**

**Figure 59** below displays the results of the transects carried out over August - September 2016 site visit. A lower number of bat passes was detected throughout the site, with *Tadarida aegyptiaca* being the only species within the site. The low number could be due to the fact that the site visit occurred during the winter months.

**Figure 59** below indicates the transect routes during the fourth site visit.
**Table 39** displays the sampling effort and weather conditions prevalent during transect survey.

**Table 39:** Transect distance, duration and average weather conditions experienced during the fourth site visit transect

| Date | Distance (km) | Duration (hours and minutes) | Temperature (˚C) | Rain (mm) | Wind speed (km/h) |
|---|---|---|---|---|---|
| 31 Augustus 2016 | 74.6 | 5h 09min | 17 | 0 | 8.85 |
| 01 September 2016 | 93.9 | 5h 01min | 10 | 0 | 6.4 |
| 02 September 2016 | 65.3 | 3h 20min | 18.5 | 0 | 9.65 |

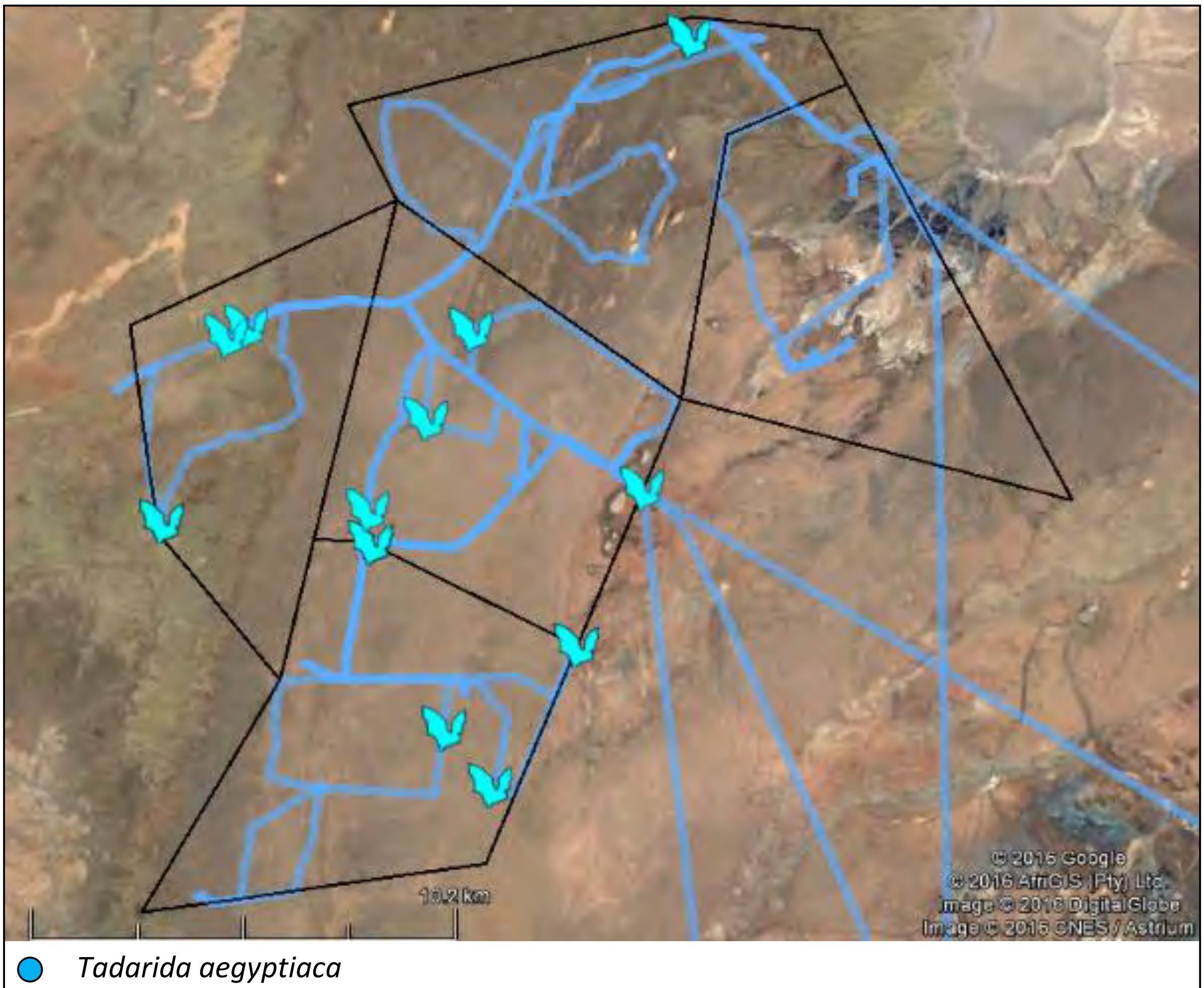



**Figure 59:** Transect routes and bat passes detected across the site over the fourth site visit

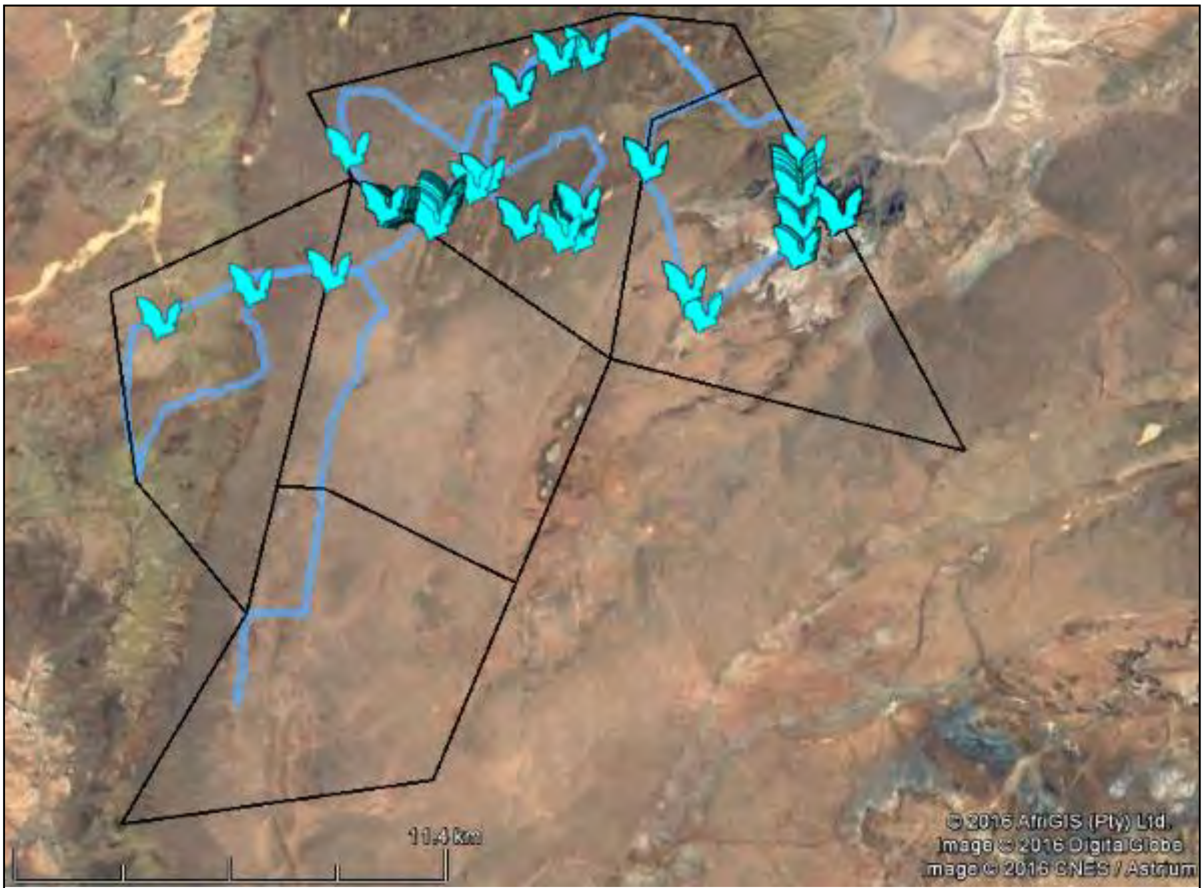
- **Fifth Site Visit**

**Figure 60** below displays the results of the transects carried out over November – December 2016 site visit. An increase in the number of bat passes was detected on the northern section of the site, with *Tadarida aegyptiaca* being the only species within the site. The increase in the number of bat passes could be due to the fact that the site visit occurred during the spring and summer months of the year. Unfortunately, due to unforeseeable circumstances only half of the site was driven during the transects.

**Figure 60** below indicates the transect routes during the fifth site visit. Transect routes were not calculated and were carried out randomly based on available access to the farms and condition of the farm roads. The SM2BAT+ Real time expansion type detector was used. **Table 40** displays the sampling effort and weather conditions prevalent during transect survey.

**Table 40:** Transect distance, duration and average weather conditions experienced during the fifth site visit transect

| Date | Distance (km) | Duration (hours and minutes) | Temperature (˚C) | Rain (mm) | Wind speed (km/h) |
|---|---|---|---|---|---|
| 29 November 2016 | 59.8 | 2h 46min | 28.5 | 0 | 13.7 |
| 01 December 2016 | 37.0 | 1h 48min | 27.0 | 0 | 13.7 |




*Tadarida aegyptiaca*

**Figure 60:** Transect routes and bat passes detected across the site over the fifth site visit

### *8.3.2 Sensitivity Map*

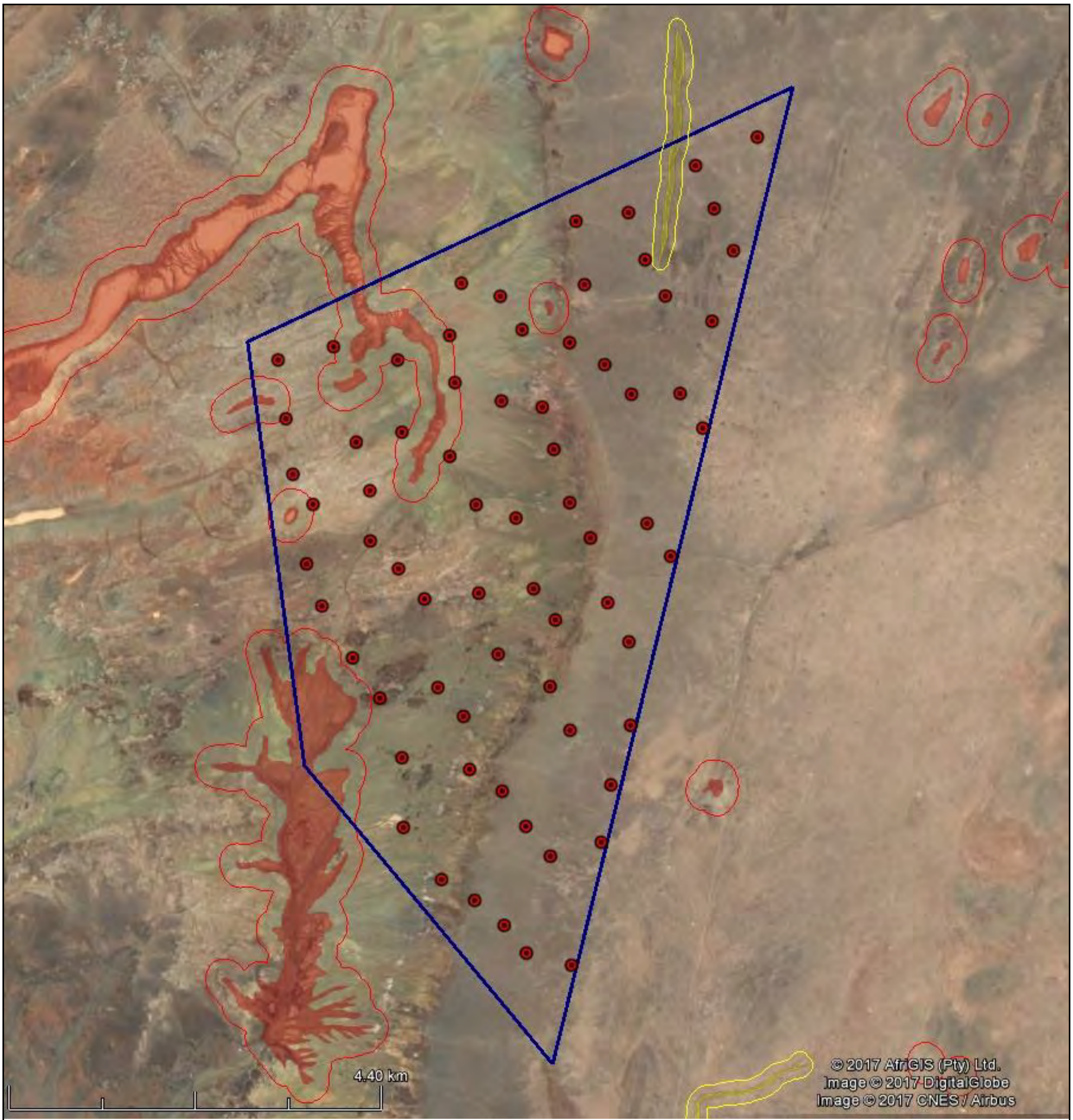
Figure 61 **-** Figure 62 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. Thus the sensitivity map is based on species ecology and habitat preferences. This map can be used as a pre-construction mitigation in terms of improving turbine placement with regards to bat preferred habitats on site.

| | |
|---|---|
| **Last iteration** | January 2016 |
| **High sensitivity buffer** | 200m |
| **Moderate sensitivity buffer** | 100m |
| **Features used to develop the sensitivity map** | Manmade structures, such as farm houses, barns, sheds, road culverts and mine adits, these structures provide easily accessible roosting sites. |
| | The presence of caves, rock faces, areas of exfoliating rock and clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. |
| | The different vegetation types and presence of riparian/water drainage habitat is used as indicators of probable foraging areas. |
| | Open water sources, be it man-made farm dams or natural streams and wetlands, are important sources of drinking water and provide habitat that host insect prey. |

The areas designated as having a High Bat Sensitivity (**Table 41**) implicates that no turbines should be placed in these areas and their respective buffer zones, due to the elevated impacts it can have on bat mortalities. **The layout has been amended by the proponent to ensure that no turbines are located within High or Moderate sensitivities or their buffers.**

**Table 41:** Description of sensitivity categories utilised in the sensitivity map

| Sensitivity | Description |
|---|---|
| Moderate Sensitivity | Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed. |
| High Sensitivity | Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are 'no-go' areas and turbines must not be placed in these areas. |




High bat sensitivity area
Moderate bat sensitivity area
High bat sensitivity buffer
Moderate bat sensitivity buffer

**Figure 61:** Bat sensitivity map of the study area.

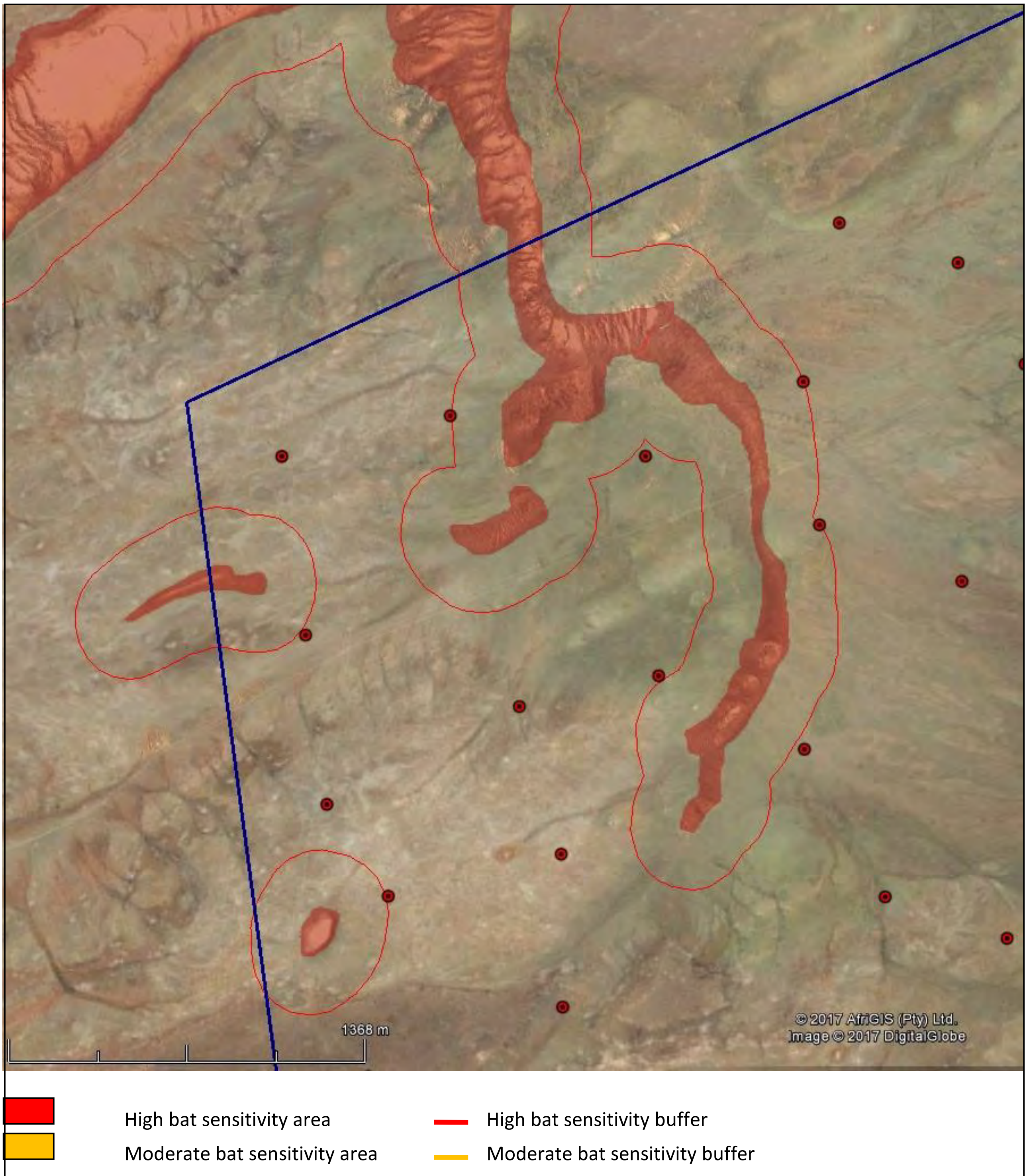



**Figure 62:** North-western part of the site indicating turbines to be outside of High sensitivity buffers.

### *8.3.3 Passive Data*

#### *8.3.3.1 Abundances and Composition of Bat Assemblages*

Average bat passes detected per bat detector night (nights on which detectors recorded correctly) and total number of bat passes detected over the monitoring period by all systems are displayed in **Figure 63-Figure 74**. Three (3) bat species were detected by the passive monitoring systems, namely, *Miniopterus natalensis, Neoromicia capensis,* and *Tadarida aegyptiaca.*

*Tadarida aegyptiaca* is the most abundant bat species recorded by all systems. Common and abundant species, such as *Neoromicia capensis, Tadarida aegyptiaca* and *Miniopterus natalensis*, are of a larger value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species due to their higher numbers.

*Miniopterus natalensis* is the only migratory species detected on site. It was detected by all the monitoring systems, with Short Mast 3 detecting the highest number of passes. The relative abundance of this species, as detected by the Short Mast 3 monitoring system, was over the months of January, March - April 2016, with it being highest in March 2016 (**Figure 72**). The results of the full 12 months monitoring study were analysed for the presence of a migratory event in order to determine whether the site is located within a migratory route. There is no indication of a migration event from any of the six monitoring systems. The operational phase bat monitoring study must be designed such that it continues to monitor for any evidence of a migration in order to effectively mitigate if such an event occurs in years to come.

Met Mast monitoring system indicates the highest amount of bat passes, followed by Short Mast 3 **(Figure 63** and **Figure 66)**.

Short Mast 2 shows a low sum of bat passes over the first three-month monitoring period due to a fault with the detector software causing the system to freeze and not record for the full monitoring period (**Figure 71**). Short Mast 1 had no data for the months of April, June, and July 2016 due to system failures (**Figure 70**).

The average nightly bat passes per month is used to show the general trend in bat activity across the different month of the year. All the masts show higher bat activity from January to April with predominant peaks for the month of March, except for Short Mast 4 which has a peak in January 2016 (**Figure 69–Figure 74**), except for Short Mast 2 which was not recording during January as explained above. Bat activity decreased as the seasons changed into winter. An increase in bat activity, for all the monitoring systems, occurred again from August to November as the seasons changed from winter to spring.

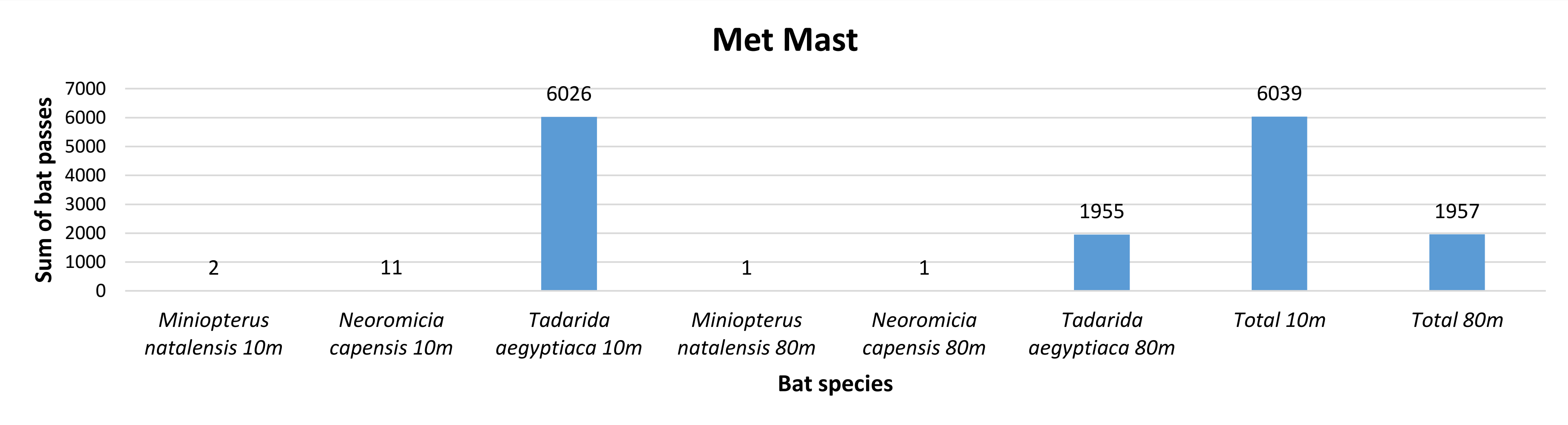



**Figure 63:** Total bat passes recorded over the monitoring period by the detector mounted on the Met Mast.

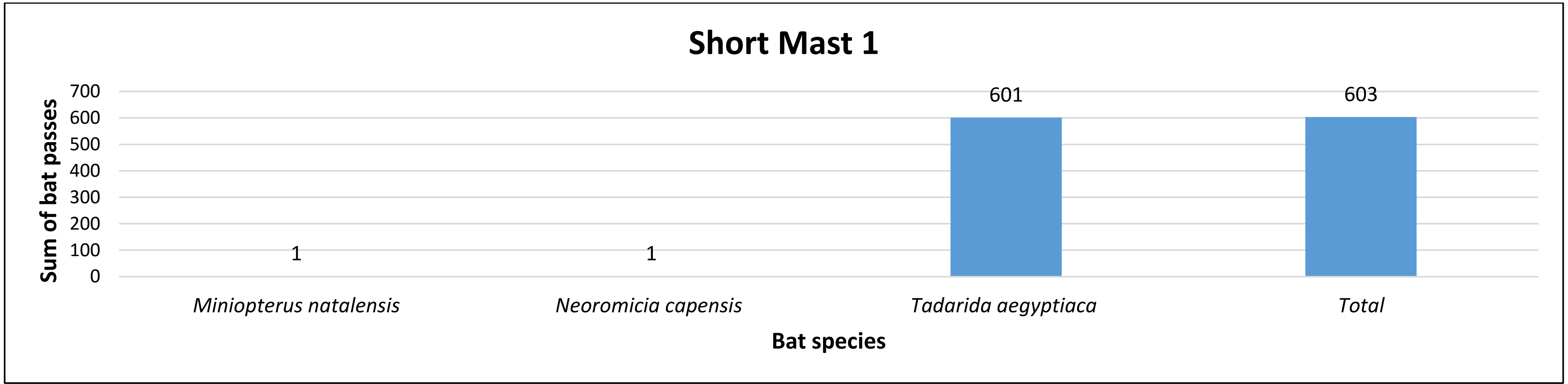



**Figure 64:** Total bat passes recorded over the monitoring period by the detector mounted on Short Mast 1.

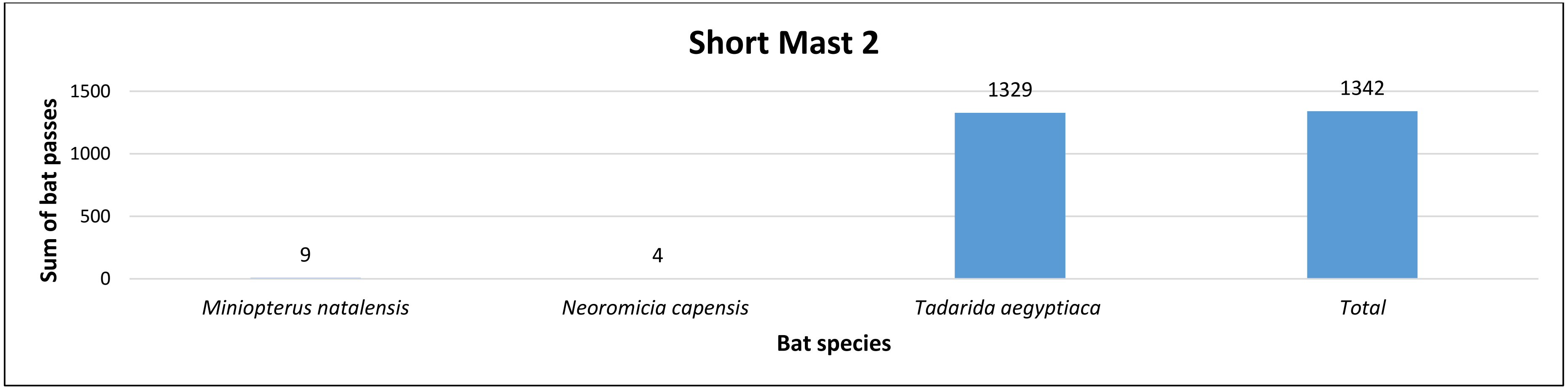



**Figure 65:** Total bat passes recorded over the monitoring period by the detector mounted on Short Mast 2.

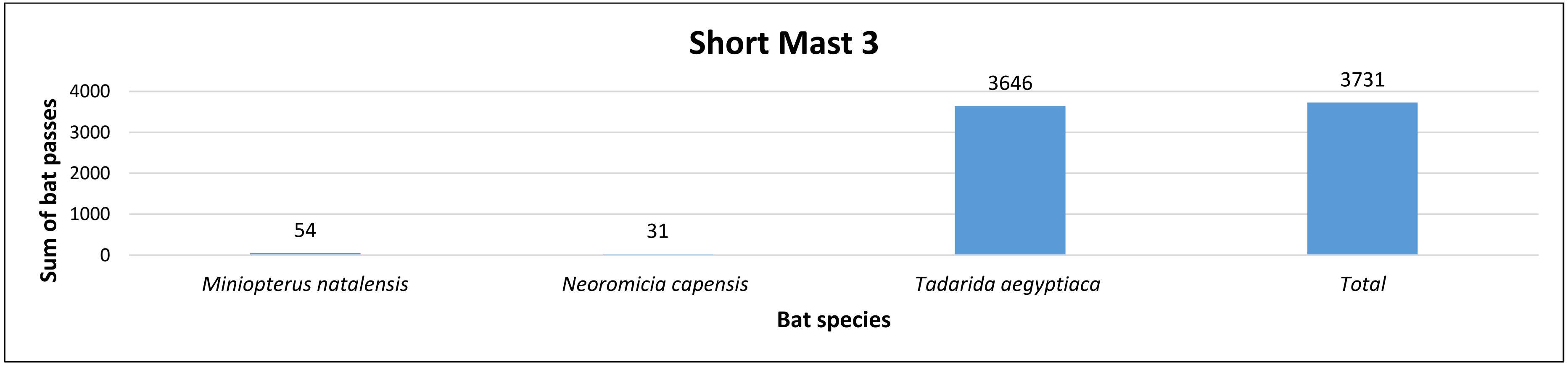



**Figure 66:** Total bat passes recorded over the monitoring period by the detector mounted on Short Mast 3.

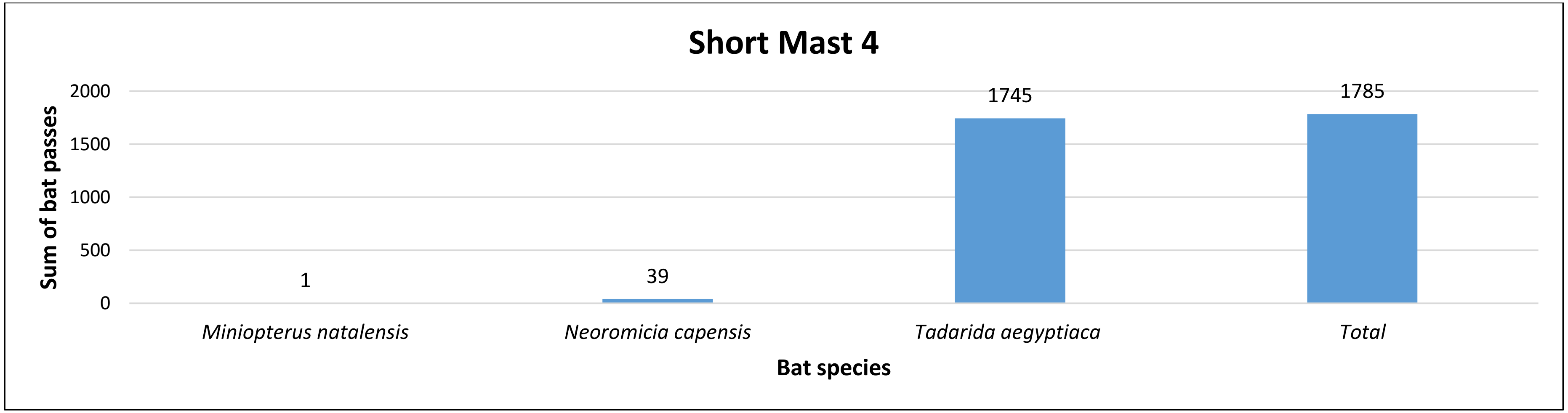



**Figure 67:** Total bat passes recorded over the monitoring period by the detector mounted on Short Mast 4.

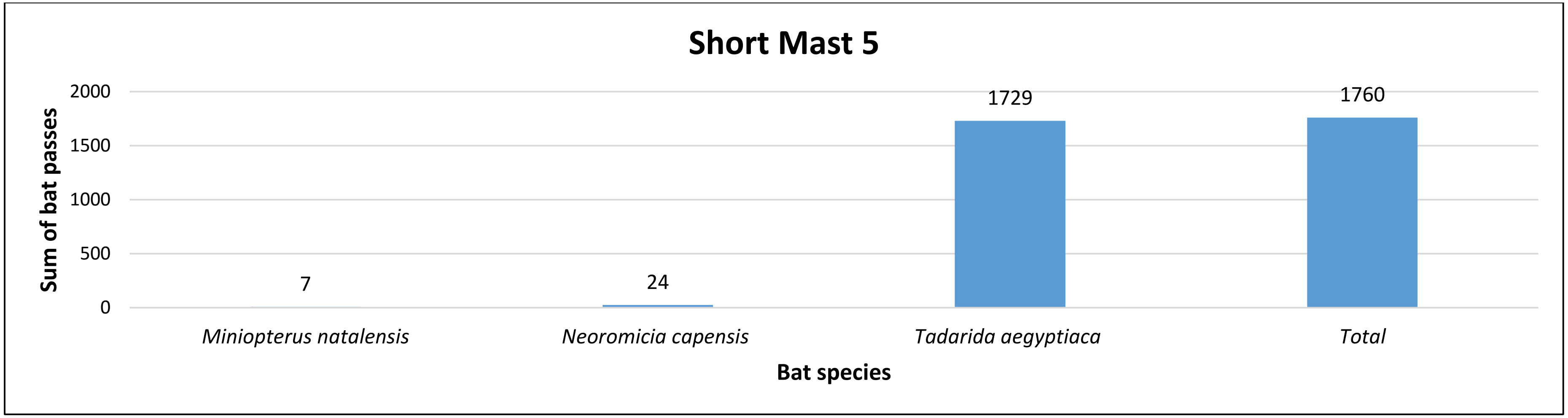



**Figure 68:** Total bat passes recorded over the monitoring period by the detector mounted on Short Mast 5.

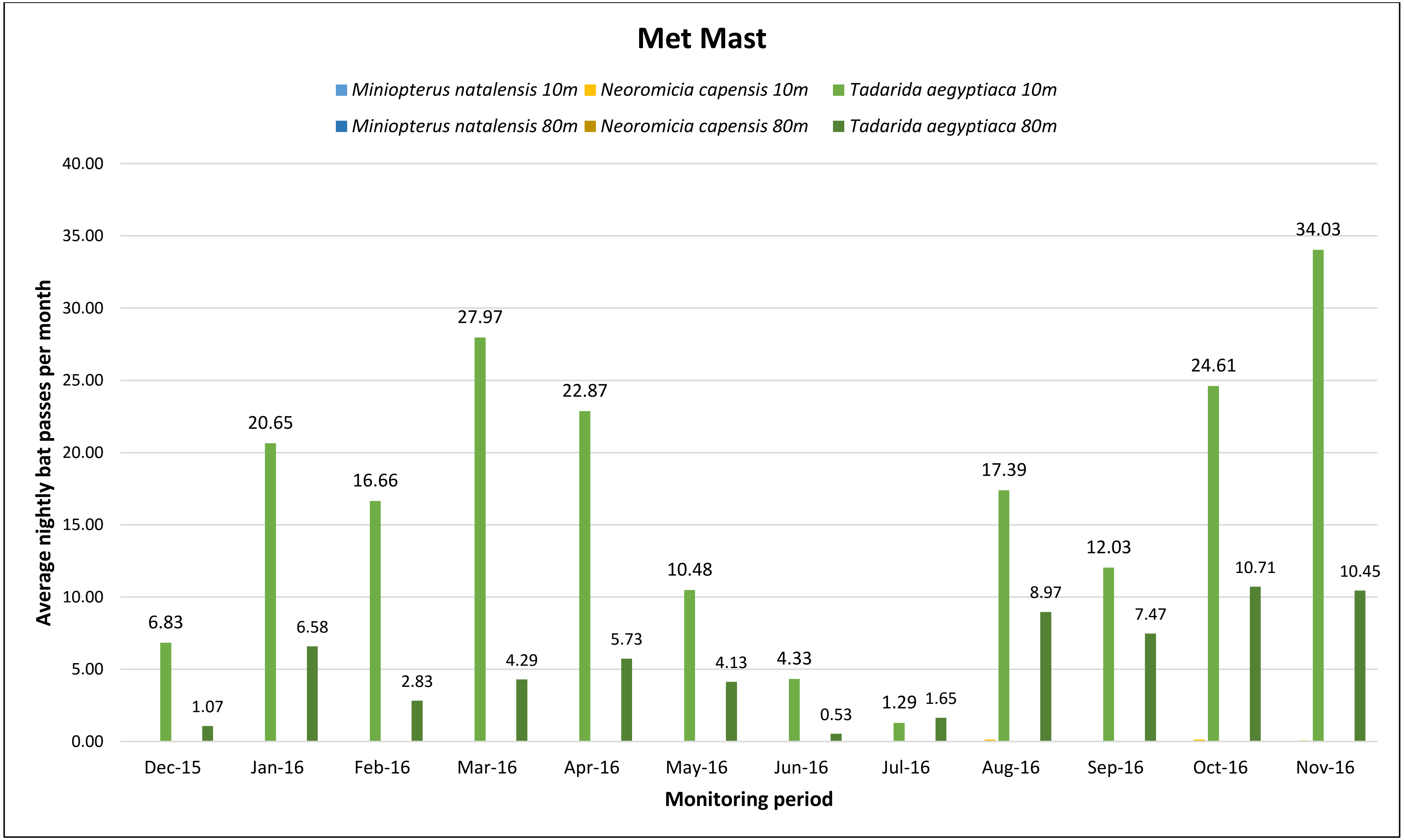



**Figure 69:** Average bat passes recorded per month by the detector mounted on the Met Mast.

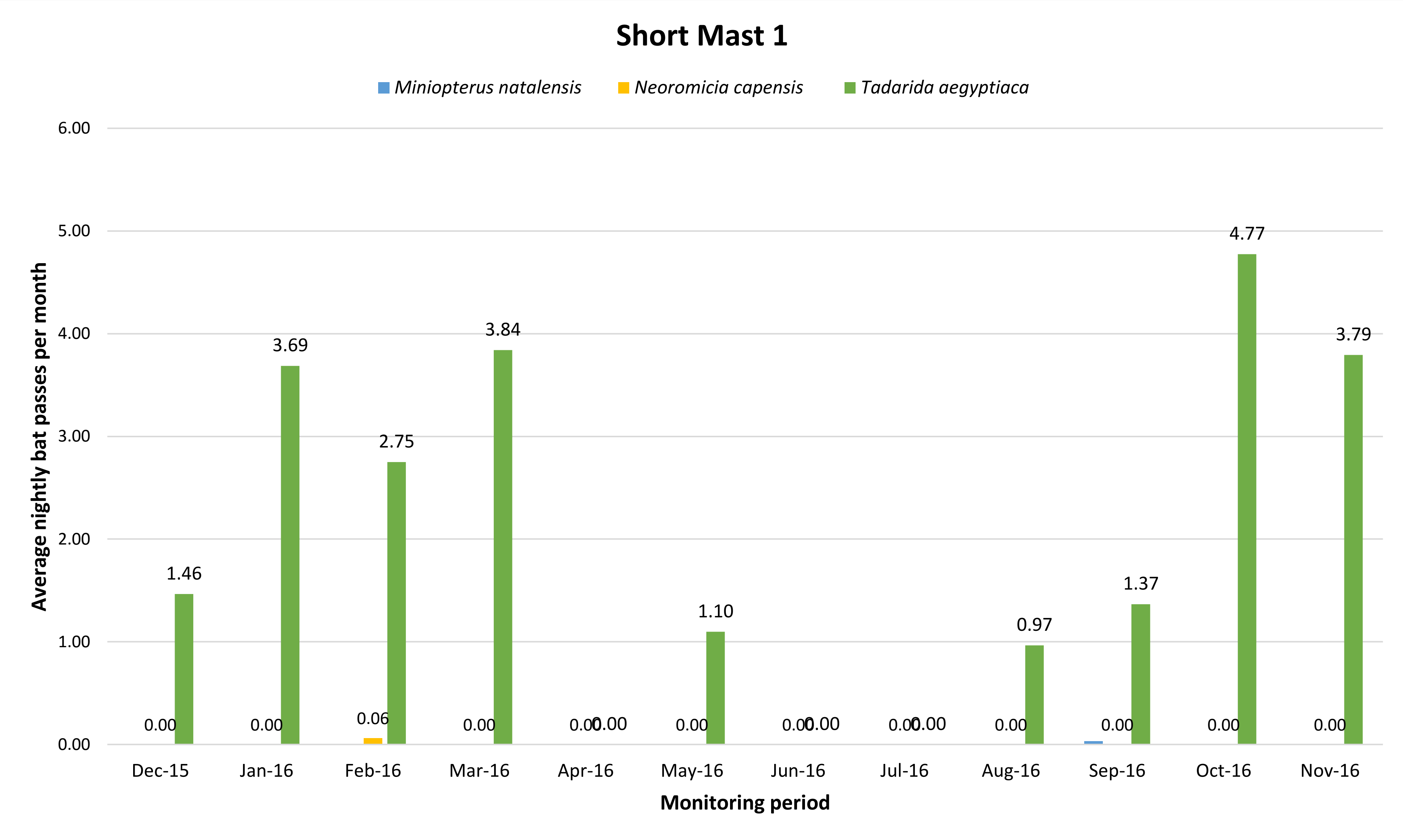



**Figure 70:** Average bat passes recorded per month by the detector mounted on Short Mast 1.

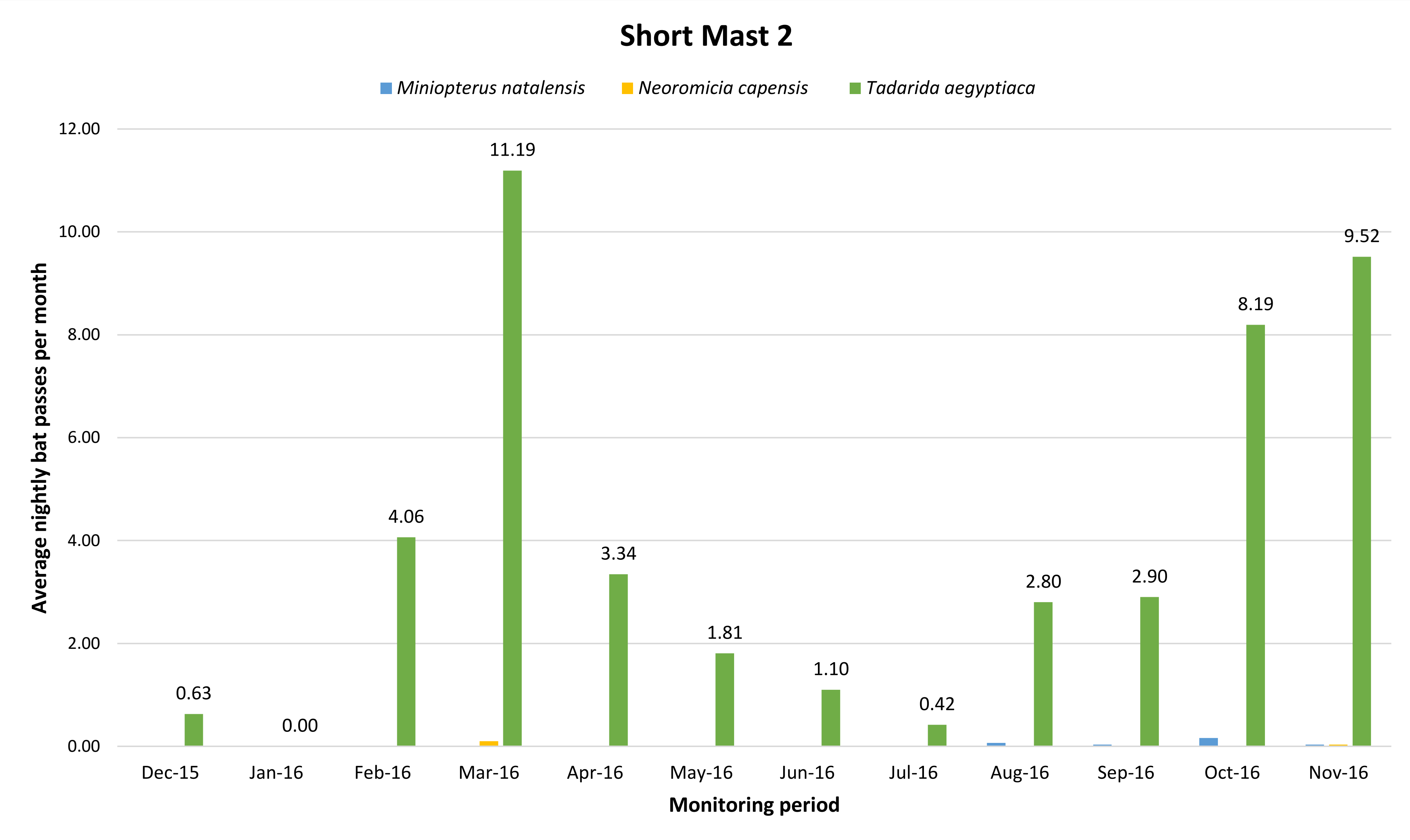



**Figure 71:** Average bat passes recorded per month by the detector mounted on Short Mast 2.

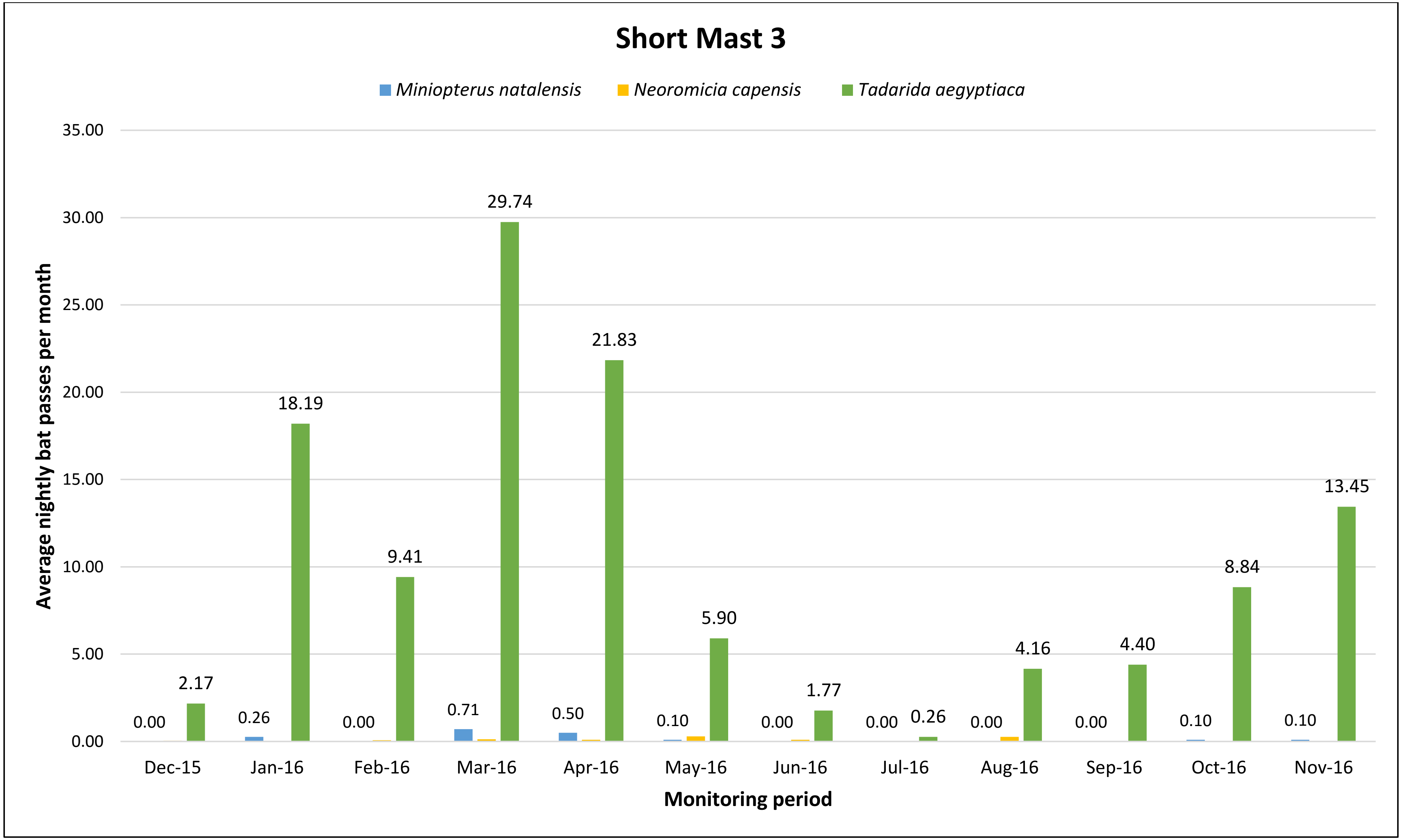



**Figure 72:** Average bat passes recorded per month by the detector mounted on Short Mast 3.

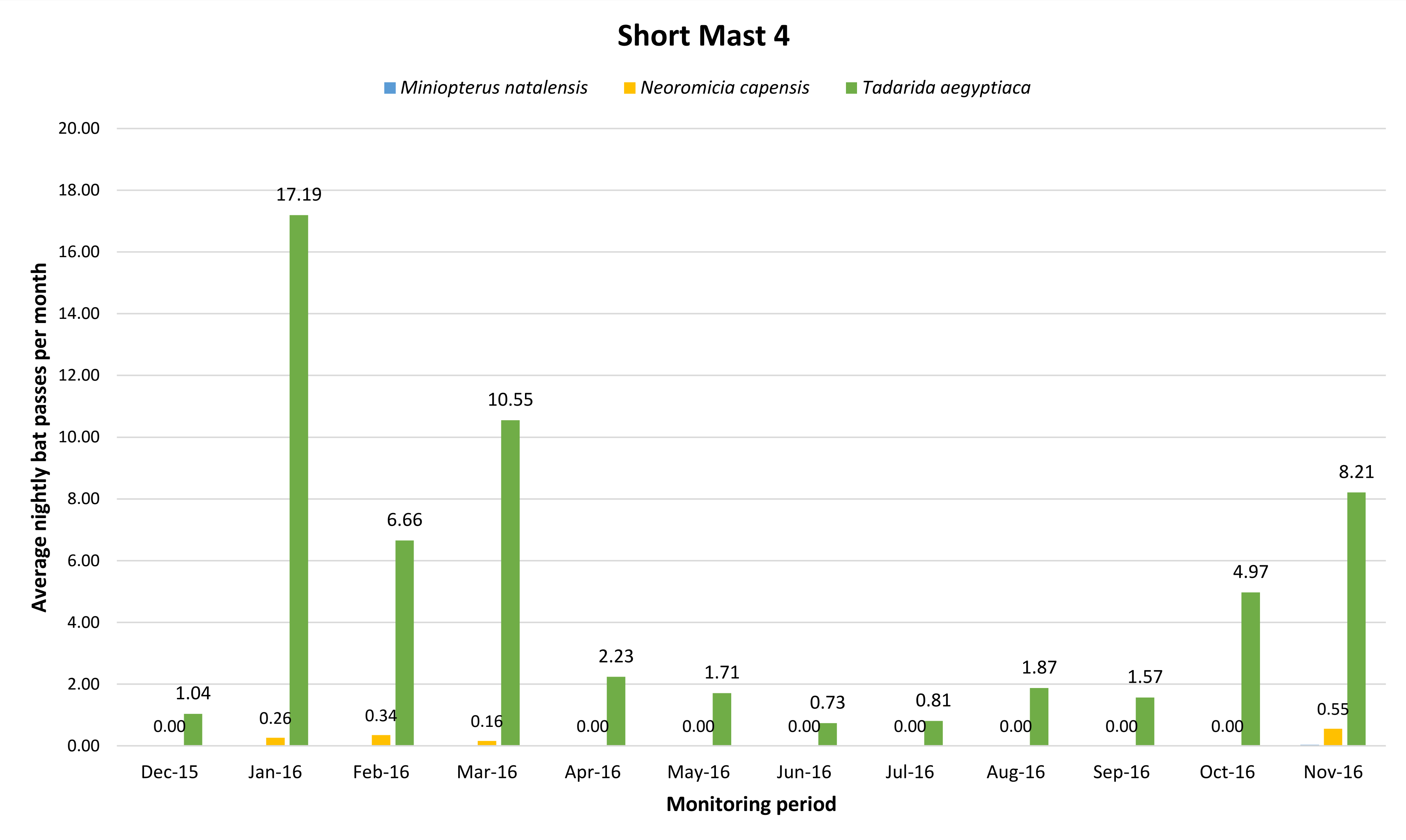



**Figure 73:** Average bat passes recorded per month by the detector mounted on Short Mast 4.

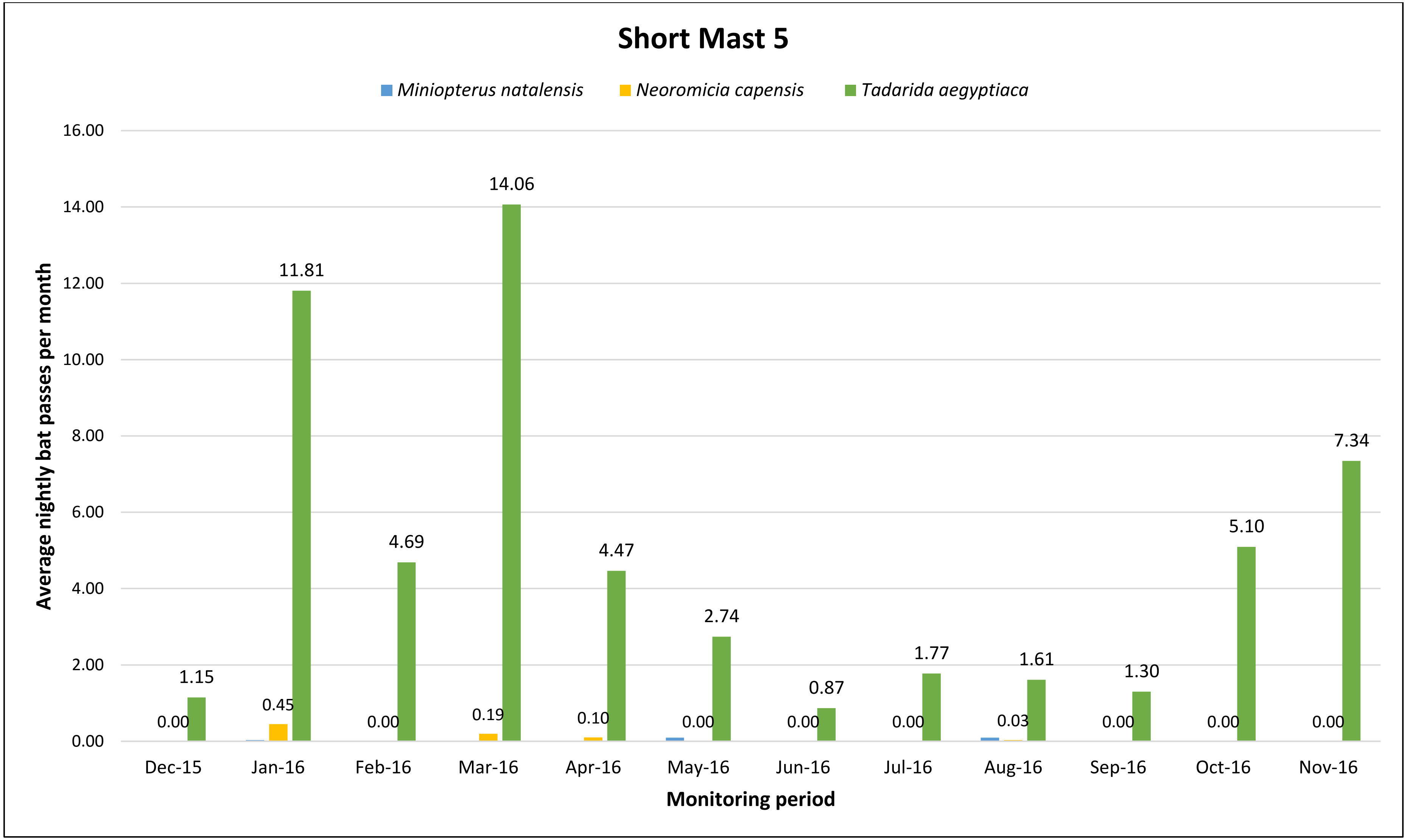



**Figure 74:** Average bat passes recorded per month by the detector mounted on Short Mast 5.

#### 8.3.3.2 *Temporal Distribution*

The sum of all bat passes recorded by the monitoring systems of the particular species are displayed per night over the entire monitoring period (**Figure 75 - Figure 80**). The peak activity times identified are mostly of the temporal distribution of *Tadarida aegyptiaca* as they were the species detected more often by a substantial margin. This data is used to inform the peak times that may inform mitigation, if needed.

The periods of elevated bat activity as depicted in **Figure 75 - Figure 80** are as follows:

**Met Mast**
- Mid to late January 2016
- Early February to early April 2016
- Mid-April 2016
- Early May to early June 2016
- End August to end November 2016 **(Highest peak occurred in August 2016)**

**Short Mast 1**
- End December 2015 to early January 2016 **(Highest peak occurred in January 2016)**
- End February to end March 2016
- Mid-September to end November 2016

**Short Mast 2**
- Mid-February to late March 2016
- Early April to end March 2016
- End August 2016
- End September to end November 2016 **(Highest peak occurred in November 2016)**

**Short Mast 3**
- End December 2015
- Mid-January to early February 2016 **(Highest peak occurred in January 2016)**
- Mid-February to mid-May 2016
- Mid-August 2016
- End August to early September 2016
- End September 2016
- Mid-October to end November 2016

**Short Mast 4**
- Mid to end January 2016 **(Highest peak occurred in January 2016)**
- Mid-February to end March 2016
- End August 2016
- Mid-October to end November 2016

**Short Mast 5**

- Mid to end January 2016 **(Highest peak occurred in January 2016)**
- Mid-February to mid-April 2016
- Early to end May 2016
- Mid-July 2016
- End August to end November 2016

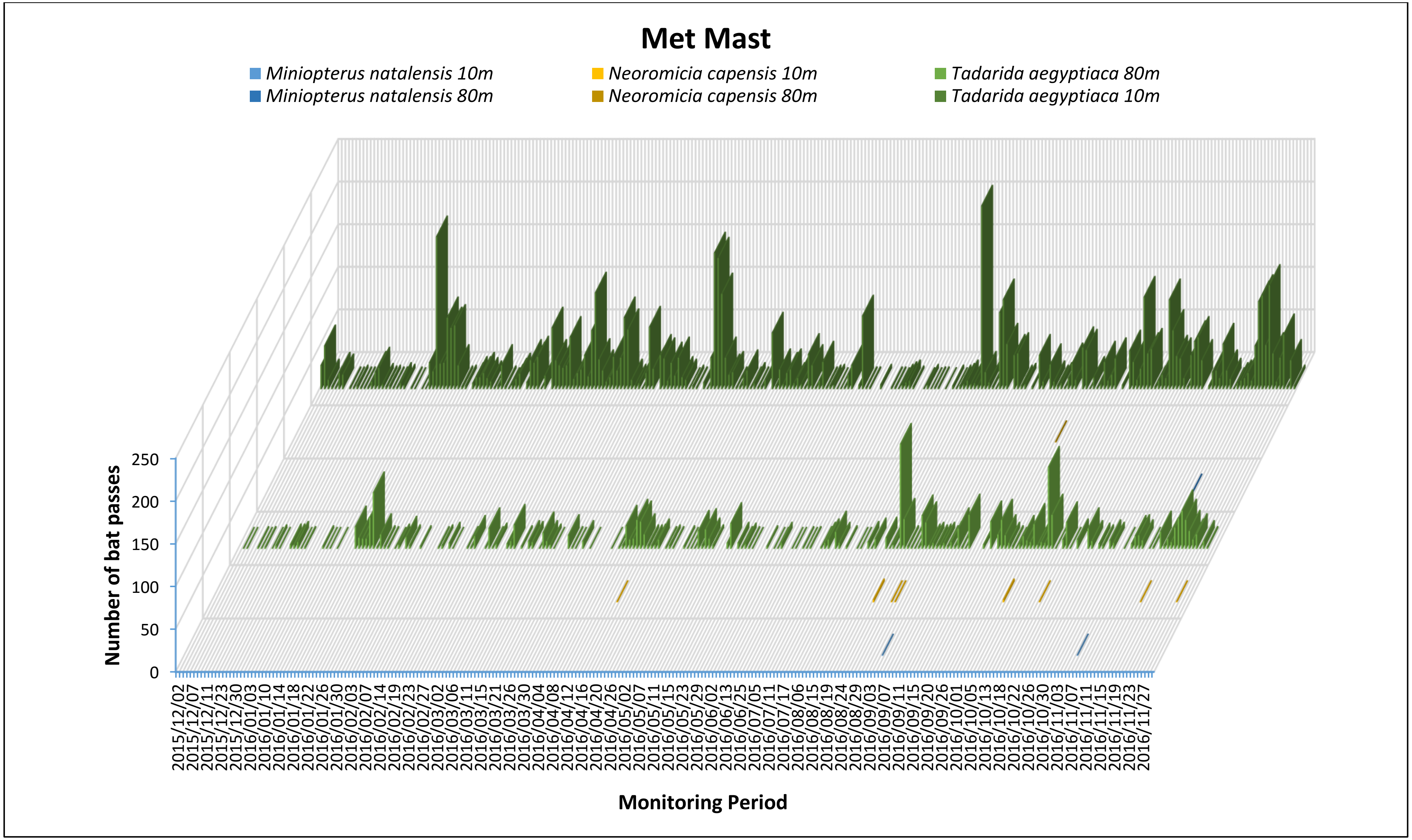



**Figure 75:** Temporal distribution of bats detected by the Met Mast.

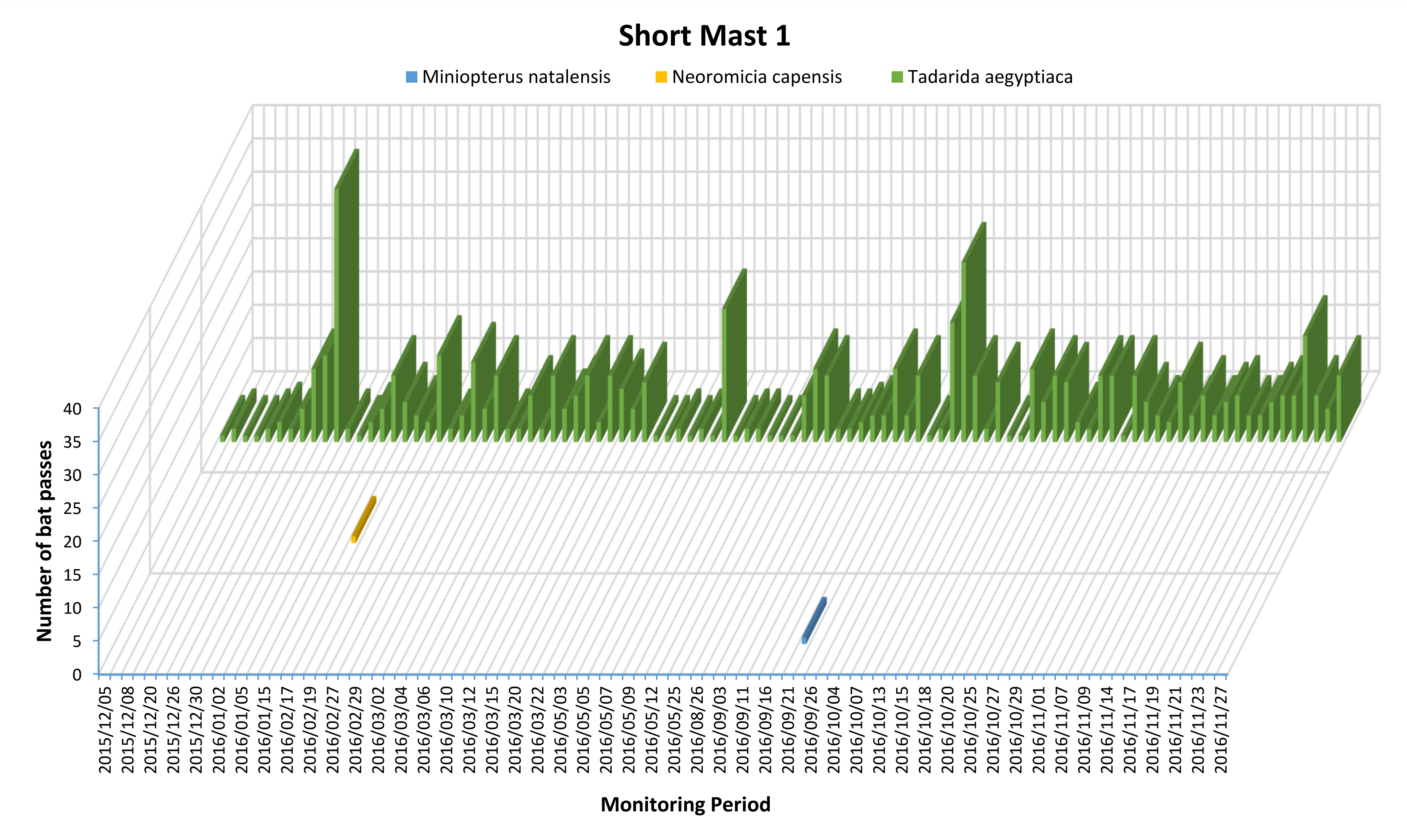



**Figure 76:** Temporal distribution of bats detected by Short Mast 1.

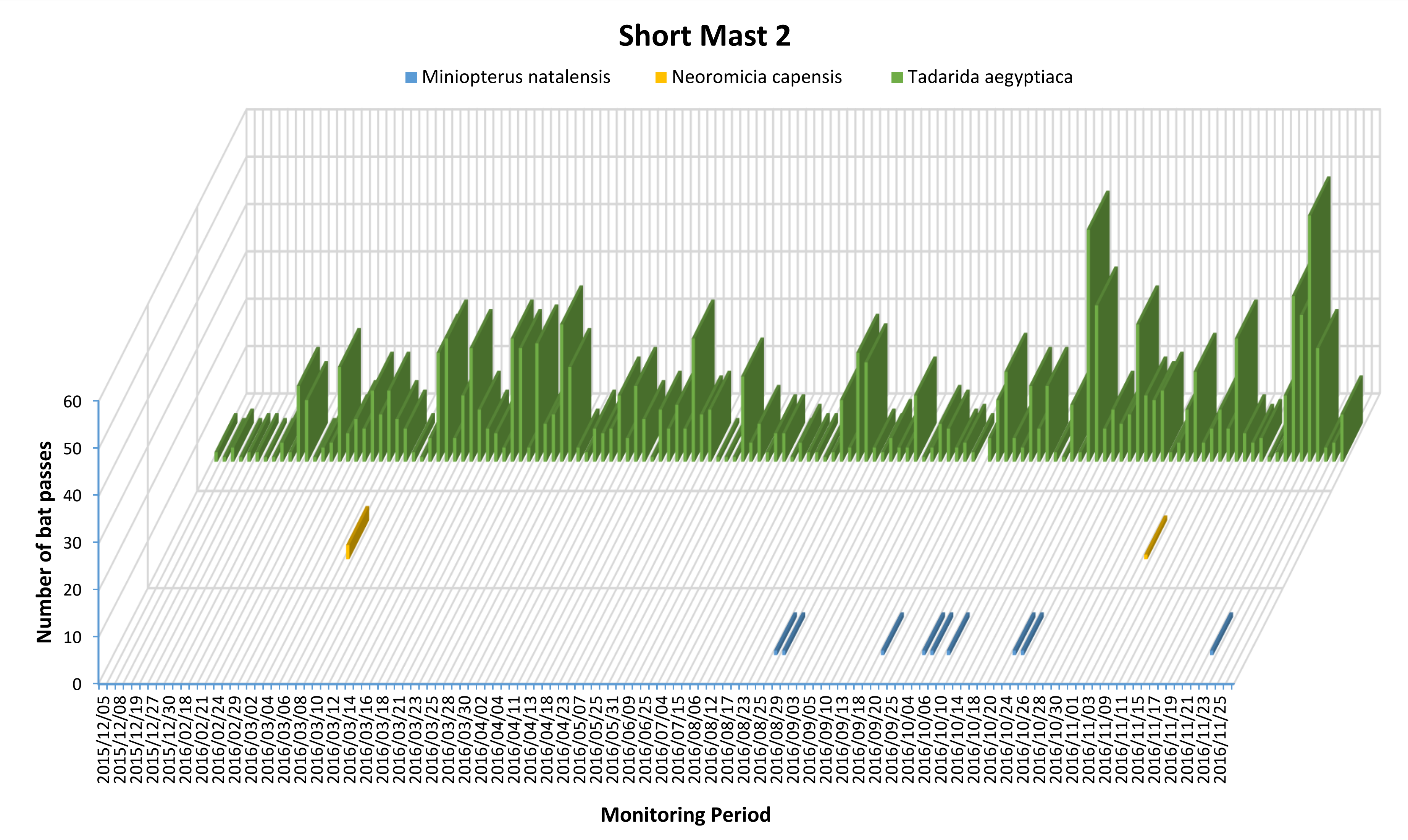



**Figure 77:** Temporal distribution of bats detected by Short Mast 2.

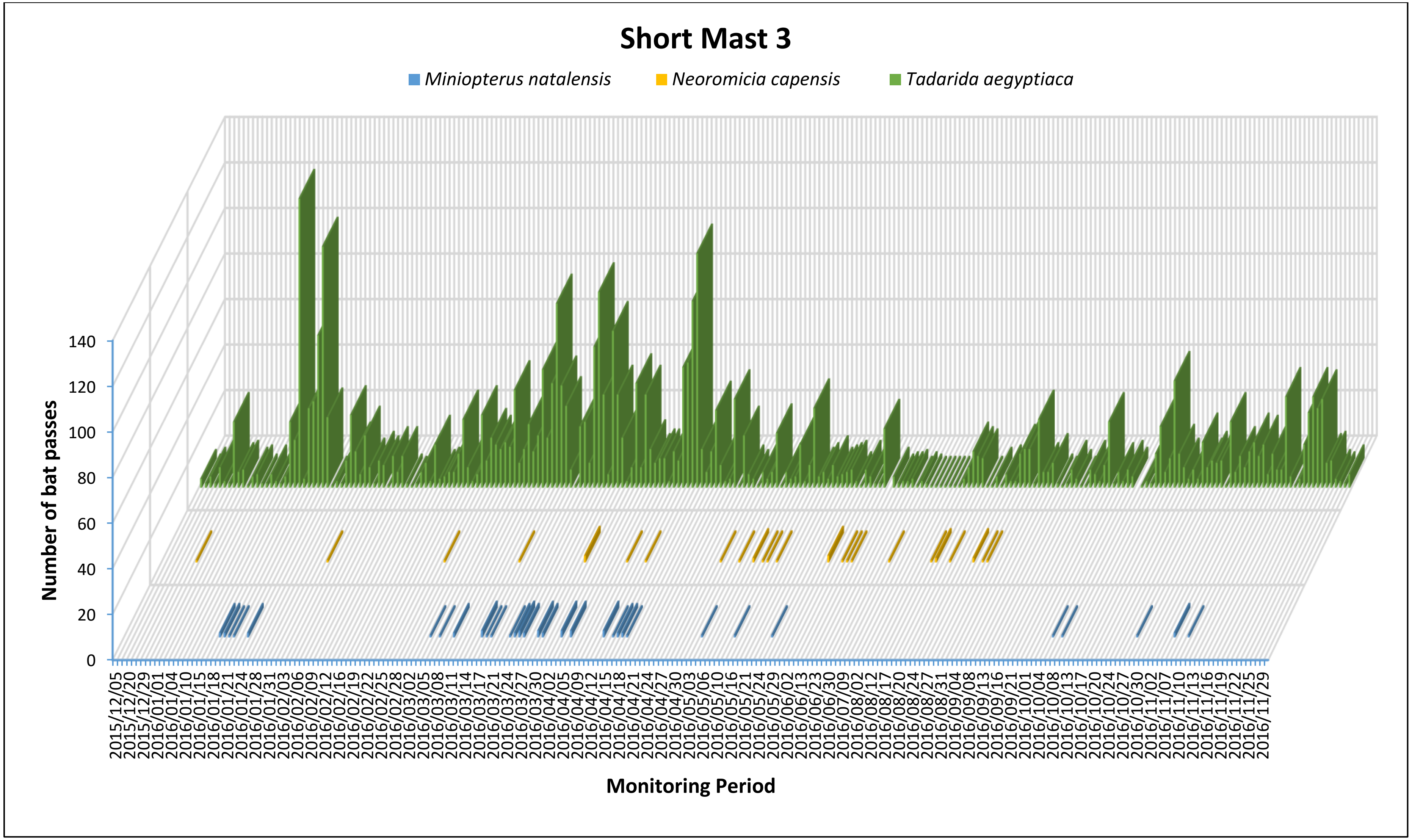



**Figure 78:** Temporal distribution of bats detected by Short Mast 3.

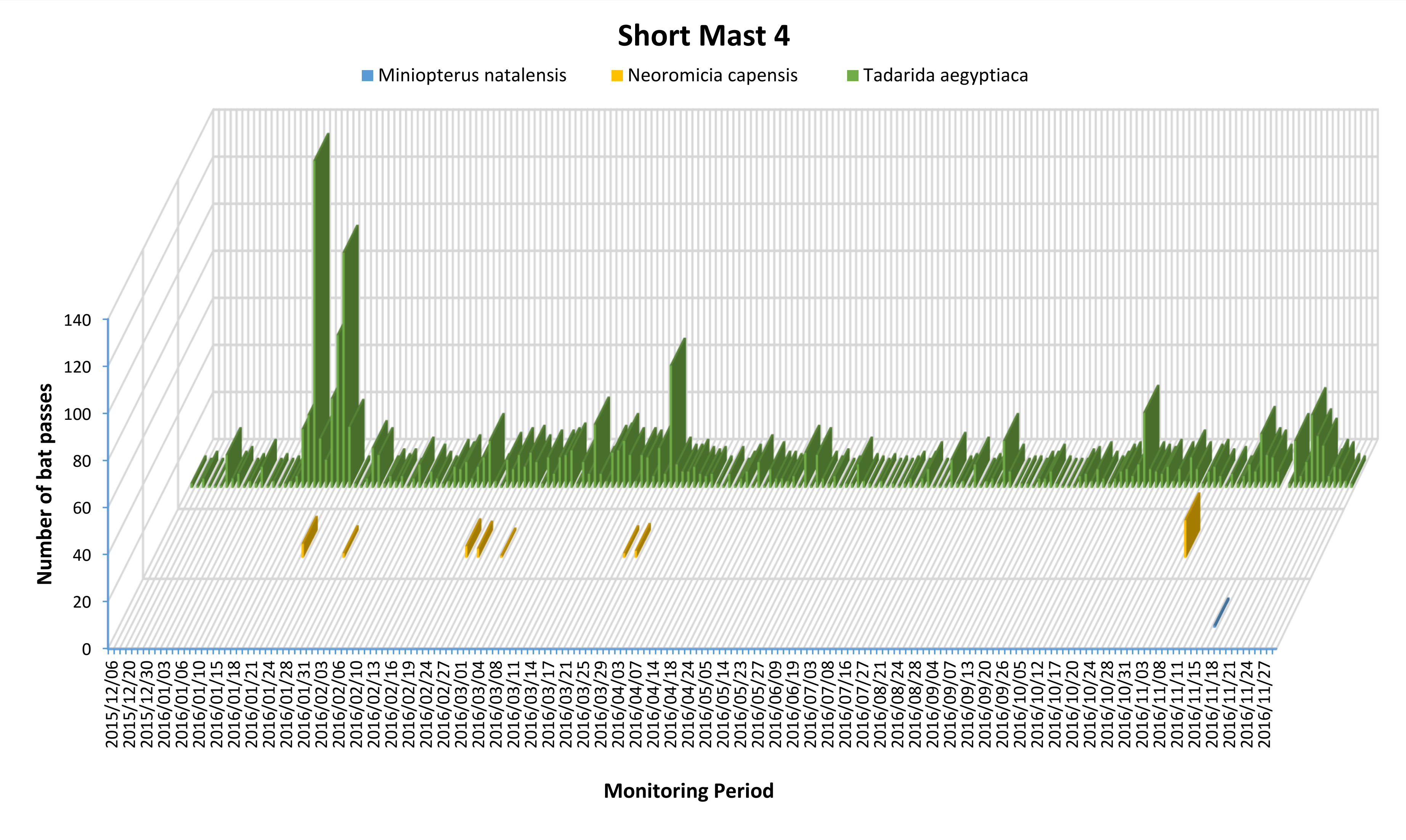



**Figure 79:** Temporal distribution of bats detected by Short Mast 4.

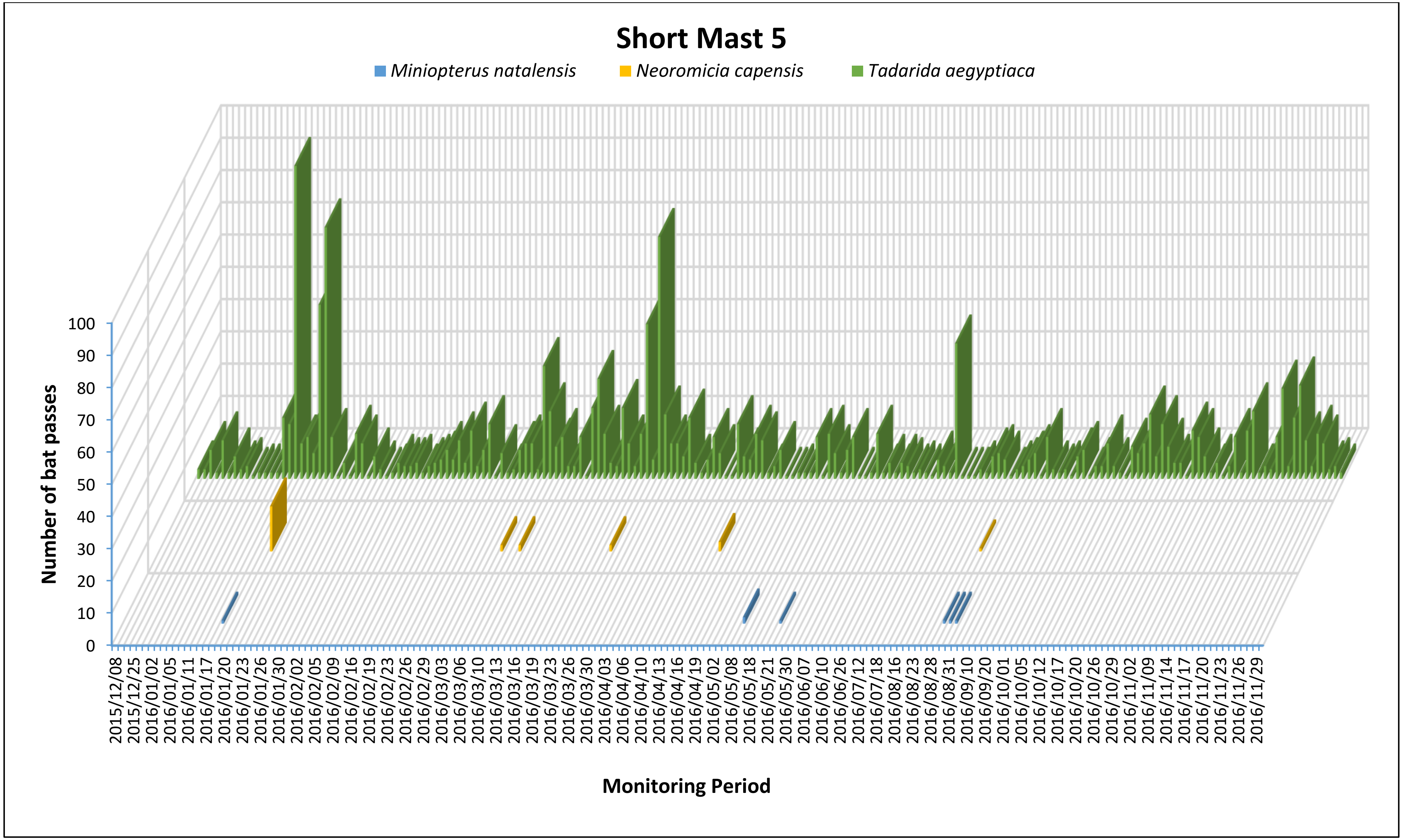



**Figure 80:** Temporal distribution of bats detected by Short Mast 5.

#### 8.3.3.3 *Distribution of bat activity across the night per season*

The distribution of bat activity across the night, per season, has been analysed in this section (Figures 32 – 55 in th Bat Impact Assessment Report). The 12-month monitoring period was divided based on generic calendar seasons outlined **Table 42**.

**Table 42:** Time frame of each season

| Season | Monitoring period |
|---|---|
| Winter | 1 June – 31 August |
| Spring | 1 September – 30 November |
| Summer | 1 December – 28 February |
| Autumn | 1 March – 31 May |

The number of bat passes per 10-minute interval over the seasonal monitoring periods were summed to generate the figures of bat activity over the time of night (Figures 32 – 55 in the Bat Impact Assessment Report). Higher levels of activity indicate preference for activity over a particular period of the night. These periods will then be used to inform mitigation implementation when and where needed.

Once again, peak activity times are mostly an amalgamation of the activity of *Tadarida aegyptiaca* especially at 10m height. The figures show that there are seldom cases of other species being highly active in the absence of high activity levels of this abundant species.

*Miniopterus natalensis* was active during spring near all the monitoring systems, except for short mast 5. They were also active during winter near short mast 2, and during winter, summer and autumn near short mast 5. Short Mast 3 had higher amount of activity of *Miniopterus natalensis* during summer, which increased into autumn (Figures 32 – 55 in the Bat Impact Report).

#### 8.3.3.4 *Relation between Bat Activity and Weather Conditions*

Several sources of literature describe how numerous bat species are influenced by weather conditions. 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 instance, 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.

- **<u>Wind speed</u>**

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 and operating wind facilities in the United States have documented discernibly lower bat activity during 'high' wind speeds (Arnett *et al*. 2010).

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). So, at edges exposed to wind, flight activity of insects, and thus bats may be suppressed and at edges to the lee side of wind, bat activity may be greater. This relationship is used in the sensitivity map whereby the larger vegetation and man-made structures provide shelter from the wind. However the turbine localities are situated on the ridges of the site such that they will be in areas exposed to the wind and not protected by vegetation or structure.

- **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 results present figures (Figure 56 – 91 in the Bat Impact Report) of the sum of bat passes that were detected within specific wind speed and temperature categories. However, the distribution of bat activity within each wind speed and temperature range may be biased due to the frequency of occurrence of each wind speed and temperature range. Thus the number of bat passes were 'normalised' wherein the frequency with which each wind speed and temperature range were recorded was taken into account. The 'normalised' sum of bat passes per wind speed and temperature range are presented in Figures 56 – 91 in the Bat Impact Assessment Report. Cumulative percentages of the normalised sum of bat passes per wind speed and temperature ranges are also presented. The lowest wind speed at which 80% of bats were detected (of the normalised sum of bat passes) are used to inform mitigation, if needed.

The aim of this analysis is to determine the wind speed and temperature range within which 80% of bat passes are detected. Ultimately these values of wind speed and temperature will be used to mitigate turbine operation where needed based on conserving 80% of detected bat passes, keeping in mind the synergistic or otherwise contradictory effects that the combination of wind speeds and temperatures can have on bat activity.

Time periods used in the analysis for each monitoring system were identified in Sections 4.6.2 and 4.6.3 of the Bat Impact Assessment Report as periods of elevated activity. The analysis was only performed for time frames of the highest activity levels. The time periods used in the analysis corresponds with the time periods and systems used to inform mitigation in Section 6 of the Bat Impact Report. Wind speed measured at a height of 61m and temperature measured at a height of 40m were used for the analysis.

## 8.4 Surface Water

### *8.4.1 Findings of the Assessment*

#### *8.4.1.1 Surface Water Fieldwork Delineation Information*

The in-field wetland delineation assessment took place from the 6$^{th}$ to the 8$^{th}$ of December 2016. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the proposed development area. The refined results for the !Xha Boom Wind Farm study site are as follows:

- Two (2) Depression Wetlands;
- Three (3) Major Drainage Line (drainage lines with channel width >5m);
- Two hundred and thirty, seven (237) Drainage Lines (drainage lines with a channel width <5m).

The refinement of the surface water resources as stated above are presented in **Figure 81** below. A more detailed description of the environmental attributes (indicators) of the surface water resources characteristics is provided in the sub-sections below. All surface water resources were identified as highly sensitive features. Buffer zones were identified as moderately sensitive features.

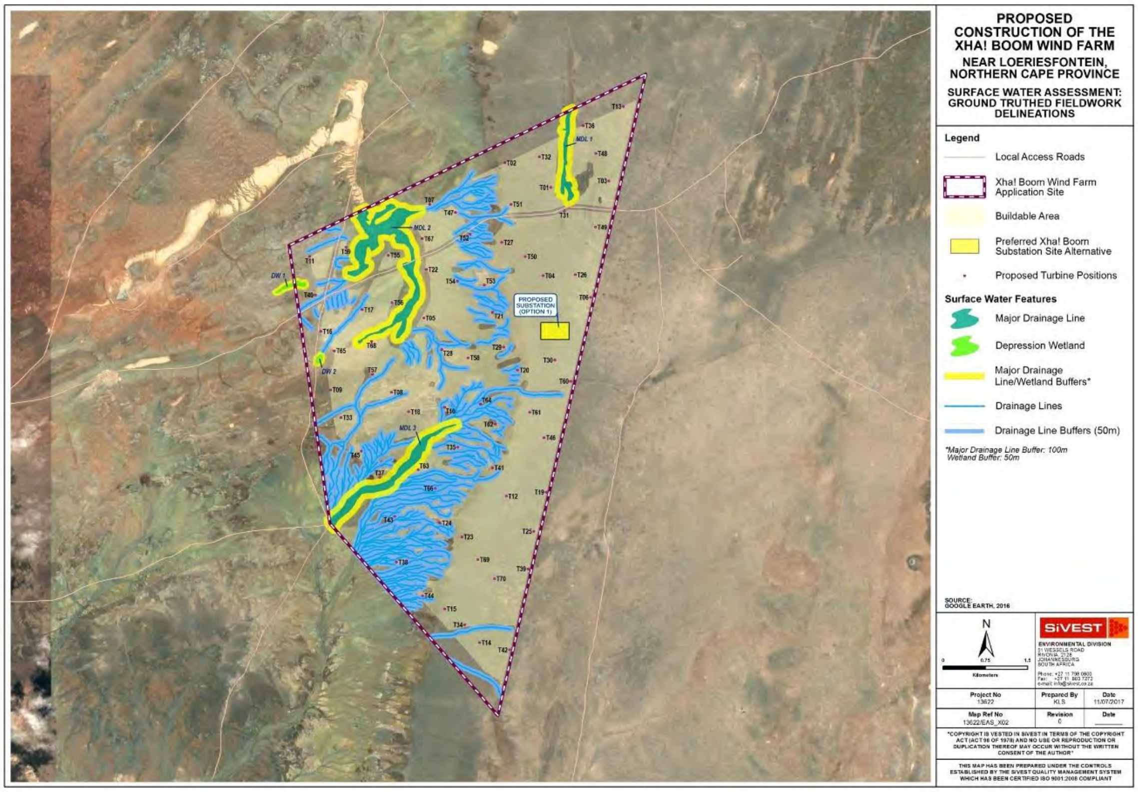



**Figure 81:** Surface Water Delineation Map

*8.4.1.1.1 Channels (Minor Drainage Lines)*

- **Topography Associated with the Watercourses**

The proposed development area is bisected by a ridgeline which runs from south to north along the entire length of the study site. To the east of the ridgeline, is a higher plateau area that gently undulates. From the ridgeline, going westwards, the terrain slopes generally to the south west into a wide floodplain area that contains a myriad of drainage lines comprising part of a greater network of channels. The channel network eventually drains into the Sandkraal watercourse approximately 6km to the south west of the study site. There is a slight watershed within the wide floodplain area located in the northern area of the study site. Here, the drainage lines flow generally in a northerly direction towards a larger major drainage line which eventually flows off-site. Overall, serving as tributaries, many of the drainage lines are higher order streams or A-section reaches. These drainage lines are considered A-section reaches due to the lack of a saturation zone. The drainage lines will however flow briefly after rainfall events (**Figure 82**). Hence, all drainage lines were identified as ephemeral watercourses. The direction of flow for all watercourses appeared to be in a south western direction.

**Figure 82:** Elevated View of the Drainage Line Network on the Study Site

The depth of soils on the proposed development area are relatively shallow (approx. 0.1-0.5m), which means that flow is predominantly via surface run-off with limited sub-surface flow only where the depth and composition of the soil profile permits infiltration. Rocky outcrops are found along the ridgeline running from the south to the north of the study site. Minor soil erosion is evident but limited due to shallow soil depth. Minor soil erosion is evident mainly where there is an incline along the ridgelines. This compromises the geomorphological integrity of the drainage lines somewhat.

- **<u>Alluvial Soils and Deposited Materials</u>**

Run-off from the surrounding landscape transports soil particles which get deposited in the drainage lines when flow subsides following rainfall events. The grain size of deposited materials range from silt to gravel further along the more developed drainage lines. Stones and cobbles are more common in the drainage lines lying in the ridgeline areas of the study site and where bedrock was exposed in the beds of the drainage lines (**Figure 83**).

**Figure 83:** Alluvial Deposits and Exposed Bedrock in a Drainage Line

- **Vegetation**

According to Todd (2017), the areas mapped as Bushmanland Basin Shrubland by Mucina & Rutherford (2006) are consistently dominated by grasses with low shrub cover and are clearly more closely aligned with Bushmanland Arid Grassland. Todd (2017) further states that, the main driver of vegetation pattern in the area is substrate and on the gravels and stony soils which characterise the western part of the site, the vegetation consists of open shrub-dominated vegetation of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by various *Stipagrostis* species and is typical of Bushmanland Arid Grassland. Considering this, the drainage lines along the ridgeline were found to be dominated by low shrubland spinescent species (**Figure 84**). Further along the drainage lines to the west, graminoid species become more prevalent consisting mainly of *Stipagrostis* species.

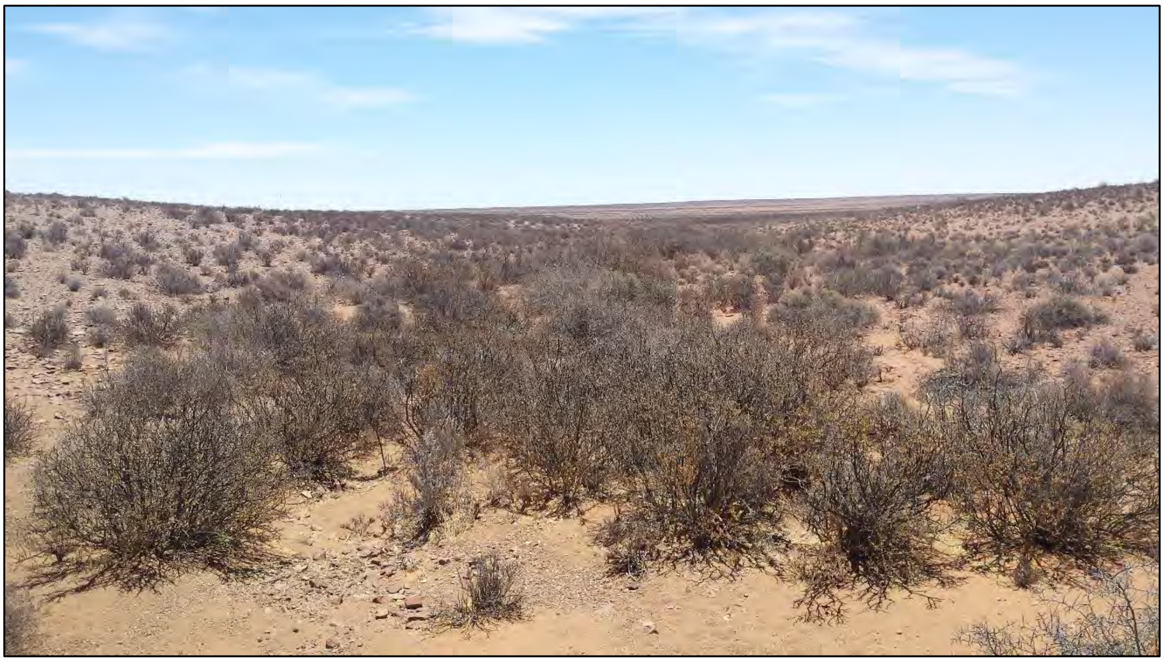


**Figure 84:** Low Shrubland Species found within the Drainage Lines along the Ridgeline of the Study Site

- **Comment on Ecological Condition of the Drainage Lines**

Overall, the drainage lines appeared to be in a largely natural condition. Existing impacts affecting the drainage lines are mainly due to grazing and anthropogenic (dirt road) impacts. Very little signs of erosion were evident in the drainage lines.

*8.4.1.1.2 Channels (Major Drainage Lines)*

- **Topography Associated with the Watercourses**

Three major drainage lines were identified on the study site. Major Drainage Line 1 is located on the west of the ridgeline in the gently undulating areas. Here, the topography gently undulates. The major drainage line follows the low point in the landscape flowing in a northerly direction. The width of Major Drainage Line 1 at the widest point is approximately 125m.

Major Drainage Line 2 is in the floodplain area east of the ridgeline running south to north across the study site. As previously stated, there is a slight watershed in this area located in the northern area of the study site. As a result of the watershed, the major drainage line flows generally in a northerly direction which eventually flows off-site. The width of Major Drainage Line 2 at the widest point is approximately 260m.

Drainage line 3 is a more developed system from which the drainage lines originating from the ridgeline bisecting the study site flow into. Drainage line 3 therefore flows in a south westerly direction much like the minor drainage lines which flow into it. The width of Major Drainage Line 3 at the widest point is approximately 200m (**Figure 85**).

The climate of the study area is very dry with little annual rainfall and high evaporation rates. Bearing this in mind, all major drainage lines were dry during the site investigation indicating the ephemeral nature of the drainage lines.

**Figure 85:** Photo of the Edge of Major Drainage Line 3

- <u>**Alluvial Soils and Deposited Materials**</u>

A range of deposited materials are left behind in the channels of the major drainage lines following rainfall events. The grain size of the sediment particles range from fine silts to gravels and stones (**Figure 86**). The width of the major drainage lines are relatively wide as specified in Sub-section 6.2.2.1 in the Surface Water Impact Assessment Report. As a consequence, the channel beds are fairly well vegetated. Bush encroachment was observed whereby small shrubs have taken advantage of the substrate available and available soil moisture.

**Figure 86:** Deposited Alluvial Sediments within Drainage Line 3

- **Vegetation**

The vegetation within Major Drainage Line 1 is was found to consist mainly of graminoid (*Stipagrostis* sp.) vegetation in addition to small shrubs. The vegetation within Major Drainage Lines 2 and 3 however, were also found to contain a mixture of graminoid species (including *Stipagrostis namaquensis*) and small shrubs, but also contained larger herbaceous species (particularly Drainage Line 3 – **Figure 87**).

**Figure 87:** *Stipagrostis namaquensis* observed in Major Drainage Line 3

- **Comment on Ecological Condition of the Drainage Lines**

Overall, the drainage lines appeared to be in a largely natural condition. Existing impacts affecting the major drainage lines include grazing impacts, anthropogenic impacts (dirt roads and fences) and minimal erosion impacts.

#### *8.4.1.1.3 Depression (Pan) Wetlands*

- **Terrain and Wetland Soil Characteristics**

The two depression wetlands identified can be found within the wide lowland floodplain area to the west of the ridgeline bisecting the study site. These wetland have formed in shallow hollowed out depressions which drain small localized catchments. Depression Wetland 1 is hydrologically linked to a drainage line whilst, Depression Wetland 2 is endorheic (in-ward draining – **Figure 88**). The prevailing climate acts as a constraint to the time that water is available or the duration of saturation (hydroperiod) for the wetlands. The wetlands are therefore rainfall driven and consequently ephemeral in nature. High temperatures and high evaporation rates in the region contribute to limited hydroperiod for the wetlands.

**Figure 88:** Depression Wetland 2

Soils samples were drawn from the wetlands to determine any hydrogeomorphic characteristics within the substrate. Soil samples drawn from the wetlands in the study site revealed fine-grained to sandy particles within a light brown matrix. Soils were relatively shallow (>0.5m). No distinct signs of wetness could however be observed. It was therefore considered that the chemical constituency of these particular soils are not considered conducive to the formation of typical wetland hydrogeomorphic (reduction, mottling and gleying) characteristics found in the wetlands in the surrounding areas. It may well be that the geochemical constituency of the sediment particles, coupled with high pH and the physico-chemical characteristics of the soils may mask the formation of the typical mottling characteristics observed in wetlands in other parts of the country. This is a limitation not expressed in the guideline for delineation of wetlands.

- **Wetland Vegetation**

Much like other nearby wetlands found in the surrounding areas of the study site, the habitat type for Depression Wetland 1 can be described as a non-saline pan vegetated by *Athanasia minuta* whereas Depression Wetland 2 can be described as a non-saline pan with an almost bare center and fringed by taller woody vegetation (Todd, 2017).

- **Comment on Ecological Condition of the Natural Depression Wetlands**

The pan wetlands were observed to be in a largely natural condition. Prevailing impacts that were found to affect the wetlands include mainly grazing impacts and anthropogenic (dirt roads and fences) impacts.

#### *8.4.2 Surface Water Buffer Zones*

When determining the buffer zones for the watercourses and wetlands, critical factors that need to be considered that may be affected by the proposed development include the drivers of these hydrological features.

The primary threats related to the proposed wind farm and associated operation and maintenance buildings, substation and internal access roads are mainly during the construction phase. These include increased run-off, erosion and sediment inputs. Additional potential threats include direct physical degradation from vehicular activity, soil contamination and water quality impacts from spills and leakages of hazardous substances and liquids. Given this, increased run-off will have impacts on the hydrology of the surface water resources in terms of alteration of flood peaks. Clearing of vegetation can also affect the surface roughness of the catchment thereby also contributing to accelerated surface run-off, consequent sedimentation and erosion of surface water resources. Sedimentations and erosion impacts can affect the geomorphological integrity of the surface water resources. In terms of contamination impacts, leakages and spill of hazardous substances such as fuels and oils can affect the water quality and contaminate soils of the surface water resources following transportation of these substances and liquids in surface run-off following rainfall events. Potential negative impacts to the biota and vegetation inhabiting the surface water resources may result in affecting the biodiversity and overall ecological functioning of the surface water resources.

For the operation phase, degradation impacts as a result of vehicle movement is a concern. Compaction impacts and degradation of vegetation associated with the surface water resources is the main concern for this impact from a surface water perspective. Compaction impacts negatively impacts on the geomorphological integrity of the surface water resources potentially causing alteration of the physical conditions of the soil as well as making surface water resources vulnerable to erosion. Additionally, storm water run-off impacts can be anticipated due to the increased hard and impermeable surfaces to be constructed. As such, accelerated run-off can impact on the hydrology of the surface water resources.

Moreover, erosion and sedimentation risks can also be associated with increased run-off and need to be taken into consideration.

Given the above, a buffer zone of 100m for major drainage lines and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the factors above.

### *8.4.3 Nature of the Potential Impacts Associated with the Proposed !Xha Boom Wind Farm*

#### *8.4.3.1 Construction Phase Potential Impacts*

- **Loss of Wetland and Riparian Habitat**

There are a number of direct impacts during the construction phase that can potentially have an adverse effect on the identified and delineated surface water resources habitat. These include construction of the lay-down area and other components of the wind farm (i.e. wind turbines, substation, operation and maintenance buildings etc.) directly or in close proximity to surface water resources and the associated buffer zones (<50m of wetland and drainage lines buffer zones; within 100m of major drainage lines), clearing of drainage line or wetland vegetation, human degradation to surface water habitat during construction activities, and vehicle degradation.

Firstly, placement of the construction lay-down area directly within or near surface water resources can have impacts in terms of removal of vegetation and / or indirect edge impacts. Removal of vegetation will degrade the condition of the wetlands and expose the soil leaving the wetlands vulnerable to erosion. Additionally, disturbance due to construction activities may provide opportunities for pioneer and / or alien species to colonise the wetlands.

The construction lay-down area is an area that will need to be cleared of all vegetation and ideally flattened so as to establish temporary site offices, and storage areas for waste (temporary), vehicles, materials and machinery. Here removal of vegetation and edge impacts will degrade the state of vegetation associated with the surface water resources. With regards to clearing vegetation in general, the areas where the wind turbines are to be placed will need to be cleared of vegetation in order for the hard stand areas to be established. Additionally, vegetation clearing will need to take place where roads are to be established for transport of workers and materials.

Ultimately, removal of vegetation associated with surface water resources in these areas will result in loss of habitat. Moreover, degradation caused by movement of vehicles within the drainage line(s) and wetland habitat will likely result in degradation of habitat. Lastly, human degradation specifically can take the form of physical direct degradation such as lighting fires in or near the drainage lines and / or wetlands, as well as directly damaging or removing wetland vegetation. Disturbance and potential removal of drainage line and / or wetland vegetation may therefore occur.

- **Impacts to the Geomorphology of Surface Water Resources**

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly sensitive, sensitive and nearby surrounding areas is likely to result in exposing the soil, leaving the ground susceptible to wind and water erosion particularly during and after rainfall events. Due to the climate of the study area (generally arid with sudden sporadic rainfall) general soil erosion, as a consequence of the proposed development, is a possibility. A further impact due to erosion and potential storm water run-off impacts is increased run-off and sedimentation to surface water resources. Increased run-off can erode channels more easily, whilst an increased load of deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Soil compaction due to vehicle and worker movement within the internal road access area areas within the surface water resources is another distinct possibility. This is likely to take place during the construction phase of the proposed development. Vehicles (heavy and light) will require access to the various wind farm components.

- **Impacts to Soil and Water in Surface Water Resouorces**

With the movement of vehicles and personnel potentially in surface water resources, there is the possibility of soil and water contamination. Soil contamination may take place as a result of oil, fuel leakages and / or cement spills from the vehicles passing in close proximity or directly within surface water resources. Similarly, where and when surface water is present, water contamination from the same source may result. In addition, other amenities and / or storage of substances may also lead to both soil and water contamination either directly or indirectly. Where temporary toilets for workers are placed within the buffer zones, indirect contamination may result where leakages from temporary toilet units drain into surface water resources. Moreover, direct soil and water contamination can take place where temporary toilets are placed directly in surface water resources and where leakage takes place.

In terms of other substances, fuel, paints and oil in storage areas may similarly spill, leak and drain directly within surface water resources where these substance and liquids are stored and or used directly in surface water resources. Indirectly, soil and water contamination may equally take place where storage areas are situated within buffer zones and spills of leaks take place. Furthermore, run-off from storage areas can also accumulate such hazardous liquids and drain into surface water resources. Lastly, from a construction point of view specifically, mixing cement and cleaning construction tools in the wetland can affect the water quality of the wetland.

Altering the chemical composition of the soil and water disrupts the natural baseline condition to which organisms and vegetation have adapted to in order to survive. Contamination of water and soil may affect the functionality of organisms and vegetation, even potentially leading to death. Importantly, altering the chemical composition of water is considered pollution and must be prevented in terms of the NWA.

- **Impacts to Fauna associated with Surface Water Resources**

The possibility of impacts to fauna associated with surface water resources may occur during the construction phase. Fauna are often hunted, trapped, killed or eaten by workers for various reasons.

#### 8.4.3.2 Operation Phase Potential Impacts

- **<u>Impacts to the Geomorphology and Hydrology of Surface Water Resources</u>**

Vehicle access may be required to the wind turbines, structures, buildings and infrastructure (such as roads, cables and power lines) in and / or through and / or over (spanning) surface water resources. It is therefore important that access routes and service roads to wind turbines, structures, buildings and infrastructure are not planned and constructed within surface water resources as far as practically possible. However, where this is required and the relevant environmental authorization and water use license is obtained, access routes and service roads for vehicles in or through surface water resources may be susceptible to soil compaction and consequent erosion impacts. Regular vehicle movement in surface water resources can compact the soil affecting the hydrology of the surface water resources. Similarly, regular movement from vehicles can flatten the ground surface making it a preferential flow path for storm water and thereby becoming susceptible to accelerated run-off which may result in progressive erosion. Compaction from vehicles can also create incisions which may induce donga erosion over time.

The impact of stormwater run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces and foundations are to be laid for wind turbines, buildings and associated infrastructure. These can act as preferential flow paths for storm water. In general, flat and hard surfaces aid with the acceleration and generation of run-off which can also indirectly impact on nearby surface water resources through the onset of erosion, as well as by means of increased sedimentation.

With the above in mind, stormwater and erosion control management will be important so that where impacts to surface water resources are permitted, stormwater and erosion is controlled so as not to drastically alter the hydrology and structural integrity and sediment regime of the potentially affected surface water resources. Altering the hydrology of the surface water resources can disrupt the drainage dynamics of the landscape. Likewise, long term erosion of surface water resources compromises the structural integrity of the surface water resources and can lead to long term degradation and possibly failure.

#### 8.4.3.3 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar impacts are therefore expected to occur and the stipulated mitigation measures where relevant and appropriate must be employed as appropriate to minimise impacts.

### 8.4.4 Legislative Implications

#### 8.4.4.1 National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2017)

In the context of NEMA (1998) and the EIA Regulations (2017), it is provisionally identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to roads access roads through surface water resources, thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below. Importantly, the applicability of these triggered activities can however only be confirmed once a more detailed layout is available.

- **Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 327, Activity 12:**

*The development of-*
*(x) buildings exceeding 100 m² in size;*
*(xii) infrastructure or structures with a physical footprint of 100 m² or more;*

*where such development occurs-*

*a) within a watercourse (wetland);*
*b) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse (wetland); -*

Where access roads will route directly through of within 32m of any of the identified surface water resources, this activities will be triggered.

- **Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 327, Activity 19:**

*The infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from-*

*(I) a watercourse;*

Where access roads will route directly through any of the identified surface water resources and will be associated with the infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from surface water resources, this activities will be triggered.

##### *8.4.4.2 National Water Act, 1998 (Act No. 36 of 1998)*

In the context of the NWA (1998) and the proposed development, a "water use" is required to be registered where construction activities will impact directly or indirectly (within the regulated area as per Government Notice 509 of 2016 (No. 40229)) on a water resource. The regulated area as per Government Notice 509 of 2016 (No. 40229) is defined as follows:

- Activities within 500 meter radius of a wetland or pan;
- Activities within the outer edge of the 1:100 year flood line or riparian habitat (whichever is greatest);
- Activities within 100m from the edge of a watercourse (annual bank fill flood bench) in absence of the 1:100 year flood line or riparian habitat.

In this light, "water use" is defined *inter alia* as follows:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38 (1) of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

In this context, a water use license will be required where any of the above water uses are required for a development. As such, for the proposed development, it has been identified that surface water resources may be affected by construction of roads, and it is therefore possible that water uses (c) and (i) may be applicable thereby requiring a water use license. Additionally however, if it can be determined that the proposed development will be associated with a LOW risk as per the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229), it may be possible that General Authorisation can be issued. The applicability of these water uses and the relevant licensing process can however only be confirmed once a more detailed layout containing road infrastructure is available.

## 8.5 Soils and Agricultural Potential

### *8.5.1 Agricultural Capability*

Land capability is defined as the combination of soil suitability and climate factors. The area has a land capability classification, according to the 8 category scale of Class 7 which is non-arable, low potential grazing land. The limitations to agriculture are the extreme aridity and lack of access to water as well as the predominantly shallow, rocky soils. Due to these constraints, agricultural land use is restricted to low intensity grazing only. The natural grazing capacity is given on AGIS as very low, at 45 hectares per animal unit. This is amongst the lowest grazing capacity areas in the country.

### *8.5.2 Land use and development on and surrounding the site*

The farm is located in a sheep farming agricultural region, and grazing (sheep and some cattle) is the only agricultural land use on the site and surrounds. There is no agricultural infrastructure in the study area, apart from fencing into camps and wind pumps with stock watering points. There is an abandoned and slightly derelict farmstead near the northern boundary of the site.

### *8.5.3 Status of the land*

As previously mentioned, the vegetation classification for the site is Bushmanland Basin Shrubland. Refer to **Section 6.7.1** for the broadscale vegetation descriptions. The land is classified as having a low to moderate water erosion hazard (class 5), but it is classified as highly susceptible to wind erosion (class 1a and 1d) because sands, as a soil textural class, are dominant.

### *8.5.4 Possible land use options for the site*

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

### *8.5.5 Agricultural sensitivity*

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

### *8.5.6 Idetification and Assessment of Impacts on Agriculture*

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

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

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 (including associated infrastructure and roads) is very small in relation to the available grazing land on the effected farm portions (will be <2% of the surface area). All agricultural activities will be able to continue unaffected on all parts of the farm other than the small development footprint for the duration of and after the project. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing. These factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

From an agricultural impact perspective, land on this site is ideally suited to renewable energy development because of its very limited production potential. It is agriculturally strategic from a national perspective to steer as much of the country's renewable energy development as possible to such land.

## 8.6 Noise

Increased noise levels are directly linked with the various activities associated with the construction of the WEF’s and related infrastructure, as well as the operational phase of the wind farms. The activities relating to construction of the WEF’s are discussed in a generalised manner in the following sections.

The most significant stage relating to noise is generally the operational phase, and not the construction phase. This is due to the relatively short duration of construction activities.

### *8.6.1 Potential Noise Sources: Construction Phase*

- **<u>Construction Equipment</u>**

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 large distances, they 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. Potential maximum noise levels generated by various construction equipment, as well as the potential extent of these sounds are presented in **Table 43**.

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. Typical sound power levels associated with various activities that may be found at a construction site are presented in
**Table 44**.

**Table 43:** Potential maximum noise levels generated by construction equipment (for illustration purposes)

| Equipment Description | Impact Device? | Maximum Sound Power Levels (dBA) | Operational Noise Level at given distance considering potential **maximum** noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **5 m** | **10 m** | **20 m** | **50 m** | **100 m** | **150 m** | **200 m** | **300 m** | **500 m** | **750 m** | **1000 m** | **2000 m** |
| Auger Drill Rig | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Backhoe | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Chain Saw | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Compactor (ground) | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Compressor (air) | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Concrete Batch Plant | No | 117.7 | 92.7 | 86.7 | 80.6 | 72.7 | 66.7 | 63.1 | 60.6 | 57.1 | 52.7 | 49.2 | 46.7 | 40.6 |
| Concrete Mixer Truck | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Concrete Pump Truck | No | 116.7 | 91.7 | 85.7 | 79.6 | 71.7 | 65.7 | 62.1 | 59.6 | 56.1 | 51.7 | 48.2 | 45.7 | 39.6 |
| Concrete Saw | No | 124.7 | 99.7 | 93.7 | 87.6 | 79.7 | 73.7 | 70.1 | 67.6 | 64.1 | 59.7 | 56.2 | 53.7 | 47.6 |
| Crane | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Dozer | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Drill Rig Truck | No | 118.7 | 93.7 | 87.7 | 81.6 | 73.7 | 67.7 | 64.1 | 61.6 | 58.1 | 53.7 | 50.2 | 47.7 | 41.6 |
| Drum Mixer | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Dump Truck | No | 118.7 | 93.7 | 87.7 | 81.6 | 73.7 | 67.7 | 64.1 | 61.6 | 58.1 | 53.7 | 50.2 | 47.7 | 41.6 |
| Excavator | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Flat Bed Truck | No | 118.7 | 93.7 | 87.7 | 81.6 | 73.7 | 67.7 | 64.1 | 61.6 | 58.1 | 53.7 | 50.2 | 47.7 | 41.6 |
| Front End Loader | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Generator | No | 116.7 | 91.7 | 85.7 | 79.6 | 71.7 | 65.7 | 62.1 | 59.6 | 56.1 | 51.7 | 48.2 | 45.7 | 39.6 |
| Generator (<25KVA) | No | 104.7 | 79.7 | 73.7 | 67.6 | 59.7 | 53.7 | 50.1 | 47.6 | 44.1 | 39.7 | 36.2 | 33.7 | 27.6 |
| Grader | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Impact Pile Driver | Yes | 129.7 | 104.7 | 98.7 | 92.6 | 84.7 | 78.7 | 75.1 | 72.6 | 69.1 | 64.7 | 61.2 | 58.7 | 52.6 |
| Jackhammer | Yes | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Man Lift | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Mounted Impact Hammer | Yes | 124.7 | 99.7 | 93.7 | 87.6 | 79.7 | 73.7 | 70.1 | 67.6 | 64.1 | 59.7 | 56.2 | 53.7 | 47.6 |
| Paver | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Pickup Truck | No | 89.7 | 64.7 | 58.7 | 52.6 | 44.7 | 38.7 | 35.1 | 32.6 | 29.1 | 24.7 | 21.2 | 18.7 | 12.6 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pumps | No | 111.7 | 86.7 | 80.7 | 74.6 | 66.7 | 60.7 | 57.1 | 54.6 | 51.1 | 46.7 | 43.2 | 40.7 | 34.6 |
| Rivit Buster/Chipping Gun | Yes | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Rock Drill | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Roller | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Sand Blasting (single nozzle) | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Scraper | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Sheers (on backhoe) | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Slurry Plant | No | 112.7 | 87.7 | 81.7 | 75.6 | 67.7 | 61.7 | 58.1 | 55.6 | 52.1 | 47.7 | 44.2 | 41.7 | 35.6 |
| Slurry Trenching Machine | No | 116.7 | 91.7 | 85.7 | 79.6 | 71.7 | 65.7 | 62.1 | 59.6 | 56.1 | 51.7 | 48.2 | 45.7 | 39.6 |
| Soil Mix Drill Rig | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Tractor | No | 118.7 | 93.7 | 87.7 | 81.6 | 73.7 | 67.7 | 64.1 | 61.6 | 58.1 | 53.7 | 50.2 | 47.7 | 41.6 |
| Vacuum Excavator | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Vacuum Street Sweeper | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Ventilation Fan | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Vibrating Hopper | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Vibratory Concrete Mixer | No | 114.7 | 89.7 | 83.7 | 77.6 | 69.7 | 63.7 | 60.1 | 57.6 | 54.1 | 49.7 | 46.2 | 43.7 | 37.6 |
| Vibratory Pile Driver | No | 129.7 | 104.7 | 98.7 | 92.6 | 84.7 | 78.7 | 75.1 | 72.6 | 69.1 | 64.7 | 61.2 | 58.7 | 52.6 |
| Warning Horn | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Welder/Torch | No | 107.7 | 82.7 | 76.7 | 70.6 | 62.7 | 56.7 | 53.1 | 50.6 | 47.1 | 42.7 | 39.2 | 36.7 | 30.6 |

**Table 44:** Potential equivalent noise levels generated by various equipment (for illustration purposes)

| Equipment Description | Equivalent (average) Sound Levels (dBA) | Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 m | 10 m | 20 m | 50 m | 100 m | 150 m | 200 m | 300 m | 500 m | 750 m | 1000 m | 2000 m |
| Bulldozer CAT D11 | 113.3 | 88.4 | 82.3 | 76.3 | 68.4 | 62.3 | 58.8 | 56.3 | 52.8 | 48.4 | 44.8 | 42.3 | 36.3 |
| Bulldozer CAT D9 | 111.9 | 86.9 | 80.9 | 74.9 | 66.9 | 60.9 | 57.4 | 54.9 | 51.3 | 46.9 | 43.4 | 40.9 | 34.9 |
| Bulldozer CAT D6 | 108.2 | 83.3 | 77.3 | 71.2 | 63.3 | 57.3 | 53.7 | 51.2 | 47.7 | 43.3 | 39.8 | 37.3 | 31.2 |
| Bulldozer CAT D5 | 107.4 | 82.4 | 76.4 | 70.4 | 62.4 | 56.4 | 52.9 | 50.4 | 46.9 | 42.4 | 38.9 | 36.4 | 30.4 |
| Bulldozer Komatsu 375 | 114.0 | 89.0 | 83.0 | 77.0 | 69.0 | 63.0 | 59.5 | 57.0 | 53.4 | 49.0 | 45.5 | 43.0 | 37.0 |
| Bulldozer Komatsu 65 | 109.5 | 84.5 | 78.5 | 72.4 | 64.5 | 58.5 | 54.9 | 52.4 | 48.9 | 44.5 | 41.0 | 38.5 | 32.4 |
| Diesel Generator (Large - mobile) | 106.1 | 81.2 | 75.1 | 69.1 | 61.2 | 55.1 | 51.6 | 49.1 | 45.6 | 41.2 | 37.6 | 35.1 | 29.1 |
| Dumper/Haul truck - Terex 30 ton | 112.2 | 87.2 | 81.2 | 75.2 | 67.2 | 61.2 | 57.7 | 55.2 | 51.7 | 47.2 | 43.7 | 41.2 | 35.2 |
| Dumper/Haul truck - Bell 25 ton (B25D) | 108.4 | 83.5 | 77.5 | 71.4 | 63.5 | 57.5 | 53.9 | 51.4 | 47.9 | 43.5 | 40.0 | 37.5 | 31.4 |
| Excavator - Cat 416D | 103.9 | 78.9 | 72.9 | 66.8 | 58.9 | 52.9 | 49.3 | 46.8 | 43.3 | 38.9 | 35.4 | 32.9 | 26.8 |
| Excavator - Hitachi 870 (80 t) | 108.1 | 83.1 | 77.1 | 71.1 | 63.1 | 57.1 | 53.6 | 51.1 | 47.5 | 43.1 | 39.6 | 37.1 | 31.1 |
| Excavator - Hitachi 270 (30 t) | 104.5 | 79.6 | 73.5 | 67.5 | 59.6 | 53.5 | 50.0 | 47.5 | 44.0 | 39.6 | 36.0 | 33.5 | 27.5 |
| FEL - CAT 950G | 102.1 | 77.2 | 71.2 | 65.1 | 57.2 | 51.2 | 47.6 | 45.1 | 41.6 | 37.2 | 33.7 | 31.2 | 25.1 |
| FEL - Komatsu WA380 | 100.7 | 75.7 | 69.7 | 63.7 | 55.7 | 49.7 | 46.2 | 43.7 | 40.1 | 35.7 | 32.2 | 29.7 | 23.7 |
| General noise | 108.8 | 83.8 | 77.8 | 71.8 | 63.8 | 57.8 | 54.2 | 51.8 | 48.2 | 43.8 | 40.3 | 37.8 | 31.8 |
| Grader - Operational Hitachi | 108.9 | 83.9 | 77.9 | 71.9 | 63.9 | 57.9 | 54.4 | 51.9 | 48.4 | 43.9 | 40.4 | 37.9 | 31.9 |
| Grader | 110.9 | 85.9 | 79.9 | 73.9 | 65.9 | 59.9 | 56.4 | 53.9 | 50.3 | 45.9 | 42.4 | 39.9 | 33.9 |
| JBL TLB | 108.8 | 83.8 | 77.8 | 71.8 | 63.8 | 57.8 | 54.3 | 51.8 | 48.3 | 43.8 | 40.3 | 37.8 | 31.8 |
| Road Transport Reversing/Idling | 108.2 | 83.3 | 77.2 | 71.2 | 63.3 | 57.2 | 53.7 | 51.2 | 47.7 | 43.3 | 39.7 | 37.2 | 31.2 |
| Road Truck average | 109.6 | 84.7 | 78.7 | 72.6 | 64.7 | 58.7 | 55.1 | 52.6 | 49.1 | 44.7 | 41.1 | 38.7 | 32.6 |
| Vibrating roller | 106.3 | 81.3 | 75.3 | 69.3 | 61.3 | 55.3 | 51.8 | 49.3 | 45.8 | 41.3 | 37.8 | 35.3 | 29.3 |
| Water Dozer, CAT | 113.8 | 88.8 | 82.8 | 76.8 | 68.8 | 62.8 | 59.3 | 56.8 | 53.3 | 48.8 | 45.3 | 42.8 | 36.8 |
| Wind turbine (Vestas V90 maximum) | 108.0 | 83.0 | 77.0 | 71.0 | 63.0 | 57.0 | 53.5 | 51.0 | 47.5 | 43.0 | 39.5 | 37.0 | 31.0 |

Construction activities include:

- construction of access roads;
- establishment of turbine tower foundations and electrical substation(s);
- the possible establishment, operation and removal of concrete batching plants;
- the construction of any buildings;
- digging of trenches to accommodate underground power cables; and
- the erection of turbine towers and assembly of WTG's.

The equipment likely to be required to complete the above tasks will typically include:

- excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, TLB, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.

▪ **<u>Material Supply: Concrete batching plants and use of Borrow Pits</u>**

Instead of transporting the required material to the site using concrete trucks, portable concrete batching plants may be required to supply concrete onsite. Batching plant equipment may be relocated between the sites as the works progress to different areas of the site. Materials from cuttings and excavations will be reused where possible. If not available, materials will be sourced from registered and licensed burrow pits in the area.

▪ **<u>Blasting</u>**

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations.

Blasting will not be considered during the EIA phase for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner. With regards to blasting in borrow pits, explosives are used with a low detonation speed, reducing vibration, sound pressure levels and air blasts. The breaking of obstacles with explosives is also a specialized field, and when correct techniques are used, it causes less noise than using a rock-breaker.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast.
- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relative fast, resulting in a higher acceptance of the noise.

▪ **<u>Traffic</u>**

The last significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. The use of a borrow pit(s), onsite crushing and screening and concrete batching plants will significantly reduce heavy vehicle movement to and from the site.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to traffic will be estimated using the methodology stipulated in SANS 10210:2004 (Calculating and Predicting Road Traffic Noise).

#### *8.6.2 Potential Noise Sources: Operational Phase*

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. These sources normally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the sub-stations, traffic (maintenance) and transmission line noise.

- **Wind Turbine Noise: Aerodynamic sources**

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

1. Self-noise due to the interaction of the turbulent boundary layer with the blade trailing edge;
2. Noise due to inflow turbulence (turbulence in the wind interacting with the blades).
3. Discrete frequency noise due to trailing edge thickness;
4. Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade); and
5. Noise generated by the rotor tips.

Therefore, as the wind speed increases, noises created by the wind turbine also increase. At a low wind speed the noise created by the wind turbine is generally relatively low, and increases to a maximum at a certain wind speed when it either remains constant, increases very slightly or even drops as illustrated in **Figure 89**.

The propagation model makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions providing a higher accuracy than models that only use the total sound power level. The octave sound power levels for various wind turbines are presented on **Figure 90**.

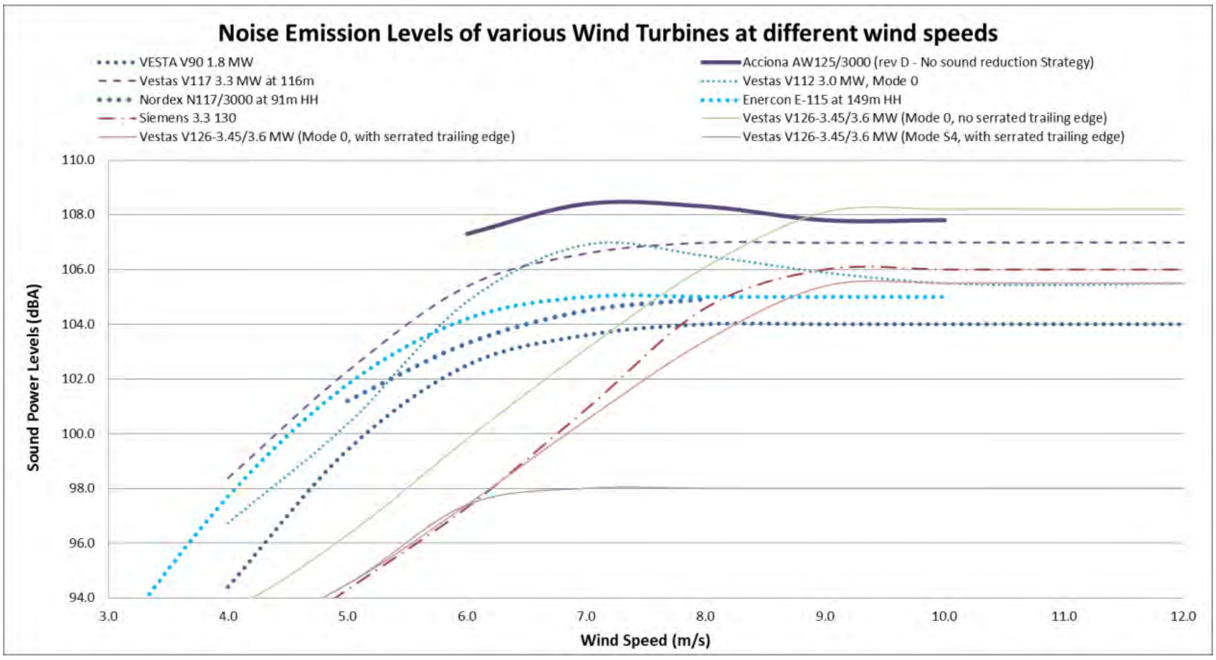



**Figure 89:** Noise Emissions Curve of a number of different wind turbines

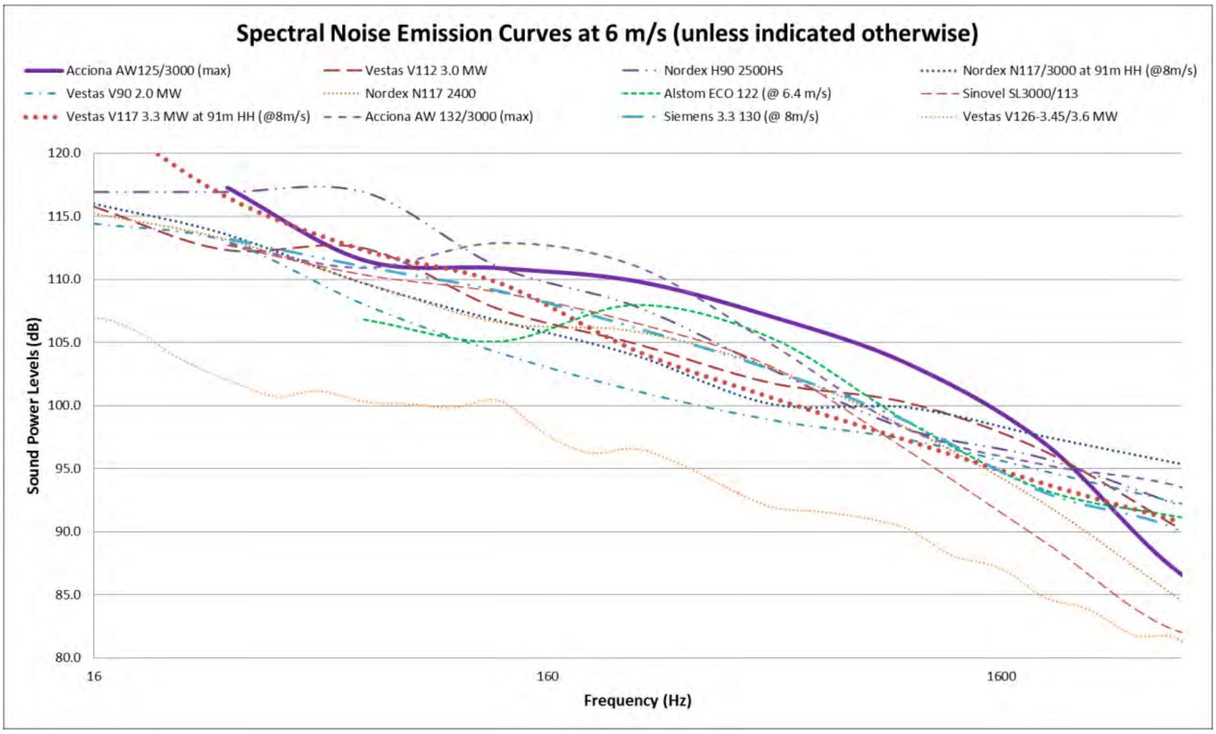



**Figure 90:** Octave sound power emissions of various wind turbines

- **<u>Wind Turbine: Mechanical Sources</u>**

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.

Tones are noises with a narrow sound frequency composition (e.g., the whine of an electrical motor). Annoying tones can be created in numerous ways: machinery with rotating parts, such as motors, gearboxes, fans and pumps, often create tones. An imbalance or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones. Pulsating flows of liquids or gases can also create tones, which may be caused by combustion processes or flow restrictions. The best and most well-known example of a tonal noise is the buzz created by a flying mosquito.

Where complaints have been received due to the operation of wind farms, tonal noise from the installed wind turbines appears to have increased the annoyance perceived by the complainants and indeed has been the primary cause for complaint.

However, tones were normally associated with the older models of turbines. All turbine manufacturers have started to ensure that sufficient forethought is given to the design of quieter gearboxes and the means by which these vibration transmission paths may be broken. Through the use of careful gearbox design and/or the use of anti-vibration techniques, it is possible to minimise the transmission of vibration energy into the turbine supporting structure. The benefits of these design improvements have started to filter through into wind farm developments, which are using these modified wind turbines. New generation wind turbine generators do not emit any clearly distinguishable tones.

- **Transformer noises (Sub-stations)**

Also known as magnetostriction, this is when the sheet steel used in the core of the transformer tries to change shape when being magnetised. When the magnetism is taken away, the shape returns, only to try and deform in a different manner when the polarity is changed.

This deformation is not uniform; consequently it varies all over a sheet. With a transformer core being composed of many sheets of steel, these deformations is taking place erratically all over each sheet, and each sheet is behaving erratically with respect to its neighbour. The result is the “hum” frequently associated with transformers. While this may be a soothing sound in small home appliances, various complaints are lodged in areas where people stay close to these transformers. At a voltage frequency of 50 Hz, these “vibrations” take place 100 times a second, resulting in a tonal noise at 100Hz. This is a relative easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer and will not be considered further in this ENIA study.

- **Transmission Line Noise (Corona noise)(Grid connection impact)**

Corona noise is caused by the partial breakdown of the insulation properties of air surrounding the conducting wires. It can generate an audible and radio-frequency noise, but generally only occurs in humid conditions, as provided by fog or rain. A minimum line potential of 70 kV or higher is generally required to generate corona noise depending on the electrical design. Corona noise does not occur on domestic distribution lines.

Corona noise has two major components: a low frequency tone associated with the frequency of the AC supply (100 Hz for 50 Hz source) and broadband noise. The tonal component of the noise is related to the point along the electric waveform at which the air begins to conduct. This varies with each cycle and consequently the frequency of the emitted tone is subject to great fluctuations. Corona noise can be characterized as broadband 'crackling' or 'buzzing', and *it is generally only a feature during fog or rain*.

It will not be investigated further, as corona discharges result in:

- Power losses,
- Audible noises,
- Electromagnetic interference,
- A purple glow,
- Ozone production; and
- Insulation damage.

Electrical Service Providers, such as Eskom, go to great lengths to design power transmission equipment to minimise the formation of corona discharges. In addition, it is an infrequent occurrence with a relatively short duration compared to other operational noises.

- **<u>Low Frequency Noise</u>**

    - *Background and Information*

"Low frequency sound" is the term used to describe sound energy in the region below ~200Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range. Infrasound is often used to describe sound energy in the region below 20 Hz. Almost all noise in the environment has components in this region although they are of such a low level that they are not significant (wind, ocean, thunder).

While significant work has been done in this field, uncertainties exist around Infrasound and Low Frequency Noise.

- *The generation of Low Frequency Sounds*

Because of the low rotational rates of the blades of a WTG, the peak acoustic energy radiated by large wind turbines is in the infrasonic range with a peak in the 8-12 Hz range. For smaller machines, this peak can extend into the low-frequency "audible" (20-20KHz) range because of higher rotational speeds and multiple blades.

- *Detection of Low Frequency Sounds*

Investigations have shown that the perception and the effects of sounds differ considerably at low frequencies as compared to mid- and high frequencies. The main aspects to these differences are:

- a weakening of pitch sensation as the frequency of the sound decreases below 60 Hz;
- perception of sounds as pulsations and fluctuations;
- a much more rapid increase of loudness and annoyance with increasing sound level at low frequencies than at mid- or high frequencies;
- complaints about the feeling of ear pressure;
- annoyance caused by secondary effects like rattling of building elements, e.g. windows and doors or the tinkling of bric-a-brac;
- other psycho acoustic effects, e.g. sleep deprivation, a feeling of uneasiness; and
- reduction in building sound transmission loss at low frequencies compared to mid- or high frequencies.

  - *Measurement, Isoloation and Assessment of Low Frequnecy Sounds*

Significant debate remains regarding the noise from WTG's, public response to that noise, as well as the presence or absence of low frequency sound and how it affects people. While low frequency sounds can be measured, it is far more difficult to isolate low frequency sounds, due to the numerous sources generating these sounds.

From sound power level emission tables (for Wind Turbines) it can be seen that a wind turbine has the potential to generate low frequency sounds with sufficient energy to warrant the need to investigate WTG as a source of low frequency sounds. Each turbine make, model and size has a specific noise emission characteristic. The larger a wind turbine (especially the blades), the higher the acoustical energy in the lower frequencies and the potential for low frequency sounds should be evaluated for each project and turbine proposed.

SANS 10103:2004 proposes a method to identify whether low frequency noise could be an issue. It proposes that if the difference between the A-frequency weighted and the C-frequency weighted equivalent continuous ($L_{Aeq}$ >> $L_{Ceq}$) sound pressure levels is greater than 10 dB, a predominant low frequency component may be present.

  - *Summary: Low Frequnecy Noise*

Low frequency noise is always present around us, as it is produced by both man and nature. While problems have been associated with older downwind wind turbines in the 1980s, this has been considered by the wind industry and modern upwind turbines do not suffer from the same problems.

- **Amplitude modulation**

Although very rare, there is one other characteristic of wind turbine sound that increases the sleep disturbance potential above that of other long-term noise sources. The amplitude modulation of the sound emissions from the wind turbines creates a repetitive rise and fall in sound levels synchronised to the blade rotation speed, sometimes referred to as a "swish" or "thump".

Regrettably, the mechanism of this noise is not known though various possible reasons have been put forward. Although the prevalence of complaints about amplitude modulation is relatively small, it is not clear whether this is because it does not occur often enough or whether it is because housing is not in the right place to observe it. Furthermore the fact that the mechanism is unverified means that it is not possible to predict when or whether it will occur.

Even though there are thousands of wind turbine generators in the world, amplitude modulation is one subject receiving the least complaints and due to these very few complaints, little research has gone into this subject. It is included in this report to highlight all potential risks, albeit extremely low risks such as this (low significance due to very low probability).

### *8.6.3 Noise Impact on Animals*

While there are few specific studies focusing on noises from wind turbines, there are a number of publications where the effects of increased noises on certain species were studied. This is because hearing is critical to an animal's ability to:

- React;
- Compete;
- Seek mates and reproduce;
- Hunt and forage;
- Communicate; and
- Survive.

Overall, the research suggests that species differ in their response to:

- Various types of noise;
- Durations of noise; and
- Sources of noise.

The only animal species studied in detail are humans, and studies are still continuing today. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as humans age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar with all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals (see **Figure 91**).

Only a few faunal species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject with a few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies do indicate definitive levels where noises start to impact on animals, with most based on laboratory level research that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in the environment (excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

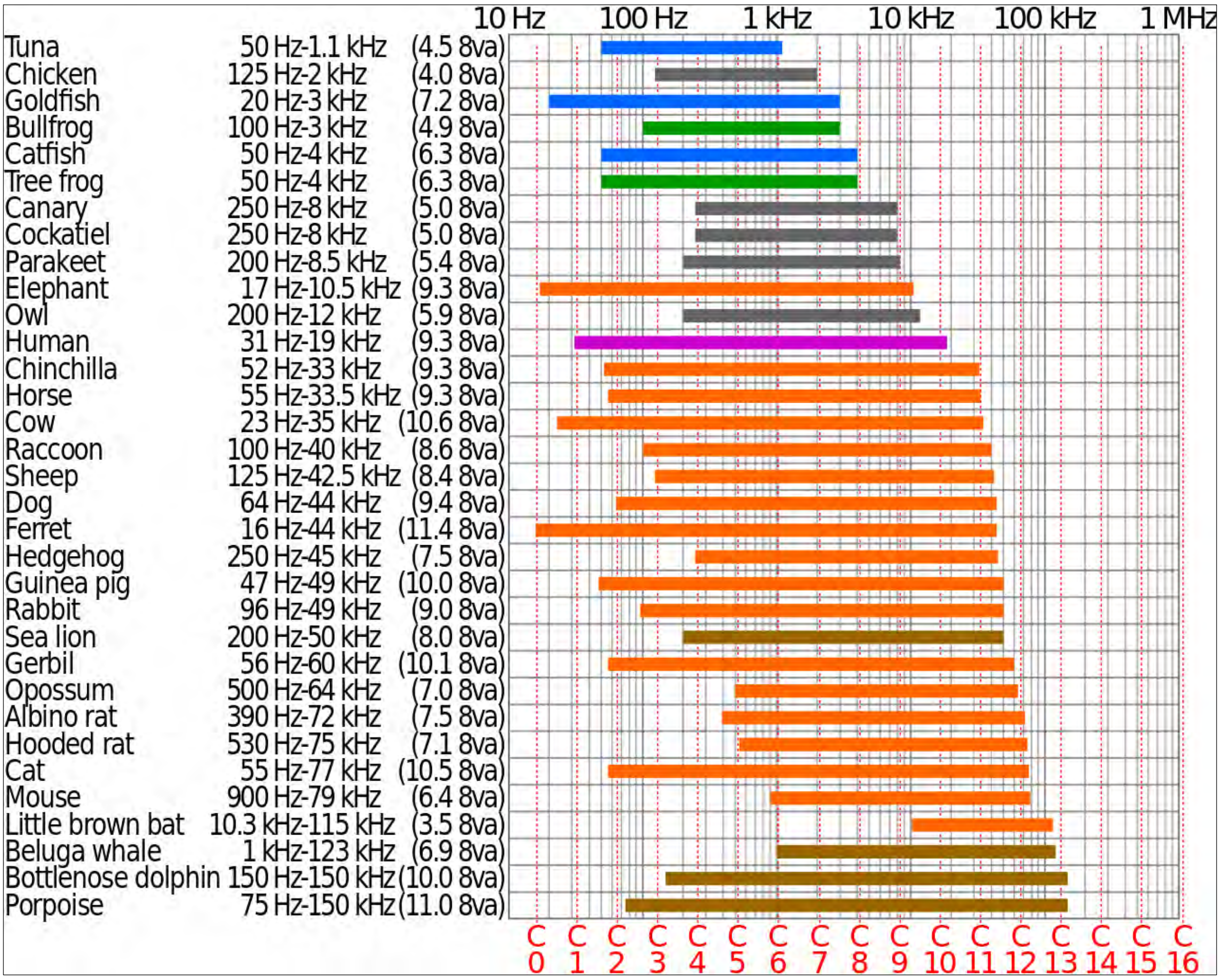



**Figure 91:** Logarithmic chart of the hearing ranges of some animals

A general animal behavioural reaction to impulsive is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed;
- whether there is one animal or a group; and
- whether there have been some previous exposures.

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

From these and other studies the following can be concluded:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate.
- Animals of most species exhibit adaptation with noise, including impulsive noises by changing their behaviour;
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate; and

- Noises associated with helicopters, motor- and quad bikes does significantly impact on animals.

To date there however no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals.

- **<u>Domestic Animals</u>**

It has been observed that most domestic animals are generally not bothered by noise and can easily adjust to increased noise levels. As with all animals, impulsive noises will affect them as previously discussed.

- **<u>Wildlife</u>**

Studies showed that most animals adapt (leave noise area, change communication, change times when they forage/hunt, etc.) to noises but may even return to a site after an initial disturbance, even if the noise is continuing. The availability of habitat, water and food sources are more important than environmental factors such as noise. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area unless they are restricted in movement. As mentioned, noise impacts are very highly species dependent.

### *8.6.4 Why Noise Concerns Communities*

Noise can be defined as "unwanted sound", an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalize by saying that sound becomes unwanted when it:

- Hinders speech communication,
- Impedes the thinking process,
- Interferes with concentration,
- Obstructs activities (work, leisure and sleeping),
- Presents a health risk due to hearing damage.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears no noise, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to,
- The manner in which the receptor can control the noise (helplessness),
- The time, unpredictability, frequency distribution, duration, and intensity of the noise,
- The physiological state of the receptor,
- The attitude of the receptor about the emitter (noise source).

▪ **<u>Annoyance associated with Wind Energy Facilities</u>**

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that that non-acoustic factors plays a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity.

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 92**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in Environmental Health Impact Assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise climate.

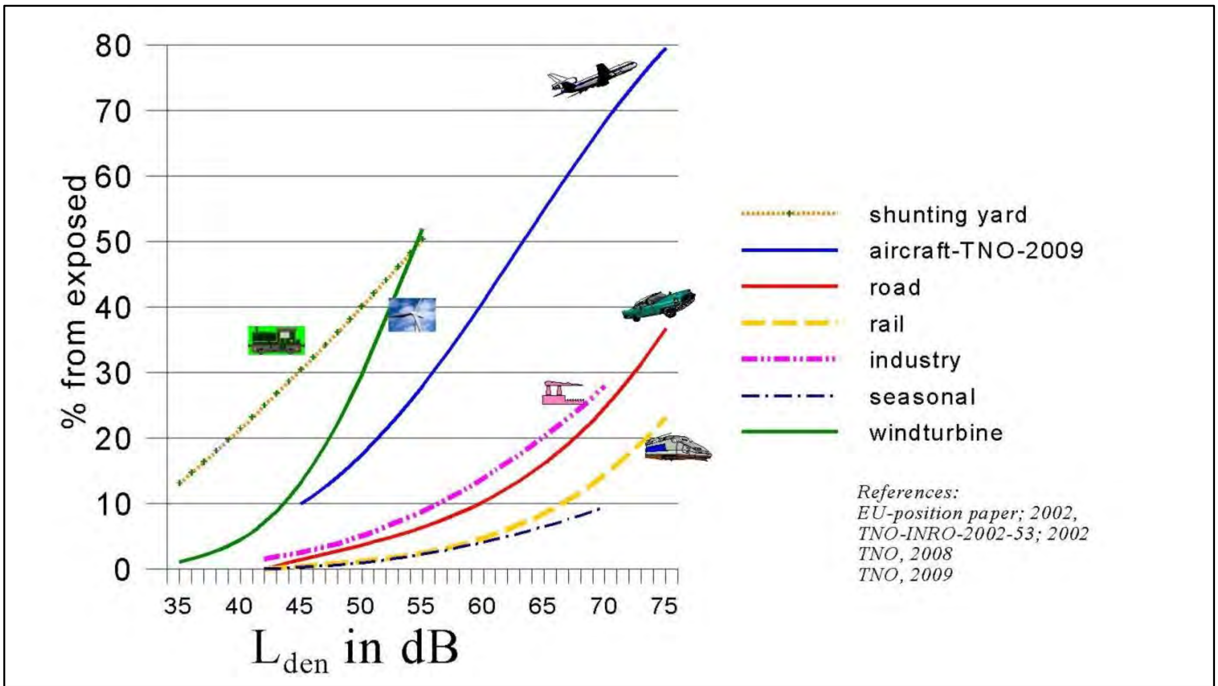



**Figure 92:** Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling

### 8.6.5 Current Sound Levels

Considering the location of the project site in relation to roads or industrial activities, the current low developmental character and measurements done in the area indicates very low ambient sound levels. There is very high confidence that the ambient sound levels will also be very low on the project site.

Agricultural and other anthropogenic activities may raise ambient sound levels in the vicinity of the dwellings and agricultural structures in the area, but, as the night-time soundscape is of interest, these activities are unlikely to influence night-time sound levels.

### 8.6.6 Proposed Construction Phase Noise Impact

This section investigates the noise of conceptual construction activities as discussed in **section** Error! eference source not found. of the Noise Impact Report. Noise from construction activities are dependent on the final operational layout, the type of activity taking place as well as the number of activities taking place simultaneously.

The following construction activities could take place simultaneously and were considered:

- General work at a temporary workshop area. This would be activities such as equipment maintenance, off-loading and material handling. All vehicles will travel to this site where most equipment and material will be off-loaded (general noise, crane). Material, such as aggregate and building sand, will be taken directly to the construction area (foundation establishment). It was assumed that activities will be taking place for 16 hours during the 16 hour daytime period.
- Surface preparation prior to civil work. This could be the removal of topsoil and levelling with compaction, or the preparation of an access road (bulldozer/grader). Activities will be taking place for 8 hours during the 16 hour daytime period.
- Preparation of foundation area (sub-surface removal until secure base is reached – excavator, compaction, and general noise). Activities will be taking place for 10 hours during the 16 hour daytime period.
- Pouring and compaction of foundation concrete (general noise, electric generator/compressor, concrete vibration, mobile concrete plant, TLB). As foundations must be poured in one go, the activity is projected to take place over the full 16 hour day time period.
- Erecting of the wind turbine generator (general noise, electric generator/compressor and a crane). Activities will be taking place for 16 hours during the 16 hour daytime period.
- Traffic on the site (trucks transporting material, aggregate/concrete, work crews) moving from the workshop/store area to the various activity sites. Up to 20 heavy and light vehicles may travel between 40 and 60 km/h on the access roads.

There will be a number of smaller equipment, but the addition of the general noise source (at each point) covers most of these noise sources. It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. This is likely the worst case scenario that can occur during the construction of the facility.

As it is unknown where the different activities may take place it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise emission level – various equipment operating simultaneously) at all locations (over the full daytime period of 16 hours) where wind turbines may be erected for both layouts, calculating how this may impact on potential noise-sensitive developments (see **Figure 93**). Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated in **Figure 94**.

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:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore, it is hard to judge beforehand if a construction team would be required to work late at night.

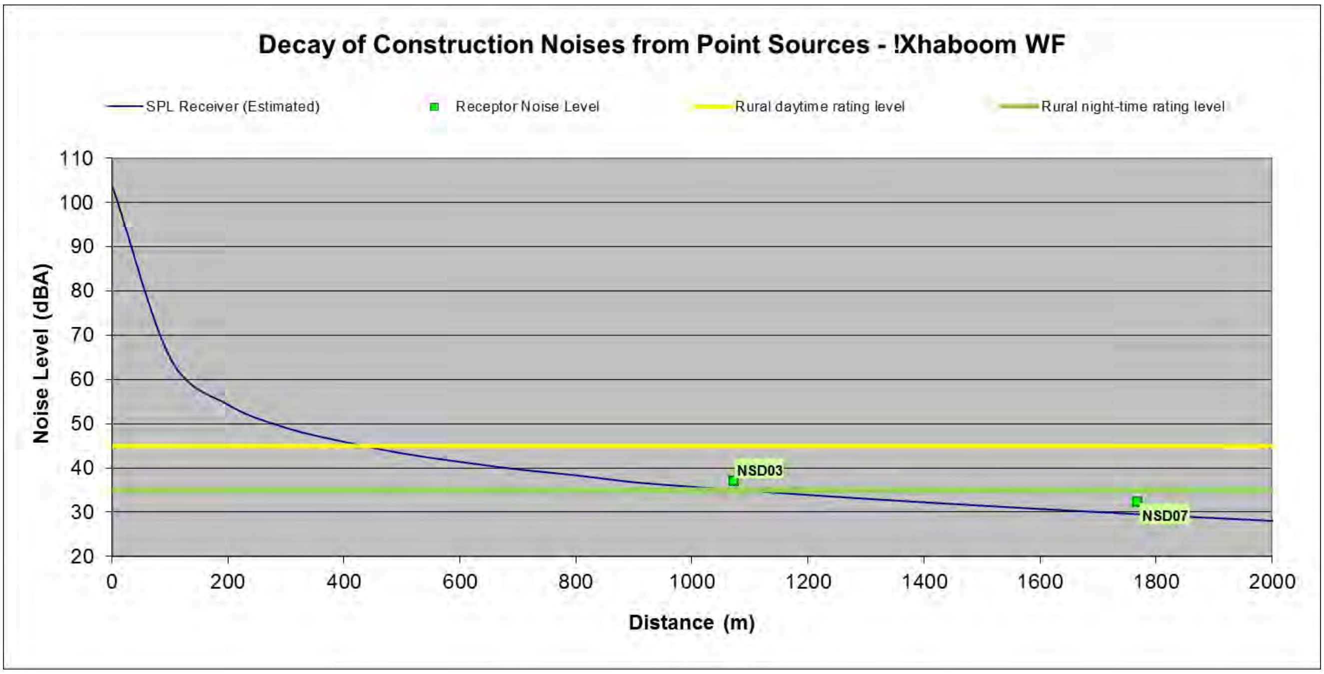



**Figure 93:** Projected conceptual construction noise levels – Decay of noise from construction activities

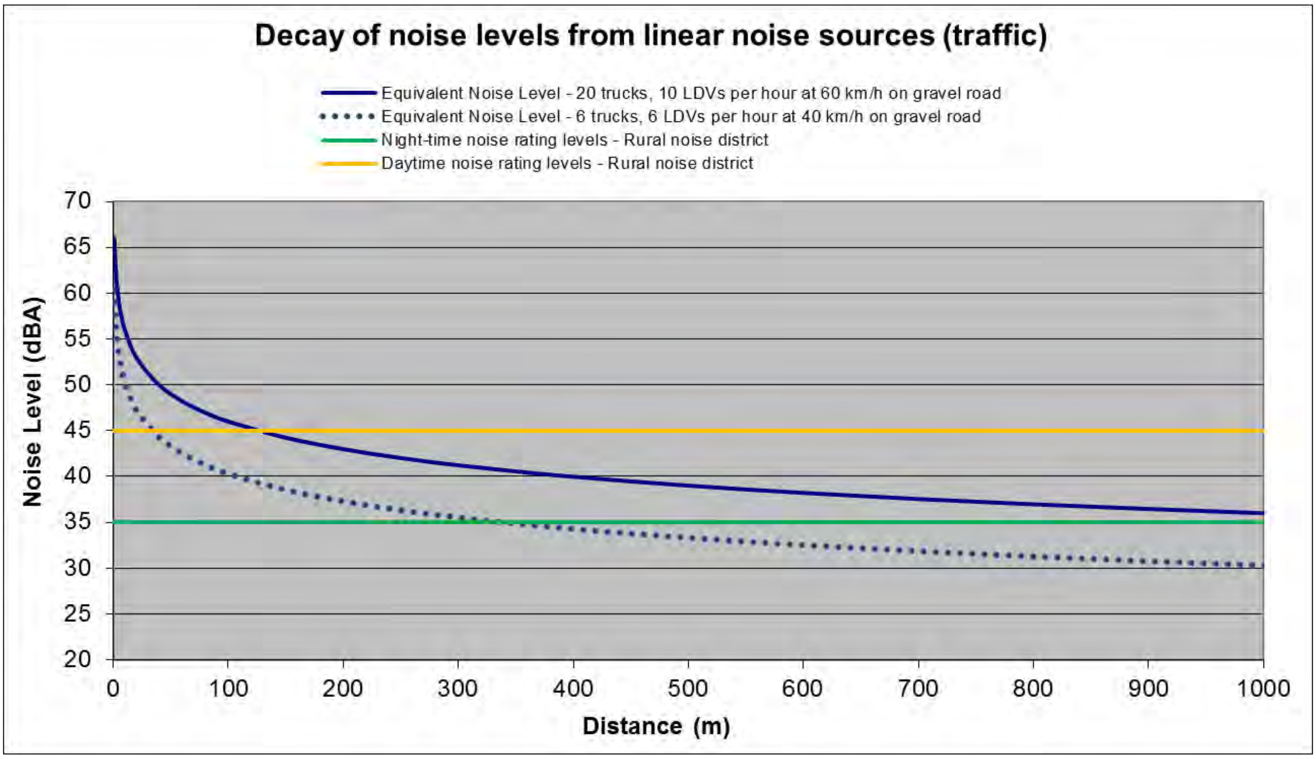


**Figure 94:** Projected conceptual construction traffic noise levels – Decay over distance from linear activities

### *8.6.7 Operational Phase Noise Impact*

Typical day time activities would include:

- The operation of the various Wind Turbines,
- Maintenance activities (relatively insignificant noise source).

The daytime period however, was not considered for the EIA because noise generated during the day by the WEF is generally masked by other noises from a variety of sources surrounding potentially noise-sensitive developments. 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 (WTG's) at night.

The presented layout was modeled in detail. While the developer have not yet identified a wind turbine to use, this report makes use of the sound power emission levels for an Acciona AW125 3000 wind turbine as defined in **Table 45**. This wind turbine was selected as it is a relatively loud wind turbine and it will illustrate a worst-cast scenario (precautionary principle).

**Table 45:** Sound Power Emission Levels used for modelling: Acciona AW125

| **Wind Turbine: Acciona AW125/3000 at hub height 120** |
| --- |
| **Source Reference: Acciona Windpower. General Document DG200383, Rev D dated 04/04/14** |
| **Maximum expected A-weighted Octave Sound Power Levels** |

| Frequency | 16 | 31.5 | 63 | 125 | 250.0 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Lpa (dB) | *not reported* | 117.3 | 111.5 | 110.9 | 109.9 | 107.0 | 103.3 | 97.0 | 86.6 | 81.3 |
| $L_{WA}$ (dBA) | *not reported* | 77.4 | 85.3 | 94.7 | 101.2 | 103.8 | 103.3 | 98.2 | 87.6 | 81.3 |

| **A-Weighted Sound Power Levels (at wind speeds)** | | |
|---|---|---|
| **Wind speed at 10 m height** | **Wind speed at hub height** | **Sound Power Level** |
| 6 m/s | 8.5 m/s | 107.3 dBA |
| 7 m/s | 9.9 m/s | 108.4 dBA |
| 8 m/s | 11.3 m/s | 108.2 dBA |
| 9 m/s | 12.7 m/s | 107.8 dBA |
| 10 m/s | 14.1 m/s | 107.7 dBA |

Contours of the total noise rating levels are presented in **Figure 95**. **Table 46** defines the maximum noise rating levels at the closest potential noise-sensitive receptors.

**Table 46:** Maximum noise rating levels at closest potential noise-sensitive receptors

| NSD | Maximum A-weighted Noise Rating Levels (dBA) | Comments |
|---|---|---|
| 3 | 38.5 | Dwelling only used temporary |
| 4 | 34.0 | Dwelling only used a few nights in summer during sheering |
| 7 | 39.1 | Dwelling, status unknown |

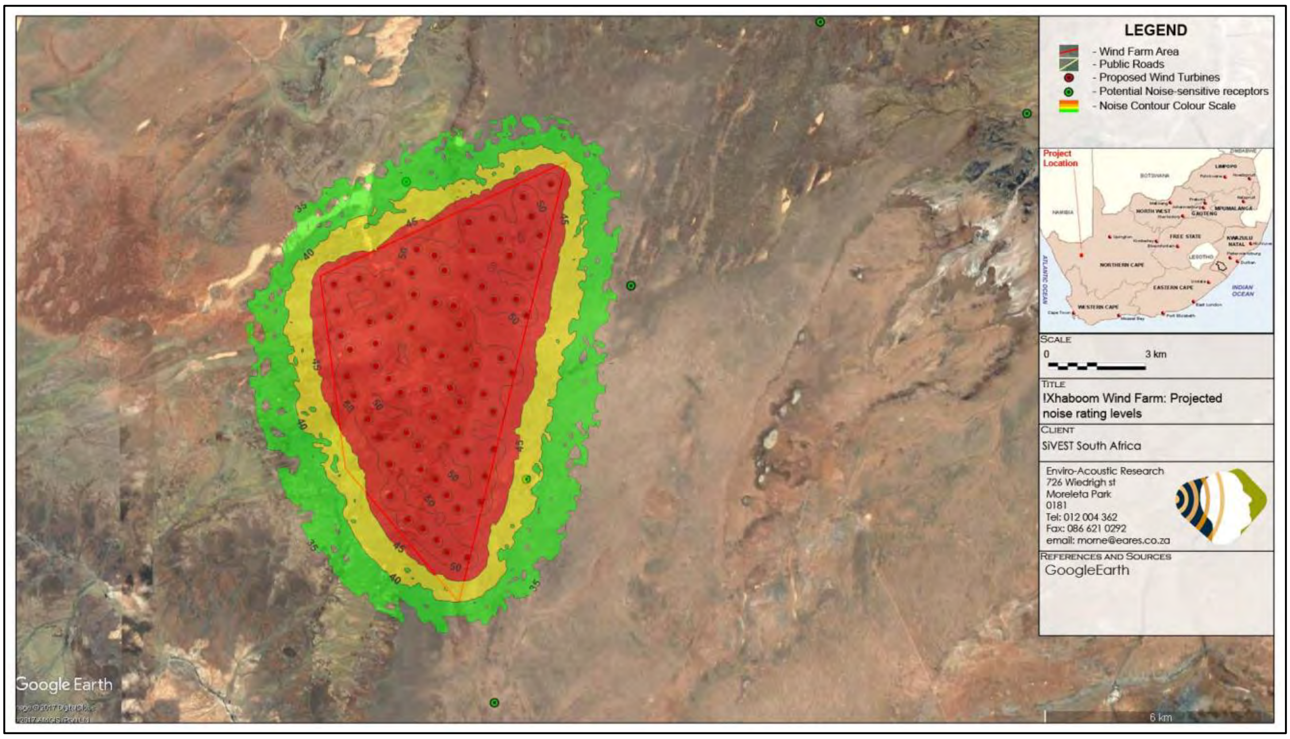


**Figure 95:** Projected conceptual night-time maximum noise rating levels during operation

### *8.6.8 Decommissioning and Closure Phase Noise Impact*

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 and noise from the decommissioning and closure phases will therefore not be investigated further.

#### *8.6.9 Significane of the Noise Impact*

- **<u>Planning Phase Noise Impact</u>**

No noise is associated with the planning phase and this will not be investigated in further.

- **<u>Construction Phase Noise Impact</u>**

The impact assessment for the various construction activities are described in **section 4.1** of the Noise Impact Assessment Report, defined and assessed in **section 8.2** of the Noise Impact Assessment Report. Considering the projected noise levels for the construction of wind turbines (around 40 dBA) as well as the expected daytime ambient sound level (possibly higher than 45 dBA), there is a very low risk for a noise impact from this source during the day. At night these noises will be higher than the night-time rating level for a rural area, but this is not considered to be a disturbing noise.

Noise issues may be associated with the construction of access routes as well as construction traffic noises (considering potential routes of access roads, location of potential receptors as well as **Figure 93** and **Figure 94**). This will depend on the location of the access roads in relation to the potential noise-sensitive receptors. Mitigation is available that will reduce the potential noise impact.

- **<u>Operational Phase Noise Impact</u>**

The impact assessment for the various activities defined in **section 4.2** of the Noise Impact Assessment Report with the projected noise levels calculated in **section 8.3** of the Noise Impact Assessment Report.

As can be seen from **Table 46**, the projected noise levels will be higher than the night-time rural rating level (of 35 dBA) at NSD06 (projected noise level of 44 dBA). It is important to note that this would be at a 10m wind speed of 7 m/s when ambient sound levels would be ranging between 35 and 55 dBA, averaging at 41 dBA.

Considering the MoE guideline noise levels (see also **section 2.6.3** of the Noise Impact Assessment Report) the noise levels will not be higher than the MoE guideline levels. The significance of the noise impact considers the ambient sound levels measured onsite, ambient sound levels measured at other locations as well as international guidelines.

- **<u>Decommissioning Phase Noise Impact</u>**

Final decommissioning activities will have a noise impact lower than either the construction or operational phases. This is because decommissioning and closure activities normally take place during the day using minimal equipment (due to the decreased urgency of the project). While there may be various activities, there is a very small risk for a noise impact.

## 8.7 Visual

### *8.7.1 Impact Assessment*

#### *8.7.1.1 Receptor Impact Rating*

In order to assess the impact of the proposed development on the potentially sensitive receptor locations listed above, a matrix that takes into account a number of factors has been developed (**Table 48**), and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of a receptor location away from the proposed development (zones of visual impact)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.)
- Visual character and sensitivity of the surrounding area
- 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 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 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.

The orientation of a receptor becomes important in many cases, as a receptor is typically oriented in a certain direction, e.g. with views towards a certain area from a highly frequented area like a porch or garden. The visual impact of a development could thus be potentially much greater if the development intruded into such a view, and thus the highest rating has been given to a situation where the development would cross directly across an 'arc of view / orientation' – i.e. the 180° panorama in a certain direction. Where the receptor does not have a primary orientation, such as a residential community where the dwellings are focused in different directions, a medium rating has been specified.

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 receptor location and an object could completely shield the object from the receptor. Topography (relative elevation and aspect) plays a similar role as a 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 receptor.

The visual character of the surrounding area and the views experienced from receptor locations are also considered in the matrix, as introducing a new development into a natural area may adversely affect or degrade scenic views experienced by receptors. Although pastoral' or rural landscapes often have a relative density of anthropogenic (human) infrastructure (e.g. fences, centre pivots, buildings such as barns and farmhouses), views of these landscape are often perceived as sensitive to visual impacts, particularly to visual impacts of more industrial or large-scale infrastructure. A moderate rating is thus assigned to the visual character of these views. Transformed industrial landscapes have been assigned a low impact rating as a new development is unlikely to be regarded as negative within this context.

The visual contrast of a development refers to the degree to which the 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 receptors within a specific context. A development that is incongruent with the surrounding area could have a significant visual impact on sensitive receptors as it may change the visual character of the landscape.

Through the matrix a score for each receptor location is calculated. The range in which the score falls, as listed in **Table 47** below, determines the visual impact rating for each receptor location.

**Table 47:** Ratings scores

| Rating | Overall Score |
|---|---|
| High Visual Impact | 13-15 |
| Medium Visual Impact | 9-12 |
| Low Visual Impact | 5-8 |
| Negligible Visual Impact | (overriding factor) |

An explanation of the matrix is provided in **Table 48** below.

**Table 48:** Visual assessment matrix used to rate the impact of the proposed development on potentially sensitive visual receptors

| | VISUAL IMPACT RATING | | | |
|---|---|---|---|---|
| **VISUAL FACTOR** | **HIGH** | **MEDIUM** | **LOW** | **OVERRIDING FACTOR: NEGLIGIBLE** |
| **Distance of receptor away from proposed development** | 0 ≤ 2km<br><br>**Score 3** | 2km ≤ 5km<br><br>**Score 2** | 5km ≤ 8km<br><br>**Score 1** | 8km < |
| **Primary focus / orientation of receptor** | 'Arc of view' directly towards the proposed development<br><br>**Score 3** | 'Arc of view' partially towards the proposed development / no primary orientation<br>**Score 2** | 'Arc of view' in opposite direction of the proposed development<br>**Score 1** | |
| **Presence of screening factors** | No / almost no screening factors – development highly visible<br><br>**Score 3** | Screening factors partially obscure the development<br><br>**Score 2** | Screening factors obscure most of the development<br><br>**Score 1** | Screening factors completely block any views towards the development, i.e. the development is not within the viewshed |
| **Visual character and sensitivity of the area / surrounding views** | **Scenic:** Highly natural; almost no visually 'degrading' factors, the area is valued for its scenic quality and is **highly sensitive to change**<br><br>**Score 3** | **Rural / pastoral:** Mostly natural with typical rural infrastructure present, the area is valued for its uninhabited nature and is **potentially sensitive to change**<br><br>**Score 2** | **Transformed:** Presence of industrial-type infrastructure (e.g. urban areas and outlying residential areas), not highly valued and **not sensitive to change**<br>**Score 1** | |
| **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)<br><br>**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)<br><br>**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)<br>**Score 1** | |

The impact of the development on each potentially sensitive receptor location has been determined based on the factors detailed above (**Table 48**). As previously mentioned, a few of the farmsteads / homesteads identified during the scoping phase were initially excluded as potentially sensitive receptor locations for the purposes of this EIA phase study as these appeared to be uninhabited and/or abandoned at the time of the site visit. No further assessment was undertaken from these farmsteads / homesteads as it was assumed that no individuals currently live in these farmsteads / homesteads and therefore no visual impact will be experienced from these locations.

A summary of the impact ratings on each potentially sensitive receptor location is provided in **Table 49** below.

**Table 49:** Visual Impact of the proposed !Xha Boom Wind Farm on the potentially sensitive visual receptor locations identified within the study area- Summary and Results

| RECEPTOR LOCATION | IMPACT RATING | | | | | |
|---|---|---|---|---|---|---|
| | Distance | Orientation | Screening | Character / Sensitivity | Contrast | OVERALL IMPACT RATING |
| VR 5 | Low | Low | High | Medium | High | MEDIUM Score 10 |
| VR 13 | High | Medium | High | Medium | High | HIGH Score 13 |
| VR 18 | High | Medium | High | Medium | High | HIGH Score 13 |
| VR 44 | Low | Medium | High | Medium | High | MEDIUM Score 11 |

### *8.7.2 Visual Modelling*

In order to provide an indication of what the proposed wind farm would look like from some of the potentially sensitive receptor locations currently in use, visual models were created to strengthen the findings of the receptor impact ratings. 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. The models illustrate how views from the each vantage point will be transformed by the proposed 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 will be restored to its current state after the construction phase. This is 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 early planning stages. Therefore, the layout plans of the turbines, as provided by Mainstrream may change. In addition, all infrastructure associated with the wind farm has been excluded from the models.

#### *8.7.2.1 Vantage Point 1 – View towards the proposed !Xha Boom Wind Farm Application Site from the farmstead / homestead at VR 5 (within 8km of the proposed development)*

**Figure 96:** Existing view to the south-west (SW) from the farmstead / homestead at VR 5, towards the proposed !Xha Boom Wind Farm application site (within 8 km of the proposed development).

**Figure 97:** Visually modelled post-construction view to the south-west (SW) from the farmstead / homestead at VR 5, towards the proposed !Xha Boom Wind Farm application site (within 8km of the proposed development).

As indicated in **Figure 97** above, the area surrounding this farmstead / homestead is characterised by a largely flat terrain with minor / slight undulations. In addition, there are almost no vegetative screening factors present, as there are no trees and other significant vegetation in the area surrounding this farmstead / homestead. As such, the lack of screening factors (such as undulations, tall trees and other vegetation) in the area surrounding this farmstead / homestead are expected to result in the proposed development being highly visible. It should however be noted that the proposed wind turbines will be located approximately 8km from this point, and as such the turbines are not expected to be highly visible. The visible wind turbines would contrast highly with the dominant natural landscape elements as there are no tall linear elements in view from the farmstead / homestead except for telephone poles, fence poles and windmills.

#### *8.7.2.2 Vantage Point 2 – View towards the proposed !Xha Boom Wind Farm Application Site from the farmstead / homestead at VR 13 (within 2km of the proposed development)*

**Figure 98:** Existing view to the west (W) from the farmstead / homestead at VR 13, towards the proposed !Xha Boom Wind Farm application site (within 2km of the proposed development).

**Figure 99:** Visually modelled post-construction view to the west (W) from the farmstead / homestead at VR 13, towards the proposed !Xha Boom Wind Farm application site (within 2km of the proposed development).

As indicated in **Figure 99** above, the area surrounding this farmstead / homestead is characterised by a largely flat terrain with slight undulations. In addition, there are almost no tall trees or other significant vegetative screening factors surrounding this farmstead / homestead. As such, the lack of significant screening factors in the area surrounding this farmstead / homestead is expected to result in the proposed development being highly visible. In addition, the close proximity of the proposed development (i.e. within 2km) is also expected to result in the wind turbines being highly visible. The visible wind turbines would contrast highly with the dominant natural landscape elements as there are no tall linear elements in view from the farmstead / homestead except for telephone poles, fence poles and windmills.

##### *8.7.2.2 Vantage Point 3 – View towards the proposed !Xha Boom Wind Farm Application Site from the south-eastern section of the visual assessment zone, within 5km of the proposed application site*

**Figure 100:** Existing view (to the north north-west) towards the proposed Xha! Boom Wind Farm application site from the south-eastern section of the visual assessment zone, within 5km of the proposed application site.

**Figure 101:** Visually modelled post-construction view (to the north north-west) towards the proposed Xha! Boom Wind Farm application site from the southeastern section of the visual assessment zone, within 5km of the proposed application site

As indicated in **Figure 101** above, the area surrounding this point is characterised by a largely flat terrain with slight undulations. In addition, there are almost no tall trees or other significant vegetative screening factors surrounding this point. As such, the lack of significant screening factors in the area surrounding this point is expected to result in the proposed development being highly visible. In addition, the relatively close proximity of the proposed development (i.e. within 5km) is also expected to result in the wind turbines being highly visible. The visible wind turbines would contrast highly with the dominant natural landscape elements as there are no tall linear elements in view from the farmstead / homestead except for telephone poles, fence poles and windmills.

It should be noted that visual modelling was undertaken using the previously assessed 70 turbine layout which Mainstream initially proposed to construct on the wind farm site. However, as previously mentioned, Mainstream have now amended the turbine layout to include a reduced 47 turbine layout. The new proposed 47 turbine layout will subsequently be preferred from a visual perspective when compared to the previously assessed 70 turbine layout as the reduction in the number of turbines is expected to reduce the visual impacts of the proposed development due to a number of reasons. As such, the visual models are representative of a similar but greater visual impact than that which will actually result from the 47 turbine layout. This has been described in more detail in the specialist comment letter regarding the final turbine layout which is included along with the EIA phase Visual Impact Assessment Report in **Appendix 6G**.

### *8.7.3 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 wind farm at night.

The area surrounding the proposed development site is largely uninhabited and as a result, very few light sources are present. The town of Loeriesfontein is also too far away to have an impact on the night scene. At night, the study area is characterised by a picturesque dark starry sky and the visual character of the night environment is considered to be mostly 'unpolluted' and pristine. The most prominent light sources within the study area at night include the operational and security lighting at the newly constructed Loeriesfonten Wind Farm as well as the construction camp area for the Khobab Wind Farm which is situated at the Helios Substation (**Figure 102**).

**Figure 102:** View of the Khobab Wind Farm construction camp area which is situated at the Helios Substation. This construction camp is however situated well outside of the visual assessment zone

It should however be noted that during the time of the in-field investigation it was noted that the Khobab Wind Farm was still in the early stages of construction and no turbines had been erected (**Figure 103**).

**Figure 103:** View of the construction activities associated with the proposed Khobab Wind Farm. During the time of the in-field investigation it was noted that this wind farm was still in the early stages of construction and no turbines had thus been erected.

Other prominent light sources within the study area at night include the operational and security lighting at the Helios Substation (**Figure 104**), which can be seen from approximately 50km away, as well as operational and security lighting at the on-site Khobab IPP substation which had already been constructed during the time of the in-field investigation (**Figure 105**). It should however be noted that the Loeriesfontein and Khobab Wind Farms (including the construction camp and on-site IPP Substation for the Khobab Wind Farm), as well as the Helios substation, are situated well outside of the visual assessment zone. Other sources of light are limited to, isolated lighting from the few surrounding farmsteads / homesteads, transient light from the train and passing cars travelling along gravel access roads.

**Figure 104:** View of the Helios Substation. This substation is however situated well outside of the visual assessment zone

**Figure 105:** View of the on-site Khobab IPP Substation which had already been constructed during the time of the in-field investigation. This on-site IPP Substation is however located well outside of the visual assessment zone.

Operational and security lighting at night will be required for the proposed wind farm. 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 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 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 project is likely to intrude on the nightscape and create glare, which will contrast with the extremely dark backdrop of the surrounding area. In addition, the red hazard lights may be particularly noticeable as their colour will differ from the few 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).

### *8.7.4 Visual Impacts of Associated Infrastructure*

- **Access Roads**

As previously mentioned, there are no main or arterial roads in close enough proximity to the proposed development. The district road that connects the town of Loeriesfontein with Granaatboskolk to the north, can however be found some 4kms north-east of the study area. This road is a public road which is in very poor condition. It should however be noted that this road is found well outside the visual impact zone.

Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6 – 8m for maintenance purposes during the operational phase. The proposed internal access roads will include the net load carrying surface excluding any V drains that might be required.

Roads are typically only associated with a visual impact if they traverse sloping ground on an aspect that is visible to the surrounding area. Considering that the proposed access roads are located on relatively flat terrain it is likely that the visual impact associated with upgrading these roads would be minimal. However, 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.

- **Underground cabling**

As with the internal gravel access roads, the underground cabling (if required) will most likely be positioned to follow the internal access roads. The visual impact of this cabling would be very similar to 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. In addition, 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. As with the access roads, 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 relatively flat terrain and there are no high ridges / high points on the proposed wind farm site, the visual impact of the cabling would be minimal. In spite of this it is 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.

- **<u>Power lines</u>**

As previously mentioned, the wind turbines will be connected to the proposed !Xha Boom IPP Substation using buried medium voltage cables. However, overhead power lines may also be used where a technical assessment of the proposed design suggests that they will be more appropriate, such as over rivers and gullies. Where overhead power lines are to be constructed, self-supported or H-pole tower types will be used. The height will vary based on the terrain, but will ensure minimum Overhead Line (OHL) clearances with buildings, roads and surrounding infrastructure will be maintained. The dimensions of the specific OHL structure types will depend on electricity safety requirements. The exact location of the towers, the selection of the final OHL structure types and the final designs will comply with the best practice and SANS requirements. 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. 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 no high voltage power lines located within study area which would lessen the visual contrast associated with the introduction of a new power line.

In addition, the electricity generated from the proposed !Xha Boom Wind Farm will be fed into the national grid at the Helios Substation via a 132kV power line. This 132kV power line is however 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.

- **<u>On-Site IPP Substation</u>**

A new on-site IPP substation (approximately 500m x 300m) is being proposed which will supply the generated electricity to the Eskom grid. 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 wind farm. Thus the substation would only be constructed if the proposed wind farm was developed as well. The substations would likely form part of the proposed wind farm 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 substations are not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

## 8.8 Heritage and Palaeontology

### *8.8.1 Field Work Findings*

#### *8.8.1.1 Methodology*

A survey of the study area was conducted from 24-30 October 2016. Due to the nature of cultural remains, with the majority of artefacts occurring below surface, two archaeologists of PGS conducted a vehicle and foot-survey that covered the study area. The fieldwork was logged with a GPS to provide a background of the areas covered (**Figure 108**).

The proposed study area is situated approximately 75 kilometres north of Loeriesfontein off the R355 in the Northern Cape.

The proposed site is characterised by an arid landscape with a large ridge running from north to the south of the study area. The vegetation is typical Karoo. The area is being utilized for game (mostly springbok) and sheep.

**Figure 106:** View of the western side of the study area.

**Figure 107:** View of the southern side of the study area from the ridge

The fieldwork identified 3 heritage resources as well as several areas with existing infrastructure such as fenced off camps, windmills and reservoirs.

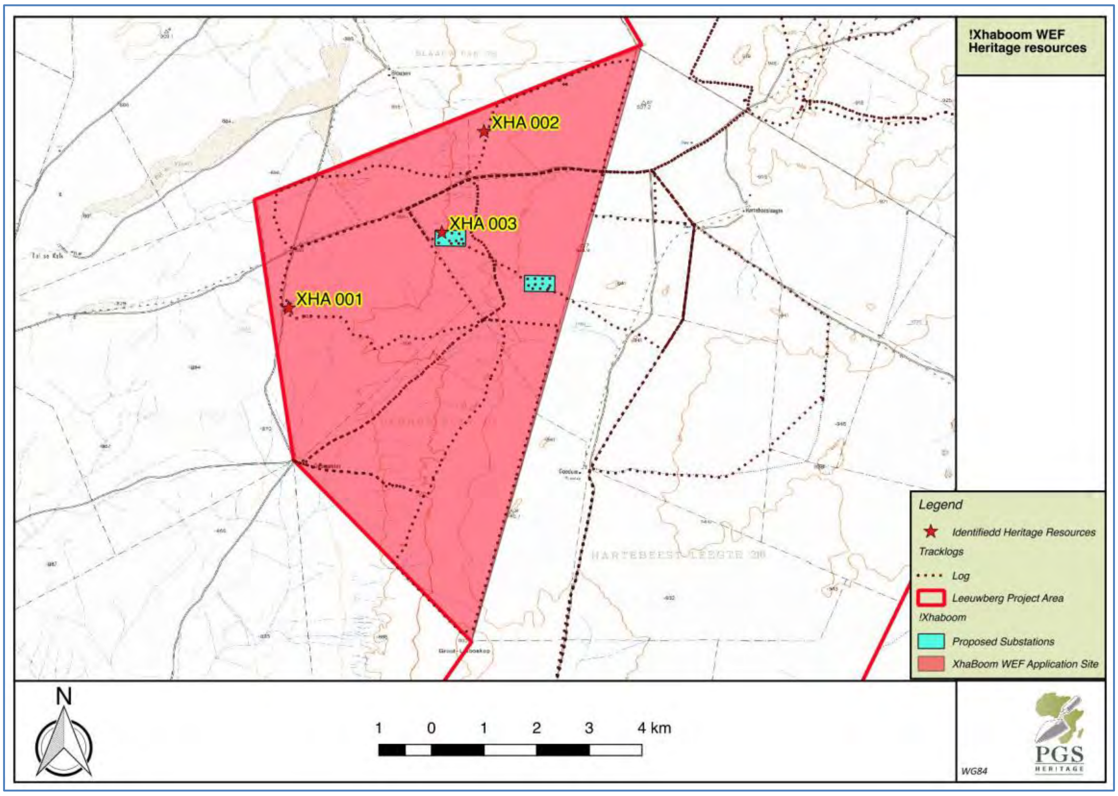


**Figure 108:** Heritage resources with tracklog

| **Table 50:** Heritage resources found | | | | | | |
|---|---|---|---|---|---|---|
| **Site Number** | **Lat** | **Lon** | **Type Find** | **Description** | **Significance** | **Heritage Rating** |
| XHA 001 | S30.299104° | E19.237811° | Findspot | A low density find spot was located at a small pan on the western boundary of the study area. LSA artefacts consisting of quartzite and cryptocrystalline silicate (CCS) were located.<br><br>The site is of low significance and no further mitigation is necessary.<br><br>However, it must be noted that as pans represent seasonal water sources, there are very often concentrations of archaeological resources in close proximity Pans are considered heritage sensitive areas and should be avoided where possible. | Low | GP.C |

**Figure 109: Small pan at XHA 001**

**Figure 110: LSA artefacts identified at XHA 001**

| **Table 50:** Heritage resources found | | | | | | |
|---|---|---|---|---|---|---|
| **Site Number** | **Lat** | **Lon** | **Type Find** | **Description** | **Significance** | **Heritage Rating** |
| XHA 002 | S30.268934° | 19.271189°E | Find spot | A low density scatter was located at this location, on and around a rocky outcrop. The tools are from the LSA and consist of quartzite and CCS. Ostrich egg shell (OES) is also present.<br><br>The site is of low significance and no further mitigation is required. | Low | GP.C |

**Figure 111: View of rocky out crop at XHA 002**

**Figure 112:LSA Artefacts located ot XHA 002**

### *8.8.2 Impact assessment*

The proposed WEF layout in relation to the identified heritage resources is shown in **Figure 113**.

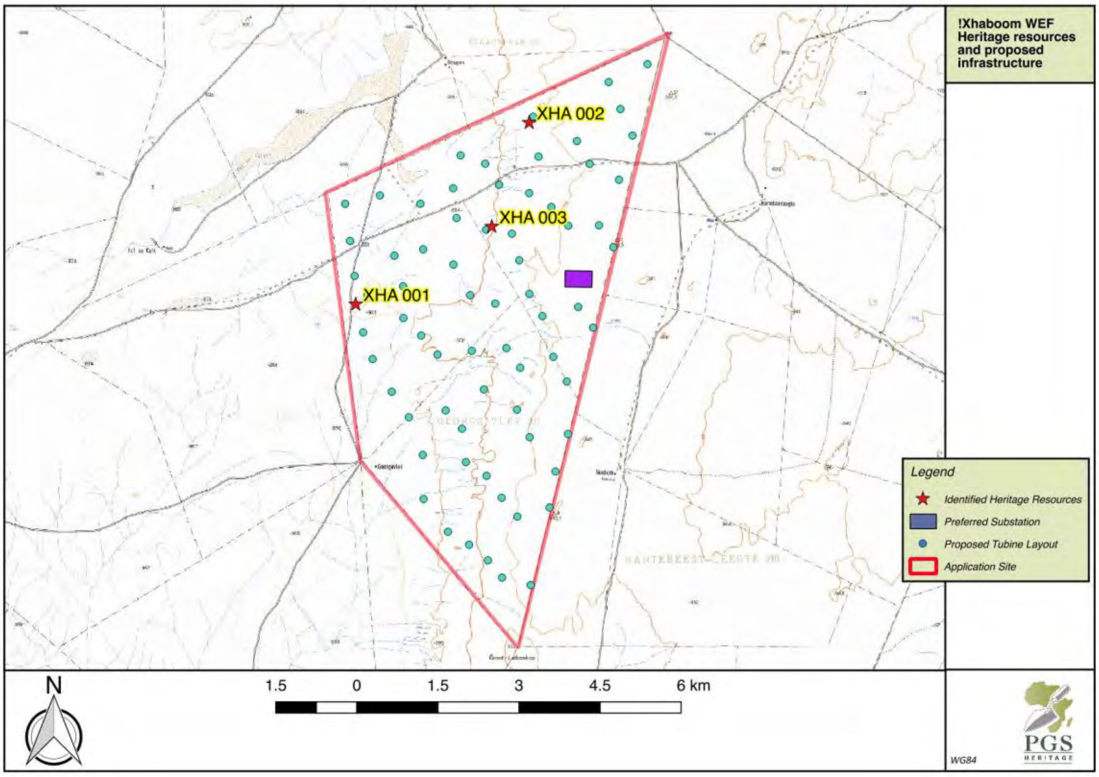



**Figure 113:** Proposed !Xha Boom WEF turbine layout in relation to the identified heritage resources

The impact rating and analysis was done based on the methodology as explained and summarised in Appendix C of the Heritage Impact Assessment Report. The design process and methodology followed by the developer for this project has enabled the heritage assessment to provide input into the proposed layouts. This resulted in cognisance being taken of the positions of the heritage resources and thus the reduction of impacts at an early design phase. Analysis of the impact matrix tables reflect this fact.

No identified heritage resources are affected by the proposed WEF layout and the following impact assessment tables are based on this fact.

### *8.8.3 Palaeontology (Desktop Assessment)*

#### *8.8.3.1 Impact Assessments*

An assessment of the impact significance of the proposed construction of four Leeuwberg Wind Farms and four grid connections near Loeriesfontein in the Northern Cape Province and associated infrastructure on local fossil heritage is presented here:

- **Nature of the impact**

The excavations and site clearance will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research. According to the Geology of the development site there is a possibility of finding fossils in the Dwyka and Ecca Groups but the palaeontological sensitivity is low (see description).

- **Geographical extent of impact**

The impact on fossil materials and thus palaeontological heritage will be limited to the construction phase when new excavations into fresh potentially fossiliferous bedrock take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as local.

- **Duration of the impact**

The expected duration of the impact is assessed as potentially permanent to long term.

- **Potential significance of the impact**

The Permo-Carboniferous Dwyka Group and Early to Middle Permian lower part of the Ecca Group are known to be of low significance in Palaeontological terms.

- **Severity / benefit scale**

The proposed project is potentially beneficial on not only a local level, but regional and national levels as well. The wind farm will provide a long term benefit to the community in terms of the provision of electricity from a renewable energy resource to a progressively stressed national electricity grid

- **Intensity**

The intensity of the impact on fossil heritage is rated as low.

- **Probability of the impact occurring**

The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian basinal mudrocks of the lower part of the Ecca Group (Karoo Supergroup). These assemblage zones are known to be fossiliferous, but due to poor preservation and weathering the impact on fossil heritage is rated as low. The intrusive Karoo dolerites are of no palaeontological significance and the Late Caenozoic superficial deposits are generally of very low palaeontological sensitivity.

## 8.9 Socio Economic

### *8.9.1 Impact Analysis*

The following sections discuss the socio-economic impacts that the proposed project is envisaged to create, considering the knowledge of the potentially affected socio-economic environment and the project components. The analysis of impacts is divided into the following groups:

- Impact on natural capital
- Impact on human capital
- Impact on social capital
- Impact on cultural and spiritual capital
- Impact on physical capital
- Impact on financial capital
- Impact on political and institutional capital

The review of the potential impact considers the entire project inclusive of all its components (construction and operation phase) and considered alternatives. All impacts identified are assessed in terms of the impact ratings methodology as prescribed by the Environmental Assessment Practitioner (EAP) (refer to Annexure A of Socio-Economic Imoact Assessment Report). It should be noted that some impacts that are to be exerted by activities during construction may remain during the operation phase. In this instance, impacts are analysed under the phase when they were first experienced and their duration reflected over the period not limited to the actual phase of the project.

#### *8.9.1.1 Impact on natural capital*

- **Impact on commercial agricultural resources**

The land that is currently proposed for the development of the wind farm is used for commercial sheep farming purposes. Should the proposed project be successfully implemented, several agricultural impacts are expected to ensue. These include impacts such as the sterilisation of agricultural land, relocation of sheep, destruction of veld as well as the potential overgrazing of the allocated farm portion all of which are linked to the loss of agricultural potential and employment opportunities. Due to their nature, impacts related to agricultural productivity of the farms are omitted in this report as they are addressed in the Agricultural Specialist Report.

#### *8.9.1.2 Impact on human capital*

- **Impact on employment**

**During Construction:** The project proponent estimates that the construction of the proposed Graskoppies wind facility will create 190 employment opportunities for skilled individuals and 233 job opportunities for unskilled individuals. As such, the establishment of the Graskoppies wind farm is expected to create a total of 423 jobs over the 18-24-month construction period. Of these opportunities, 29% of the positions will be made available to local labour which equates to a total of 123 new jobs.

As of the year 2011, a total of 13.8% of the total Hantam LM had no form of education whilst 30% did not complete their secondary education. A very small proportion (7.1%) of people within the Hantam LM continued to further their studies at a higher education institution. Loeriesfontein had 23.3% of people who failed to complete primary school, whilst 15.4% completed their high school. The lack of a formal education and evident low literacy levels in the local municipality implies a limited skills base for appointment of local labour during the construction phase. This means that the 29% of employment opportunities that will be specifically for the local community will be largely filled by the unskilled labour force as it is unlikely that the local area will be able to supply workers with highly specialised skills as this would've required more of a formal education.

The estimated employment will be a short-term temporary situation as they will only last for the duration of the construction phase which is a period of 18- 24 months.

**During Operation:** Once operational, it is expected that the wind farm will permanently employ 31 individuals. It is envisaged that 17 (55%) of these jobs will be created for skilled individuals whilst 14 (45%) job opportunities will cater for unskilled people. Similar to the construction phase of the wind farm, a total of 9 jobs (29%) will be filled by individuals from the local community.

The Hantam LM is said to have an unemployment rate of 12.6% which equates to 882 individuals looking for work opportunities but are unable to find any. Loeriesfontein has a slightly higher unemployment rate of 14.7%. Considering the percentage of unemployment in the town, the magnitude of the impact expected to be generated by the Graskoppies on the unemployment levels of the town is relatively low.

Furthermore, according to one of the I&AP's, Loeriesfontein town has always been dependent on income from extensive farming, however; although farms have increased in order to achieve economies of scale, employment figures remained the same. As a result of this, the introduction of RE projects in the region have provided Loeriesfontein community members with an alternative source of employment and income as it is more labour intensive and does not negatively impact on the jobscreated by the agricultural sector. Due to this, the expectation of the development of similar projects in the vicinity is expected to result in a significant cumulative impact. The impact is expected to be of a long-term effect as it will last for the duration of the operational phase which encompasses the duration of the entire lifespan of the project (20 years).

- **<u>Impact on skills and knowledge</u>**

**During Construction:** The development of the wind farm will require specialised as well as general labourrelated construction skills

Local community members who will be employed during the construction phase are expected to gain experience from on-the-job training during their employment period. The project proponent estimates that a total of 423 total jobs will be created during the construction phase. Of these job opportunities, 29% (123 jobs) will be filled by members of the local community. The duration of this impact is expected to be of a long-term effect as the skills cannot be reversed once acquired.

**During Operations:** Once the wind farm is operational, available employment opportunities will specifically require skilled labour. Labourers, engineers and mechanics are among the group of people that will most likely be required for the continual upkeep and maintenance of the wind facility.

In light of the literacy levels of Loeriesfontein town, it is unlikely that the skilled labour required during the operational phase will be sourced from the town implying the need to outsource persons possessing specialised skills from neighbouring towns or they will need to be recruited from the rest of the country. This means that few local people will benefit from jobs created within this phase. The duration of this impact is of a long-term nature as it will last for the duration of the operational phase.

- **<u>Impact on health (and nutrition) of the community</u>**

The health-related impacts that are expected to ensue as a result of the development of the proposed wind facility are:

- Dust formation created by movement of heavy construction vehicles,
- An increase in the spread of Sexually Transmitted Diseases (STD's) as a result of the influx of jobseekers and migrant workers, and
- An increase in the incidence of social ills such as prostitution, drugs and alcohol abuse.

During the construction phase, dust and noise pollution from construction activities as well as the constant movement of heavy construction vehicles often results in disturbances to farm workers as well as Merino sheep as they are deemed to be vulnerable to dust. This impact will have a short-term duration but could have a longer-term effect if people or animals are negatively impacted.

The construction phase of a wind facility attracts a number of migrant workers and jobseekers. In a community such as Loeriesfontein, the consequential result of this is often the mingling of the male workers with the young females of the area as well as unemployed women who have the hope of receiving financial support from the construction workers. During the interviews, a disgruntled I&AP added that "construction workers are an evil to the town, they bring their tablets and phones and use it to entice young girls who fail to resist the temptation". The subsequent effect of this is an increase in prostitution, unwanted pregnancies, as well as an increase in cases of STDs. In the event that similar projects of this nature are approved, the spread of communicable diseases is expected to increase at a much more rapid rate due to the greater number of migrant construction workers being present in the area.

An increase in disposable income tends to increase the demand for personal services and goods in the area. During the interviews conducted in the area, community members of Loeriesfontein concurred that since the construction of the two wind facilities (i.e. Khobab & Loeriesfontein 2), construction workers employed by these facilities tend to spend their income in the local area specifically opting to purchase drugs and alcohol, which also attract a number of local young females. Due to this, more alcohol licences have been issued whilst alcohol sales have also increased. One of the prominent store owners in the area added that, although drug abuse has always been a challenge in the local community, the presence of wind farms has exacerbated the problem. On the other hand, it can be argued that the increase in income may improve peoples' standard of living through variables such as access to higher quality health-care, and better nutrition due to the availability of varied choices.

In light of the effect of the projects under construction on the community, positive cumulative impacts such as improved living standards are expected to increase as and when the projects are implemented. Social ills such as alcohol and drug abuse as well as prostitution is also expected to have a high cumulative impact over a long-term period further threatening the health of Loeriesfontein residents.

#### *8.9.1.3 Impact on social capital*

- **<u>Impact on social relations (i.e. social ills)</u>**

The Hantam LM's skills base is mostly dominated by semi-skilled (29%) and low-skilled individuals (30%). A very small percentage of people employed within the formal sector are skilled (14%). Due to this, it is highly likely that the Hantam LM and nearby towns do not possess a sufficiently skilled workforce to supply all the labour requirements for the construction and operation of the proposed wind farm facility. This means that low- and semi-skilled labour requirements for both phases can be procured locally however, specialised and skilled workers will most probably be migrant workers. Sourcing skilled migrant workers will then result in an increase in the influx of jobseekers thus increasing the population of the area.

Unemployed individuals from other areas around the region are also mostly likely to migrate to the study area hoping to obtain employment from the Graskoppies development during the construction phase and may remain in the area till the operation phase, regardless of whether they received employment during construction or not. Influx of male workers into the area is likely lead to the increased number of unwanted pregnancies. Due to this, a change in demographics in the shortterm and in the long-term is expected to occur. Furthermore, as the number of wind projects are approved, it is likely that the number of jobseekers will increase, resulting in a greater cumulative impact on the demographics of the area.

The change in demographics has the potential to result in a spiral of interlinked social ills. The effect of an influx of male workers in the study area has the potential to fuel an increase in social pathologies through the following ways:

- Tension between locals and migrants (South African or non-South Africans) who are competing for the same job. During the interview with the local community members, it was revealed that, local contract workers were not pleased with the Poles and black workers coming from other countries 'to take their jobs' for the construction of the Khobab and Loeriesfontein 2 wind farms.
- In addition to this, an influx of people from the rest of the country and Province who are unable to find employment may lead to increased criminal activities.

- **<u>Impact of local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan</u>**

As part of the requirements of the RE IPPPP, project proponents are expected to invest in local communities in which developments are established. During the pre-construction and construction phase, Mainstream Renewable Power South Africa plans to invest about R450 000 into the Loeriesfontein community through various community development projects such as eye tests' and provision of glasses, provision of jungle-gyms, rehabilitation of school infrastructure, community health and wellness days as well as visits to the construction sites.

During operations, the project developer will continue investing in the local community focusing on enterprise development initiative and initiatives that assist in improving the living standards of the local residents. These investments will be made into the projects that will be selected in consultation with the local authorities and community representatives.

The impact is expected to be of a high magnitude considering the small size of the local community and the long-term personal and community benefits derived from these projects. Seeing that Loeriesfontein is a relatively small town, once similar projects in the vicinity are approved, they will also be investing into SED and ED initiatives resulting in the greater cumulative impact on the local economy and residents.

- **Impact on safety**

During the construction phase of the project, it is expected that the number of people traversing the directly affected farm portions as well as those in close proximity to project site will increase. This will make it difficult for landowners to monitor movements within farms as it will most likely be difficult to differentiate between legitimate construction workers and trespassers (loitering jobseekers). As a result of this, land owners and I&APs raised concerns regarding the possibility of an increase in criminal activities during the construction phase with particular mention of personal safety and stock-theft as the main issues.

This means that if the expectations of employment provision during the construction phase are not effectively managed by the proponent, an influx of migrant workers and jobseekers is to be expected. This will result in the increased movement of people in and around the project site placing further emphasis on the concerns of the interviewed land owners.

Furthermore, considering the unemployment rate in Namakwa DM (20.1%), Hantam LM (12.6%), Khai-Ma LM (20.9%) and Loeriesfontein town (14.7%), it is sensible to deduce that should word spread pertaining the potential employment opportunities brought by the proposed development as well as the added possibility of the approval of more proposed developments in the area, the influx of people to the local area from other parts of the province and possibly the country will intensify. The resulting implication of this would be a low to medium cumulative impact.

With the likely possibility of construction phase workers continuing to reside in the nearest town in hope for employment once the construction of the Graskoppies wind facility is complete, such an impact is also most likely to go beyond the construction phase. This would increase the effect of the negative cumulative impact as more people move to the region, it would become increasingly unlikely for all the individuals to get a job as their chances have been reduced due to the spiralling influx of people.

##### *8.9.1.4 Impact on cultural and spiritual capital*

- **Change in sense of place**

Broadly defined, sense of place refers to a collection of qualities and characteristics (visual, cultural, social, and environmental), which provide meaning to a place. Individuals and communities are able to identify with such a space as and when there is an interaction and a balance between the previously listed characteristics. Due to the intertwined nature of a sense of place and the sense of belonging to an area, a change in the surroundings has the potential to affect the wellbeing of the person as it alters the sense of place.

In the context of the proposed wind facility, the potential change in sense of place and associated impact on the cultural capital of the impacted individuals can be analysed on two levels:

- Landowners could potentially have a negative experience if the area distinctly special to them in terms of social and cultural capital is altered to an industrialised space ensued due to the changes in the landscape. The increase in traffic and noise levels from the heavy construction vehicles may negatively affect the sense of place of people residing in close proximity to the project site.
- On the contrary, there could also be a positive experience if landowners view the presence of wind farms within their farms as a way to stimulate the local economy and alleviate poverty levels.

During the interviews with the directly affected and adjacent landowners, the common concern highlighted by all interviewees is the possible destruction of the surrounding veld. This is of grave concern to the farm owners as the veld is a source of food for the sheep. This means that landowners aren't specifically against the development of the proposed wind facilities in the area but they are concerned about the veld that could be destroyed during construction activities. To highlight their comfort with the development, one of the landowners interviewed during the site visit jokingly said that the sheep will most probably enjoy the shade from the wind turbines and shared a view that that the wind turbines add to the aesthetic appeal of the environment.

#### *8.9.1.5 Impact on physical capital*

- **<u>Impact on production and Gross Domestic Product (GDP)</u>**

The impact of increased production as well as the stimulation of GDP is an impact expected to ensue in the construction and the operational phase. During the construction phase, it is expected to be a temporary increase in production and stimulation in GDP whilst in the operation phase, it will be sustained over a longer time period as it will span across the entire life-span of the wind facility.

**During Construction:** According to the information provided by the project proponent, the anticipated capital expenditure (CAPEX) that will be spent during the construction period for the initiation of the Graskoppies wind facility is R2.5 billion. During the construction phase, the demand for necessary goods will also induce the production of supporting industries and their supply value chains. However, due to the specialized nature of some of the goods required, many will be sourced from outside the local economy and possibly the Province in general.

In order to enhance the benefit of increased production to the local community during the construction phase, where possible; there ought to be a commitment towards maximising the use of local labour as well as small local businesses that are able to provide the goods and services required during this stage. As such the project proponent aims to create small medium & micro enterprises (SMME's) for the local community through hiring supporting services such as security, transportation of employees, fencing works, general construction (i.e. gabions, culverts) and cleaning works, plant (equipment) hire as well as the supply of cabling and electrical appliances.

Although the ultimate desire is to involve the local community as much as possible, the local economic base of the region in question is not very well developed and is not diversified; therefore, it is important to note that such opportunities will be limited. This makes it also impossible to determine the magnitude of this impact on the local economy; however, it is likely to be of a short-term effect as it will only last for the duration of the construction phase (18-24 months).

**During Operations:** Although the figure is uncertain, once the wind facility is operational, it will generate an annual revenue for the project proponent.

The long-term upkeep and maintenance of the wind farm will incur specific operational costs during its entire life-span (20 years). Although it would be of benefit to the local community of Hantam, it is highly unlikely that a large portion of the proponents' operating expenditure (OPEX) will be spent in the local economy. This is because the current economic base of the local economy is not sufficient to meet the demands for goods and services required to maintain the facility. Having said this, the local economy will still benefit from the rates and taxes that the facility will pay the local government, security services to be hired, and other less specialised activities required to support operations (i.e. transport of workers, etc.). The national economy will benefit from the payment of income taxes.

In the event that this project as well as the other proposed developments are approved, the potential benefit to the local community may be greater as more projects will be concentrated in the area resulting in a higher positive cumulative impact. Local business people may also see an opportunity in starting businesses that supply small mechanical parts for the continual maintenance of all wind facilities located in the area, further stimulating the local economy.

- **<u>Impact on social facilities</u>**

The proposed development is expected to attract a number of jobseekers and migrant workers in search for employment opportunities during the construction phase (up to two years). Due to the fact that Loeriesfontein is a relatively small town, an influx of people is expected to place increased demand on social and recreational infrastructure in the local economy.

Although the municipal area as a whole does not seem to have any gaps in social infrastructure provision, the continual increase in the total population of the town will exacerbate the pressure on such facilities. Such an impact can be further aggravated in instances where jobseekers are accompanied by their families. In order to avoid the deterioration of social facilities, suitable mitigation measures ought to be put in place so as to lengthen the depreciation rate of social and recreational infrastructure.

In relation to the proposed wind facility, the impact on social facilities is expected to be short-term, however; the recurring in-migration of workers in the town as a result of similar developments in the area might increase the cumulative impact to be of a significant effect.

- **<u>Impact on service delivery</u>**

One of the greatest challenges facing the municipality are backlogs experienced in housing provision, water supply, maintaining public areas, and upgrade of roads.

- In the year 2015, Loeriesfontein had a housing backlog of 310 houses requiring ±21 hectares of land.
- Although all residents in the municipal area have complete access to water, Loeriesfontein has recently experienced a water crisis upon which all the wells, which provide the town with water, dried up.
- As was suggested by one of the community members, the development of the other two projects in the area has led to an increase in the amount of litter on the towns streets' as a result of the influx of people to the region in search for employment. This points to the local municipality's limited capacity to mitigate these issues and maintain the streets clean.
- As previously mentioned, the main route in the area is the R27, which is also the only tarred road connecting Nieuwoudtville and Brandvlei via Loeriesfontein. According to one of the I&AP's, since the construction of Khobab and Loeriesfontein 2 wind facilities, this tar road has been rapidly deteriorating due to increased heavy traffic as it as originally tarred for low frequency traffic.

This impact is expected to last for duration of the construction phase (18-24 months) making the duration of the impact to be short-term. In the likely event that most of the people will remain in the area in hope for employment elsewhere or in the operational phase of the project, the demand for certain services will continue to increase placing further pressure on the ability of government to adequately provide basic services to the local economy.

#### 8.9.1.6 *Impacts on financial capital*

- **<u>Impacts on household income and financial resources</u>**

**During Construction:** The average monthly income for the Hantam LM is R9 690. Of the total population, 54% of people fell below the poverty line as they earned <R3200. Since April 2015, the Hantam municipal area was estimated to have a total of 2 482 indigent households. These are households that, due to a number of socio-economic factors, are unable to afford basic services such as water, basic sanitation, basic energy, health care, housing, food and clothing (usually earning <R1500 per month).

Since all employers are legally obligated to pay their employees, the project proponent estimates that a certain percentage of the annual revenue will be utilised for construction and operation phase labour related costs. However, considering the local labour procurement figures for the construction phase and operation phase, it is reasonable to assume that the employment benefit to local community members will be limited. With that being said, households that have individuals who are amongst the ones who receive employment either during the construction and operation phase of the project will experience an increase in disposable income. In addition to these, some households will receive indirect benefits through the creation of the previously mentioned SMME's through the procurement of catering, gardening, security, cleaning, and transportation services. The accompanying increase in disposal income for individuals receiving indirect benefits will be able to improve the living standards of local residents through factors such as better access to healthcare facilities (nutrition) and less restricted economic choices.

The impact of an increase in disposable income is expected to be of a short-term during the construction period whilst in the operational phase, it will be sustained over a longer period as locals will receive income throughout the lifespan of the wind farm.

- **<u>Impact on the informal hospitality industry</u>**

There was a general consensus amongst interviewees regarding the positive economic impact of other projects under construction on the local economy. Broadly, gross profits have doubled for all businesses. Furthermore, the influx of jobseekers as well as migrant workers will have a spiral effect as it will increase the demand for accommodation. Since the establishment of similar projects in the vicinity, the informal hospitality industry has grown as a result of the construction workers needing accommodation in Loeriesfontein town. Residents have opted to availing their backyards and garages for rental purposes. Although it may have a positive outcome for the local tourism industry, I&AP's expressed concerns relating to the possible oversupply of accommodation once the construction phase is complete. However, it can also be argued that this concern may become obsolete with the development of similar proposed projects within the area.

The effect of the impact is expected to be of a short-term effect as it will only last for the duration of the construction phase (period of 18-24 months). The likely establishment of similar projects in the vicinity may result in a significantly high cumulative impact.

#### *8.9.1.7 Impacts on political and institutional capital*

- **<u>Impact on government ability to service community</u>**

Listed amongst one of Namakwa DM's pressing needs is the minimisation of existing infrastructure backlogs. Linked to this, according to the Hantam SDF, the main goal of the LM IDP is to focus on service delivery and to deal with backlogs particularly in housing and access to water. In most instances, certain regions experience backlog problems due to cases where the influx of people (growth in population) in the region exceeds the means to efficiently provide services to the local community. Though this is a common occurrence, it is not the case with the Hantam LM as it is challenged by a lack of resources as well as a lack of capacity to deliver (Umsebe Development Planners, 2010).

Should the proposed wind facility receive authorisation, the wind farm will generate revenue for the government. This will either be in the form of tax-related revenue collected by national government (i.e. VAT, payroll, company taxes, and income taxes) and tax-and-rates related revenue collected by local government (i.e. property rates, service rates, etc.). Once government has collected taxes, it is allocated across all local municipalities to assist, support and improve the socioeconomic condition of the local population.

The collection of revenue is expected to occur throughout the construction and operational phase of project, the impact is therefore expected to shift from a short-term effect during the construction phase to having a long-term effect during the operational life. The significance of the increase in the local government's ability to deliver services will intensify due to the potential cumulative impact of various proposed renewable energy projects to be developed within the LM.

## 8.10 Preliminary Geotechnical Assessment

### *8.10.1 Geotechnical Evaluation*

From the available site information, conditions on the site are generally seen as favourable for the proposed development. An evaluation of the impact of the expected geotechnical characteristics on the development are discussed below.

- **<u>Geotechnical Constraints to Development</u>**

Unfavourable geotechnical conditions on the site include:

1) Medium hard excavatability of hardpan (cemented) calcrete and soft rock shale. Hard excavatability through soft rock dolerite and hard rock shale.
2) Instability of excavation side walls within fractured bedrock.
3) Rocky risk for both turbines and roads.

Precautionary measures for foundations as detailed below will have to be incorporated in the design and construction of the proposed development.

- **<u>Construction Material</u>**

Generally the natural gravel, calcrete, fractured shale, weathered dolerite and sand are expected to be suitable for road building material. All of the material in the Leeuwberg Wind Energy Facility (LWEF) is expected to be suitable for general fill, but the weathered dolerite may also be suitable for a wearing course, however this material should first be tested to verify its quality before use.

Possible quarry sources for concrete aggregate include the hard rock dolerite sill which covers most of the site. Loeriesfontein 2 and Khobab both utilise the existing quarry located on the Loeriesfontein site. The quarry was reopened for these projects and as such the mining license was easier to obtain. There is therefore an opportunity to utilise this quarry for the LWEF project. However, given that the quarry is some 80km away, the tipper trucks required to transport the material makes this option unfavourable. Instead, it is recommended that a new mining license be applied for the LWEF project, utilising in-situ material as far as possible. The location of the mine site can only be determined once material suitability has been confirmed through further testing.

The dolerite within the northern portion of the site seems most promising, as this area is characterised with less preferential drainage channels and associated deeper weathered conditions. Generally significant overburden (up to 5m below surface) is expected. Overburden at the base of existing borrow pits may be thinner and the vegetation over these areas is already disturbed. The source should however be drilled to assess quantities, with additional laboratory testing to confirm the durability of the material. A map, indicating existing borrow pots recorded on the 1:50 000 map and the most promising area for a potential quarry is provided in Appendix G of the Preliminary Geotechnical Assessment.

- **Foundations**

Founding conditions are seen as relatively favourable on the site, with excavatability seen as the main oncern.

It is likely that all the foundations would be placed on spread footings at shallow depth.

Estimated safe bearing capacities for these foundations include:

- Hardpan calcrete 200 - 500kPa.
- Fractured shale 500 -1,000kPa
- Soft to medium hard rock dolerite and hard rock shale >1,000kPa.

- **Geotechnical Evaluation**

1. *Mining activity and undermining*. No mining has occurred on site, thus no undermined areas occur on site. There is, however occurrences of economic mineral deposits on the northern portion of the site.
2. *Dolomite*. The site is not situated on dolomitic land.
3. *Contaminated soils (including tailings)*. No contaminated soils were noted. The site is also not onor near a tailings dam.

### *8.10.2 Further Geotechnical Investigations*

The assessment of ground conditions on the site is based on limited information obtained during previous investigations on neighbouring farms. Although geotechnical conditions is expected to be favourable over the site, it is recommended that further, more detailed investigations are undertaken to confirm the assumed ground conditions given in this report. These additional investigations would also be aimed at optimising design assumptions so as to ultimately result in a reduced project cost.

Aspects which should specifically be addressed during these investigations include:

- Foundation conditions for turbine structures - Detailed investigations comprising rotary core drilling covering approximately 30% of the site, with percussion drilling and / or Continuous Surface Wave (CSW) test on the remainder of the positions. This investigation should extend to a minimum depth of 10m at each of the final turbine positions. Piezometers are also recommended to locate the permanent groundwater levels for the site.

- Excavatability - Rock excavation trials and/or either CSW or geophysical testing where excavations deeper than 1m are required.
- Mass haul and materials - Investigation of the suitability of materials from excavations for engineered layerworks and the identification and investigation of potential borrow areas.
- Electrical & thermal resistivity - Investigation of ground resistivity for the design of earthing for substations, and grading of buried cables.

#### *8.10.3 Conclusion*

From the available site information, conditions on the site are generally seen as favourable for the proposed development. However the Preliminary Geotechnical Report should be supplemented with a detailed geotechnical investigation prior to construction commencing.

## 8.11 Traffic

#### *8.11.1 Traffic Generation*

The traffic generation estimates detailed below have been determined based on a single project.

- **Construction Phase:**

These vehicle trips occur during the construction phase and include the transport of materials, equipment and people to site. This phase also includes the civil works required for the construction of the internal roads themselves, the excavations of the footings, and trenching for electrical cables. The delivery of the wind turbine components and lifting cranes would require abnormal vehicles that require access to site via the public road network. The construction traffic typically generates the highest number of vehicular trips.

In order to calculate the amount of traffic generated for this element of works, certain assumptions were made regarding staff and staff travel behaviour. It is estimated that a total of 127 full time employees are required during the construction of the LWEF project. Not all personnel will be required at once since the project will be constructed in phases. It is also assumed that the majority of employees would reside in Loeriesfontein.

Based on this it can be assumed that approximately 40 vehicular trips will be generated during the peak hours of 07:00 – 08:00 and 16:00 – 17:00. The details used to calculate the total labour during the construction of the project is shown in **Table 51** below.

**Table 51:** Assumed Labour Requirements

| Construction Phase | Technical Staff | Skilled labour | Unskilled labour | TOTAL |
|---|---|---|---|---|
| Road construction | 3 | 8 | 5 | 16 |

| | | | | |
|---|---|---|---|---|
| Foundation construction | 3 | 15 | 20 | 38 |
| Electrical system construction | 2 | 10 | 10 | 22 |
| Substation construction | 2 | 10 | 5 | 17 |
| Wind turbine assembly and Installation | 4 | 10 | 15 | 34 |
| **TOTALS** | **14** | **58** | **55** | **127** |
| **Vehicle Trips/Day** | **14** | **15** | **14** | **43** |

**Table 52** below shows an assumption made to envisage the number of daily traffic generated by the transportation of materials, equipment and people. It was also assumed that the material required for construction will be obtained from suppliers off-site.

**Table 52:** Estimated Trip Generation

| Activity | | Assumptions | Trips/day |
|---|---|---|---|
| People | Technical and Non-technical Staff | See **Table 51** above. | 43 |
| Foundation | Concrete | 3675 Bags of 50kg cement required per concrete foundation. One truck capable of carrying 680 bags of cement. Equates to 5 trucks per foundation. | 5 |
| | Stone | 239m$^3$ required per foundation. One truck capable of carrying 20tonnes of stone. Equates to 12 trucks per foundation. | 12 |
| | Sand | 239m$^3$ required per foundation. One truck capable of carrying 20 tonnes of sand. Equates to 12 trucks per foundation. | 12 |
| | Steel | 306 tonnes of steel required per foundation based on the assumption that 130kg of concrete requires 100kg of steel to support it. Assuming one truck is capable of carrying 20 tonnes per trip, this equates to 15 trucks per foundation construction. | 15 |
| Road | Internal Roads | It is assumed that 1.2km of natural gravel roads will be constructed every week in 150mm layers at 0.2km/day using tipper trucks at 10m$^3$/truck to import material. | 10 |
| Foundation and Road | Water | Based on preliminary water use calculation discussed further on in this report it is assumed that the following number of 32 000 litre water trucks will be required per day. | 8 |
| Electrical | Substations, cables, overhead | 200 transmission poles (30 poles/week) using an interlink truck | 1 |

| | | | |
|---|---|---|---|
| | cables and transmission poles | Trucks for carting electrical equipment using an interlink truck. | 1 |
| Total Light Motor Vehicles | | | **43** |
| Total Heavy Motor Vehicles | | | **64** |
| **TOTAL DAILY TRAFFIC** | | | **107** |

From **Table 52** it can be seen that the total daily traffic generated by the transport of people, materials and equipment is estimated at approximately 107 vehicles per day (60% being HGV's). It is estimated that the number of heavy vehicles trips, per 235MW Project, during the construction phase would be between 3000 and 4000. These trips would be made over an estimated period of 9 to 12 months.

It has been assumed that the workforce (or a portion thereof) will be based at the construction camp, located some 40km from site. Construction is expected to take place during normal daily working hours (starting 07:00 - 08:00 and ending 17:00 – 18:00) and the workers are expected to arrive from the construction camp over a one hour period in the morning and depart over a one hour period in the afternoon. Assuming a traffic management plan is in place the HGV vehicles are likely to be distributed throughout the day. The HGV vehicle trips have also been excluded from the peak hours as these vehicles would not be allowed on-site prior to the workforce arriving.

Should a dedicated bus system be implemented, the 127 peak hour person trips can be converted to vehicle trips using the bus occupancy rate of 40, which equates to 3 bus round trips per hour. More specific requirements will be determined at the feasibility stage. From a land-use/transportation planning point of view, a bus system would be the preferred method.

The windfarm construction will also require the transportation of large volumes of construction material to site on an ongoing basis throughout the construction period as shown in **Table 52**. The approximate daily mass of the material to be transported onto site, as well as the type(s) of vehicle to be used for this purpose, will inform the type of road required to withstand the wear.

In addition to the normal daily demand for construction materials that can be transported using normal heavy construction vehicles, there will also be several abnormally large consignments to be transported by road to the LWEF site. In order to safely accommodate abnormally large vehicles and their loads, the future road intersections between the harbour and site should be designed accordingly.

If there are existing intersections that limit the size of construction vehicles, new routes should be planned or the consignments could be transported in smaller portions and assembled on-site.

As detailed information regarding the construction material and labour requirement becomes available, this transportation component will be analysed in sufficient detail at feasibility level to inform the infrastructure requirements.

In summary, the additional traffic generated during the construction phase will have a low negative impact.

- **<u>Traffic Generation for the Delivery of the Wind Turbine Components</u>**

**Table 53** below shows the estimated daily traffic that can occur during the delivery of the wind turbine componets to site. The calculations are based on the delivery on six (6) complete turbines per week

**Table 53:** Traffic Generation Rates for the Delivery of Wind Turbine Components

| **GENERATED TRAFFIC FOR THE DELIVERING OF THE WIND TURBINE COMPONENTS** | | | | |
|---|---|---|---|---|
| Activity | Assumptions | Trips/Week | No. Used | Trips/Day |
| Turbine Components | 3X Tower sections per turbine = 1 Tower/truck (AV) | 18 | 3 | 3 |
| | 1X Nacelle (hub) per turbine = 1 Nacelle/truck (AV) | 6 | 1 | 1 |
| | 3X Blades per turbine = 1 Blade per truck (AV) | 18 | 3 | 3 |
| **Estimated Abnormal Truck per day** | | | | **7** |

From **Table 53** it can be seen that seven (7) abnormal vehicles (AV) will be required for the delivery of ne (1) complete wind turbine.

In addition to the construction vehicles, each wind turbine will require at least 9 abnormal loads to transport the individual components. These components consist of 3 Blades, 5 Towers and 1 Nacelle. Since each Project proposes 47 turbines the total number abnormal loads anticipated for LWEF project is estimated to be 423 abnormal vehicles per Project (1692 trips for all four projects). In addition to the wind turbines, some electrical equipment such as the Padmount transformers, Main Transformer and OHL pole segments will also generate abnormal loads. This equipment is estimated to generate approximately 50 additional abnormal loads.

- **<u>Operation and Maintenance Phase:</u>**

This phase involves the operation and maintenance of the LWEF estimated over a 20 year period. Typically the replacement of one of the wind turbine components would require access for cranes and replacement parts delivered using abnormal vehicles, both of whom would arrive to site via the public road network. In terms of vehicle generation this phase generates the least traffic.

It is assumed that a maximum of 10 permanent employees' will be employed per phase to oversee the operation and maintenance of the wind farm. It is therefore assumed that a total of 40 persons will be employed once all the phases are operational.

Assuming the worst case where each worker drives to site, the increase in traffic is estimated at 10 vehicles per day which is negligible.

In addition to private vehicle trips, some additional trips can be expected in the form of water supply, refuse and sanitation collection vehicles. These services are anticipated to collectively generate an additional 3 HGV trips per week.

Some abnormal loads will be generated during this phase, when faulty components need replacing, although this will conducted on an ad-hoc basis and unlikely to have any impact on the overall traffic conditions on the surrounding public roads.

- **Decommissioning Phase:**

It is estimated that the number of heavy vehicles trips, per 140MW Project, during the decommissioning phase would be between 2000 and 3000. The decommissioning phase is assumed to take 12 months.

The significance of the additional traffic generated during this phase would be low negative.

### *8.11.2 Recommended Routes to Site*

This section provides a summary of the preferred routes. A more detailed description is provided in the Transportation Study report, also undertaken by SMEC.

- **Preferred Port**

At this stage it is unsure whether the wind turbines will be manufactured locally or imported. It is possible that the wind turbine tower sections will be manufactured locally, ideally in Atlantis in the Western Cape were a dedicated manufacturing facility has been set up to service the wind farm industry and to stimulate economic growth. Items not manufactured locally will be imported from international suppliers. It has been assumed that the wind turbine components are of such size that they would arrive by ship at one of South Africa’s ports. Two ports were considered, namely Coega and Saldhana Bay Harbour. Saldhana Bay Harbour is the preferred port due it being 410km closer to the LWEF site than Coega, and has previously accommodated wind turbine components for other wind farm projects.

- **Preferred Abnormal Vehicle Route**

Having established that the wind turbines would enter the country via either the Saldhana Bay Harbour or be generated in Atlantis, a routing exercise was undertaken to determine the most preferred route to site. The alternatives were either via the N1 to Loeriesfontein (1476km) or via the N7 towards Kliprand via R358 (630km). Both alternatives are shown in **Figure 114**.


**Figure 114:** Abnormal Loads Main Alternatives

The recommended route for abnormal vehicles is via the N7 due to it being significantly shorter as well as carrying significantly less traffic which assists in reducing any safety concerns to other road users. The N7 route has also been discussed with the Western Cape Government Permitting office that supports the N7 route as the preferred option. One key concern was the ability for abnormal loads to pass under an existing railway bridge across the Sout River. SMEC's structural engineers have recently completed a bridge inspection of this structure and conform that the clearance is 5.94m. Appendix B of the Traffic Impact Assessment Report provides an extract of the bridge inspection.

Other transport concerns associated with this route were:

1) Piekenierskloof Pass towards Citrusdal; and
2) N7 turn-off onto the R358 towards Kliprand

The Piekernierskloof Pass is an acceptable abnormal route for most loads. However, given that blade lengths could be in the order of up to 70m in length, a detailed route study will need to be conducted to accurately determine whether blades of this length can safely navigate the pass. It is imperative that this limit be established prior to exploring alternative routes as this will negate almost all the benefits of using the N7 corridor all together.

**Figure 115** shows the existing N7/R358 intersection while **Figure 116** shows the swept path of a typical extendable trailer used for transporting blades. It clearly shows that despite rear steerable axles, some local widening at the intersection is required. The following upgrades are therefore proposed

1) Extend N7 road shoulder of the northbound carriageway by approximately 5m or preferably up to the road reserve fenceline. This local widening should be from the intersection extending 100m south to provide hardstanding for the rear axle group when performing the turn;
2) Widen the southern splay at the N7/R358 intersection to provide additional space for turning;
3) Relocate existing road signs to be outside the turning envelope of the abnormal vehicle swept path;
4) Relocate the existing telephone poles to be outside the operational area of the intersection (see **Figure 115**). It is also proposed that the telephone line be buried under the N7 to avoid telkom height clearances being required for every load being transported.in the future.

**Figure 115:** N7 / R358 Intersection

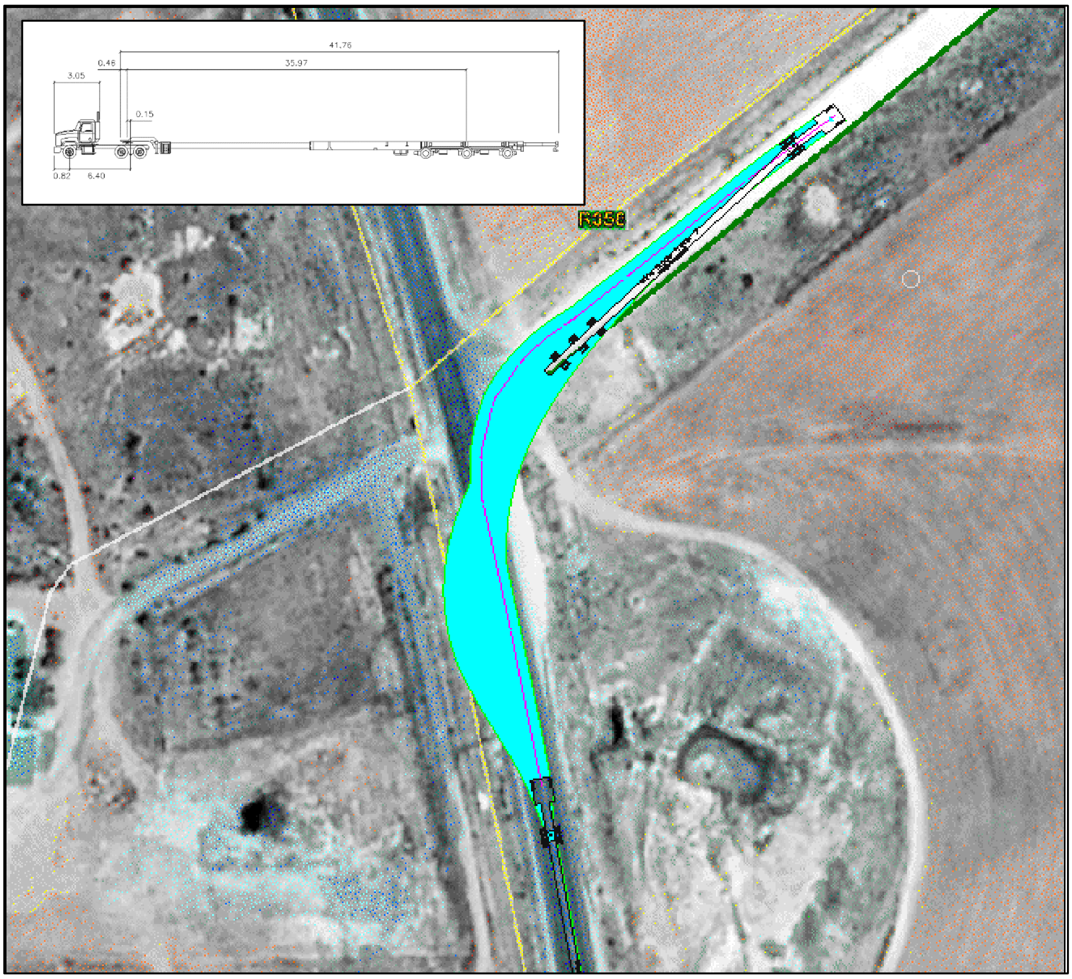


**Figure 116:** Swept Path Analysis N7/R358

The transportation of materials, plant and people are envisaged to be transported from the nearest town, Loeriesfontein. Materials sourced from elsewhere will generally arrive via the N7 which further supports this route as the preferred route. Ultimately, the transportation of materials, plant and people will be user dependant.

- **Preferred Access to Site**

Three alternative site accesses were reviewed and are evaluated below. These include

1) Access Option 1 – Northern access via DR2972;
2) Access Option 2 – Eastern access via DR2972;
3) Access Option 3 – Southern access via P2948; and
4) Access Option 4 – Western access via P2948.

The various access routes are shown in **Figure 117** below.

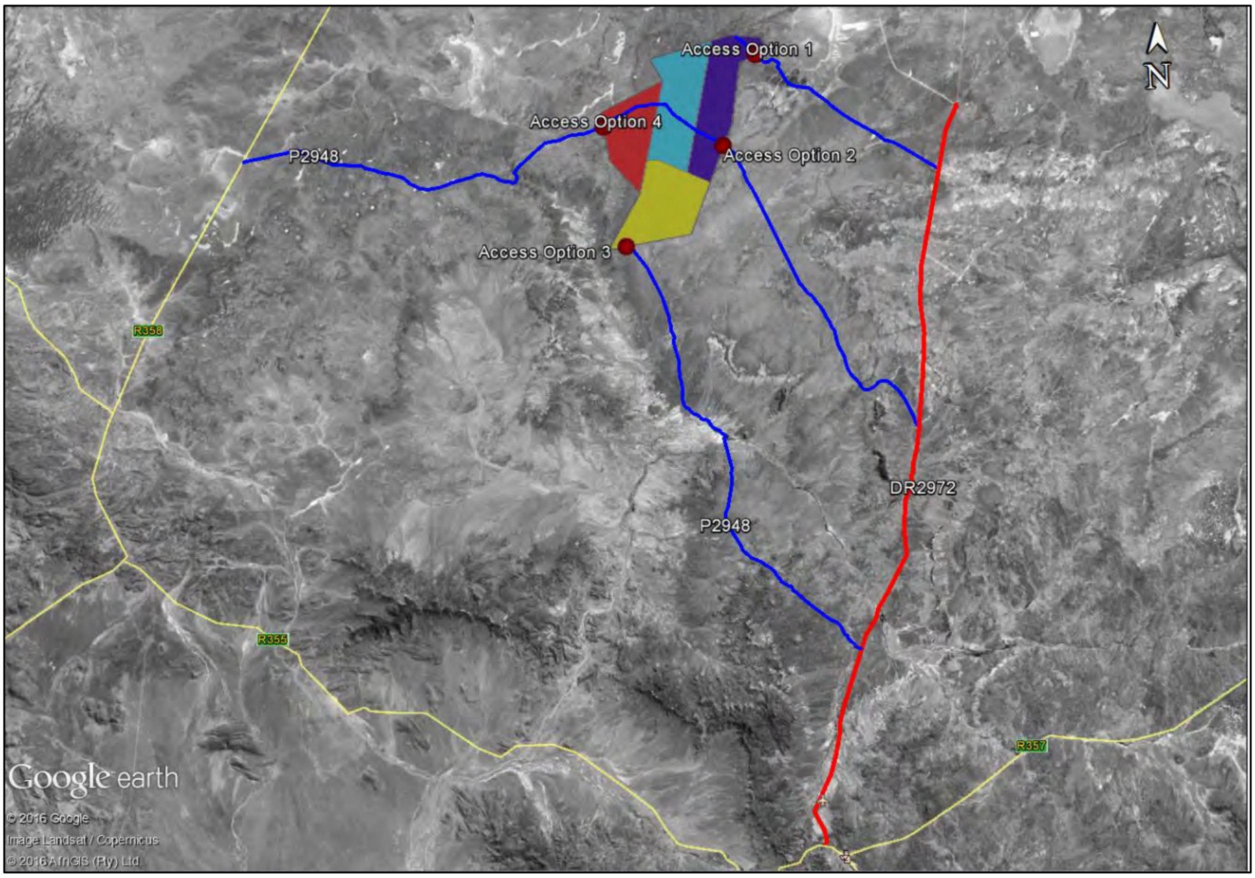



**Figure 117:** Site Access Route Alternatives

The site observations assisted in evaluating the advantages and disadvantages of each access option and these are summarised in **Table 54** below.

**Table 54:** Evaluation of Access

| Route Criteria | Access Option 1 | Access Option 2 | Access Option 3 | Access Option 4 |
|---|---|---|---|---|
| Road Gradient | Flat | Steep | Steep | Flat |
| No. of Farms Gates | Few | Numerous | Numerous | Few |
| No. of Structures (bridges) | None | 1 major bridge, 1 culvert | 1 major bridge, 1 river crossing | None |
| No. Farm Buildings Located Close to Road | Few | Numerous | Some | Few |
| Existing Traffic | High | Medium | Low | Low |
| Road Conditions | Fair | Fair | Bad | Fair |
| Likely Road Upgrade Cost | Medium | High | High | Medium |
| Drivability | Medium | Low | Low | Medium |
| Distance to Site from N7 | Longest | Long | Short | Shortest |

| **Preference Ranking** | Unfeasible | Feasible | Least Feasible | Most Feasible |
|---|---|---|---|---|
| **Preferred Access** | **Option 4** | | | |

Based on the above Access options 1 and 3 were deemed least favourable. The two feasible options were compared against one another and Access option 4 is our preferred option for the following reasons:

1) Access options 2 and 4 are almost equidistance if measured from Vanrhynsdorp, although option 4 route avoids Vanrhynsdorp Pass which is unsuitable for HGV's;
2) Access option 4 provides a single route from the N7 to the site, thereby reducing signage requirements and any confusion to drivers travelling to the site;
3) Having a single access route for all vehicle types reduces costs as only one route needs to be maintained during construction;
4) Access option 4 negates the need to travel through Loeriesfontein; and
5) Utilises the N7 corridor as far as possible, which has the most robust and resilient pavement layers capable of accommodating high HGV volumes.

In summary, the access route (option 4) via the R358 in combination with the N7 is the preferred route both for abnormal vehicles as well as other legal vehicles. Legal vehicle have the added option to utilise the DR2972 (option 2) as an alternative, although allowing multiple site entrances adds additional security/operational complications which might not be desirable.

*8.11.3 Internal Roads*

Mainstream engineers provided SMEC with locations of the wind turbines as shown in **Figure 118**. Given the extent of land incorporated under the LWEF project several alternative layouts were possible for the internal road arrangements.

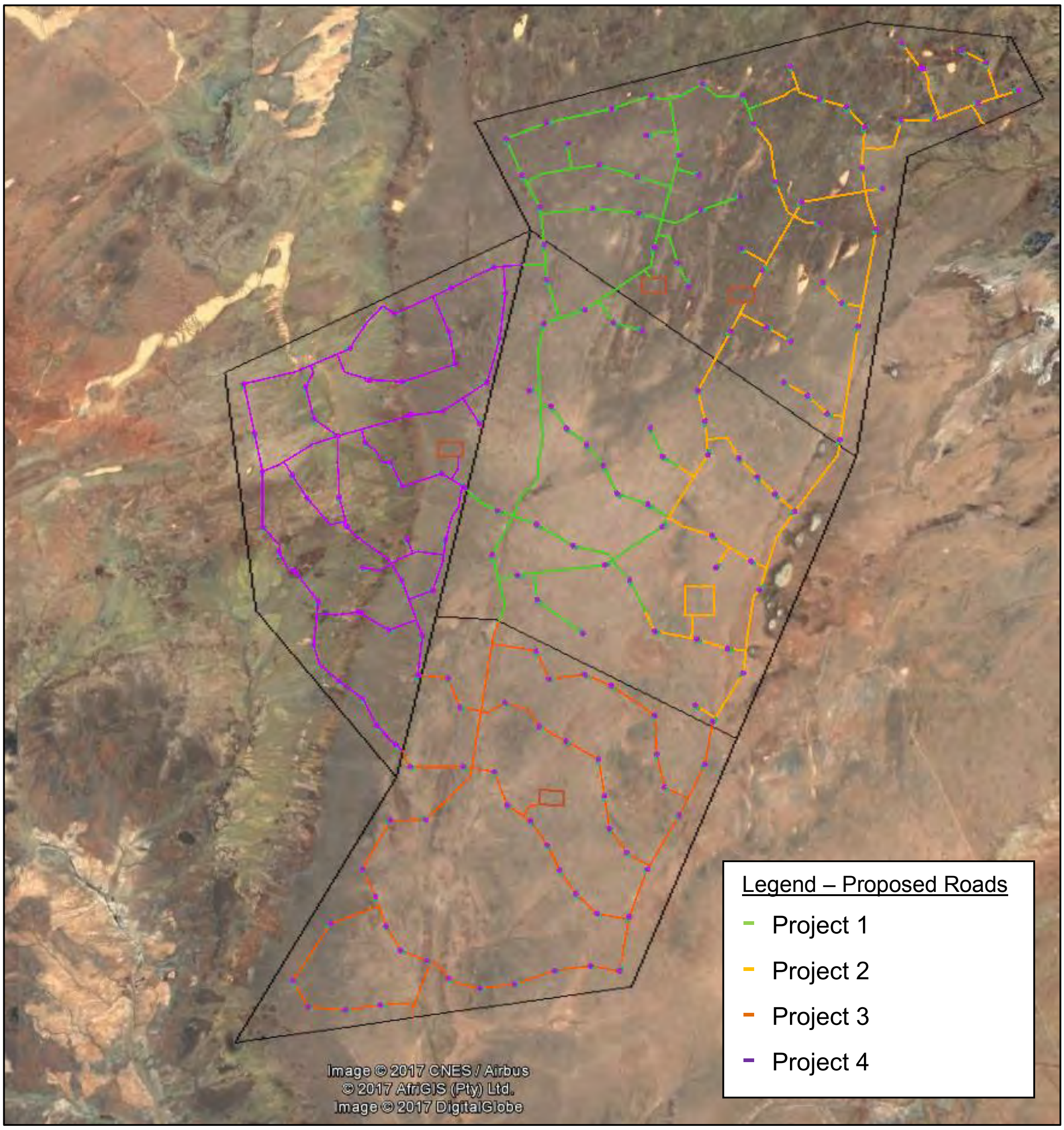



**Figure 118:** Internal Roads

The following criteria were deemed appropriate for the internal roads.

- Roads to be widened to at least 8m wide together with 2m verges either side to accommodate battered slopes in areas where the road rises or falls below the natural ground level;
- Road surface to be gravel; and
- Local material to be used.

The LWEF project will require a total of 167.9km of road to be constructed of which 32.51km are existing track roads that need to be upgraded. The Internal roads must be constructed with material excavated from turbine foundations to minimise costs. Further details relating to the internal roads are discussed in Chapter 7 of the Preliminary Geotechnical Assessment.

## 8.12 Path Loss and Risk Assessment (SKA)

The SKA is a stakeholder listed in the Interested and Affected parties of the proposed development. In order to determine whether the planned wind farm development could have any influence on the SKA, Mainstream requested a risk evaluation of the planned development to SKA activities. The frequency band of concern for SKA mid-band is 200MHz to 20GHz.This assessment does not consider any potential telecommunication services or networks that are to be established as part of the operational plan.

This risk assessment assumes the use of 47 Acciona AW 125 TH100A turbines within the !Xha Boom development and will be compared to known radiated emission data from the AW125 TH100A Acciona WTG as presented in the Acciona Control Plan.

The Acciona AW 125 TH 100A is the model within the AW 3000 platform that will be evaluated for this project. This assessment will be updated based on additional measurement results and design information as it becomes available.

The intent of this evaluation is to ensure that the !Xha Boom facility poses a low risk of detrimental impact on the SKA by using known radiated emission amplitudes of the Acciona AW3000/125 TH100 50Hz wind turbine. Specific mitigation measures to be implemented on the AW3000/125 TH100 50Hz wind turbine in order to achieve 40 dB of attenuation has been reviewed and agreed by SKA South Africa as described in the Emission Control Plan for the AW125 TH100A WTG.

### *8.12.1 EMC Requirements*

The current Emission Control Plan for the AW125 TH100A WTG provides for a 40dB reduction in radiated emissions to ensure the cumulative emission level of previously assessed wind farms where the Acciona AW 125 TH100A WTG will be used is within the requirements of SKA. This requirement is based on measurements on the Acciona AW 125 TH100A WTG at the Gouda facility in South Africa and Barosoain wind farm, Navarra, Spain.

As previously mentioned, two (2) WTG locations (WTG 1 and WTG 36) and two (2) SKA installations (Rem Opt 7 and SKA 2377) were used for the evaluation (**Figure 41**).

**Table 55:** Graskoppies layout distance from SKA infrastructure

| | **!Xha Boom WTG 1** | **!Xha Boom WTG 36** |
|---|---|---|
| **SKA Rem Opt 7** | 52.7km | 60.5km |
| **SKA ID 2377** | 74.8km | 73.2km |
| **MeerKAT (Core)** | 212.0km | 212km |

- **<u>Path Loss Calculations</u>**

The path loss was calculated using the parameters as specified in **Table 56**.

**Table 56:** Path Loss Input Data

| Parameter | Description | Quantity | Comment |
|---|---|---|---|
| Source/ Victim separation distance | SKA 2377 to WTG 41 | 63.5km | Line of sight |
| Source/ Victim separation distance | Rem Opt 7 to WTG 1 | 53.2km | Non line of sight |
| Frequency | Frequencies assessed | 100MHz, 300MHz, 500MHz, 1000MHz, 3000MHz, 6000MHz | Free space loss increases with frequency. |
| SARAS | Protection level | dBm/Hz = -17.2708 log 10 (f) -192.0714 for f<2GHz | Government Gazette 10 February 2012 |
| Location | WTG 1 | Lat: - -30.3440982793° Lon: 19.3405668479° | Waypoint received from Mainstream |
| Location | WTG 41 | Lat: -30.2296490751° Lon: 19.3980976928° | Waypoint received |
| Location | SKA 2377 | Lat: -30.340201° Lon: 20.047739° | Waypoint received from SKA SA (Pty) Ltd |
| Location | Rem Opt 7 | Lat: -30.822164° Lon: 19.311400° | Waypoint received from SKA SA (Pty) Ltd |
| TX height | Nacelle<br><br>Base | 150m<br><br>2m | Height of nacelle eqp<br><br>Height of base eqp |
| RX height | All SKA receivers | 15m | Height used for SKA receive horn |

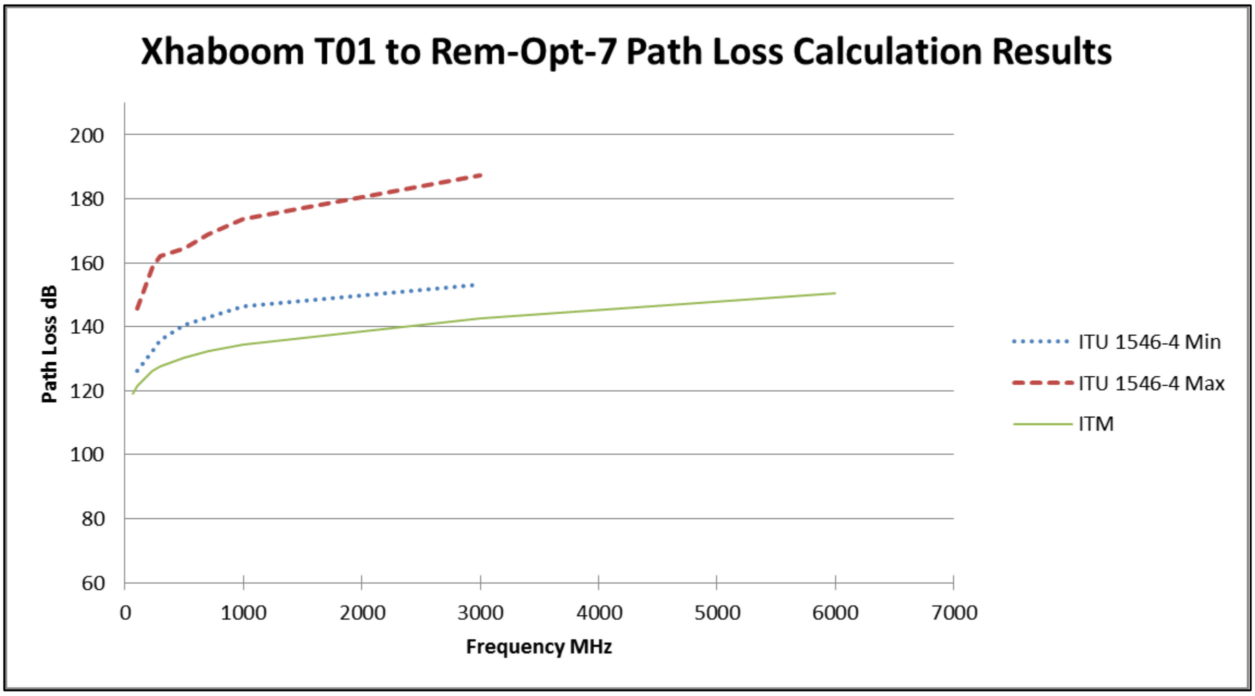



**Figure 119:** WTG 1 (150m height) to SKA Rem Opt 7 Path Loss Calculation result

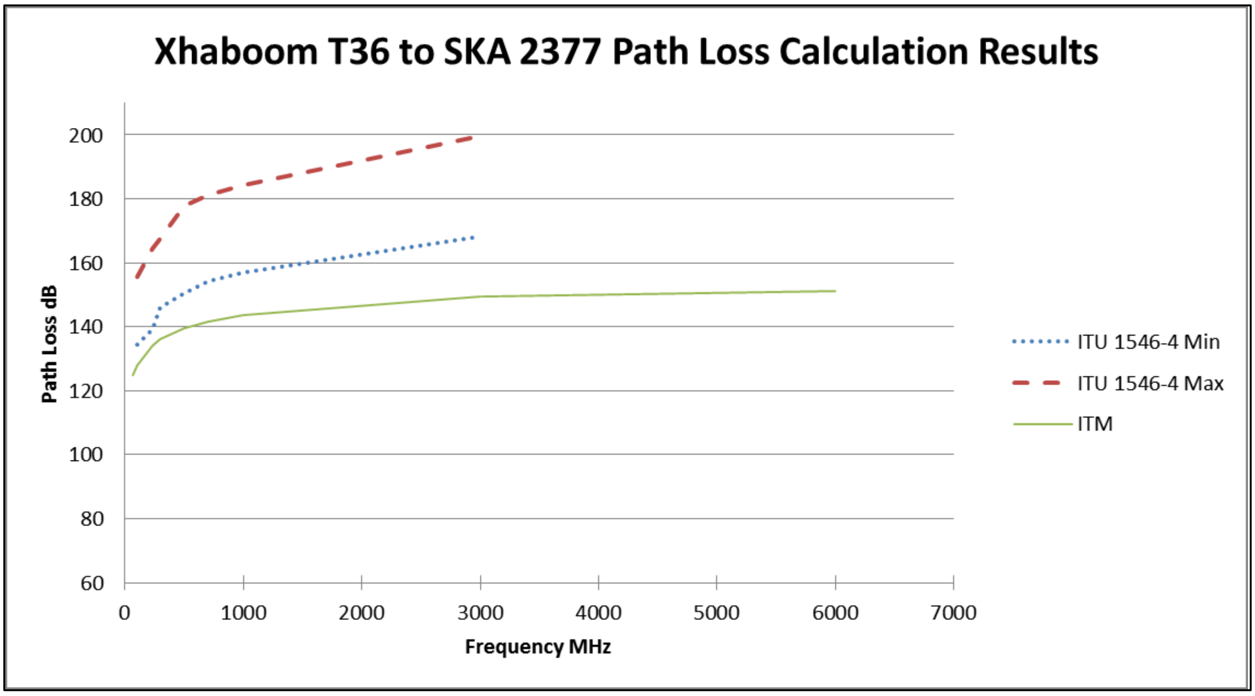



**Figure 120:** WTG 41 (150m) to SKA 2377 Path Loss Calculation result

**Figure 119** and **Figure 120** show path loss calculations for the nacelle equipment emissions at 150m hub height.

SPLAT! (Signal Propagation, Loss And Terrain) analysis and Radio Mobile Deluxe was used to calculate the ITM path loss values. Both are based on the Longley –Rice Irregular Terrain Model and Irregular Terrain With Obstruction Model. The digital elevation model resolution data used was 3-arc –seconds.

The ITU 1546-4 was calculated with Monte Carlo based ITU 1546-4 path loss software to obtain a minimum and maximum path loss values.

A standard factor of 10 log10 N, where N = the number of turbines (16.7dB for 47 turbines) to account for cumulative emissions should also be applied.

- **Conclusion**

Due to natural terrain barriers and the 52.6km distance between !Xha Boom and Rem-opt 7, the closest SKA unit, no degradation of performance is expected when the mitigated AW 125 TH100A Acciona turbines are installed. This shown by the 10 to 20dB higher path loss for !Xha Boom compared to Garob.

- **Tests at the New Site**

To verify overall wind farm emissions, ambient measurements should be done at the new site before construction starts. Tests points should be carefully selected based on test equipment sensitivity with the objective to observe the increase in ambient emissions as construction progresses.

- **Final Site Tests**

Final site tests will be done on completion of the project to confirm the radiated emission levels. Although not anticipated, proper mitigation measures on identified emitters will be studied and implemented if final test shows emissions exceeding the SKA threshold.

### *8.12.2 Impacts associated with change in turbine dimension from a SKA perspective*

Due to the fact that the proposed turbine dimensions were changed from a hub height of up to 150m and rotor diameter of up to 150m, to a hub height of up to 160m and a rotor diameter of up to 160m, the specialist was requested to compile a letter which details the impacts associated with the change in the proposed turbine dimensions from a SKA perspective. This letter is included in **Appendix 9C**.

The risk of interference between wind turbines and the SKA radio telescope is primarily a function of the following factors:

- Radiated emission amplitude from turbine;
- Turbine hub height;
- Number of turbines;
- Distance between turbine and SKA infrastructure; and
- Terrain between the turbine and the SKA infrastructure (line of sight or natural barriers between the installations).

The dB increase in the electromagnetic noise by increasing the number of turbines from 47 units to 70 units can be estimated with the standard 10 x Log (N), where N is the number of turbines, formula as a reasonable assumption. Changing the number of turbines from 47 to 70 will therefor result in a 13.6dB increase in electromagnetic noise.

Increasing the turbine hub height could result in the nacelle being elevated above the natural terrain barriers that provided a shield between the turbine and the SKA infrastructure at a lower hub height. The change in interference risk profile will have to be re-evaluated if the nacelle height is different from the initial proposed height to verify the line of sight/ terrain shielding conditions.

It should however be noted that Mainstream have recently amended the turbine layout to be up to 47 turbines. As such, the above-mentioned impacts on the SKA are deemed to be negliglbe.

Further studies would in any case be required at a later stage once a final turbine type has been confirmed, at this stage all these uncertainties would be clarified. As mentioned, the EMI and RFI studies were based on the currently available worst case scenario turbines. Due to technology improvements a different turbine will be used for the proposed development. This turbine would have to be subjected to the same EMI and RFI studies. More accurate EMI and RFI studies will thus be required and undertaken when a final turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will also be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from ICT confirming this has been included in **Appendix 9C**. It should be noted that these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, it is recommended that the DEA include a condition that further modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process.

# 9 ENVIRONMENTAL IMPACT ASSESSMENT

## 9.1 Methodology for Impact Assessment

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

### *9.1.1 Determination of Significance of Impacts*

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 58**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

### *9.1.2 Impact Rating System*

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- Planning
- Construction
- Operation
- Decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

- Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

**Table 57:** Description

| | | |
|---|---|---|
| **NATURE** | | |
| Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity. | | |
| | | |
| **GEOGRAPHICAL EXTENT** | | |
| This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined. | | |
| 1 | Site | The impact will only affect the site |
| 2 | Local/district | Will affect the local area or district |
| 3 | Province/region | Will affect the entire province or region |
| 4 | International and National | Will affect the entire country |
| | | |
| **PROBABILITY** | | |
| This describes the chance of occurrence of an impact | | |
| 1 | Unlikely | The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence). |
| 2 | Possible | The impact may occur (Between a 25% to 50% chance of occurrence). |
| 3 | Probable | The impact will likely occur (Between a 50% to 75% chance of occurrence). |
| 4 | Definite | Impact will certainly occur (Greater than a 75% chance of occurrence). |
| | | |
| **REVERSIBILITY** | | |
| This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity. | | |
| 1 | Completely reversible | The impact is reversible with implementation of minor mitigation measures |
| 2 | Partly reversible | The impact is partly reversible but more intense mitigation measures are required. |
| 3 | Barely reversible | The impact is unlikely to be reversed even with intense mitigation measures. |
| 4 | Irreversible | The impact is irreversible and no mitigation measures exist. |

| | | |
|---|---|---|
| | | |
| **IRREPLACEABLE LOSS OF RESOURCES** | | |
| This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity. | | |
| 1 | No loss of resource. | The impact will not result in the loss of any resources. |
| 2 | Marginal loss of resource | The impact will result in marginal loss of resources. |
| 3 | Significant loss of resources | The impact will result in significant loss of resources. |
| 4 | Complete loss of resources | The impact is result in a complete loss of all resources. |
| | | |
| **DURATION** | | |
| This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity | | |
| 1 | Short term | The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years). |
| 2 | Medium term | The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years). |
| 3 | Long term | The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years). |
| 4 | Permanent | The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite). |
| | | |
| **CUMULATIVE EFFECT** | | |
| This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question. | | |
| 1 | Negligible Cumulative Impact | The impact would result in negligible to no cumulative effects |
| 2 | Low Cumulative Impact | The impact would result in insignificant cumulative effects |
| 3 | Medium Cumulative impact | The impact would result in minor cumulative effects |
| 4 | High Cumulative Impact | The impact would result in significant cumulative effects |
| | | |
| **INTENSITY/ MAGNITUDE** | | |

| | | |
|---|---|---|
| Describes the severity of an impact | | |
| 1 | Low | Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible. |
| 2 | Medium | Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity). |
| 3 | High | Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation. |
| 4 | Very high | Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation. |

**SIGNIFICANCE**

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

**(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

| Points | Impact Significance Rating | Description |
|---|---|---|
| 6 to 28 | Negative Low impact | The anticipated impact will have negligible negative effects and will require little to no mitigation. |
| 6 to 28 | Positive Low impact | The anticipated impact will have minor positive effects. |
| 29 to 50 | Negative Medium impact | The anticipated impact will have moderate negative effects and will require moderate mitigation measures. |
| 29 to 50 | Positive Medium impact | The anticipated impact will have moderate positive effects. |

| | | |
|---|---|---|
| 51 to 73 | Negative High impact | The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact. |
| 51 to 73 | Positive High impact | The anticipated impact will have significant positive effects. |
| 74 to 96 | Negative Very high impact | The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws". |
| 74 to 96 | Positive Very high impact | The anticipated impact will have highly significant positive effects. |

**Table 58:** Rating of impacts

| IMPACT TABLE FORMAT | | |
|---|---|---|
| Environmental Parameter | A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water | |
| Issue/Impact/Environmental Effect/Nature | A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as A result of the proposed activity e.g. oil spill in surface water | |
| Extent | A brief description indicating the chances of the impact occurring | |
| Probability | A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity | |
| Reversibility | A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water | |
| Irreplaceable loss of resources | A brief description of the degree in which irreplaceable resources are likely to be lost | |
| Duration | A brief description of the amount of time the proposed activity is likely to take to its completion | |
| Cumulative effect | A brief description of whether the impact will be exacerbated as a result of the proposed activity | |
| Intensity/magnitude | A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily | |
| Significance Rating | A brief description of the importance of an impact which in turn dictates the level of mitigation required | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| | **Pre-mitigation impact rating** | |
| Extent | 1 | 4 |
| Probability | 1 | 4 |

| IMPACT TABLE FORMAT | | |
|---|---|---|
| Reversibility | 1 | 4 |
| Irreplaceable loss | 1 | 4 |
| Duration | 1 | 4 |
| Cumulative effect | 1 | 4 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -12 (low negative) | -48 (medium negative) |
| Mitigation measures | *Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analysing the significance. These measures will be detailed in the EMPr.* | |

The 2014 regulations also specify that alternatives must be compared in terms of impact assessment.

## 9.2 Environmental Impact Assessment

Based on the specialist review of the new proposed 47 turbine layout, some of the impact rating tables provided in the EIA phase specialist assessments for the previously assessed 70 turbine layout were amended / updated. As such, the amended / updated impact rating tables which are applicable for the new proposed 47 turbine layout have been provided in the sections below. It should be noted that the EIA phase specialist assessments do not reflect these amended / updated impact rating tables and still include the impact rating tables which are applicable for the previously assessed 70 turbine layout.

### *9.2.1 Biodiversity*

- Planning

No impacts are expected during planning.

- Construction

**Table 59:** Impacts on vegetation and protected plant species

| **Impact 1. Impacts on vegetation and protected plant species** | |
|---|---|
| Environmental Parameter | Vegetation and protected plant species |
| Issue/Impact/Environmental Effect/Nature | Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species. |
| Extent | The extent of the impact will be restricted the wind farm site and as such would be local in nature. |

| Impact 1. Impacts on vegetation and protected plant species | | |
|---|---|---|
| Probability | This impact will definitely occur as vegetation clearing will be required for the construction and establishment of the project. | |
| Reversibility | This impact is not highly reversible as it would take a long time for any cleared areas to return to their former state and rehabilitation of arid environments is very difficult. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources. | |
| Duration | The construction phase itself will be of short duration, but the resulting impact would persist for a long time. | |
| Cumulative effect | The clearing would contribute to vegetation impacts in the area, the contribution of a single facility would be low, but as there are several facilities in the area, the cumulative impact would be moderate at the local level, but low at a broader scale. | |
| Intensity/magnitude | The intensity of the impact would be moderate to high as all vegetation within the footprint would be cleared. | |
| Significance Rating | Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a low level. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -48 (medium negative) | -28 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Placement of turbines within the High Sensitivity areas and drainage lines should be avoided.<br>2) Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are avoided where possible.<br>3) Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible.<br>4) Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development.<br>5) A large proportion of the impact of the development stems from the access roads and the number of roads should be reduced to the minimum possible and routes should also be adjusted to | |

| Impact 1. Impacts on vegetation and protected plant species | |
|---|---|
| | avoid areas of high sensitivity as far as possible, as informed by a preconstruction walk-though survey.<br>6) Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes topics such as no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.<br>7) 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. |

**Table 60:** Impacts on fauna due to construction phase activities

| Impact 2. Impacts on fauna during construction | | |
|---|---|---|
| Environmental Parameter | Faunal impacts due to construction activities | |
| Issue/Impact/Environmental Effect/Nature | Vegetation clearing, the use of heavy machinery and human presence during construction is likely to negatively affect resident fauna during construction. | |
| Extent | The extent of the impact will be restricted the site and as such would be local in nature. | |
| Probability | This impact is likely to occur and cannot be easily mitigated or avoided. | |
| Reversibility | Noise and disturbance is largely reversible but habitat loss due to transformation of intact habitat is not considered easily reversible. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources in terms of fauna. | |
| Duration | The construction phase itself will be of relatively short duration, but some impact will persist into operation on account of the habitat loss created by transformation. | |
| Cumulative effect | The clearing would contribute to cumulative habitat loss for fauna in the area, but this would be largely local in nature. | |
| Intensity/magnitude | The intensity of the impact would be moderate. | |
| Significance Rating | Construction phase impact would be of relatively short duration (2 years) but of moderate to high intensity. Overall significance is likely to be moderate before mitigation and moderate to low thereafter. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |

| Impact 2. Impacts on fauna during construction | | |
|---|---|---|
| Irreplaceable loss | 1 | 1 |
| Duration | 4 | 4 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -45 (medium negative) | -26 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Preconstruction walk-through of the facility to identify areas of faunal sensitivity.<br>2) During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.<br>3) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site.<br>4) No fires should be allowed within the site as there is a risk of runaway veld fires.<br>5) No fuelwood collection should be allowed on-site.<br>6) No dogs or cats should be allowed on site apart from that of the landowners.<br>7) If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs) as far as practically possible, which do not attract insects and which should be directed downwards.<br>8) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.<br>9) No unauthorized persons should be allowed onto the site and site access should be strictly controlled<br>10) All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. Speed limits should apply within the facility as well as on the public gravel access roads to the site.<br>11) All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and snakes which are often persecuted out of fear or superstition. | |

- Operation

**Table 61:** Impacts on fauna due to operational phase activities

| **Impact 2. Impacts on fauna during operation** | | |
|---|---|---|
| Environmental Parameter | Faunal impacts due to operational activities | |
| Issue/Impact/Environmental Effect/Nature | Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise generated by the wind turbines as well. | |
| Extent | The extent of the impact will be restricted the site and as such would be local in nature. | |
| Probability | This impact is likely to occur but can to a large degree be mitigated. | |
| Reversibility | Noise and disturbance are generally reversible impacts that would occur on an occasional basis during the life of the wind farm, but cease thereafter. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources in terms of fauna. | |
| Duration | This impact would persist for the operational life of the wind farm, but apart from habitat loss would cease after decommissioning. | |
| Cumulative effect | The clearing would contribute to cumulative habitat loss for fauna in the area, but this would be largely local in nature. | |
| Intensity/magnitude | The intensity of the impact would be low. | |
| Significance Rating | This impact would occur at a relatively low intensity and overall significance is likely to be moderate before mitigation and moderate to low thereafter. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 4 | 4 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -42 (medium negative) | -26 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Management of the site should take place within the context of an Open Space Management Plan.<br>2) No unauthorized persons should be allowed onto the site. | |

| Impact 2. Impacts on fauna during operation | |
|---|---|
| | 3) Any potentially dangerous fauna such snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.<br>4) The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden by anyone except landowners or other individuals with the appropriate permits and permissions where required.<br>5) If any parts of the site need to 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.<br>6) 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.<br>7) 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.<br>8) If parts of the facility such as the substation are to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences as they do not move away when electrocuted but rather adopt defensive behavior and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside. |

**Table 62:** Increased Erosion Risk

| Impact 3. Increased Soil Erosion Risk | |
|---|---|
| Environmental Parameter | Ecosystem integrity |
| Issue/Impact/Environmental Effect/Nature | Following construction, the site will be highly vulnerable to soil erosion due to the disturbance created and likely low natural revegetation of disturbed areas. |
| Extent | The extent of the impact will be restricted the wind farm site and as such would be local in nature. |
| Probability | This impact would be likely to occur due to the large amount of disturbance generated during construction. |
| Reversibility | Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion. |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources if this impact is managed. |

| **Impact 3. Increased Soil Erosion Risk** | | |
|---|---|---|
| Duration | This impact is likely to persist for several years after construction. | |
| Cumulative effect | Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided. | |
| Intensity/magnitude | The intensity of the impact would be moderate as the site is not considered highly vulnerable to erosion. | |
| Significance Rating | Without mitigation, this impact would be of moderate to low significance, but with avoidance this impact can be reduced to a very low level. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -39 (medium negative) | -12 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan.<br>2) All roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.<br>3) 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.<br>4) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.<br>5) All cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow. | |

**Table 63:** Alien plant invasion risk

| **Impact 4. Alien Plant Invasion** | | |
|---|---|---|
| Environmental Parameter | Ecosystem integrity | |
| Issue/Impact/Environmental Effect/Nature | Following construction, the site will be highly vulnerable to alien plant invasion due to disturbance | |
| Extent | The extent of the impact will be restricted the wind farm site and as such would be local in nature. | |
| Probability | This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance. | |
| Reversibility | Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources if this impact is managed. | |
| Duration | This impact is likely to persist for several years after construction. | |
| Cumulative effect | Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided. | |
| Intensity/magnitude | The intensity of the impact would be moderate as the site is not considered highly vulnerable to invasion. | |
| Significance Rating | Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -42 (medium negative) | -12 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species.<br>2) Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented. | |

| Impact 4. Alien Plant Invasion | |
|---|---|
| | Problem woody species such as *Prosopis* are already present in the area and are likely to increase rapidly if not controlled.<br>3) Regular monitoring for alien plants within the development footprint as well as adjacent areas which receive runoff from the facility as there are also likely to be prone to invasion problems.<br>4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible. |

- Decommissioning

**Table 64:** Impacts on fauna due to decommissioning phase activities

| **Impact 2. Impacts on fauna during operation** | | |
|---|---|---|
| Environmental Parameter | Faunal impacts due to decommissioning activities | |
| Issue/Impact/Environmental Effect/Nature | Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated. | |
| Extent | The extent of the impact will be restricted the site and as such would be local in nature. | |
| Probability | This impact is highly likely to occur to some degree. | |
| Reversibility | Noise and disturbance would be of relatively short duration and are considered reversible. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources in terms of fauna. | |
| Duration | This impact would be transient and persist for the active decommissioning period only. | |
| Cumulative effect | There would be transient contribution to cumulative disturbance impacts, but this would cease after decommissioning. | |
| Intensity/magnitude | The intensity of the impact would be moderate. | |
| Significance Rating | This impact would occur at a moderate intensity but would be transient in nature and overall significance is likely to be moderate before mitigation and low thereafter. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |

| Impact 2. Impacts on fauna during operation | | |
|---|---|---|
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -36 (medium negative) | -20 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decommissioning activities.<br>2) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.<br>3) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises.<br>4) No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped.<br>5) All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan, and as per the agreements with the land owners concerned. | |

**Table 65:** Increased Erosion Risk due to Decommissioning

| Impact 3. Increased Soil Erosion Risk | |
|---|---|
| Environmental Parameter | Ecosystem integrity |
| Issue/Impact/Environmental Effect/Nature | Following decommissioning, the site will be highly vulnerable to soil erosion due to the disturbance created by the removal of infrastructure from the site. |
| Extent | The extent of the impact will be restricted the wind farm site and as such would be local in nature. |
| Probability | This impact would be likely to occur due to the large amount of disturbance generated during decommissioning. |
| Reversibility | Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion. |

| Impact 3. Increased Soil Erosion Risk | | |
|---|---|---|
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources if this impact is managed. | |
| Duration | This impact is likely to persist for several years after decommissioning. | |
| Cumulative effect | Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided. | |
| Intensity/magnitude | The intensity of the impact would be moderate as the site is not considered highly vulnerable to erosion. | |
| Significance Rating | Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -39 (medium negative) | -12 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Any roads that will not be rehabilitated should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.<br>2) There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as a result of the disturbance, and if they do, to immediately implement erosion control measures.<br>3) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.<br>4) All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area. | |

**Table 66:** Alien plant invasion risk following decommissioning

| Impact 4. Alien Plant Invasion | |
|---|---|
| Environmental Parameter | Ecosystem integrity |

| Impact 4. Alien Plant Invasion | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | Following decommissioning, the site will be highly vulnerable to alien plant invasion due to disturbance | |
| Extent | The extent of the impact will be restricted the wind farm site and as such would be local in nature. | |
| Probability | This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance. | |
| Reversibility | Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources if this impact is managed. | |
| Duration | This impact is likely to persist for several years after decommissioning. | |
| Cumulative effect | Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided. | |
| Intensity/magnitude | The intensity of the impact would be moderate as the site is not considered highly vulnerable to invasion. | |
| Significance Rating | Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -42 (medium negative) | -12 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species.<br>2) Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned. | |

| Impact 4. Alien Plant Invasion | |
|---|---|
| | 3) Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are no longer a problem at the site.<br>4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible. |

- Cumulative Impacts

**Table 67:** Cumulative Impact 1 - Cumulative habitat loss and fragmentation

| **Impact 5. Cumulative impacts and loss of broad-scale connectivity** | | |
|---|---|---|
| Environmental Parameter | Broad-scale ecological processes | |
| Issue/Impact/Environmental Effect/Nature | Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation. | |
| Extent | Should all the developments in the area go ahead, then this would result in a landscape-level impact. | |
| Probability | This impact is highly likely to occur as some facilities have already been built and some additional habitat loss would occur if the current development proceeds. | |
| Reversibility | This impact would to some degree be reversible when the facilities are decommissioned. | |
| Irreplaceable loss of resources | It is not likely that there would be significant irreplaceable loss of resources. | |
| Duration | This impact would persist for the lifespan of the facility. | |
| Cumulative effect | The development would contribute to cumulative impacts on habitat loss and fragmentation in the area, and while the contribution of a single facility would be low, there are several facilities in the area and so overall cumulative impacts are likely to be moderate. | |
| Intensity/magnitude | The intensity of the impact would be moderate to low as the area is not sensitive and the overall total footprint is not highly significant. | |
| Significance Rating | Due to the relatively low contribution of the development and the low overall current level of impact in the area, the significance of this impact is likely to be moderate to low. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 3 |
| Reversibility | 2 | 2 |

| Impact 5. Cumulative impacts and loss of broad-scale connectivity | | |
|---|---|---|
| Irreplaceable loss | 2 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -30 (medium negative) | -26 (low negative) |
| Mitigation measures | Mitigation measures to reduce residual risk or enhance opportunities:<br>1) Minimise the development footprint within the high sensitivity areas.<br>2) There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora.<br>3) All disturbed areas that are not used such as excess road widths, should be rehabilitated with locally occurring shrubs and grasses after construction to reduce the overall footprint of the development. | |

### *9.2.2 Avifauna*

- Planning

No impacts are expected during planning.

- Construction

**Table 68:** Displacement of priority species due to disturbance during construction phase

| **IMPACT TABLE 1** | |
|---|---|
| *Environmental Parameter* | *Avifauna* |
| *Issue/Impact/Environmental Effect/Nature* | *Displacement of priority species due to disturbance during* ***construction*** *phase* |
| *Extent* | *The impact will only affect the site.* |
| *Probability* | *Impact will certainly occur (greater than a 75% chance of occurrence) for some species, particularly the larger ones.* |
| *Reversibility* | *Partly reversible. The construction activities will inevitably cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, most species should re-colonise the areas which have not been transformed by the footprint. However, the indirect effect of habitat fragmentation could result in lower densities of priority species.* |
| *Irreplaceable loss of resources* | *Marginal loss of resources. The displacement of priority species is likely to be partial.* |

| IMPACT TABLE 1 | | |
|---|---|---|
| *Duration* | *Short term. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, priority species should re-colonise the areas which have not been transformed by the footprint, albeit possibly at a lower density.* | |
| *Cumulative effect* | *Minor cumulative impact. The priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges, the cumulative impact of displacement would therefore be at most locally significant in some instances, rather than regionally or nationally significant (see also Section 10 below).* | |
| *Intensity/magnitude* | *High. Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease.* | |
| *Significance Rating* | *Medium significance.* | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 2 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 2 | 2 |
| Duration | 1 | 1 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -39 (medium negative) | -18 (low negative) |
| Mitigation measures | • Restrict the construction activities to the construction footprint area.<br>• Do not allow any access to the remainder of the property during the construction period.<br>• Measures to control noise and dust should be applied according to current best practice in the industry.<br>• Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place. | |

**Table 69:** Displacement of priority species due to habitat destruction during construction phase

| IMPACT TABLE 2 | |
|---|---|
| *Environmental Parameter* | *Avifauna* |
| *Issue/Impact/Environmental Effect/Nature* | *Displacement of priority species due to habitat destruction during **construction** phase* |
| *Extent* | *The impact will only affect the site.* |

| IMPACT TABLE 2 | | |
|---|---|---|
| *Probability* | *Impact will certainly occur (greater than a 75% chance of occurrence)* | |
| *Reversibility* | *Partly reversible. The footprint of the wind farm is an inevitable result of the development, but it is likely that priority species will still utilise the site, albeit at lower densities.* | |
| *Irreplaceable loss of resources* | *Marginal loss of resources. It is likely that priority species will still utilise the site albeit at lower densities.* | |
| *Duration* | *Long term. The habitat transformation will be permanent* | |
| *Cumulative effect* | *Moderate cumulative impact. There are several renewable energy developments planned around Loeriesfontein which could result in a significant area of transformed habitat, but only at a local scale, for some species (see also Section 10 below).* | |
| *Intensity/magnitude* | *Medium. It is likely that priority species will still utilise the site albeit at lower densities.* | |
| *Significance Rating* | *Medium significance.* | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 4 | 4 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -32 (medium negative) | -30 (medium negative) |
| Mitigation measures | • The recommendations of the specialist ecological study must be strictly adhered to.<br>• Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place.<br>• Post-construction monitoring should be implemented to make comparisons with baseline conditions possible.<br>• If densities of key priority species are proven to be significantly reduced due to the operation of the wind farm, the management of the wind farm must be engaged to devise ways of reducing the impact on these species. | |

- Operation

**Table 70:** Displacement of priority species due to disturbance during operational phase

| IMPACT TABLE 3 | | |
|---|---|---|
| *Environmental Parameter* | *Avifauna* | |
| *Issue/Impact/Environmental Effect/Nature* | *Displacement of priority species due to disturbance during* ***operational*** *phase* | |
| *Extent* | *The impact will only affect the site.* | |
| *Probability* | *Probable. The impact may occur (between a 50% to 75% chance of occurrence).* | |
| *Reversibility* | *Partly reversible. The operational activities could cause displacement of some priority species, but the impact is likely to be much less than during the construction phase.* | |
| *Irreplaceable loss of resources* | *Marginal loss of resources. Habituation is likely for some species after the construction phase, especially smaller species.* | |
| *Duration* | *Long term. Although habituation may happen in some instances, it must be assumed that in some instances the impact may be long term i.e. for the life-time of the activity.* | |
| *Cumulative effect* | *Minor cumulative impact. The priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges, the cumulative impact of displacement would therefore be locally significant at most, rather than regional or national (see also Section 9 below).* | |
| *Intensity/magnitude* | *Medium. Although habituation may happen in some instances, it must be assumed that in some instances the impact may be long term i.e. for the life-time of the activity.* | |
| *Significance Rating* | *Low significance.* | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -26 (low negative) | -24 (low negative) |
| Mitigation measures | • Operational activities should be restricted to the plant area. Maintenance staff should not be allowed to access other parts of the property unless it is necessary for wind farm related work. | |

**Table 71:** Collisions of priority species with the turbines in the operational phase

| IMPACT TABLE 4 | |
|---|---|
| *Environmental Parameter* | *Avifauna* |

| IMPACT TABLE 4 | |
|---|---|
| *Issue/Impact/Environmental Effect/Nature* | *Collisions of priority species with the turbines in the operational phase* |
| *Extent* | *The impact will affect the local area or district* |
| *Probability* | *Possible. The impact may occur (between 25% - 50% chance of occurrence).* |
| *Reversibility* | *Partly reversible. Mitigation measures could reduce the risk of collisions.* |
| *Irreplaceable loss of resources* | *Significant loss of resources.* |
| *Duration* | *Long term. The risk of collision will be present for the life-time of the development.* |
| *Cumulative effect* | *Moderate cumulative impact. The cumulative impact will depend largely on which species are killed. If Verreaux's Eagles or Martial Eagles are regularly killed, the regional impact could be significant (see also Section 10 below). However, the low reporting rate for priority species makes this an unlikely scenario.* |
| *Intensity/magnitude* | *Medium. The wind turbines could cause mortality of some priority species.* |
| *Significance Rating* | *Medium significance.* |

| | Pre-mitigation impact rating | Post mitigation impact rating |
|---|---|---|
| Extent | 2 | 2 |
| Probability | 2 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 3 | 3 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | -45 (medium negative) | -30 (medium negative) |
| Mitigation measures | • A 300m no-go buffer is proposed around water points and pans as they serve as focal points for bird activity.<br>• Formal monitoring should be resumed 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 purpose of this would be (a) to establish if and to what extent displacement of priority species has occurred through the altering of flight patterns post-construction, and (b) to search for carcasses at turbines.<br>• As an absolute minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in year 5, and again every five | |

| IMPACT TABLE 4 | |
|---|---|
| | years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the results of the monitoring through a process of adaptive management.<br>• The minimum turbine tip height should be no less than 50m to reduce the risk of Red Lark mortality during display flight activity.<br>• Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including selective curtailment of problem turbines during high risk periods if need be.<br>• If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations).<br>• Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations). |

**Table 72:** Mortality of priority species due to electrocution on the internal MV lines in the operational phase

| IMPACT TABLE 5 | |
|---|---|
| *Environmental Parameter* | *Avifauna* |
| *Issue/Impact/Environmental Effect/Nature* | *Mortality of priority species due to electrocution on the internal MV lines in the operational phase* |
| *Extent* | *The impact could affect the local area or district* |
| *Probability* | *Possible. The impact may occur (Between a 25% to 50% chance of occurrence)..* |
| *Reversibility* | *Comletely reversible. Mitigation measures could eliminate the risk* |
| *Irreplaceable loss of resources* | *Significant loss of resources.* |
| *Duration* | *Long term. The risk of electrocution could potentially be present for the life-time of the development if not mitigated at the onset.* |
| *Cumulative effect* | *Moderate cumulative impact. The cumulative impact will depend largely on which species are killed. If Verreaux's Eagles or Martial Eagles are regularly killed, the regional impact could be significant (see also Section 10 below). However, the low reporting rate for priority species makes this an unlikely scenario.* |
| *Intensity/magnitude* | *Medium. The powerlines could cause mortality of some priority species.* |
| *Significance Rating* | *Medium significance.* |
| | |

| IMPACT TABLE 5 | | |
|---|---|---|
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 2 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 3 | 3 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -42 (medium negative) | -11 (low negative) |
| Mitigation measures | • The avifaunal specialist must approve the powerline design to ensure that bird-friendly structures are used. | |

### *9.2.3 Bats*

- Planning

No impacts are expected during planning.

- Construction

**Table 73:** Destruction of bat roosts due to earthworks and blasting

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Bat populations will be impacted upon through earthworks and blasting close to bat roosts. |
| Issue/Impact/Environmental Effect/Nature | Earthworks and blasting close to bat roosts will negatively affect bat populations through high mortality or disturbances |
| Extent | If bat roosts are found to be within the site, blasting will have a negative effect on the bat populations in the local area. |
| Probability | It is possible for the impact to occur, although unlikely due to the geology around proposed turbine positions. |
| Reversibility | Blasting occurring at bat roosts will cause damage to the bat population in the roost. Depending on the extent, the impact is reversible, however recovery of the roost numbers may take several years. |
| Irreplaceable loss of resources | If blasting and earthworks occurs at or very close to a bat roost, it may be destroyed and lost. |
| Duration | The disturbance impact will be of short duration, as blasting and earthworks will only occur during construction phase. Roost destruction is permanent, but very unlikely on this site. |
| Cumulative effect | Moderate effect, as the destruction of the bat roosts impact the population numbers within the broader area. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Intensity/magnitude | Blasting of bat roosts will cause mortality to the bats inhabiting the roosts, and will negatively impact the population and system. | |
| Significance Rating | The anticipated impact may have a significant effect if unmitigated and if actually occurring. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 2 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 26 (low negative) | - 7 (low negative) |
| Mitigation measures | Adhere to the sensitivity map during turbine placement. If a bat roost is discovered close to a turbine position during construction, and if blasting is required, a bat specialist should be consulted before the blasting occurs. The mitigation measures of avoiding sensitive areas will reduce the probability of the impact significantly. | |

**Table 74:** Loss of foraging habitat

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Loss of foraging habitat within the site boundaries. |
| Issue/Impact/Environmental Effect/Nature | Loss of foraging habitat. Some minimal foraging habitat will be lost by construction of turbines and access roads. Temporary foraging habitat loss will occur during construction due to storage areas and movement of heavy vehicles. |
| Extent | Loss of foraging habitat will be contained within the boundaries of the development site. |
| Probability | The impact will definitely occur. |
| Reversibility | Depending on the degree of habitat loss, it can be reversed with some rehabilitation |
| Irreplaceable loss of resources | In areas where vegetation is removed for roads and turbines, there will be a loss of habitat resources, but can be rehabilitated. |
| Duration | The impact will be for the operational phase of the development. |
| Cumulative effect | Low effect, the removal of habitat is minimal in relation to the larger scale of unaltered habitat in the facility and neighbouring facilities. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Intensity/magnitude | Removal of foraging grounds may negatively impact the population and system, but on a small scale since the developmental footprint is low. | |
| Significance Rating | The anticipated impact will have low negative effects but will still require some mitigation measures. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 28 (low negative) | - 9 (low negative) |
| Mitigation measures | Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles. Damaged areas not required after construction should be rehabilitated by a vegetation succession specialist. | |

- Operation

**Table 75:** Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration)

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Impact on bat population numbers. |
| Issue/Impact/Environmental Effect/Nature | Bat mortalities due to direct blade impact or barotrauma during foraging activities. If the impact is too severe (e.g. in the case of no mitigation) local bat populations may not recover from mortalities for several decades. |
| Extent | The impact will affect the broader region |
| Probability | There is a definite chance of the impact occurring, if unmitigated. |
| Reversibility | Population and diversity genetics may be permanently altered in the local region, if unmitigated. |
| Irreplaceable loss of resources | If unmitigated population numbers may take several decades to recover, resources can be lost for a significant time period. |
| Duration | The impact will be of long duration, even past the operational phase of the development. It will take some time for the population to achieve its previous numbers after the impact is removed. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Cumulative effect | High effect, as the decrease in bat numbers will in effect cause an increase in the number of insects in the area which changes the system of the area. | |
| Intensity/magnitude | Possibly high intensity impact on the bat population numbers in the area, if unmitigated and unmonitored. | |
| Significance Rating | The impact will have a high significant effect if unmitigated and may affect bat populations severely in the local area. However, if mitigated the significance is considerably lower. | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 2 |
| Reversibility | 3 | 2 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 57 (high negative) | - 28 (low negative) |
| Mitigation measures | Adhere to the sensitivity maps, avoid areas of high bat sensitivity and their buffers as well as preferably avoid areas of Moderate bat sensitivity and their buffers. Adhere to operational mitigation measures described in Section 1 of the Bat specialist's comment letter on the final turbine layout. An operational phase bat monitoring study must be implemented as soon as the facility has been constructed. | |

**Table 76:** Artificial lighting

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Impact on bat populations and diversity. |
| Issue/Impact/Environmental Effect/Nature | During operation, artificial lights that may be used at the turbine base or immediate surrounding infrastructure will attract insects and thereby also bats. This will significantly increase the likelihood of impact on bats foraging around such lights. Additionally, only certain species of bats will readily forage around strong lights, whereas others avoid such lights even if there is insect prey available, which can draw insect prey away from other natural areas and thereby artificially favour only certain species. |
| Extent | Artificial lighting will be contained within the boundaries of the development site. |
| Probability | Very high probability if unmitigated, very low probability if mitigated. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Reversibility | High reversibility if mitigated | |
| Irreplaceable loss of resources | If unmitigated population numbers may be impacted significantly and take long to recover. | |
| Duration | The impact will be of a long-term duration, the lifespan of the development. | |
| Cumulative effect | If artificial light persists over a larger area of several facilities, the population dynamics of that entire area may be altered and the overall likelihood of blade impact mortalities will be significantly higher. | |
| Intensity/magnitude | May have a high intensity is unmitigated, but low if mitigated. | |
| Significance Rating | The impact will have a high negative effect if unmitigated, but with simple mitigations it can be lower to a low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 51 (high negative) | - 8 (low negative) |
| Mitigation measures | Utilize lights with wavelengths that attract less insects (low thermal/infrared signature). If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors. These simple mitigation measures will significantly reduce the likelihood of bat mortalities. | |

- Decommissioning

**Table 77:** Loss of foraging habitat

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Minimal loss of foraging habitat within the site boundaries. |
| Issue/Impact/Environmental Effect/Nature | Some minimal foraging habitat will be lost by construction of turbines and access roads. Temporary foraging habitat loss will occur during construction due to storage areas and movement of heavy vehicles. |
| Extent | Loss of foraging habitat will be contained within the boundaries of the development site. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Probability | The impact will definitely occur. | |
| Reversibility | Depending on the degree of habitat loss, it can be reversed with some rehabilitation. | |
| Irreplaceable loss of resources | In areas where vegetation is removed for roads and turbines, there will be a loss of habitat resources, but can be rehabilitated | |
| Duration | The impact will be for the decommissioning phase only. | |
| Cumulative effect | Low effect, the removal of habitat is minimal in relation to the larger scale of unaltered habitat in the facility and neighbouring facilities. | |
| Intensity/magnitude | Removal of foraging grounds may negatively impact the population and system, but on a small scale since the developmental footprint is low. | |
| Significance Rating | The anticipated impact will have low negative effects but will still require some mitigation measures. | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 2 |
| Duration | 1 | 1 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 24 (low negative) | - 7 (low negative) |
| Mitigation measures | Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or large vehicles and keep to designated roads with all large vehicles. Damaged areas not required after decommissioning should be rehabilitated by a vegetation succession specialist. | |

- Cumulative Impact

The main impact on bats that raises concern from a cumulative impact assessment point of view is the bat mortalities due to direct turbine blade collision or barotrauma during operation. There is potential for mass loss of locally active bats and migratory bats from the area due to cumulative mortality from wind turbines of several neighbouring wind farms. This impact is assessed below.

**Table 78:** Cumulative bat mortalities due to direct blade impact or barotrauma during foraging (resident and migrating bats affected).

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Impact on bat population numbers. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | Bat mortalities due to direct blade impact or barotrauma during foraging activities. If the impact is too severe (e.g. in the case of no mitigation) local bat populations may not recover from mortalities for several decades. | |
| Extent | The impact will affect the region or province | |
| Probability | There is a definite chance of the impact occurring, if unmitigated. | |
| Reversibility | Population and diversity genetics may be permanently altered in the broader region, if unmitigated. | |
| Irreplaceable loss of resources | If unmitigated population numbers may take several decades to recover, resources can be lost for a significant time period. | |
| Duration | The impact will be of long duration, even past the operational phase of the development. It will take some time for the population to achieve its previous numbers after the impact is removed. | |
| Cumulative effect | Mortalities of bats due to wind turbines during foraging and migration can have significant ecological consequences as the bat species at risk are insectivorous and thereby contribute significantly to the control of nocturnal flying insects. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species. If migrating bats are killed off it can have detrimental effects on the cave ecology of the caves that a specific colony utilises. This is due to the fact that bat guano is the primary form of energy input into a cave ecology system. | |
| Intensity/magnitude | High intensity impact on the bat population numbers in the broader area if unmitigated. | |
| Significance Rating | The impact will have high significant effects if unmitigated. Even though mitigation will make a very significant difference in the level of impact, the presence of several facilities in the area will still have a certain level of unavoidable cumulative impact. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 3 | 3 |
| Probability | 3 | 2 |
| Reversibility | 3 | 2 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 4 | 2 |
| Significance rating | - 57 (high negative) | - 30 (medium negative) |

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Mitigation measures | The high sensitivity waterways, valleys and other features can serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several WEF's in an area. Adhere to recommended mitigation measures for this project. It is essential that project specific mitigations be applied and adhered to for each project, as there is no overarching mitigation that can be recommended on a regional level due to habitat and ecological differences between project sites. Adhere to the sensitivity map during any possible further turbine layout revisions. |

### *9.2.4 Surface Water*

- Planning / Pre-construction

No impacts are expected during planning.

- Construction

**Table 79:** Potential Construction Impacts to Drainage Line Habitat

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | Major / Minor Drainage Lines and Wetlands | |
| Issue/Impact/Environmental Effect/Nature | Impacts associated with the degradation of drainage line and wetland habitat | |
| *Extent* | *Site* | |
| *Probability* | *Definite* | |
| *Reversibility* | *Partly reversible* | |
| *Irreplaceable loss of resources* | *Marginal loss of resources* | |
| *Duration* | *Long term* | |
| *Cumulative effect* | *Medium cumulative Impact* | |
| *Intensity/magnitude* | *High* | |
| *Significance Rating* | *Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a lower level.* | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |

| | | |
|---|---|---|
| Significance rating | - 45 (medium negative) | - 28 (low negative) |
| Mitigation measures | **Designation of Highly Sensitive Areas**<br>The wetlands and drainage lines must be designated as "highly sensitive" and any impact must be limited to the minimum possible extent. All wetlands and drainage lines must be visibly demarcated prior to construction activities taking place where construction is within 50m of any delineated surface water resource. The demarcation of wetlands and drainage lines must be visible and last for the duration of the construction activities.<br><br>**Establishment of Internal Road Access Areas**<br>For general access to the various components of the wind farm, existing roads are to be used as far as possible. No roads are to be routed through any wetlands (including buffer zones). Additionally, roads should not be planned through any drainage lines and the associated buffer zones. Where this is not possible however, and where no other access exists to the desired construction areas, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly.<br><br>A single access route or internal road access area is then to be established before construction takes place, if required. This should be planned to cross perpendicularly through any drainage line(s). For wetlands, the internal road access area must be planned for minimal impact on wetlands (i.e. shortest route, not routed through the core of the wetlands, minimal destruction of habitat etc.). The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings and / or similar design crossings using the stream / wetland bed as part of the road can be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to access proposed construction areas during construction the construction phase only. Where the access route will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, this design should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as | |

| | |
|---|---|
| | well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing and / or similar design crossings, little to no modification of the stream banks or wetland will be required where banks are low (approximately 1,2m) for drainage lines or topography is flat for wetlands, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line and / or wetland. However, where modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction.<br><br>For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line and / or wetland beds. The weak substrate layer will need to be excavated an infilled by the rock or gravel material to the same level of the original drainage line or wetland bed. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support.<br><br>Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction.<br><br>In general, the width of the internal road access area must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The internal road access area must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings and / or similar design crossings, vegetation should not be totally cleared across the entire internal road |

| | |
|---|---|
| | access area. Rather, only the vehicle tracks should be cleared. Remaining vegetation can be kept trimmed to below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated.<br><br>Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary and permanent ford crossings and / or similar design crossings. Additionally, rehabilitation will need to take place if and where required.<br><br>Overall, no wetlands and or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road access areas are only permissible after rainfall events once flows have ceased.<br><br>Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the internal road access areas of the wetland and drainage line areas due soil instability factors.<br><br>Construction workers are only allowed in the designated internal road access area maintenance areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation.<br><br>**Control of Alien and Invasive Vegetation in Surface Water Resources**<br>Control of alien and invasive vegetation within surface water resources will be required. Where alien and invasive vegetation encroachment / colonization takes place, these areas are to be cleared as soon as practically possible. Clearing should take place by means of mechanical removal, either by physically pulling or slashing and clearing of unwanted alien and invasive vegetation near or within the surface water resources. Monitoring of alien and invasive vegetation should be undertaken in accordance with the |

| | |
|---|---|
| | environmental compliance monitoring during the construction phase.<br><br>**Avoidance of Direct Impact to Delineated Surface Water Resources**<br>The lay-down area or any other permanent building structure (including wind turbines) must not be placed directly within any of the identified and delineated wetlands and / or drainage lines.<br><br>**Emergency Measures**<br>Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons and variable winds that the region experiences, it is recommended that a fire management and emergency plan is compiled. A suitably qualified health and safety officer must compile the fire management and emergency plan for the operation and maintenance phase of the project.<br><br>**Post-construction Rehabilitation**<br>Rehabilitation of the internal road access area areas will be required post-construction. Ideally, the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation can re-establish where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped.<br><br>**Buffer Zone Specific Mitigation Measures**<br>During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as “sensitive” and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is within 50m. The demarcation of the buffer zones must be visible and last for the duration of the construction activities.<br><br>The buffer zone areas are also to be included as part of the internal road crossing areas through the surface water resources. |

| | |
|---|---|
| | All wind turbine hardstand areas within buffer zones are to be lined at the edges with grass blocks or similar run-off energy dissipating soft structures to prevent siltation within drainage lines downstream during construction. For the operation phase, permanent run-off dissipating structures are to be implemented as part of the stormwater designs and management plan.<br><br>See above for same access internal road crossing area mitigation measures to be implemented within buffer zones. |

**Table 80:** Potential Construction Impacts to the Geomorphology of Drainage Lines

| **IMPACT TABLE** | | |
|---|---|---|
| Environmental Parameter | Major / Minor Drainage Lines and Wetlands | |
| Issue/Impact/Environmental Effect/Nature | Impacts associated with the degradation of the soils associated with the drainage lines and wetlands | |
| *Extent* | *Site* | |
| *Probability* | *Definite* | |
| *Reversibility* | *Partly reversible* | |
| *Irreplaceable loss of resources* | *Marginal loss of resources* | |
| *Duration* | *Long term* | |
| *Cumulative effect* | *Medium cumulative Impact* | |
| *Intensity/magnitude* | *High* | |
| *Significance Rating* | *Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.* | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 45 (medium negative) | - 28 (low negative) |
| Mitigation measures | **General Mitigation Measures**<br>Apply same mitigation measures stipulated in Section 7.1.1 of the Surface Water Impact Assessment Report in terms of the following:<br>▪ Designation of Highly Sensitive Areas<br>▪ Establishment of Internal Road Crossing Areas<br>▪ Avoidance of Direct Impact to Delineated Surface Water Resources | |

| | |
|---|---|
| | ▪ Emergency Measures<br>▪ Post-construction Rehabilitation<br>▪ Buffer Zone Specific Mitigation Measures<br><br>**Preventing Increased Run-off, Erosion and Sedimentation Impacts**<br>Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future.<br><br>An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.<br><br>In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to prevent erosion in susceptible construction areas during the construction phase. Grass blocks on the perimeter of the wind turbine hard stand areas or similar soft engineering structures can also be used to reduce run-off and onset of erosion. Wind turbine locations that are in close proximity to the buffer zones of the surface water resources which will require such measures include the hardstand areas of wind turbines T10, T16, T19, T30, T 41, T44, T45 and T46.<br><br>Where required more permanent structures such as attenuation ponds and gabions can be constructed if needs be, however this is unlikely given the study area. All impacted areas are to be adequately sloped to prevent the onset of erosion.<br><br>Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated above) are to be implemented as and where required. |

**Table 81:** Potential Construction Impacts to the Soil and Water Contamination Impacts to Surface Water Resources

| **IMPACT TABLE** |
|---|

| Environmental Parameter | Major / Minor Drainage Lines and Wetlands | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | Impacts associated with the contamination of the soils and water associated with the drainage lines and wetlands | |
| *Extent* | *Site* | |
| *Probability* | *Probable* | |
| *Reversibility* | *Partly reversible* | |
| *Irreplaceable loss of resources* | *Marginal loss of resources* | |
| *Duration* | *Long term* | |
| *Cumulative effect* | *Medium cumulative Impact* | |
| *Intensity/magnitude* | *High* | |
| *Significance Rating* | *Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.* | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 42 (medium negative) | - 26 (low negative) |
| Mitigation measures | **General Mitigation Measures**<br>Apply same mitigation measures stipulated in **Section 7.1.1** of the Surface Water Impact Assessment Report in terms of the following:<br>▪ Designation of Highly Sensitive Areas<br>▪ Establishment of Right of Way (internal road access area) Areas<br>▪ Avoidance of Direct Impact to Surface Water Resources<br>▪ Emergency Measures<br>▪ Post-construction Rehabilitation<br>▪ Buffer Zone Specific Mitigation Measures<br><br>**Preventing Soil and Water Contamination**<br>No vehicles are to be allowed in the highly sensitive and sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles and machinery are not to be allowed into any drainage sensitive and highly sensitive areas. | |

| | |
|---|---|
| | All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive and sensitive areas.<br><br>Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available and fire extinguishers.<br><br>Storage areas for fuel, oil, paints and other hazardous substance are not to be stored directly within surface water resources or the associated buffer zones. These substances must also be contained in bunded areas with a capacity of at least 110%.<br><br>No "long drop" toilets are allowed on the construction site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must not be placed directly within any surface water resource(s) or the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills.<br><br>No cement mixing is to take place in any surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive and sensitive areas. |

**Table 82:** Potential Construction Impacts to the Fauna associated with Surface Water Resources

| **IMPACT TABLE** | |
|---|---|
| Environmental Parameter | Major / Minor Drainage Lines and Wetlands |
| Issue/Impact/Environmental Effect/Nature | Impacts to fauna associated with drainage lines and wetlands |
| *Extent* | *Site* |
| *Probability* | *Possible* |
| *Reversibility* | *Partly reversible* |
| *Irreplaceable loss of resources* | *Marginal loss of resources* |
| *Duration* | *Medium term* |
| *Cumulative effect* | *Low cumulative impact* |

| | | |
|---|---|---|
| *Intensity/magnitude* | *Medium* | |
| *Significance Rating* | *Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced to an even lower level.* | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 2 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 2 | 1 |
| Duration | 2 | 1 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 22 (low negative) | - 6 (low negative) |
| Mitigation measures | **Preventing Impacts to Fauna Associated with Drainage lines and Wetlands** No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed, may not be killed. Additionally, these animals are to be relocated outside the internal road access area or construction areas, within relative close proximity where they were found. | |

- Operation

**Table 83:** Impacts to the Geomorphology of Surface Water Resources

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Major / Minor Drainage Lines and Wetlands |
| Issue/Impact/Environmental Effect/Nature | Impacts associated with the geomorphological and hydrological impacts associated with the drainage lines and wetlands |
| *Extent* | *Site* |

| | | |
|---|---|---|
| *Probability* | *Definite* | |
| *Reversibility* | *Partly reversible* | |
| *Irreplaceable loss of resources* | *Significant loss of resources* | |
| *Duration* | *Long term* | |
| *Cumulative effect* | *Medium cumulative impact* | |
| *Intensity/magnitude* | *High* | |
| *Significance Rating* | *Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.* | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 4 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 48 (medium negative) | - 28 (low negative) |
| Mitigation measures | **Minimising Vehicle Damage to the Surface Water Resources**<br>Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones.<br><br>Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as stormwater flow pipes, culverts, culvert bridges etc.) be submitted to the relevant environmental and water departments for approval prior to construction.<br><br>Internal access and services roads authorised in sensitive areas will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall the roads will need to be checked for erosion. Rehabilitation measures will need to be employed should erosion be identified.<br><br>**Erosion Management** | |

| | |
|---|---|
| | Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the surface water resources. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland / aquatic specialist must be obtained in this respect should this be required.<br><br>Control of erosion on the construction site in general must be managed through implementation of an erosion management plan. Erosion and subsequent sedimentation of surface water resources are considered significant impacts in terms of the proposed development that must be managed adequately throughout the operation of the proposed development.<br><br>**Stormwater Management**<br>Any hardstand area or building within 50m proximity to a surface water resource and the associated buffer zone must have energy dissipating structures in an appropriate location to prevent increased run-off entering adjacent areas or surface water resources. This can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example).<br><br>A suitable operational storm water management plan should be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering adjacent areas or surface water resources, thereby also preventing erosion. This must be submitted to the relevant environmental and water authority for approval, if undertaken. |

- Decommissioning

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar impacts are therefore expected to occur and the stipulated mitigation measures where relevant and appropriate must be employed as appropriate to minimise impacts

*9.2.5 Soils and Agricultural Potential*

- Planning

No impacts are expected during planning.

- All Phases of the Development - Construction, Operation and Decommissioning

**Table 84:** Loss of Agricultural Land (Grazing)

| **Environmental parameter: agricultural land (grazing)** | | |
|---|---|---|
| **Impact 1:** Loss of agricultural land use, caused by direct occupation of land by footprint of development infrastructure and having the effect of taking affected portions of land out of agricultural production (grazing). 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 only a small proportion of the land surface area. During the construction phase there is somewhat more disturbance due to temporary lay down areas. | | |
| | Pre-mitigation | **Post-mitigation** |
| Extent | 1 Site | n/a |
| Probability | 4 Definite | n/a |
| Reversibility | 2 Partly reversible | n/a |
| Irreplaceable loss | 2 Marginal | n/a |
| Duration | 3 Long term | n/a |
| Cumulative effect | 2 Low | n/a |
| Intensity | 1 Low | n/a |
| Significance | 14 Low negative | n/a |
| Mitigation measures: none possible | | |

**Table 85:** Farm Economic Sustainability

| **Environmental parameter: farm economic sustainability** | | |
|---|---|---|
| ***Impact 2:*** Generation of additional land use income through rental to energy facility. This is a positive impact for agriculture. It will provide the farming enterprises on site with increased cash flow and rural livelihood, and thereby improve their financial sustainability. | | |
| | **Pre-mitigation** | **Post-mitigation** |
| Extent | 1 Site | n/a |
| Probability | 4 Definite | n/a |
| Reversibility | 1 Completely reversible | n/a |
| Irreplaceable loss | 1 No loss | n/a |

| | | |
|---|---|---|
| Duration | 3 Long term | n/a |
| Cumulative effect | 1 Negligible | n/a |
| Intensity | 1 Low | n/a |
| Significance | 11 Low positive | n/a |
| Optimization: none possible | | |

**Table 86:** Erosion due to alteration of the land surface run-off characteristics

| Environmental parameter: soil | | |
|---|---|---|
| **Impact 3:** Erosion due to alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Risk of water erosion is low, but the area is susceptible to wind erosion. | | |
| | **Pre-mitigation** | **Post-mitigation** |
| Extent | 1 Site | 1 Site |
| Probability | 3 Probable | 2 Possible |
| Reversibility | 2 Partly reversible | 2 Partly reversible |
| Irreplaceable loss | 2 Marginal | 2 Marginal |
| Duration | 3 Long term | 3 Long term |
| Cumulative effect | 1 Negligible | 1 Negligible |
| Intensity | 2 Medium | 1 Low |
| Significance | 24 Low negative | 11 Low negative |
| Mitigation measures:<br>▪ Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion from occurring there. This should be in place and maintained during all phases of the development.<br>▪ Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion. | | |

**Table 87:** Increased security against stock theft due to the presence of the energy facility and its personnel.

| Environmental parameter: farm security | | |
|---|---|---|
| **Impact 4:** Increased security against stock theft due to the presence of the energy facility and its personnel. | | |
| | **Pre-mitigation** | **Post-mitigation** |
| Extent | 1 Site | n/a |

| | | |
|---|---|---|
| Probability | 3 Probable | n/a |
| Reversibility | 1 Completely reversible | n/a |
| Irreplaceable loss | 1 No loss | n/a |
| Duration | 3 Long term | n/a |
| Cumulative effect | 1 Negligible | n/a |
| Intensity | 1 Low | n/a |
| Significance | 10 Low negative | n/a |
| Optimization measures: none possible. | | |

- Construction Phase Only

**Table 88:** Loss of topsoil caused by poor topsoil management during construction related soil profile disturbance

| **Environmental parameter: soil** | | |
|---|---|---|
| **Impact 5:** Loss of topsoil caused by poor topsoil management (burial, erosion, etc.) during construction related soil profile disturbance (levelling, excavations, disposal of spoils from excavations etc.) and having the effect of loss of soil fertility on disturbed areas after rehabilitation. The very low proportion of surface area that is likely to be impacted, reduces the significance of this impact. | | |
| | Pre-mitigation | Post-mitigation |
| Extent | 1 Site | 1 Site |
| Probability | 3 Probable | 2 Possible |
| Reversibility | 2 Partly reversible | 2 Partly reversible |
| Irreplaceable loss | 2 Marginal | 2 Marginal |
| Duration | 3 Long term | 3 Long term |
| Cumulative effect | 1 Negligible | 1 Negligible |
| Intensity | 2 Medium | 1 Low |
| Significance | 24 Low negative | 11 Low negative |
| Mitigation measures:<br>▪ If an activity will mechanically disturb 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.<br>▪ Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them.<br>▪ Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land.<br>▪ During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. | | |

| |
|---|
| ▪ Erosion must be controlled where necessary on topsoiled areas. |

**Table 89:** Degradation of veld vegetation beyond the direct development footprint caused by trampling due to vehicle passage, and deposition of dust

| **Environmental parameter: veld vegetation (grazing)** | | |
|---|---|---|
| **Impact 6:** Degradation of veld vegetation beyond the direct development footprint caused by trampling due to vehicle passage, and deposition of dust. | | |
| | Pre-mitigation | Post-mitigation |
| Extent | 1 Site | 1 Site |
| Probability | 2 Possible | 1 Unlikely |
| Reversibility | 2 Partly reversible | 2 Partly reversible |
| Irreplaceable loss | 2 Marginal | 2 Marginal |
| Duration | 2 Medium term | 2 Medium term |
| Cumulative effect | 1 Negligible | 1 Negligible |
| Intensity | 1 Low | 1 Low |
| Significance | 10 Low negative | 9 Low negative |
| Mitigation measures:<br>▪ Minimize road footprint and control vehicle access on approved roads only.<br>▪ Control dust as per standard construction site practice. | | |

**Table 90:** Impact on Air Quality due to Dust Generation

| **Environmental parameter: air quality** | | |
|---|---|---|
| **Impact 7:** Dust generation is likely to result from disturbance of surface and surface vegetation cover, and consequent exposure to wind erosion. Dust has a negative impact on surrounding veld vegetation, animals and humans. | | |
| | Pre-mitigation | Post-mitigation |
| Extent | 1 Site | 1 Site |
| Probability | 2 Possible | 1 Unlikely |
| Reversibility | 2 Partly reversible | 2 Partly reversible |
| Irreplaceable loss | 2 Marginal | 2 Marginal |
| Duration | 2 Medium term | 2 Medium term |
| Cumulative effect | 1 Negligible | 1 Negligible |
| Intensity | 1 Low | 1 Low |
| Significance | 10 Low negative | 9 Low negative |
| Mitigation measures: | | |

| |
|---|
| ▪ Control dust as per standard construction site measures which may include damping down with water or other appropriate and effective dust control measures. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site. |

**Table 91:** Soil contamination

| **Environmental parameter: soil** | | |
|---|---|---|
| **Impact 8:** Soil contamination can occur from hydrocarbon spillages from construction activities. The very low proportion of surface area that is likely to be impacted and its low consequence for farming activities, reduces the significance of this impact. | | |
| | Pre-mitigation | Post-mitigation |
| Extent | 1 Site | 1 Site |
| Probability | 2 Possible | 1 Unlikely |
| Reversibility | 2 Partly reversible | 2 Partly reversible |
| Irreplaceable loss | 2 Marginal | 2 Marginal |
| Duration | 2 Medium term | 2 Medium term |
| Cumulative effect | 1 Negligible | 1 Negligible |
| Intensity | 1 Low | 1 Low |
| Significance | 10 Low negative | 9 Low negative |
| Mitigation measures:<br>▪ Implement effective spillage and waste management system. | | |

- Cumulative Impacts

**Table 92:** Loss of agricultural land use (Grazing)

| **Environmental parameter: agricultural land (grazing)** | | |
|---|---|---|
| **Cumulative Impact:** Loss of agricultural land use, caused by direct occupation of land by footprint of the development infrastructure of all renewable energy developments in the surrounding area. This applies to the direct footprint of the developments which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure, including panel areas in the case of PV. This represents only a small proportion of the land surface area. | | |
| | Pre-mitigation | **Post-mitigation** |
| Extent | 2 Local / district | n/a |
| Probability | 4 Definite | n/a |
| Reversibility | 2 Partly reversible | n/a |
| Irreplaceable loss | 2 Marginal | n/a |
| Duration | 3 Long term | n/a |

| | | |
|---|---|---|
| Cumulative effect | 2 Low | n/a |
| Intensity | 1 Low | n/a |
| Significance | 15 Low negative | n/a |
| Mitigation measures: none possible | | |

*9.2.6 Noise*

- Planning

No noise is associated with the planning phase and this will not be investigated in further.

- Construction

**Table 93:** Daytime Construction (and Upgrade) of access roads and other infrastructure

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction of the access roads and grid infrastructure during daytimes - Increase in sound levels at the dwellings of receptors during the day. Construction activities will generate noises up to 45 dBA at 450m and 52 dBA (potential disturbing noise) at 220m. Impulsive noises are associated with construction activities and these noises may be intrusive and increase annoyance with the project. The route of the access roads or grid infrastructure was not defined but could go past structures.<br><br>Considering the location of existing roads, there may be an access road (if accessing from the south) approximately 600m from NSD01, directly passing NSD02 and 160m from NSD03.<br><br>If the access road is developed from the Buchufontein road (if accessing from the east), it could pass as close as 85m from NSD05. It should be noted, while most of the NSDs only use the farms for a few months during the year, this assessment will assume that the dwellings will be used for residential purposes during the construction phase. |
| Extent | The impact will only affect residences on site. |
| Probability | It is probable that the impact will occur. |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |

| IMPACT TABLE | | |
|---|---|---|
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. | |
| Duration | Short term. Construction noise ceases once infrastructure is in place. | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | High. Construction noise would intrude on residential activities during daytime. | |
| Significance Rating | Medium significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -32 (Medium negative) | -6 (low negative) |
| Mitigation measures | ▪ Relocate access roads further from houses. To minimize noise levels below a low significance ensure that roads (or grid lines) are further than 220m from dwellings used for residential purposes during the construction period.<br>▪ Construct the access roads during a period when receptors are not using their dwellings.<br>▪ Locate contractors camp and storage areas at locations where construction traffic will pass occupied dwellings minimally. Develop a separate road or upgrade an existing access road to the contractors camp to minimise traffic past residents. | |

**Table 94:** Night-time Construction (and Upgrade) of access roads and other infrastructure

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction of the access roads and grid infrastructure at night - Increase in sound levels at the dwellings of receptors during at night. Construction activities will generate noises up to 35 dBA at 1,100m and 42 dBA (potential disturbing noise) at 580m. Ambient sound levels are very low in this area at night and these noises may be intrusive and increase |

| IMPACT TABLE | | |
|---|---|---|
| | annoyance with the project, especially if impulsive noises are present. The route of the access roads or grid infrastructure was not defined but could go past structures.<br><br>Considering the location of existing roads, there may be an access road (if accessing from the south) approximately 600m from NSD01, directly passing NSD02 and 160m from NSD03.<br><br>If the access road is developed from the Buchufontein road (if accessing from the east), it could pass as close as 85m from NSD05. It should be noted, while most of the NSDs only use the farms for a few months during the year, this assessment will assume that the dwellings will be used for residential purposes during the construction phase. | |
| Extent | The impact will only affect residences on site. | |
| Probability | Definite. Impact will certainly occur | |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. | |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. | |
| Duration | Short term. Construction noise ceases once infrastructure is in place. | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Very High. Construction noise would intrude on residential activities during night-time. | |
| Significance Rating | Medium significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 4 | 1 |
| Significance rating | -36 (Medium negative) | -6 (low negative) |
| Mitigation measures | ▪ Due to the low ambient sound levels, it is highly recommended that no construction activities are allowed within 580m from occupied dwellings at night. This | |

| IMPACT TABLE | |
|---|---|
| | includes construction of roads, power lines or construction of wind turbines.<br>▪ Construct the access roads during a period when receptors are not using their dwellings.<br>▪ Locate contractors camp and storage areas at locations where construction traffic will pass occupied dwellings minimally. Develop a separate road or upgrade an existing access road to the contractors camp to minimise traffic past residents. |

**Table 95:** Daytime Construction Traffic

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction traffic passing residential dwellings during the day - Increase in sound levels at the dwellings of receptors during the day due to traffic passing the dwellings. This activity could take place for up to 3 years. Construction traffic can generate noises up to 45 dBA at 130m during busy periods. These noises may be intrusive and increase annoyance with the project. Route of the access roads was not defined but could go past structures.<br><br>Considering the location of existing roads, there may be an access road (if accessing from the south) approximately 600m from NSD01, directly passing NSD02 and 160m from NSD03.<br><br>If the access road is developed from the Buchufontein road (if accessing from the east), it could pass as close as 85m from NSD05. It should be noted, while most of the NSDs only use the farms for a few months during the year, this assessment will assume that the dwellings will be used for residential purposes during the construction phase. |
| Extent | The impact will only affect residences on site. |
| Probability | Probable. The impact will likely occur |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Medium Term. The impact and its effects will continue or last for some time after the construction phase but will be |

| IMPACT TABLE | | |
|---|---|---|
| | mitigated by direct human action or by natural processes thereafter (2 – 10 years). | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | High. Construction noise would intrude on residential activities during daytime. | |
| Significance Rating | Medium significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 4 | 1 |
| Significance rating | -36 (Medium negative) | -7 (low negative) |
| Mitigation measures | • If possible, the relocation of access roads to be further than 160m from any dwelling to be used for residential purposed during the construction phase. | |

**Table 96:** Night-time Construction Traffic

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction traffic passing residential dwellings at night - Increase in sound levels at the dwellings of receptors at night due to traffic passing the dwellings. This activity could take place for up to 3 years. Construction traffic can generate noises up to 35 dBA at 1,200m during busy periods and higher than 42 dBA when closer than 250m. These noises may be intrusive and increase annoyance with the project. Route of the access roads was not defined but could go past structures.<br><br>Considering the location of existing roads, there may be an access road (if accessing from the south) approximately 600m from NSD01, directly passing NSD02 and 160m from NSD03.<br><br>If the access road is developed from the Buchufontein road (if accessing from the east), it could pass as close as 85m |

| IMPACT TABLE | | |
|---|---|---|
| | from NSD05. It should be noted, while most of the NSD's only use the farms for a few months during the year, this assessment will assume that the dwellings will be used for residential purposes during the construction phase. | |
| Extent | The impact will only affect residences on site. | |
| Probability | Definite. The impact will certainly occur | |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. | |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. | |
| Duration | Medium Term. The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years). | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Very High. Construction noise would intrude on residential activities during daytime. | |
| Significance Rating | Medium significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 4 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 4 | 1 |
| Significance rating | -40 (Medium negative) | -7 (low negative) |
| Mitigation measures | • Ideally, do not allow construction traffic to drive past dwellings used for residential purposes at night. If people, material or equipment must be moved at night, no traffic should be allowed closer than 250m from receptors. Minimize night-time traffic as much as possible.<br>• If significant traffic is anticipated at night, access roads must be located further than 580m from receptors.<br>• Locate contractor's camp and storage areas at locations where construction traffic will not need to pass occupied dwellings (or pass them minimally). Develop a separate | |

| IMPACT TABLE | |
|---|---|
| | or upgrade an existing access road to the contractors camp to minimise traffic past residents.<br>• Noise impact would depend if night-time activities are anticipated. If significant traffic is anticipated at night, access roads must be located further than 250m from receptors. Lower traffic may allow the development of access roads closer to the NSD. |

**Table 97:** Daytime Construction of Wind Turbines and other infrastructure

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction activities of the Wind Turbine Generators and other infrastructure during the day - Increase in sound levels at the dwellings of receptors during the day. Construction activities will generate noises up to 45 dBA at 450m and 52 dBA (potential disturbing noise) at 220m. Impulsive noises are associated with construction activities and these noises may be intrusive and increase annoyance with the project.<br><br>There are no receptors or dwellings closer than 1,000m from any wind turbine and construction activities would not be significant. |
| Extent | The impact will only affect residences on site. |
| Probability | Unlikely. The chance of the impact occurring is extremely low |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Short Term. The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years). |
| Cumulative effect | Negligible cumulative impact. |
| Intensity/magnitude | Low. |
| Significance Rating | Low significance. |

| IMPACT TABLE | | |
|---|---|---|
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | -7 (Medium negative) | -6 (low negative) |
| Mitigation measures | • Mitigation not required as the locations were the wind turbines will be constructed is too far from potential noise-sensitive receptors. | |

**Table 98:** Night-time Construction of Wind Turbines and other infrastructure

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction of the Wind Turbine Generators and other infrastructure at night - Increase in sound levels at the dwellings of receptors during at night. Construction activities will generate noises up to 35 dBA at 1,100m and 42 dBA (potential disturbing noise) at 580m. Ambient sound levels are very low in this area at night and these noises may be intrusive and increase annoyance with the project, especially if impulsive noises are present.<br><br>There are no receptors or dwellings closer than 1,000m from any wind turbine, but construction activities may be clearly audible at night. The projected construction noise levels are higher than the 35 dBA sound levels typical of a rural area and the projected noise impacts would be of low significance. |
| Extent | The impact will only affect residences on site. |
| Probability | Unlikely. The chance of the impact occurring is extremely low |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Short Term. The impact and its effects will either disappear with mitigation or will be mitigated through natural process in |

| IMPACT TABLE | | |
|---|---|---|
| | a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years). | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Low. | |
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | -7 (Low negative) | -6 (low negative) |
| Mitigation measures | • The residential dwelling is seldom used and the developer can ensure that the construction of Wind Turbines take place during a period when the owners are not using the property. | |

**Table 99:** Construction of the onsite substation (both options)

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | <u>Construction of substations and operational noises from the transformers humming</u> - Increase in sound levels at the dwellings of receptors. |
| Extent | The impact will only affect residences on site. |
| Probability | Unlikely. The chance of the impact occurring is extremely low |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Long Term. The impact and its effects will continue or last for the entire operational life of the development, but will be |

| IMPACT TABLE | | |
|---|---|---|
| | mitigated by direct human action or by natural processes thereafter (10 – 50 years). | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Low. | |
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | -8 (Low negative) | -8 (low negative) |
| Mitigation measures | • No mitigation required. | |

- Operation

**Table 100:** Operation of Wind Farm – Daytime

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Noise from operating wind turbines.- Increase in sound levels at the dwellings of receptors during the day. Operating wind turbines will generate noises less than 40 dBA at all the surrounding NSD. |
| Extent | The impact will only affect residences on site. |
| Probability | Unlikely. The chance of the impact occurring is extremely low |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Long Term. The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years). |

| IMPACT TABLE | | |
|---|---|---|
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Low. | |
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 1 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | - 8 (Low negative) | -6 (low negative) |
| Mitigation measures | • Mitigation not required as the potential daytime noise impact would be insignificant. | |

**Table 101:** Operational Activities – Night-time

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Noise from operating wind turbines.-<br>Increase in sound levels at the dwellings of receptors at night. Operating wind turbines will generate noise levels less than 40dBA at all NSD. |
| Extent | The impact will affect the local area or district |
| Probability | Possible. The impact may occur |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. |
| Duration | Long Term. The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years). |
| Cumulative effect | Low-medium cumulative impact. |
| Intensity/magnitude | Medium. |

| IMPACT TABLE | | |
|---|---|---|
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 2 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 24 (Low negative) | - 9 (low negative) |
| Mitigation measures | Mitigation not required as the potential night-time noise impact would be insignificant. Mitigation measures are highlighted for the developer to consider, including:<br>• The developer can change the layout and not develop any wind turbines within approximately 1,200m from this dwelling (due to the cumulative effects of the number of wind turbines proposed in the area), or the number of wind turbines closer than 1,500m from potential noise-sensitive receptors can be reduced.<br>• The developer can use a different wind turbine that have a maximum sound power emission level of less than 106dBA.<br>• The developer can confirm periods when the dwelling will be used for residential purposes, and the closest wind turbines can be operated in a noise mode that generates less noise (less than 106dBA) or one or more of these wind turbines can be switched off (to ensure total noise levels below 45 dBA). | |

**Table 102:** Operation of the onsite substation (both options)

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Construction of substations and operational noises from the transformers humming - Increase in sound levels at the dwellings of receptors. |
| Extent | The impact will only affect residences on site. |
| Probability | Unlikely. The chance of the impact occurring is extremely low |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. |

| IMPACT TABLE | | |
|---|---|---|
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. | |
| Duration | Long Term. The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years). | |
| Cumulative effect | Negligible cumulative impact. | |
| Intensity/magnitude | Low. | |
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | -8 (Low negative) | -8 (low negative) |
| Mitigation measures | • No mitigation required. | |

- Cumulative Noise Impact

**Table 103:** Cumulative noise levels for Leeuberg Wind Energy Facility – Night-time

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Noise |
| Issue/Impact/Environmental Effect/Nature | Cumulative noises from operating wind turbines for the Graskoppies, Ithemba, Xha! Boom and Hartebeest Leegte Wind Farms.- Increase in sound levels at the dwellings of receptors at night due to cumulative noises. The contribution from the !Xha Boom WF is insignificant (less than 1 d, but the cumulative effect of the number of wind turbines operating in the area may result in a maximum noise level of up to 46.7 dBA at NSD03. This is higher than the recommended 45 dBA night-time noise limit (as set by the International Finance Corporation for a night-time residential use). |
| Extent | The impact will affect the local area or district |

| IMPACT TABLE | | |
|---|---|---|
| Probability | Possible. The impact may occur | |
| Reversibility | Completely reversible. Construction noise ceases once infrastructure is in place. | |
| Irreplaceable loss of resources | No loss of resources is anticipated. The increase in noise levels can increase annoyance levels with the project but will not result in the loss of any resource or an irreplaceable loss. | |
| Duration | Long Term. The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years). | |
| Cumulative effect | Low-medium cumulative impact. | |
| Intensity/magnitude | Medium | |
| Significance Rating | Low significance. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 2 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 24 (Low negative) | - 9 (low negative) |
| Mitigation measures | Mitigation is recommended if the owner will use this property for residential purposes. There is a potential for a cumulative impact and mitigation is recommended and required:<br>• The developer can change the layout and not develop any wind turbines within approximately 1,200m from this dwelling (due to the cumulative effects of the number of wind turbines proposed in the area), or the number of wind turbines closer than 1,500m from potential noise-sensitive receptors can be reduced.<br>• The developer can use a different wind turbine that have a maximum sound power emission level of less than 106 dBA.<br>• The developer can confirm periods when the dwelling will be used for residential purposes, and the closest wind turbines can be operated in a noise mode that generates less noise (less than 106dBA) or one or more of these wind turbines can be switched off. | |

*9.2.7 Visual*

- Planning

No visual impacts are expected during planning.

- Construction

**Table 104:** Rating of visual impacts of the proposed !Xha Boom Wind Farm during construction

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Visual Impact |
| Issue/Impact/Environmental Effect/Nature | During the construction phase, large construction vehicles and equipment will alter the natural character of the study area and expose visual receptors 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 these roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to contribute significantly to the overall visual impact. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. In addition, temporary stockpiling of soil during construction may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact. |
| *Extent* | Local / District (2) |
| *Probability* | Probable (3) |
| *Reversibility* | Completely reversible (1) |
| *Irreplaceable loss of resources* | Marginal loss (2) |
| *Duration* | Short term (1) |
| *Cumulative effect* | Medium cumulative effects (3) |
| *Intensity/magnitude* | Medium (2) |

| | | |
|---|---|---|
| *Significance Rating* | Prior to mitigation measures: Low negative impact<br>After mitigation measures: Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 2 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -24(negative low) | -20 (negative low) |
| Mitigation measures | • Carefully plan to reduce the construction period.<br>• Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.<br>• Maintain a neat construction site by removing rubble and waste materials regularly.<br>• Make use of existing gravel access roads where possible.<br>• Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developer should consider making use of a tarred construction road or a road with less chance of generating dust. | |

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

**Table 105:** Rating of visual impacts of the infrastructure associated with the !Xha Boom Wind Farm during construction

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Visual Impact |
| Issue/Impact/Environmental Effect/Nature | During the construction of the underground cables, overhead power lines (if required), on-site 132kV substation, access roads and building infrastructure, large construction vehicles and equipment could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts associated with the construction phase. 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 these roads and the resultant dust plumes could create a visual |

| | | |
|---|---|---|
| | impact and may evoke negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to contribute significantly to the overall visual impact. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. In addition, temporary stockpiling of soil during construction may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact. | |
| *Extent* | Local/district (2) | |
| *Probability* | Probable (3) | |
| *Reversibility* | Completely reversible (1) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | Medium cumulative effects (3) | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | Prior to mitigation measures: Low negative impact<br>After mitigation measures: Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -22 (low negative) | -20 (low negative) |
| Mitigation measures | • All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid.<br>• Carefully plan to reduce the construction period.<br>• Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.<br>• Maintain a neat construction site by removing rubble and waste materials regularly.<br>• Make use of existing gravel access roads where possible. | |

| | |
|---|---|
| | • Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developer should consider making use of a tarred construction road or a road with less chance of generating dust. |

* Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.

**Table 106:** Rating of cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby during construction

| **IMPACT TABLE** | |
|---|---|
| Environmental Parameter | Cumulative Visual Impact |
| Issue/Impact/Environmental Effect/Nature | Large construction vehicles and equipment during the construction phase of the other renewable energy developments and their associated infrastructure proposed nearby will alter the natural character of the study area further and expose a greater number of visual receptors to visual impacts associated with the construction phase. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Vehicles and trucks travelling to and from all of the proposed sites on gravel access roads are also expected to increase dust emissions. The increased traffic on gravel roads and the dust plumes could create a greater visual impact and may evoke more negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around these 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 expose a greater amount of bare soil which could result in a greater visual contrast with the surrounding environment. In addition, temporary stockpiling of soil during construction may alter the flat landscape further. Wind blowing over these disturbed areas could result in a greater amount of dust which would have a visual impact. |
| *Extent* | Local / District (2) |
| *Probability* | Probable (3) |
| *Reversibility* | Partly reversible (2) |
| *Irreplaceable loss of resources* | Significant loss (3) |

| | | |
|---|---|---|
| *Duration* | Medium term (2) | |
| *Cumulative effect* | High cumulative effects (4) | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures:** Medium negative impact<br>**After mitigation measures:** Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 3 | 2 |
| Duration | 2 | 2 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | -32 (medium negative) | -24 (low negative) |
| Mitigation measures | ▪ Carefully plan to reduce the construction period.<br>▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.<br>▪ Vegetation clearing should take place in a phased manner.<br>▪ Maintain a neat construction site by removing rubble and waste materials regularly.<br>▪ Make use of existing gravel access roads, where possible.<br>▪ Limit the number of vehicles and trucks travelling to and from the proposed sites, where possible.<br>▪ Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developers should consider making use of tarred construction roads or roads with less chance of generating dust.<br>▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place.<br>▪ Ensure that dust suppression techniques are implemented on all soil stockpiles.<br>▪ Temporarily fence-off the construction sites (for the duration of the construction period).<br>▪ All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid, where possible. | |

** Please note in the context of the visual environment ‘resources’ are defined as scenic / natural views that are almost impossible to replace.*

- Operation

**Table 107:** Rating of visual impacts of the proposed !Xha Boom Wind Farm during operation

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | Visual Impact | |
| Issue/Impact/Environmental Effect/Nature | The proposed !Xha Boom Wind Farm could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations, such as farmsteads / homesteads, 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 wind energy facility via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to contribute significantly to the overall visual impact. Security and operational lighting at the proposed wind energy facility could result in light pollution and glare, which could be an annoyance to surrounding viewers | |
| *Extent* | Local/district (2) | |
| *Probability* | Definite (4) | |
| *Reversibility* | Irreversible (4) | |
| *Irreplaceable loss of resources* | Marginal (2) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | High cumulative effects (4) | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | Prior to mitigation measures: Medium negative impact<br>After mitigation measures: Medium negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 2 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 3 |

| | | |
|---|---|---|
| Intensity/magnitude | 2 | 2 |
| Significance rating | -38 (medium negative) | -36 (medium negative) |
| Mitigation measures | • 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.<br>• Light fittings for security at night should reflect the light toward the ground and prevent light spill.<br>• Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developer should consider making use of a tarred construction road or a road with less chance of generating dust. | |

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

**Table 108:** Rating of visual impacts of the infrastructure associated with the !Xha Boom Wind Farm during operation

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | Visual Impact |
| Issue/Impact/Environmental Effect/Nature | The proposed underground cables, overhead power lines (if required), on-site 132kV substation, access roads and building infrastructure could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptors 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 infrastructure associated with the wind energy facility via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to contribute significantly to the overall visual impact. Security and operational lighting at the associated infrastructure could result in light pollution and glare, which could be an annoyance to surrounding viewers |
| *Extent* | Local / District (2) |
| *Probability* | Probable (3) |
| *Reversibility* | Partly reversible (2) |

| | | |
|---|---|---|
| *Irreplaceable loss of resources* | No loss of resource (1) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | Low cumulative effect (2) | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | Prior to mitigation measures: Low negative impact<br>After mitigation measures: Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | -26 (low negative) | -13 (low negative) |
| Mitigation measures | • Light fittings for security at the on-site 132kV substation at night should reflect the light toward the ground and prevent light spill.<br>• The operation and maintenance buildings should not be illuminated at night.<br>• If overhead power lines are required, align power lines to run parallel to existing power lines and other linear features, where possible.<br>• Bury cables underground where possible.<br>• The operation and maintenance building should be painted with natural tones that fit with the surrounding environment. Non-reflective surfaces should be utilised where possible.<br>• Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developer should consider making use of a tarred construction road or a road with less chance of generating dust.<br>• Select the alternatives that will have the least impact on visual receptors. | |

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

**Table 109:** Rating of cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby during operation

| **IMPACT TABLE** |
|---|

| | | |
|---|---|---|
| Environmental Parameter | Visual Impact | |
| Issue/Impact/Environmental Effect/Nature | The renewable energy development and their associated infrastructure proposed nearby could exert a visual impact by altering the visual character of the surrounding area further and exposing a greater number of sensitive visual receptor locations to visual impacts. The nearby renewable energy developments may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the renewable energy developments and their associated infrastructure proposed nearby 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 greater visual impact and may evoke more negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around these 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. Security and operational lighting at the renewable energy developments and their associated infrastructure proposed nearby could result in a greater amount of light pollution and glare, which could be a significant annoyance to surrounding viewers. | |
| *Extent* | Local/district (2) | |
| *Probability* | Definite (4) | |
| *Reversibility* | Irreversible (4) | |
| *Irreplaceable loss of resources* | Significant (3) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | High cumulative effects (4) | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures:** Medium negative impact<br>**After mitigation measures:** Medium negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 2 | 2 |

| | | |
|---|---|---|
| Significance rating | -40 (medium negative) | -36 (medium negative) |
| Mitigation measures | ▪ 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.<br>▪ Light fittings for security at the proposed renewable energy developments and their associated infrastructure at night should reflect the light toward the ground (except for aviation lighting) and prevent light spill.<br>▪ The operations and maintenance buildings should not be illuminated at night, if possible.<br>▪ Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011). Bright colours or obvious logos should not be permitted.<br>▪ Turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011).<br>▪ 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.<br>▪ 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).<br>▪ As far as possible, limit the number of maintenance vehicles, which are allowed to access the sites.<br>▪ Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developers should consider making use of tarred construction roads or roads with less chance of generating dust.<br>▪ Bury cables under the ground where possible.<br>▪ Select the alternatives that will have the least impact on visual receptors. | |

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

*9.2.8 Heritage and Palaeontology*

It is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some heritage sites.

The impact assessment conducted for heritage sites assumes the possibility of finding heritage resources during the project life and has been conducted as such.

- Planning

No impacts are expected during planning.

- Construction

**Table 110:** Palaeontology

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | *Impact on the Palaeontology Heritage (fossils) of the development footprint* |
| Issue/Impact/Environmental Effect/Nature (E) | The excavations and site clearance during the construction phase will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research.<br>This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase. |
| *Extent* | The Leeuwberg Wind Farm project area will be located approximately 62km north of Loeriesfontein, in the Khai-ma and Hantam Local Municipalities within the Northern Cape Province.<br>*A brief description of the area over which the impact will be expressed* |
| *Probability* | The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian basinal mudrocks of the lower part of the Ecca Group (Karoo Supergroup). Permian and Jurassic bedrocks are mantled with a range of superficial deposits, mostly Late Caenozoic (Quaternary to Recent) in age. The intrusive Karoo dolerites are of no palaeontological significance and the Late Caenozoic superficial deposits are generally of very low palaeontological sensitivity.<br>The probability of significant impacts on palaeontological heritage during the construction phase is low. |
| *Reversibility* | Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific |

| | | |
|---|---|---|
| | perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.<br>*Fossil Heritage is expected and* fossils other than trace assemblages are generally scarce and most of the Ecca sediments are of low overall palaeontological sensitivity. | |
| *Irreplaceable loss of resources* | The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian basinal mudrocks of the lower part of the Ecca Group and is rated as insignificant loss of resources | |
| *Duration* | The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent | |
| *Cumulative effect* | Low Cumulative Impact<br>The cumulative effect of the development area within the proposed location is considered to be low. The broader area near Loeriesfontein is underlain by the Dwyka, Lower Ecca, Karoo Dolerite and Late Caenozoic deposists. Karoo Dolerite is unfossiliferous while the fossil sensitivity in the Caenozoic is low. Fossils other than trace assemblages are generally scarce and most of the Ecca and Dwyka sediments are of low overall palaeontological sensitivity. | |
| *Intensity/magnitude* | Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low | |
| *Significance Rating* | *A brief description of the importance of an impact which in turn dictates the level of mitigation required* | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 1 |
| Probability | 2 | 1 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 2 | 1 |
| Duration | 4 | 1 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | -28 (low negative) | -6 (low negative) |
| Mitigation measures | Recommended mitigation of the inevitable damage and destruction of fossil within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a professional palaeontologist. This work | |

| | |
|---|---|
| | should take place after initial vegetation clearance has taken place but *before* the ground is levelled for construction<br><br>Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.<br><br>Not deemed necessary as the Allanridge Formation is unfossiliferous. |

**Table 111:** Archaeological Resources

| **IMPACT TABLE** | | |
|---|---|---|
| Environmental Parameter | Stone Age resources | |
| Issue/Impact/Environmental Effect/Nature | Archaeological finds have been identified during the fieldwork having low archaeological significance.<br><br>All the identified find spots could be impacted by construction activities however the impact is seen as negligible. | |
| Extent | Localised | |
| Probability | Probable | |
| Reversibility | Non- renewable. | |
| Irreplaceable loss of resources | Archaeological sites are irreplaceable | |
| Duration | Permanent | |
| Cumulative effect | Low cumulative impact | |
| Intensity/magnitude | Medium | |
| Significance Rating | Negative medium impact before mitigation and low negative after mitigation. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 1 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 4 | 4 |
| Duration | 4 | 4 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | -40 (Negative Medium Impact | -16 (Low negative |

| | |
|---|---|
| Mitigation measures | • A walk down of the final layout to determine if any significant sites will be affected.<br>• Monitor find spot areas if construction is going to take place through them.<br>• A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. Possible surface collections for sites with a medium to high significance as well as conducting a watching brief by heritage practitioner during the construction phase. |

**Table 112:** Chance Finds

| **IMPACT TABLE** | | |
|---|---|---|
| Environmental Parameter | Unidentified heritage structures | |
| Issue/Impact/Environmental Effect/Nature | Due to the size of the area assessed and the design process requiring fieldwork before identification of the layout. The possibility of encountering heritage features in unsurveyed areas does exist. | |
| Extent | Localised and in most cases no more than 1000m$^2$ | |
| Probability | Probable | |
| Reversibility | Heritage resources are non-renewable. | |
| Irreplaceable loss of resources | A brief description of the degree in which irreplaceable resources are likely to be lost | |
| Duration | Permanent | |
| Cumulative effect | Medium | |
| Intensity/magnitude | Medium | |
| Significance Rating | Medium negative before mitigation and low negative after mitigation for both the expanded and the constrained layout. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 1 | 1 |
| Probability | 3 | 3 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 2 | 2 |
| Duration | 4 | 4 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | -34 (Medium negative) | -17 (Low negative) |
| | Post mitigation impact rating | |

| | |
|---|---|
| Mitigation measures | • A walk down of the final approved layout will be required before construction commence;<br>• Any heritage features of significance identified during this walk down will require formal mitigation or where possible a slight change in design could accommodate such resources.<br>• A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. |

- Operation

**Table 113:** Cumulative Impacts

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | Heritage Resources | |
| Issue/Impact/Environmental Effect/Nature | The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources | |
| Extent | Local | |
| Probability | Possible | |
| Reversibility | Non- renewable. | |
| Irreplaceable loss of resources | The nature of heritage resources are that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research | |
| Duration | Permanent | |
| Cumulative effect | It is my reserved but considered opinion that this additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate. | |
| Intensity/magnitude | Low | |
| Significance Rating | Negative low impact before mitigation and low negative after mitigation. | |
| | | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 2 | 1 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 4 | 4 |
| Duration | 4 | 4 |
| Cumulative effect | 1 | 1 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | -18 (Negative medium impact) | -18 (Low negative) |

| | |
|---|---|
| Mitigation measures | • A walk down of the final approved layout will be required before construction commence;<br>• Any heritage features of significance identified during this walk down will require formal mitigation or where possible a slight change in design could accommodate such resources.<br>• A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. |

### *9.2.9 Socio-economic*

- Planning

No impacts are expected during planning.

- Construction

**Table 114:** Impact on employment

| **Employment creation during construction phase** | |
|---|---|
| Environmental Parameter | Employment: Towns and settlements surrounding the project site are characterised by very high levels of unemployment, reflecting that the economy of the area is stagnant and is in need of economic stimulation. |
| Issue/Impact/Environmental Effect/Nature | During the establishment of a wind farm, over 400 job opportunities will be created lasting for the duration of the construction phase. Of these, about 29% will be filled by members from the local community. |
| *Extent* | The impact will affect the local community and district. (2) |
| *Probability* | Definite (4). The impact will certainly occur (>75% chance of occurrence). |
| *Reversibility* | Completely reversible (1) |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) |
| *Duration* | The impact will last during construction (± 2 years), which will be of a short-term period. (1) |
| *Cumulative effect* | The developments of other renewable projects in the area could significantly increase the number of jobs created, with wind energy projects, it could grow proportionally to the number of new projects implemented. |
| *Intensity/magnitude* | Considering the high unemployment rate in the district as well the local community, the impact could have a |

| | | |
|---|---|---|
| | significant impact on alleviating the unemployment levels in the area. | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have moderate positive effects.<br>**After mitigation measures**: Ensuring that jobs are allocated to workers in the local area will significantly increase the impact of job creation | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 4 | 1 |
| Cumulative effect | 3 | 4 |
| Intensity/magnitude | 3 | 4 |
| Significance rating | + 36 (medium positive) | + 52 (High positive) |
| Mitigation measures | • Drafting legal and binding enforcements stipulating that majority of the unskilled positions in the project be allocated to local labourers<br>• Where possible, subcontract to local construction companies<br>• Consultation with local authorities is essential so as to manage job creation expectations and ensure that all eligible workers in the primary study area are informed of the opportunities. | |

**Table 115:** Skills development during construction phase

| **Skills development during construction phase** | |
|---|---|
| Environmental Parameter | Skills development: it is expected that those who will receive employment as a result of the construction activities will either be improving an existing skill or acquiring a new skill. |
| Issue/Impact/Environmental Effect/Nature | The population of the primary study area mainly consists of unskilled workers with low literacy rates; therefore, employees will benefit from a skills development programme, which is a key component of the development of this project. |
| *Extent* | The impact will affect the local community and district. (2) |
| *Probability* | Definite (4). The impact will certainly occur (>75% chance of occurrence). |
| *Reversibility* | Completely reversible (1) |

| | | |
|---|---|---|
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will have a permanent effect on the employed individuals as the acquired skills and necessary knowledge will remain with the relevant workers and improve their employability (4) | |
| *Cumulative effect* | The development of similar projects in the area will lead to greater labour productivity and employability of construction phase workers. | |
| *Intensity/magnitude* | The low primary school completion rate in the area indicates a lack of skills amongst local communities, thus the opportunity to develop a skilled workforce will have a high impact on the community. | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a significant positive effect.<br>**After mitigation measures**: Utilising appropriate mitigation measures, which ensure that skills development is implemented as part of the establishment will increase the intensity of the impact. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 3 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 1 | 1 |
| Duration | 4 | 4 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | + 51 (High positive) | + 54 (High positive) |
| Mitigation measures | • Contracts ensuring that on-the-job training is included and enforced as a condition for the development of this project.<br>• To improve the chances of skills development during the construction phase, contractors are encouraged to provide learner-ships and encourage further knowledge sharing. | |

**Table 116:** Impact on health during construction

| Impact on health during construction | |
|---|---|
| Environmental Parameter | Health impacts resulting from the potential influx of migrant workers as well as jobseekers. |
| Issue/Impact/Environmental Effect/Nature | The proposed development may lead to adverse impacts on the local community members due to the increased alcohol and drug abuse, prostitution, and possibly alleviated levels of dust pollution. |

| | | |
|---|---|---|
| *Extent* | The impact will affect the local community and district. (2) | |
| *Probability* | The impact will definitely occur, given the empirical evidence with the existing projects in the area (4) | |
| *Reversibility* | The impact is barely reversible as it is unlikely that unwanted pregnancies and STD's can be reversed even with intense mitigation measures (3) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | Although some health issues might be of a short-term, some may have a long-lasting impact, e.g. HIV/AIDS (3) | |
| *Cumulative effect* | The impact will result in significant cumulative effect, considering the number of projects planned in the area and the fact that most of the construction worker will need to come from out of town. | |
| *Intensity/magnitude* | The intensity of the impact is expected to be high considering the size of the local community to be affected. | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a significant positive effect. The intensity of the impact is expected to be high considering the size of the local community to be affected.<br>**After mitigation measures**: The anticipated impact will still have moderate negative effects even after the implementation of proposed mitigations. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 3 |
| Reversibility | 3 | 3 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | -42 (Medium negative) | - 39 (medium negative) |
| Mitigation measures | • Raising awareness among construction workers on health issues, including HIV/AIDS.<br>• Make condoms available to employees and all contractor workers for free.<br>• Introduce alcohol testing on a weekly basis for construction workers.<br>• Developing a Code of Conduct for all employees related to the project, which includes no tolerance of activities such as alcohol and drug abuse.<br>• Initiating the education campaign among the local community (in partnership with the community | |

| | |
|---|---|
| | members already active in the area) focusing on alcohol abuse, drug abuse, HIV/AIDS, STDs, etc. prior the start of construction and maintaining these throughout the project's duration. |

**Table 117:** Rating of impact of loss of farm labour to the construction phase

| **Change in demographics due to migration of workers from other areas and influx of jobseekers** | | |
|---|---|---|
| Environmental Parameter | Demographics of the area: the area has a relatively small community. | |
| Issue/Impact/Environmental Effect/Nature | The Loeriesfontein as well as Hantam LM labour force does not have the essential skills and is not diversified enough to provide all skills required in the construction phase; this will necessitate the migration of workers to the area. The projects will also attract jobseekers from various parts of the Province and possibly outside its borders. | |
| *Extent* | The impact will affect the local area and district as the demographics of the area will be altered (2) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | In the likely event that migrant workers as well as job seekers remain in the area after the construction phase in the hope for employment during the operating phase, the impact would only be partly reversible (2) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact is rated as long-term based on the likelihood that migrant workers will stay in the area for the life of the project (3) | |
| *Cumulative effect* | Considering other renewable energy projects that are planned in the area, the impact would result in a significant cumulative effect as it might attract a significantly greater number of migrant workers. | |
| *Intensity/magnitude* | The male population is expected to increase in the area thus affecting the demographics of the area (short-term and long-term due to chances of unwanted pregnancies), thus resulting in an impact of a medium intensity (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will result in a medium negative effect.<br>**After mitigation measures**: Considering the proposed mitigation measures, the intensity of the impact will remain the same. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |

| | | |
|---|---|---|
| Probability | 4 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | - 32 (Medium negative) | - 30 (medium negative) |
| Mitigation measures | • Developers should be open to local recruitment processes and be willing to offer some skills transfer during this phase of the project to ensure maximum local labour procurement.<br>• Recruitment should be done following a transparent approach and adequately communicated in the area to limit the chances of people staying for longer period in hope of finding a job.<br>• Initiating the education campaign among the local community (in partnership with the community members already active in the area) focusing specifically on vulnerable groups of population and motivating them to make right choices in their lives. | |

**Table 118:** Increase in social pathologies associated with the influx of migrant labourers and jobseekers to the area

| **Increase in social pathologies associated with the influx of migrant labourers and jobseekers to the area** | |
|---|---|
| Environmental Parameter | Social pathologies: factors such as the deterioration in health, increase in crime, prostitution, xenophobia and drugs, etc. |
| Issue/Impact/Environmental Effect/Nature | Activities in the construction phase will attract jobseekers and wil linvolve the migration of construction workers to the local town. The increase in the number of construction workers is expected to cause a further increase in social pathologies. |
| *Extent* | The impact will affect the local area and district (2) |
| *Probability* | Considering the impacts that the already existing wind farms (Khobab & Loeriesfontein 2) have had on the Loeriesfontein community, the impact will certainly occur (>75% chance of occurrence) (4) |
| *Reversibility* | Impacts such as social ills are not defined to a particular area and tend to develop over long time periods. Therefore, if the migrant workers choose to remain in the area after the construction, the impact is rated as only party reversible (2) |

| | | |
|---|---|---|
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | In the event that migrant workers remain in the area after the construction period, the impact is rated as long-term (3) | |
| *Cumulative effect* | Considering the other renewable projects in the area, the cumulative impact of increased social pathologies is expected to be high (4) | |
| *Intensity/magnitude* | The increase in social pathologies is most likely to jeopardise the integrity of the area resulting in a medium intensity effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have moderate negative effects and will require mitigation measures.<br>**After mitigation measures**: The anticipated impact will be reduced but will remain categorised as a medium negative effect. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 48 (Medium negative) | - 30 (medium negative) |
| Mitigation measures | • Assist local communities crippled by high levels of drug and alcohol abuse through remedial intervention and awareness programs<br>• Introduce awareness campaigns for local community members and workers on the dangers of substance abuse<br>• Place more emphasis on the role of and need of a social worker in the areaInitiating the education campaign among the local community (in partnership with the community members already active in the area) focusing specifically on vulnerable groups of population and motivating them to make right choices in their lives. | |

**Table 119:** Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED)

| **Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED)** |
|---|

| | | |
|---|---|---|
| Environmental Parameter | Investment in the local community | |
| Issue/Impact/Environmental Effect/Nature | The developer aims to invest R450 000 in nearby communities through several community development initiatives during the pre-construction and construction phase alone, which will provide long-term benefits for the communities. During operations, investment into the community will continue and include not only social but also enterprise development intuitive. | |
| *Extent* | The impact will affect the local area (2) | |
| *Probability* | Investing into the local economy is a government requirement thereforethe impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | The impact will be reversible as investment will cease upon the closure of the project (1) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | This impact is rated as long-term as it will take place during the preconstruction, construction, and operational phases of the project. (3) | |
| *Cumulative effect* | The base-town for several of the other projects planned in the area is Loeriesfontein, which is also the targeted local community of the project under analysis. If other developers follow the same approach and invest into the community, the cumulative effect will be of high level (4) | |
| *Intensity/magnitude* | The local district as well as Loeriesfontein town is in need of investment into the local community's health, infrastructure, and skills development; therefore, benefits from the investment will have a high intensity (3) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a low positive effect.<br>**After mitigation measures**: The mitigation measures will not affect the scoring of the impact. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | + 45 (Medium positive) | + 45 (medium positive) |

| | |
|---|---|
| Mitigation measures | • Proponent/project owner needs to establishe a relationship with the local authorities such as the Hantam LM and local community leaders to ensure that the SED & ED initiatives that are implemented during the pre-operational stage are aligned with the and relevant needs of the Loeriesfontein community.<br>• It is also advisory to engage with the other project developer sin the area and, where possible and feasible, coordinate the efforts and spending on community projects to ensure a balanced improvement in the standard of living of local residents and a holistic partnership-based approach to resolving local social ills. |

**Table 120:** Impact on personal safety and security during construction

| **Impact on personal safety and security during construction** | |
|---|---|
| Environmental Parameter | Increased criminal activities and safety & security risk to farmers, guest and workers. |
| Issue/Impact/Environmental Effect/Nature | Adverse effects on personal and livestock safety as a result of the influx of jobseekers and migrant workers in the vicinity. |
| *Extent* | The impact will affect the local area (2) |
| *Probability* | The impact will likely occur (Between 50% to 75% chance of occurrence) (3) |
| *Reversibility* | The impact is partly reversible as farmers can be compensated for their losses (2) |
| *Irreplaceable loss of resources* | The impact will not result in irreplaceable loss of resources (1) |
| *Duration* | The impact may last longer than the construction phase (2) |
| *Cumulative effect* | The current construction of Khobab and Loeriesfontein 2 is most likely to raise expectations regarding employment opportunities and may attract more jobseekers. Approval of other developments planned in the area will exacerbate the situation, leading to a noticeable cumulative effect (3) |
| *Intensity/magnitude* | The intensity of the impact will be of a medium impact (2) |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have negligible negative effects and requires little to no mitigation<br>**After mitigation measures**: The anticipated impact will have negligible negative effects and requires little to no mitigation. |

| | Pre-mitigation impact rating | Post mitigation impact rating |
|---|---|---|
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 1 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | - 26 (low negative) | - 20 (low negative) |
| Mitigation measures | • Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.<br>• Movement of construction workers on and off construction site must be closely monitored and managed.<br>• Prior construction, rules and regulations regarding presence of construction workers on site need to be devised in consultation with the land owners of directly affected and adjacent properties.<br>• During construction, the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided. Penalties for not adhering to the rules should be communicated and enforced.<br>• Manage workers to ensure that they are only on site during the reasonable working hours. | |

**Table 121:** Change in sense of place during construction

| **Change in sense of place during construction** | |
|---|---|
| Environmental Parameter | An altered sense of place due to the development of the wind farm. |
| Issue/Impact/Environmental Effect/Nature | The project is expected to have a notable visual impact, which will alter the landscape and could affect the sense of place of residents, visitors, and project site landowners, which is associated with the area. It may also result in the loss of some veld areas. In addition, the presence of construction workers may change the people's perception of the area as being a quite rural community. |
| *Extent* | The impact will affect the local area (2) |
| *Probability* | The impact may possibly occur (Between a 25% to 50% chance of occurrence) (2) |

| | | |
|---|---|---|
| *Reversibility* | The visual and natural resources will be impacted, but these could be partly reversed after the closure of the project (2) | |
| *Irreplaceable loss of resources* | The impact will result in marginal loss of natural and aesthetic resources (2) | |
| *Duration* | The impact is most likely to last beyond the construction phase as the approval of similar developments in the area might prolong the impact making it of a medium-term (2) | |
| *Cumulative effect* | Given the number of projects that are approved in the area, the impact may result in a notable cumulative effect (3) | |
| *Intensity/magnitude* | The intensity could reach medium levels (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation.<br>**After mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 2 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 2 | 2 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 26 (low negative) | - 24 (low negative) |
| Mitigation measures | • Adhere to the mitigations measures proposed by other environmental specialists (noise, visual, etc.)<br>• Ensure the mitigation measure proposed to limit the influx of people and the prolonged negative effects of the migrants staying in the community after the construction are implemented. | |

**Table 122:** Increased production & temporary stimulation of GDP-R during construction

| **Increased production & temporary stimulation of GDP-R during construction** | |
|---|---|
| Environmental Parameter | GDP-R: Refers to the value of all final goods and services produced within a region during a year. |
| Issue/Impact/Environmental Effect/Nature | Project capital expenditure is expected to result in an increase in the production of national and local economies as selected goods and services required for the development of the wind farm will be procured from within South Africa. A multiplier effect will be seen at a national |

| | | |
|---|---|---|
| | level as the injection of funds will in turn increase people's incomes thus increasing their demand for goods and services. | |
| *Extent* | The national economy will experience an increase in production (4) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | Impact is reversible (1) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will last during construction (± 2 years), which will be extended to a short-term period (1) | |
| *Cumulative effect* | Establishment of similar projects will multiply the positive impact; therefore, cumulative impact is high (4) | |
| *Intensity/magnitude* | Impact at a national level will be high (3) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a significant positive impact at the national level.<br>**After mitigation measures**: The anticipated impact will have a significant positive impact at the national level. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 4 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | + 54 (high positive) | + 54 (high positive) |
| Mitigation measures | • Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy. | |

**Table 123:** Increased demand for social facilities during construction

| **Increased demand for social facilities during construction** | |
|---|---|
| Environmental Parameter | Increased pressure on existing social infrastructure. |
| Issue/Impact/Environmental Effect/Nature | The influx of jobseekers in the area will result in an increased demand for social, recreational and economic facilities. |
| *Extent* | The impact will affect the local district (2) |

| | | |
|---|---|---|
| *Probability* | The impact will likely occur (Between a 50% to 75% chance of occurrence) (3) | |
| *Reversibility* | The impact is partly reversible (2) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will last for at least the duration of the construction period (± 2 years), which will be extended to a short-term period, however, it may remain for several years into the operational period, thus the impact will have a medium-term effect (2) | |
| *Cumulative effect* | The demand for social services is most likely to increase as more similar developments are approved in the area, thus the cumulative impact is high (4) | |
| *Intensity/magnitude* | Considering that there are no imminent gaps in the provision of social infrastructure, the impact is rated as a medium-sized effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a negligible negative effects and will require little to no mitigation measures.<br>**After mitigation measures**: The anticipated impact will have a negligible negative effects and will require little to no mitigation measures. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 3 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | - 28 (Low negative) | - 26 (low negative) |
| Mitigation measures | • Engage with the local authorities to inform them on the timeframes of the project.<br>• Where possible, assist the local municipality in ensuring that the quality of the social and economic infrastructure does not deteriorate by making use of social responsibility allocations. | |

**Table 124:** Added pressure on basic services during construction

| **Added pressure on basic services during construction** | |
|---|---|
| Environmental Parameter | Added pressure on basic services |

| | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | The influx of jobseekers in the area will result in an increased demand for basic services, as well as social and economic infrastructure in the area. This will place pressure on the local municipality to ensure the adequate provision and monitoring of the deterioration of such services. | |
| *Extent* | The impact will affect the local district (2) | |
| *Probability* | The impact will likely occur (Between a 50% to 75% chance of occurrence) (3) | |
| *Reversibility* | The impact is partly reversible (2) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will last for at least the duration of the construction period (± 2 years), which will be extended to a short-term period, however, it may remain for several years into the operational period, thus the impact will have a medium-term effect (2) | |
| *Cumulative effect* | The demand for basic services and infrastructure is most likely to increase as more similar developments are approved in the area, thus the cumulative impact is high (4) | |
| *Intensity/magnitude* | With the municipality already experiencing pressure in terms of affordable housing and like services, the impact is expected to be of medium effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation measures.<br>**After mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation measures. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 3 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | - 28 (Low negative) | - 26 (low negative) |
| Mitigation measures | • Engage with the local authorities to inform them on the timeframes of the project and possible risks from a service delivery perspective.<br>• Engage with the local municipality to discuss the potential impact on local road quality, social | |

| | |
|---|---|
| | infrastructure, and demand for accommodation, as well as possible mitigation measures. |

**Table 125**: Temporary increase in household income and improved standard of living during construction

| **Temporary increase in household income and improved standard of living during construction** | | |
|---|---|---|
| Environmental Parameter | Household income: the result of a household member engaging in economic activity; has a direct link to the standards of living. | |
| Issue/Impact/Environmental Effect/Nature | Currently just over half of the residents of the Hantam LM generate an income less than R3 200.Certain households are expected to experience an increase in household income as a result of the job creation as well as skills development. | |
| *Extent* | Will affect local district and community (2) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | The impact is reversible as the income will only be earned for the duration of the construction period (1) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will last during construction (± 2 years), which will be extended to a short-term period (1) | |
| *Cumulative effect* | With the potential development of similar renewable projects in the area, the number of jobs created will increase leading to increased household income (4) | |
| *Intensity/magnitude* | With just over 50% of individuals in the municipality who earn less than R3 200, the impact of the increase in disposable household income will thus result in a medium-sized effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: Due to the improved living standards accompanying household income increases, the impact will result in a low positive effect.<br>**After mitigation measures**: Utilising appropriate mitigation measures, the intensity of the impact has increased to a medium positive effect. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 4 | 4 |

| | | |
|---|---|---|
| Intensity/magnitude | 2 | 3 |
| Significance rating | + 26 (Low positive) | + 39 (medium positive) |
| Mitigation measures | • Recruit local labour as far as possible so as to ensure that the benefits accrue to local households within the community<br>• Employ labour-intensive methods as far as feasible in the construction phase<br>• Where possible, sub-contract to local companies | |

**Table 126:** Establishment of informal hospitality industry due to increased demand for accommodation

| **Establishment of informal hospitality industry due to increased demand for accommodation** | |
|---|---|
| Environmental Parameter | Formation of informal hospitality industry as a result of the increased demand for accommodation. |
| Issue/Impact/Environmental Effect/Nature | In the event that construction workers do not reside on the construction sites, local residents have identified an opportunity in providing accommodation for the construction workers and majority of them have resorted to transforming their backyards and garages into rooms available for monthly rentals. |
| *Extent* | Will affect local are or district (2) |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) |
| *Reversibility* | Considering projects similar to this one, some migrant workers and jobseekers might remain in the area therefore the impact is partly reversible (2) |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) |
| *Duration* | The impact will last for at least the duration of the construction period (± 2 years), which will be extended to a short-term period, however, it may remain for several more years if similar projects are developed in the area (2) |
| *Cumulative effect* | In consideration of projects of a similar nature, the cumulative impact is rated as high (4) |
| *Intensity/magnitude* | In consideration of the dynamics that currently characterise the existing wind farms, construction workers have a preference of residing in town as opposed to living on the construction sites resulting in increased demand for accommodation in the local town; thus, the impact is rated as high (3) |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a medium negative effect and will require moderate mitigation measures.<br>**After mitigation measures**: No mitigation measures exist. |

| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
|---|---|---|
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | + 45 (medium positive) | + 45 (medium positive) |
| Mitigation measures | • Recruit local labour as far as possible so as to ensure that the benefits accrue to local households within the community<br>• Employ labour-intensive methods as far as feasible in the construction phase<br>• Where possible, sub-contract to local companies | |

**Table 127:** Temporary increase in tax revenue for government during construction

| **Temporary increase in tax revenue for government during construction** | |
|---|---|
| Environmental Parameter | Government revenue: government obtains its revenue from collecting taxes and rates from the country's residents and business |
| Issue/Impact/Environmental Effect/Nature | The impact will mostly take place when there is an increase in the amount of tax on the salaries and wages of people, as well as payment of company taxes. The increase in employment opportunities and disposable income will also have an influence on the tax base as a result of investment on the proposed project. |
| *Extent* | The impact will affect the entire country (4) |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) |
| *Reversibility* | The impact is completely reversible (1) |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) |
| *Duration* | The impact will last during construction, which will be extended to a short-term period (1) |
| *Cumulative effect* | Considering surrounding renewable energy products, the cumulative impact could potentially be high (4) |
| *Intensity/magnitude* | At a national level, the impact (increase in government revenue) will have a medium effect (2) |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will result in a medium positive effect. |

| | | |
|---|---|---|
| | **After mitigation measures**: No mitigations measures exist and the significance of the impact will remain unchanged. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | + 30 (medium positive) | + 30 (mediumpositive) |
| Mitigation measures | • No mitigation measures proposed | |

- Operation

**Table 128:** Creation of long-term employment in local and national economies through operation and maintenance activities

| **Creation of long-term employment in local and national economies through operation and maintenance activities** | |
|---|---|
| Environmental Parameter | Sustainable employment opportunities. |
| Issue/Impact/Environmental Effect/Nature | Throughout the lifespan of the project, over 30 employment positions will be created and sustained, of which at least a third will be filled by the local community members. |
| *Extent* | Will affect the local area and district. (2) |
| *Probability* | Definite (4). The impact will certainly occur (>75% chance of occurrence). |
| *Reversibility* | Completely reversible (1) |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) |
| *Duration* | The impact and its effects is expected to last for the entire operational life of the development resulting in a long-term effect (3) |
| *Cumulative effect* | The cumulative impact of the project is expected to be medium due to the relatively large number of projects planned to be developed in the area and considering that these projects will be associated with a limited number of sustainable employment opportunities. |
| *Intensity/magnitude* | Although the operational phase promises long-term employment, in the context of the entire Hantam economy, the effect of the impact is expected to medium-sized. |

| | | |
|---|---|---|
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have minor positive effects.<br>**After mitigation measures**: The anticipated impact will have minor positive effects. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 3 |
| Significance rating | + 28 (low positive) | + 28 (low positive) |
| Mitigation measures | • Where possible, ensure that the local community members are prioritised for the allocation of the created jobs. | |

**Table 129:** Skills development during the operations phase

| **Skills development during the operations phase** | |
|---|---|
| Environmental Parameter | Skills development, long-term knowledge transfer and skills development will take place as a result of the expected new employment creation. |
| Issue/Impact/Environmental Effect/Nature | Individuals who have receive the long-term employment in the operational activities of the project will gain skills and will be able to practice already existing skills. |
| *Extent* | Will affect the entire country (4) |
| *Probability* | Considering the current skills base, the required skills may not be available locally and will need to be sourced elsewhere; thus, the impact will likely occur (3) |
| *Reversibility* | Completely reversible (1) |
| *Irreplaceable loss of resources* | The impact is irreversible as once skilled are gained, they cannot be lost (4) |
| *Duration* | Considering the duration of the phase, impact will be long-term (3) |
| *Cumulative effect* | The cumulative impact is rated as medium-level as the other projects planned for the area will create additional opportunities for skills transfer and development. |
| *Intensity/magnitude* | Considering the current skills base of local people, the intensity of the impact is expected to be low. |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a minor positive effect. |

| | | |
|---|---|---|
| | **After mitigation measures**: The anticipated impact will have a minor positive effect. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 3 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | + 18 (low positive) | + 19 (low positive) |
| Mitigation measures | • Contracts ensuring that knowledge sharing and on-the-job training should be enforced as a condition for the development of the project.<br>• To ensure that skills are adequately acquired, additional training programmes need to be held during the construction phase to prepare the identified community members to be employed at the next phase, i.e. operational. | |

**Table 130:** Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED)

| **Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED)** | |
|---|---|
| Environmental Parameter | Investment in the local community |
| Issue/Impact/Environmental Effect/Nature | The developer aims to invest R450 000 in nearby communities through several community development initiatives during the pre-construction and construction phase alone, which will provide long-term benefits for the communities. During operations, investment into the community will continue and include not only social but also enterprise development intuitive. |
| *Extent* | The impact will affect the local area (2) |
| *Probability* | Investing into the local economy is a government requirement thereforethe impact will certainly occur (>75% chance of occurrence) (4) |
| *Reversibility* | The impact will be reversible as investment will cease upon the closure of the project (1) |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) |

| | | |
|---|---|---|
| *Duration* | This impact is rated as long-term as it will take place during the preconstruction, construction, and operational phases of the project. (3) | |
| *Cumulative effect* | The base-town for several of the other projects planned in the area is Loeriesfontein, which is also the targeted local community of the project under analysis. If other developers follow the same approach and invest into the community, the cumulative effect will be of high level (4) | |
| *Intensity/magnitude* | The local district as well as Loeriesfontein town is in need of investment into the local community's health, infrastructure, and skills development; therefore, benefits from the investment will have a high intensity (3) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a low positive effect.<br>**After mitigation measures**: The mitigation measures will not affect the scoring of the impact. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 3 | 3 |
| Significance rating | + 45 (Medium positive) | + 45 (medium positive) |
| Mitigation measures | • Proponent/project owner needs to establishe a relationship with the local authorities such as the Hantam LM and local community leaders to ensure that the SED & ED initiatives that are implemented during the pre-operational stage are aligned with the and relevant needs of the Loeriesfontein community.<br>• It is also advisory to engage with the other project developer sin the area and, where possible and feasible, coordinate the efforts and spending on community projects to ensure a balanced improvement in the standard of living of local residents and a holistic partnership-based approach to resolving local social ills. | |

**Table 131:** Change in sense of place during operations

| **Change in sense of place during operations** | |
|---|---|
| Environmental Parameter | An altered sense of place due to the development of the wind farm. |

| | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | The project is expected to have a notable visual impact, which will alter the landscape and could affect the sense of place of residents, visitors, and project site landowners, which is associated with the area. It may also result in the loss of some veld areas. In addition, the presence of construction workers may change the people's perception of the area as being a quite rural community. | |
| *Extent* | The impact will affect the local area (2) | |
| *Probability* | The impact may possibly occur (Between a 25% to 50% chance of occurrence) (2) | |
| *Reversibility* | The visual and natural resources will be impacted, but these could be partly reversed after the closure of the project (2) | |
| *Irreplaceable loss of resources* | The impact will result in marginal loss of natural and aesthetic resources (2) | |
| *Duration* | The impact is most likely to last beyond the construction phase as the approval of similar developments in the area might prolong the impact making it of a medium-term (2) | |
| *Cumulative effect* | Given the number of projects that are approved in the area, the impact may result in a notable cumulative effect (3) | |
| *Intensity/magnitude* | The intensity could reach medium levels 92) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation.<br>**After mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 2 | 2 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 2 | 2 |
| Duration | 2 | 2 |
| Cumulative effect | 3 | 2 |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 26 (low negative) | - 24 (low negative) |
| Mitigation measures | • Adhere to the mitigations measures proposed by other environmental specialists (noise, visual, etc.)<br>• Ensure the mitigation measure proposed to limit the influx of people and the prolonged negative effects of the migrants staying in the community after the construction are implemented. | |

**Table 132:** Sustainable increase in production and GDP-R of the national and local economies through operation and maintenance activities

| **Sustainable increase in production and GDP-R of the national and local economies through operation and maintenance activities** | | |
|---|---|---|
| Environmental Parameter | GDP-R: The total value of all final goods and services produced in a region within a year. | |
| Issue/Impact/Environmental Effect/Nature | The operating phase of the wind farm will contribute to an increase in production of the national economy. | |
| *Extent* | The impact will affect the entire country (4) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | The impact is reversible (1) | |
| *Irreplaceable loss of resources* | The impact will not result in the loss of any resources (1) | |
| *Duration* | The impact is rated as long-term as it will last for the entire operational life of the development therefore, it is rated as long-term (3) | |
| *Cumulative effect* | In consideration of the other planned project for the area, the cumulative impact could be high (4) | |
| *Intensity/magnitude* | The impact will alter the economy of the entire community; it will therefore, result in a medium-sized effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have a moderate positive effect.<br>**After mitigation measures**: No mitigation measures exist to increase the intensity of the impact. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 4 | 4 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 4 | 4 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | + 40 (medium positive) | + 40 (medium positive) |
| Mitigation measures | • Adhere to the mitigations measures proposed by other environmental specialists (noise, visual, etc.)<br>• Ensure the mitigation measure proposed to limit the influx of people and the prolonged negative effects of the migrants staying in the community after the construction are implemented. | |

**Table 133:** Added pressure on basic services during operation

| Added pressure on basic services during operation | | |
|---|---|---|
| Environmental Parameter | Added pressure on basic services | |
| Issue/Impact/Environmental Effect/Nature | The influx of jobseekers in the area will result in an increased demand for basic services, as well as social and economic infrastructure in the area. This will place pressure on the local municipality to ensure the adequate provision and monitoring of the deterioration of such services. | |
| *Extent* | The impact will affect the local district (2) | |
| *Probability* | The impact will likely occur (Between a 50% to 75% chance of occurrence) (3) | |
| *Reversibility* | The impact is partly reversible (2) | |
| *Irreplaceable loss of resources* | The impact will not result in any loss of resources (1) | |
| *Duration* | The impact will last for at least the duration of the construction period (± 2 years), which will be extended to a short-term period, however, it may remain for several years into the operational period, thus the impact will have a medium-term effect (2) | |
| *Cumulative effect* | The demand for basic services and infrastructure is most likely to increase as more similar developments are approved in the area, thus the cumulative impact is high (4) | |
| *Intensity/magnitude* | With the municipality already experiencing pressure in terms of affordable housing and like services, the impact is expected to be of medium effect (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation measures.<br>**After mitigation measures**: The anticipated impact will have negligible negative effects and will require little to no mitigation measures. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 3 | 3 |
| Reversibility | 2 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 2 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | - 28 (Low negative) | - 26 (low negative) |

| | |
|---|---|
| Mitigation measures | • Engage with the local authorities to inform them on the timeframes of the project and possible risks from a service delivery perspective.<br>• Engage with the local municipality to discuss the potential impact on local road quality, social infrastructure, and demand for accommodation, as well as possible mitigation measures. |

**Table 134:** Sustainable increase in household income and improved standard of living during operations

| **Sustainable increase in household income and improved standard of living during operations** | | |
|---|---|---|
| Environmental Parameter | Household income: the result of a households' member engaging in economic activity which has a direct link of the living standards of a household. | |
| Issue/Impact/Environmental Effect/Nature | About 54% of the people in the municipality earn less than R3 200 a month thus the operation of the wind farm is expected to result in an injection in the salary of people so as to indirectly improve their standard of living. | |
| *Extent* | The impact will affect the local area and district (2) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | The impact is reversible (1) | |
| *Irreplaceable loss of resources* | The impact will not result in the loss of any resources (1) | |
| *Duration* | The impact will be relevant for the entire life span of the project, longterm (3) | |
| *Cumulative effect* | Based on the current size of the district and local area, the cumulative impact is expected to be medium (2) | |
| *Intensity/magnitude* | In Loeriesfontein, employment is currently dominated by the informal sector opportunities, thus the provision of sustainable jobs could notably improve the living standards of residents. However, the number of opportunities created by the project during operations will be small; thus the magnitude will be low (1) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have significant positive effects.<br>**After mitigation measures**: The intensity of the impact remains the same at a significant positive effect. | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 2 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |

| | | |
|---|---|---|
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 2 |
| Intensity/magnitude | 1 | 1 |
| Significance rating | + 13 (Low positive) | + 13 (low positive) |
| Mitigation measures | • Ensure that local labour is procured to maximise benefit to the local households. | |

**Table 135:** Sustainable increase in tax revenue for government during operations

| **Sustainable increase in tax revenue for government during operations** | | |
|---|---|---|
| Environmental Parameter | Government revenue: through the operations of the project, a contribution will be made to the government revenue, which will create an opportunity to improve the provision of basic services to the population in the local area. | |
| Issue/Impact/Environmental Effect/Nature | Operations of the proposed facility will lead to the payment of various taxes and rates, which will benefit both national and local government authorities. | |
| *Extent* | The impact will affect the entire country (4) | |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) | |
| *Reversibility* | The impact is reversible (1) | |
| *Irreplaceable loss of resources* | The impact will not result in the loss of any resources (1) | |
| *Duration* | The impact is rated as long-term as it will last for the entire operational life of the development (3) | |
| *Cumulative effect* | Considering the projects that are to be developed in the area, the tax revenue will increase and the cumulative effect could be noticeable particularly from a local authority perspective (3) | |
| *Intensity/magnitude* | The impact will potentially alter the living conditions of the population through government investment in social and economic infrastructure; thus, the impact is of a medium-sized intensity (2) | |
| *Significance Rating* | **Prior to mitigation measures**: The anticipated impact will have high positive effects<br>**After mitigation measures**: No mitigation measures exist to increase the intensity of the impact | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 4 | 4 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |

| | | |
|---|---|---|
| Duration | 3 | 3 |
| Cumulative effect | 3 | 3 |
| Intensity/magnitude | 2 | 2 |
| Significance rating | + 32 (high positive) | + 32 (high positive) |
| Mitigation measures | • No mitigation measures proposed | |

- Cumulative Impacts

**Table 136:** Negative health-related cumulative impacts

| **Negative health-related cumulative impacts** | |
|---|---|
| Environmental Parameter | Negative health-related cumulative effects are expected as a result of multiple developments in the area in addition to the project in question |
| Issue/Impact/Environmental Effect/Nature | The establishment of two renewable energy projects in the area has had a negative effect on the health of the local community, as was revealed during the interviews. This was attributed to the influx of construction workers and in-migration of jobseekers. Considering the number of other projects that could be developed in the area, the situation could be exacerbated both in terms of the magnitude, as well as the duration. Health-related impacts that are envisaged include drug abuse, alcohol abuse, spread of communicable diseases, and unwanted pregnancies. |
| *Extent* | The potential negative socio-economic cumulative effect will mainly be local community specific, but could potentially extend beyond the local area in the event that people infected by any of the communicable diseases and viruses relocate to an area outside of the local area before getting treatment (2) |
| *Probability* | The impact will certainly occur (>75% chance of occurrence) (4) |
| *Reversibility* | The impact is partly reversible (2) |
| *Irreplaceable loss of resources* | The impact will not result in the loss of any resources (1) |
| *Duration* | The impacts will have a medium-term effect (2) |
| *Cumulative effect* | The impacts will result in significant cumulative impacts (4) |
| *Intensity/magnitude* | The impacts will possibly alter the quality, use and integrity of the system but the system will continue to function in a moderately modified way and will still maintain the general integrity (3) |

| | | |
|---|---|---|
| *Significance Rating* | **Prior to mitigation measures**: The impact will be negative low<br>**After mitigation measures**: The impact will be negative low | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 2 | 4 |
| Probability | 3 | 4 |
| Reversibility | 2 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 3 |
| Cumulative effect | 4 | 3 |
| Intensity/magnitude | 3 | 2 |
| Significance rating | - 42 (mediuim negative) | - 28 (low negative) |
| Mitigation measures | • The project developer should appoint a service provider or local NGO to develop, implement and manage an STI & HIV/AIDS prevention programme and other educational campaigns. The service provider or NGO should specialise in these fields and should have sufficient experience with similar work.<br>• The prevention programme and educational campaigns should extend to the local community and should pay special attention to vulnerable groups such as women and youth.<br>• The project developer should engage with other companies planning to establish renewable energy facilities in the area to optimise their efforts in educating the local community and implementing preventative programmes. | |

### *9.2.10 Geotechnical*

- Construction

**Table 137:** Foundation Excavability - Hardpan calcrete / soft rock shale encountered during excavation

| **IMPACT TABLE** | |
|---|---|
| Environmental Parameter | Geotechnical conditions |
| Issue/Impact/Environmental Effect/Nature | Hardpan calcrete / soft rock shale encountered during excavation |
| *Extent* | Local (2) |
| *Probability* | Probable (3) |

| | | |
|---|---|---|
| *Reversibility* | Reversible (1) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Low (1) | |
| *Significance Rating* | **Prior to mitigation measures:** Low negative impact<br>**After mitigation measures:** Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 1 | 1 |
| Significance rating | - 8 (low negative) | -6 (low negative) |
| Mitigation measures | • Preliminary geotechnical investigation has identified possible locations of calcrete/shale deposits;<br>• Wind turbine foundations positioned to avoid areas requiring excavation of hardpan calcrete;<br>• Foundations can be constructed above hardpan calcrete if bearing capacities of 200 - 500kPa can be achieved during testing. | |

**Table 138:** Foundation Excavability - Dolerite rock / hard rock shale encountered during excavation

| **IMPACT TABLE** | |
|---|---|
| Environmental Parameter | Geotechnical conditions |
| Issue/Impact/Environmental Effect/Nature | Dolerite rock / hard rock shale encountered during excavation |
| *Extent* | Local (2) |
| *Probability* | Probable (3) |
| *Reversibility* | Irreversible (4) |
| *Irreplaceable loss of resources* | No loss (1) |
| *Duration* | Short term (1) |
| *Cumulative effect* | N/A |
| *Intensity/magnitude* | Very High (4) |

| | | |
|---|---|---|
| *Significance Rating* | **Prior to mitigation measures:** medium negative impact<br>**After mitigation measures:** low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 1 |
| Reversibility | 4 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 4 | 2 |
| Significance rating | - 44 (medium negative) | - 14 (low negative) |
| Mitigation measures | • Preliminary geotechnical investigation has identified possible locations of dolerite outcrops;<br>• Wind turbine foundations positioned to avoid excessive excavation of dolerite material due to high excavation costs;<br>• Foundations can be constructed above dolerite/shale in-situ material if the bearing capacities are greater than 1000kPa. | |

**Table 139:** Foundation Excavability - Instability of excavation side walls within fractured bedrock

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | Geotechnical conditions | |
| Issue/Impact/Environmental Effect/Nature | Instability of excavation side walls within fractured bedrock | |
| *Extent* | Local (2) | |
| *Probability* | Unlikely (1) | |
| *Reversibility* | Reversible (1) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures:** low negative impact<br>**After mitigation measures:** low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |

| | | |
|---|---|---|
| Cumulative effect | - | - |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 12 (low negative) | - 6 (low negative) |
| Mitigation measures | • Precautionary measures to be incorporated in the design and construction of the proposed foundations. | |

*9.2.11 Traffic*

- Planning

No impacts are expected during planning.

- Construction

**Table 140:** Access Points

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Various alternatives to access site | |
| *Extent* | Local (2) | |
| *Probability* | Likely (2) | |
| *Reversibility* | Irreversible. The impact is irreversible and no mitigation measures exist (4) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Low (1) | |
| *Significance Rating* | **Prior to mitigation measures:** Low negative impact<br>**After mitigation measures:** Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 2 | 1 |
| Reversibility | 4 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 2 | 1 |
| Significance rating | -24 (low negative) | -6 (low negative) |

| | |
|---|---|
| Mitigation measures | Three alternative access points were originally considered<br>• Access via DR2972 to eastern boundary of LWEF<br>• Access via DR2972 to southern boundary of LWEF<br>• Access via R358 to western boundary of LWEF<br>Option iii was preferred option because<br>• Most suitable route for abnormal loads;<br>• It allows all vehicle types to use the same route;<br>• Only 1 access point needed;<br>• Maximum use of N7 which is most suitable for HGV use;<br>• N7 currently not heavily utilised and therefore attractive. |

**Table 141:** Abnormal Vehicle Generation

| **IMPACT TABLE** | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Increase in the number of abnormally sized vehicles travelling along the N7 and R358 | |
| *Extent* | Regional (3) | |
| *Probability* | Definite (4) | |
| *Reversibility* | Irreversible (4) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | High (3) | |
| *Significance Rating* | **Prior to mitigation measures:** Medium negative impact<br>**After mitigation measures:** Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 3 | 3 |
| Probability | 4 | 2 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -30 (medium negative) | -8 (low negative) |
| Mitigation measures | • New abnormal route proposed along N7 instead of N1, saving 1000km per trip | |

| | |
|---|---|
| | • N7 more suited for abnormal vehicles due to lower vehicle volumes<br>• N7 shortest route from Saldanha and Atlantis<br>• Local improvements proposed to enable route for abnormal vehicle use.<br>• Disruption to other road users minimised. |

**Table 142:** Traffic Generation

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment | |
| *Extent* | Local (2) | |
| *Probability* | Unlikely (1) | |
| *Reversibility* | Completely reversible (1) | |
| *Irreplaceable loss of resources* | No loss (1) | |
| *Duration* | Medium term (2) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures:** Low negative impact<br>**After mitigation measures:** Low negative impact | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 1 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 2 | 1 |
| Significance rating | - 14 (low negative) | -6 (low negative) |
| Mitigation measures | • Implement management strategies for dust generation e.g. apply dust suppressant along the affected road segments, exposed areas and stockpiles;<br>• Postpone or reduce dust-generating activities during periods with strong wind; | |

| | |
|---|---|
| | • Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased;<br>• Ensure that all construction vehicles are roadworthy and drivers adhere to any additional safety standards imposed by the Health and Safety Manager;<br>• Ensure that all construction equipment is well maintained and serviced regularly. |

**Table 143:** Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads

| **IMPACT TABLE** | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads | |
| *Extent* | Local / district (2) | |
| *Probability* | Likely (1) | |
| *Reversibility* | Irreversible (4) | |
| *Irreplaceable loss of resources* | Complete loss of resources (4) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Very High (4) | |
| *Significance Rating* | **Prior to mitigation measures:** high negative<br>**After mitigation measures:** high negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 1 |
| Probability | 1 | 1 |
| Reversibility | 4 | 4 |
| Irreplaceable loss | 4 | 4 |
| Duration | 3 | 2 |
| Cumulative effect | - | - |
| Intensity/magnitude | 4 | 3 |
| Significance rating | - 56 (high negative) | - 36 (medium negative) |
| Mitigation measures | • Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences (such as Animal fences) installed, if needed to direct animals to safe road crossings along the primary access roads to the site;<br>• Adhere to all speed limits applicable to all roads used;<br>• Implement clear and visible signage at the intersection of the N7 and the R358. | |

**Table 144:** Change in quality of surface condition of the roads

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Change in quality of surface condition of the roads | |
| *Extent* | Local / district (2) | |
| *Probability* | Likely (1) | |
| *Reversibility* | Completely Reversible (1) | |
| *Irreplaceable loss of resources* | No Loss of resources (1) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Low (1) | |
| *Significance Rating* | **Prior to mitigation measures:** low positive<br>**After mitigation measures:** low positive | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 2 |
| Cumulative effect | - | - |
| Intensity/magnitude | 1 | 1 |
| Significance rating | +8 (low positive) | + 7 (low positive) |
| Mitigation measures | • Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage;<br>• Implement management strategies for dust generation e.g. apply dust suppressant on gravel roads, exposed areas and stockpiles; and<br>• Develop a Road Maintenance Plan for the primary access to the site to addresses the following:<br>o Grading requirements;<br>o Dust suppressant requirements;<br>o Drainage requirements;<br>o Signage; and<br>o Speed limits. | |

- Operation

**Table 145:** Increase in traffic

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Increase in traffic | |
| *Extent* | Regional (3) | |
| *Probability* | Definite (4) | |
| *Reversibility* | Completely Reversible (1) | |
| *Irreplaceable loss of resources* | No Loss of resources (1) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Low (1) | |
| *Significance Rating* | **Prior to mitigation measures:** low negative<br>**After mitigation measures:** low negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 3 | 2 |
| Probability | 3 | 2 |
| Reversibility | 4 | 2 |
| Irreplaceable loss | 1 | 1 |
| Duration | 1 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 1 | 1 |
| Significance rating | - 12 (low negative) | - 8 (low negative) |
| Mitigation measures | • Adhere to requirements made within Traffic Management Plan;<br>• Restricted access to site; and<br>• Ensure that where possible, staff members carpool to site. | |

**Table 146:** Increase in traffic

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. |

| | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads | |
| *Extent* | Local (2) | |
| *Probability* | Probable (3) | |
| *Reversibility* | Irreversible (4) | |
| *Irreplaceable loss of resources* | Irreplaceable Loss (4) | |
| *Duration* | Short term (1) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Very High (4) | |
| *Significance Rating* | **Prior to mitigation measures:** high negative<br>**After mitigation measures:** low negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 2 |
| Reversibility | 4 | 2 |
| Irreplaceable loss | 4 | 3 |
| Duration | 1 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 4 | 3 |
| Significance rating | - 56 (high negative) | - 30 (medium negative) |
| Mitigation measures | • Adhere to all speed limits applicable to all roads used;<br>• Ensure clear and visible signage is present.<br>• Install speed cameras along R358 between Loeriesfontein and the site | |

**Table 147:** Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment

| IMPACT TABLE | |
|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. |
| Issue/Impact/Environmental Effect/Nature | Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment |
| *Extent* | Local (2) |
| *Probability* | Unlikely (1) |
| *Reversibility* | Completely Reversible (1) |
| *Irreplaceable loss of resources* | No loss of resources (1) |
| *Duration* | Medium term (2) |

| | | |
|---|---|---|
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures: low** negative<br>**After mitigation measures:** low negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 2 | 1 |
| Cumulative effect | 3 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | - 30 (medium negative) | - 7 (low negative) |
| Mitigation measures | • Implement management strategies to reduce dust generation;<br>• Limit noisy maintenance/operational activities to daytime only. | |

**Table 148:** Change in quality of surface condition of the roads

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Change in quality of surface condition of the roads | |
| *Extent* | Local (2) | |
| *Probability* | Unlikely (1) | |
| *Reversibility* | Completely Reversible (1) | |
| *Irreplaceable loss of resources* | No loss of resources (1) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Low (1) | |
| *Significance Rating* | **Prior to mitigation measures: low** negative<br>**After mitigation measures:** low negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 1 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 1 |
| Cumulative effect | - | - |

| | | |
|---|---|---|
| Intensity/magnitude | 1 | 1 |
| Significance rating | - 8 (low negative) | - 6 (low negative) |
| Mitigation measures | • Execute Road Maintenance Plan. | |

**Table 149:** Cumulative Impact - Increase in traffic

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | A wind energy facility is to be constructed in the Northern Cape Province. This will have an impact on the haulage routes to site as well as the local traffic and the community. | |
| Issue/Impact/Environmental Effect/Nature | Increase in traffic | |
| *Extent* | Regional (2) | |
| *Probability* | Probable (3) | |
| *Reversibility* | Completely Reversible (1) | |
| *Irreplaceable loss of resources* | No loss of resources (1) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | N/A | |
| *Intensity/magnitude* | Medium (2) | |
| *Significance Rating* | **Prior to mitigation measures: low** negative<br>**After mitigation measures:** low negative | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 3 | 1 |
| Reversibility | 1 | 1 |
| Irreplaceable loss | 1 | 1 |
| Duration | 3 | 1 |
| Cumulative effect | - | - |
| Intensity/magnitude | 1 | 1 |
| Significance rating | - 10 (low negative) | - 6 (low negative) |
| Mitigation measures | • N/A | |

# 10 CUMULATIVE IMPACTS

The area has seen a notable interest from developers of various renewable energy projects, which could be associated with the wind and solar energy resource potential found in the region, proximity to the existing Helion Substation and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered together as they have the potential to create numerous cumulative impacts, whether positive or negative, if all are implemented. **Table 150** lists the projects that have been considered when examining the cumulative impacts; their location relative to the project under review is illustrated in **Figure 121**. The specialists have identified specific cumulative impacts and these are outlined below.

As requested by the DEA, a literature review of other specialist assessments / studies which were undertaken for the other nearby renewable energy developments (both solar and wind) proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site was also undertaken in order to ascertain any additional cumulative impacts that should be taken into consideration. Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012 which are not currently publically available to download. Nonetheless, a fair amount of information was available. The information (including specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding proposed renewable energy sites that were taken into account by the various specialists is elaborated on below.

**Table 150:** Renewable energy developments (both wind and solar) proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site

| Development | Current status of EIA/development | Proponent | Capacity | Farm details |
|---|---|---|---|---|
| **Dwarsrug Wind Farm** | EA issued | Mainstream Renewable Power | 140MW | Remainder of the Farm Brak Pan No 212 |
| **Khobab Wind Farm** | Under Construction | Mainstream Renewable Power | 140MW | Portion 2 of the Farm Sous No 226 |
| **Loeriesfontein 2 Wind Farm** | Under Construction | Mainstream Renewable Power | 140MW | Portions 1 & 2 of the Farm Aan de Karree Doorn Pan No 213 |
| **Graskoppies Wind Farm** | EIA ongoing | Mainstream Renewable Power | 235MW | • Portion 2 of the Farm Graskoppies No 176; and<br>• Portion 1 of the Farm Hartebeest Leegte No 216 |
| **Hartebeest Leegte Wind Farm** | EIA ongoing | Mainstream Renewable Power | 235MW | Remainder of the Farm Hartebeest Leegte No 216 |
| **Ithemba Wind Farm** | EIA ongoing | Mainstream Renewable Power | 235MW | • Portion 2 of the Farm Graskoppies No. 176; and<br>• Portion 1 of the Farm Hartebeest Leegte No. 216. |
| **Loeriesfontein PV3 Solar Energy Facility** | EA issued | Mainstream Renewable Power | 100MW | Portion 2 of the Farm Aan de Karree Doorn Pan No 213 |
| **Hantam PV Solar Energy Facility** | EA issued | Solar Capital (Pty) Ltd | Up to 525MW | Remainder of the Farm Narosies No 228 |

| | | | | |
|---|---|---|---|---|
| **PV Solar Power Plant** | EA issued | BioTherm Energy | 70MW | Portion 5 of the Farm Kleine Rooiberg No 227 |
| **Kokerboom 1 Wind Farm** | Environmental Impact Assessment (EIA) underway | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | 240MW | • Remainder of the Farm Leeuwbergrivier No. 1163; and<br>• Remainder of the Farm Kleine Rooiberg No. 227. |
| **Kokerboom 2 Wind Farm** | Environmental Impact Assessment (EIA) underway | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | 240MW | • Remainder of the Farm Leeuwbergrivier No. 1163; and<br>• Remainder of the Farm Kleine Rooiberg No. 227. |
| **Kokerboom 3 Wind Farm** | Environmental Impact Assessment (EIA) underway | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | 240MW | • Remainder of the Farm Aan De Karree Doorn Pan No. 213;<br>• Portion 1 of the Farm Karree Doorn Pan No. 214; and<br>• Portion 2 of the Farm Karree Doorn Pan No. 214. |
| **Wind Farm** | EA issued, however the project is no longer active. | Mainstream Renewable Power | 50MW | Portion 1 of the Farm Aan de Karree Doorn Pan 213 |

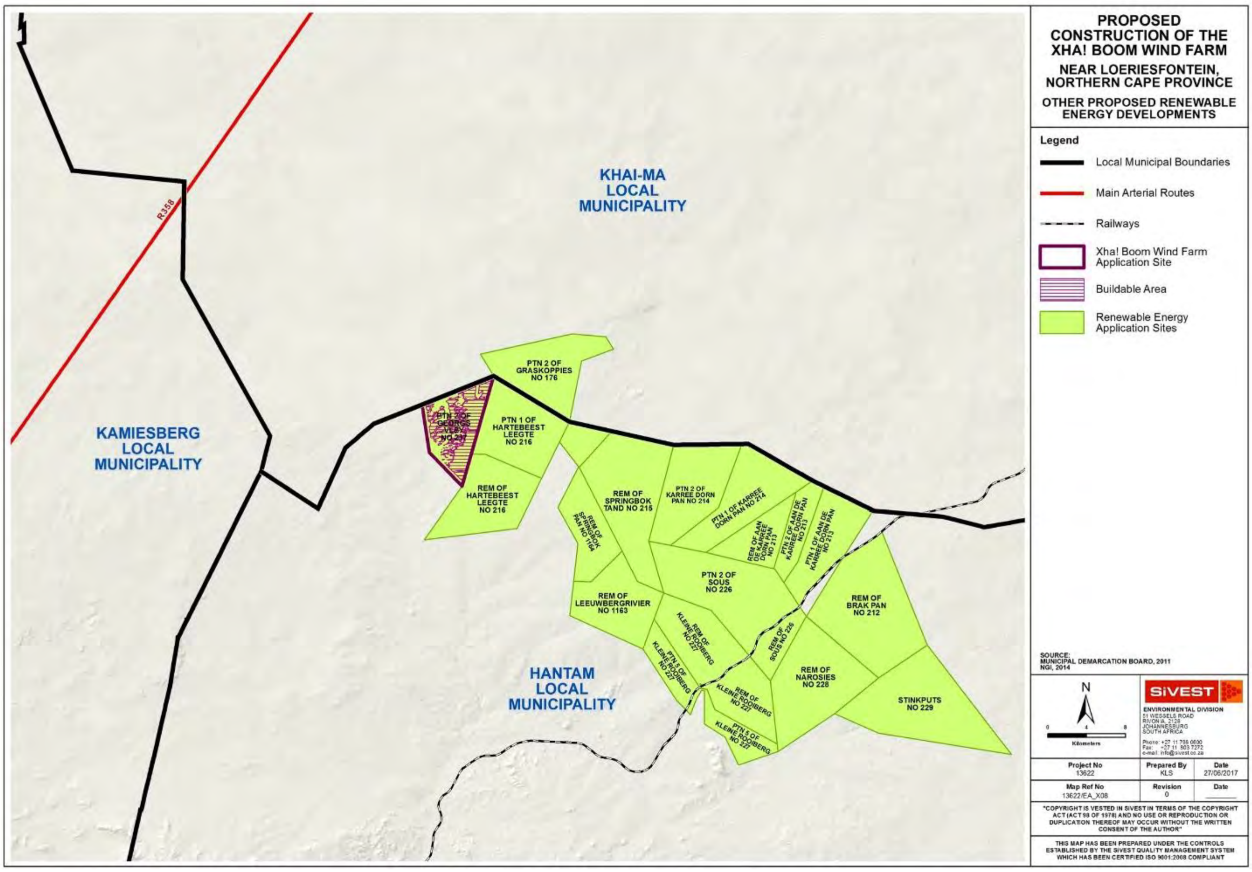



**Figure 121:** Location of the renewable energy developments proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site

## 10.1 Biodiversity Impacts

It is important to note that this consultant has worked on all of the wind farms in the area and as such has intimate knowledge of the affected environment of each as well as the distribution of impact and the recommended mitigation measures associated with each approved or in-process facility.

In terms of existing impacts in the area and the potential for the !Xha Boom Wind Farm to contribute to cumulative impacts, other renewable energy developments are detailed in **Table 150** and the affected land portions shown in **Figure 121**. Although the DEA also maintains a map of approved and in-process renewable energy facilities that are part of the RE IPPP, this is currently not up to date and is not illustrated here as a result. Most of the other wind energy developments in the area to the east of the !Xha Boom site, mostly between the site and the Helios substation, with only the Dwarsrug facility further east.

It is clear that a node of renewable energy development is developing around the Helios Substation. The large amount of development in the area would potentially generate significant cumulative impact in terms of habitat loss and potential disruption of landscape connectivity. These two major potential cumulative impacts are further explored and described with regards to the area.

In terms of developments that are preferred bidders or under construction, there are three projects, the Khobab and Loeriesfontein 2 Wind Farms and the Hantam Solar Facility. The total extent of habitat loss from these developments is approximately 500ha. In terms of already authorised wind farm projects that have not been awarded preferred bidder status and thus may or may not be built, there is only the 140MW Dwarsrug Wind Farm with the remaining authorised projects in the area being four solar PV projects. There are a number of projects which are currently still in the EIA process, which includes Graskoppies, Hartebeest Leegte and Ithemba Wind Farms which are part of the larger Leeuwberg development of which the current development is a part and then the three Kokerboom wind farms. All of the latter projects are 235-240MW in output but would not have a significantly larger footprint than the older 140MW projects due to technology advances and the larger output of the current and future turbines. The estimated footprint of each wind farm is estimated to be 100ha. As such, there is 100ha of potential habitat loss due to the authorised Dwarsrug Wind Farm and approximately 700ha of habitat loss due to the projects currently in process if they are all authorised. The total extent of habitat loss from the 4 solar projects would be up to 1600ha, although it is highly unlikely that all proposed projects would ever be built. It is important to note that the footprint of wind energy facilities is decreasing relative to solar PV plants on a per MW basis due to the increasing output of wind turbines but the relatively static nature of PV panel output. The total actual and potential extent of habitat loss is therefore 500ha of existing habitat loss, about 1700ha of potential habitat loss due to already approved projects and 700ha due to projects in process, giving rise to a total of just under 3000ha of total habitat loss.

The majority of the above footprint is located within the Bushmanland Basin Shrubland vegetation type. This vegetation unit has an extent of 34 690 km$^2$ and is one of the most extensive vegetation types in the country. The total extent of potential habitat loss from all developments in the current study area would amount to less than 0.1% of this vegetation unit. Consequently, it is clear that there is no potential for habitat loss to significantly impact the national availability of this unit or elevate it to a higher threat status. Within a 30km radius of the Helios substation, the potential habitat loss from all projects would amount to approximately 1% of the area. This suggests that even if all projects are built, the total extent of habitat loss would not be significant at this local landscape level either. At a more local level, the affected area is relatively homogenous and there are few species or habitats of conservation concern that would be affected by the developments in the area. There are also no large drainage features or other obvious environmental corridors present in the area that would be directly affected by the development of the area. These results indicate that direct habitat loss is not a highly significant concern in the area and the low fauna and flora diversity of the area further reduces the potential significance of cumulative impact in the area due to habitat loss.

The potential impacts of the current developments on landscape connectivity are more difficult to quantify as this is not directly related to the footprint of the facilities. Wind energy facilities are not fenced but occur within the general farming landscape, whereas solar PV plants are generally fenced with electrified fencing and thus prevent most fauna from traversing the fenced area. On the other hand, PV facilities are concentrated within a limited area compared to wind farms which occupy a large area at low density. A significant proportion of the impact associated with wind farms results from access roads which usually far exceed the footprint of the turbines and their hard stands. Roads pose a significant obstacle to some fauna which cannot or do not cross roads and experience habitat fragmentation as a result. Species that are typically affected by roads include subterranean and fossorial mammals and reptiles as well as many smaller above-ground species which avoid open ground on account of predation risk. However, as there is little soil in the study area, which consists mostly of exposed gravels or calcrete, subterranean species are not common at the site so this is not likely to be a significant impact. In addition, the arid nature of the area means that vegetation cover is naturally low with the result that most fauna are adapted to or accustomed to traversing open ground and not likely to be significantly affected by wind farm roads, which are gravel in any case.

Some fauna may be affected by turbine noise and thus experience habitat loss as a result of wind farms. However, this has not been documented for any fauna and indications are that most fauna quickly become habituated to turbines and do not avoid them to any significant degree. Wind farms are thus not likely to significantly contribute to landscape connectivity for most fauna present in the area and would remain porous for most species. The potential for significant disruption of landscape connectivity due to the wind farms of the area is therefore considered low.

In terms of the potential for the !Xha Boom Wind Farm to contribute to the above cumulative impacts, the total extent of habitat loss would be about 100ha, which is not highly significant and the potential for habitat fragmentation would also be low. In terms of the acceptability of a node of high renewable energy development to occur at the site, this is seen as a positive aspect rather than a negative factor. The area has generally low ecological sensitivity and the concentration of development within this low sensitivity area is seen as positive compared to a more dispersed development pattern which would generate an overall greater impact. As such, the current development is therefore seen as being acceptable in terms of its contribution to cumulative impact.

## 10.2 Avifauna Impacts

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

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

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

### *10.2.1 Species to be considered*

The potential cumulative impacts on the priority species listed in **Table 32** were considered.

### 10.2.2 Area considered in the cumulative assessment

The Helios Main Transmission Substation (MTS) approximately 50km north of the town of Loeriesfontein forms the hub of a proposed renewable energy node which is situated within a 40km radius around the MTS (See **Figure 121**). Within this 40km radius around the MTS, the habitat (karoo shrubland on gravel and sandy plains) and land-use (small-stock farming) is very uniform.

**Table 150** lists the other renewable energy projects which are currently approved, under construction or in an environmental impact assessment process within a 40km radius around Helios MTS. Appendix D of the Avifauna Impact Assessment provides details of mitigation measures proposed for the impacts associated with these projects as detailed in the respective EIAs.

### 10.2.3 Current Impacts

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

- **Overgrazing**

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

- **Poisoning**

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

- **Road-kills**

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

- **Renewable energy developments**

Several wind and solar developments have been approved for development within a 40km radius around Helios MTS (see **Table 150**). The combined footprint of these proposed developments is approximately 28 299 hectares*. This has implications for several priority species, both in terms of collision mortality for some species, especially raptors, and displacement due to permanent habitat transformation, which affects most of the priority species to some degree.

** In the case of projects already authorised or under construction, the actual infrastructure footprint (and not the land parcel size) was considered. This information was obtained through internet searches. In the case of projects currently undergoing an environmental impact assessment process, the size of the land parcel was used as the actual footprint size has as yet not been finalised.*

- **Powerlines**

Numerous existing and new power lines are significant threats to large terrestrial priority species in the Karoo. Power lines kill substantial numbers of all large terrestrial bird species in the Karoo, including threatened species such as Karoo Korhaan, Kori Bustard and Ludwig's Bustard (Jenkins *et al*. 2010; Shaw, J. 2013) There is currently no completely effective mitigation method to prevent collisions.

- **Climate change**

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

- **Shale gas fracking**

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

- **Persecution**

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

### *10.2.4 Methods*

The cumulative impact of the proposed WEF was assessed individually for each priority species (see **Table 151** below).

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

- Level of current impact on priority species in study area (all impacts);
- Susceptibility to renewable energy impacts i.e. collisions with turbines and displacement through habitat transformation and disturbance;

- The percentage of habitat which is likely to be impacted by the combined footprint of all the proposed renewable energy projects.
- The avifaunal mitigation measures proposed for the renewable energy projects listed in **Table 150** (where available).

**Table 151** below sets out the criteria applied to rank potential cumulative impacts.

**Table 151:** Framework for assessing significance of cumulative effects

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

*10.2.5 Assumptions and Limitations: Cumulative Impacts*

- The information on the other renewable energy projects in the study area was received from SiVEST and independently sourced from various websites, but the accuracy of these sources cannot be guaranteed.
- The assessment takes into account the potential impact of the associated grid connections as well.

*10.2.6 Assessment*

See **Table 152** below for a systematic exposition of the expected cumulative impacts of the existing renewable energy projects and the !Xha Boom WEF on priority species within a 40km radius around Helios MTS.

**Table 152:** Expected Cumulative Impacts

| Priority species | Level of current and future impacts on species | Susceptibility to renewable energy impacts | Preferred habitat within a 40km radius around Helios MTS | Approximate size of preferred habitat within a 40km radius around Helios MTS (ha) | Extent of habitat potentially affected by the existing renewable applications and the Graskoppies WEF (ha) | Expected combined cumulative impact of Graskoppies WEF and existing renewable applications: Pre-mitigation | Expected combined cumulative impact of Graskoppies WEF and existing renewable applications: Post-mitigation |
|---|---|---|---|---|---|---|---|
| Karoo Korhaan | Low: Powerlines, solar, overgrazing, climate change | Low | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Northern Black Korhaan | Low: Powerlines, solar, overgrazing, climate change | Low | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Kori Bustard | High: Powerlines,solar, overgrazing, climate change | Low | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Lanner Falcon | Low: Powerlines, poisoning, road kills, solar, WEF | Medium? | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Ludwig's Bustard | High: Powerlines, solar, overgrazing, climate change | Low | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Martial Eagle | High: Powerlines, persecution, solar, overgrazing, WEFs, climate | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Secretarybird | High: Powerlines, solar , overgrazing, WEFs, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Booted Eagle | Medium: Solar, overgrazing, WEFs, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Sclater's Lark | Low: Powerlines, solar, overgrazing, climate change | Low | Karoo shrubland | 510 000 | 38 750 (7.5%) | Not significant | Not significant |
| Red Lark | Low: Powerlines, solar, overgrazing, climate change | Medium? | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Black-chested Snake-Eagle | Medium: Solar, overgrazing, WEFs, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |

| Priority species | Level of current and future impacts on species | Susceptibility to renewable energy impacts | Preferred habitat within a 40km radius around Helios MTS | Approximate size of preferred habitat within a 40km radius around Helios MTS (ha) | Extent of habitat potentially affected by the existing renewable applications and the Graskoppies WEF (ha) | Expected combined cumulative impact of Graskoppies WEF and existing renewable applications: Pre-mitigation | Expected combined cumulative impact of Graskoppies WEF and existing renewable applications: Post-mitigation |
|---|---|---|---|---|---|---|---|
| Southern Pale Chanting Goshawk | Low: Powerlines, solar, overgrazing, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Greater Kestrel | Low: Solar, overgrazing, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Spotted Eagle-Owl | Medium: Powerlines, solar, overgrazing, WEFs, climate change, road | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Jackal Buzzard | Medium: Solar, overgrazing, WEFs, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |
| Burchell's Courser | Medium: Solar, overgrazing, WEFs, climate change | Low? | Karoo shrubland | 510 000 | 38 750 (7.5%) | Not significant | Not significant |
| Double-banded Courser | Medium: Solar, overgrazing, WEFs, climate change | Low? | Karoo shrubland | 510 000 | 38 750 (7.5%) | Not significant | Not significant |
| Steppe Buzzard | Medium: Solar, overgrazing, WEFs, climate change | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Yellow-billed Kite | Medium: Solar, overgrazing, WEFs, climate change | High? | Karoo shrubland | 510 000 | 38 750 (7.5%) | Minor | Not significant |
| Verreaux's Eagle | High: Powerlines, persecution, solar, overgrazing, WEFs, climate | High | Karoo shrubland | 510 000 | 38 750 (7.5%) | Moderate | Minor |

### 10.2.7 Conclusions

The cumulative impact of the proposed !Xha Boom WEF on priority avifauna within a 40km radius around the Helios MTS, should range from minor to insignificant, if appropriate mitigation is implemented.

### 10.2.8 No-Go Alternative

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

## 10.3 Bat Impacts

Several renewable energy development applications have been submitted and/or authorized within the immediate area of the proposed !Xha Boom WEF. **Figure 121** displays these areas and **Table 150** lists the neighbouring renewable energy projects. The impact of the !Xha Boom WEF was assessed in **Section 5** of the Bat Impact Assessment Report as well as in **Section 9.2.3** of the DEIAr. This section assesses the cumulative impact of all renewable energy developments within the area.

The impacts and sensitivities of the neighbouring wind farms are considered in this section as the impacts of solar developments are not easily comparable.

### 10.3.1 Cumulative Impact Assessment Rating

**Table 153** below lists and summarises the impact assessment for !Xha Boom WEF taking into account the information from available Specialist reports of the neighbouring wind energy projects. As mentioned above, this impact was also assessed in **Table 78** in **Section 9.2.3** of the DEIAr.

The main impact on bats that raises concern from a cumulative impact assessment point of view is the bat mortalities due to direct turbine blade collision or barotrauma during operation. There is potential for mass loss of locally active bats and migratory bats from the area due to cumulative mortality from wind turbines of several neighbouring wind farms. This impact is assessed below.

**Table 153:** Cumulative bat mortalities due to direct blade impact or barotrauma during foraging (resident and migrating bats affected).

| IMPACT ASSESSMENT TABLE | |
|---|---|
| Environmental Parameter | Impact on bat population numbers. |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Issue/Impact/Environmental Effect/Nature | Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration). The concerns of foraging bats in relation to wind turbines is discussed in Section 2.2 of the Bat Impact Assessment Report. If the impact is too severe (e.g. in the case of no mitigation) migrating bat populations may not recover from mortalities. | |
| Extent | The impact will occur nationally. | |
| Probability | There is a high probability of the impact occurring. | |
| Reversibility | The impact will occur throughout the lifespan of the wind facility as well as other facilities in the area, therefore population numbers may take very long to recover. There is a higher probability for population and diversity genetics to be permanently altered in cumulative impacts. | |
| Irreplaceable loss of resources | Bat population numbers will decrease in the area. | |
| Duration | The impact will be of long duration, over the operational phase of the facility. It will take many years for the population to achieve its previous numbers after the impact is removed. | |
| Cumulative effect | High cumulative effects. Mortalities of bats due to wind turbines during foraging and migration can have significant ecological consequences as the bat species at risk are insectivorous and thereby contribute significantly to the control of nocturnal flying insects. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species. If migrating bats are killed off it can have detrimental effects on the cave ecology of the caves that a specific colony utilises. This is due to the fact that bat guano is the primary form of energy input into a cave ecology system. | |
| Intensity/magnitude | Very high intensity impact on the bat population numbers in the area. | |
| Significance Rating | The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. | |
| | | |
| | **Pre-mitigation impact rating** | **Post mitigation impact rating** |
| Extent | 4 | 4 |
| Probability | 3 | 3 |
| Reversibility | 4 | 2 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 2 |
| Cumulative effect | 4 | 3 |

| IMPACT ASSESSMENT TABLE | | |
|---|---|---|
| Intensity/magnitude | 4 | 2 |
| Significance rating | - 84 (very high negative) | - 32 (medium negative) |
| Mitigation measures | The high sensitivity waterways can serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several WEF's in an area. Adhere to recommended mitigation measures for this project as described in Section 8 of this report. It is essential that project specific mitigations be applied and adhered to for each project, as there is no overarching mitigation that can be recommended on a regional level due to habitat and ecological differences between project sites. Adhere to the sensitivity map during any further turbine layout revisions. | |

## 10.4 Surface Water Impacts

Cumulative impacts are the combined impacts from different developments / facilities which, in combination, result in significant impacts that may be larger than sum of all the impacts.

The proposed renewable energy developments in the surrounding area (55km radius) outside of the study site are identified in **Table 150** and shown in **Figure 121**.

It must be noted that surface water resources change from one site to another and can range from a number of surface water resources in one area to very few on a neighbouring property depending on factors such as topography, geology, local rainfall and other environmental factors. Additionally, the characteristics of surface water resources can change along its course where longitudinal hydrological systems are involved. Nonetheless, the most important factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur, these are likely to have an impact downstream to some degree.

The main potential cumulative surface water impacts from a catchment perspective in the local area include both potential direct and indirect impacts. Direct impacts include cumulative loss of as well as further degradation of surface water resources due to the footprints of developments encroaching or destroying surface water resources in the greater catchment. The indirect impacts relate mainly to increased run-off, sedimentation and erosion for linear and endorheic hydrological systems. The indirect impacts to hydrological systems (i.e. drainage lines) which are connected across several farm boundaries have a greater risk for potential cumulative impacts from developments upstream.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level.

The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by two low ridges that act as watersheds and occupy separate local catchments. Drainage from the proposed development is in a western direction, whilst drainage for the Kokerboom 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely.

Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above.

## 10.5 Soil and Agricultural Potential Impacts

Cumulative impact has been assessed by reviewing the available soil and agriculture specialist reports for all renewable energy developments within 30km of this development. These are shown in **Figure 121** and **Table 150**. Of those included in **Table 150**, only the specialist report for Hantam PV Solar Energy Facility was not available for review. In none of the reviewed reports were there any additional specialist recommendations or mitigation measures to the ones already included in this report. The conclusion of all reports was that the agricultural impact was of low significance.

The most significant cumulative impact is the loss of agricultural land. The impact is low because of the extremely limited agricultural potential of all land in the area, predominantly as a result of climatic limitations, and the fact that there is no particular scarcity of such land in South Africa.

Furthermore 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 detail in table form (**Table 92**) in **Section 9.2.5** of the DEIAr.

Although the cumulative area is indicated in **Figure 121** and **Table 150** as the entire farm portions, it is important to note that the surface area of transformed land impact, from an agricultural perspective, as a result of a wind farm (sum of all infrastructure footprints including roads), is typically less than 2% of the surface area. The maximum cumulative impact on agricultural land, if every farm portion in a region was turned into a wind farm, would therefore be only 2%. In reality, because every farm portion will not be a wind farm, the cumulative impact is much lower.

## 10.6 Noise Impacts

Should all the wind farms of the larger Leeuwberg WEF be developed, noise levels would increase due to cumulative effects. Total cumulative noise levels were calculated and are defined in **Table 154** and illustrated in **Figure 122**. The Dwarsrug and Loeriesfontein WEFs are also proposed in the area, but the wind turbines from these facilities are too far to contribute to the cumulative effect.

**Table 154:** Maximum cumulative noise rating levels at closest potential noise-sensitive receptors

| NSD | Maximum cumulative noise level, dBA | Contribution, Ithemba (dBA) | Contribution, !Xha Boom (dBA) | Contribution, Graskoppies (dBA) | Contribution, Hartebeest Leegte (dBA) | Comments |
|---|---|---|---|---|---|---|
| 1 | 41.8 | < 30 | < 30 | < 30 | 41.8 | Status unknown |
| 2 | 45.5 | < 30 | < 30 | < 30 | 45.5 | Temporary used |
| 3 | 46.7 | 41.5 | 38.5 | < 30 | 41.2 | Temporary used |
| 4 | 45.8 | 45.8 | 34.0 | 36.8 | < 30 | Temporary used |
| 5 | 32.6 | < 30 | < 30 | < 30 | < 30 | Temporary used |
| 6 | 44.3 | < 30 | < 30 | 44.3 | < 30 | Temporary used |
| 7 | 39.5 | < 30 | 39.1 | < 30 | < 30 | Temporary used |

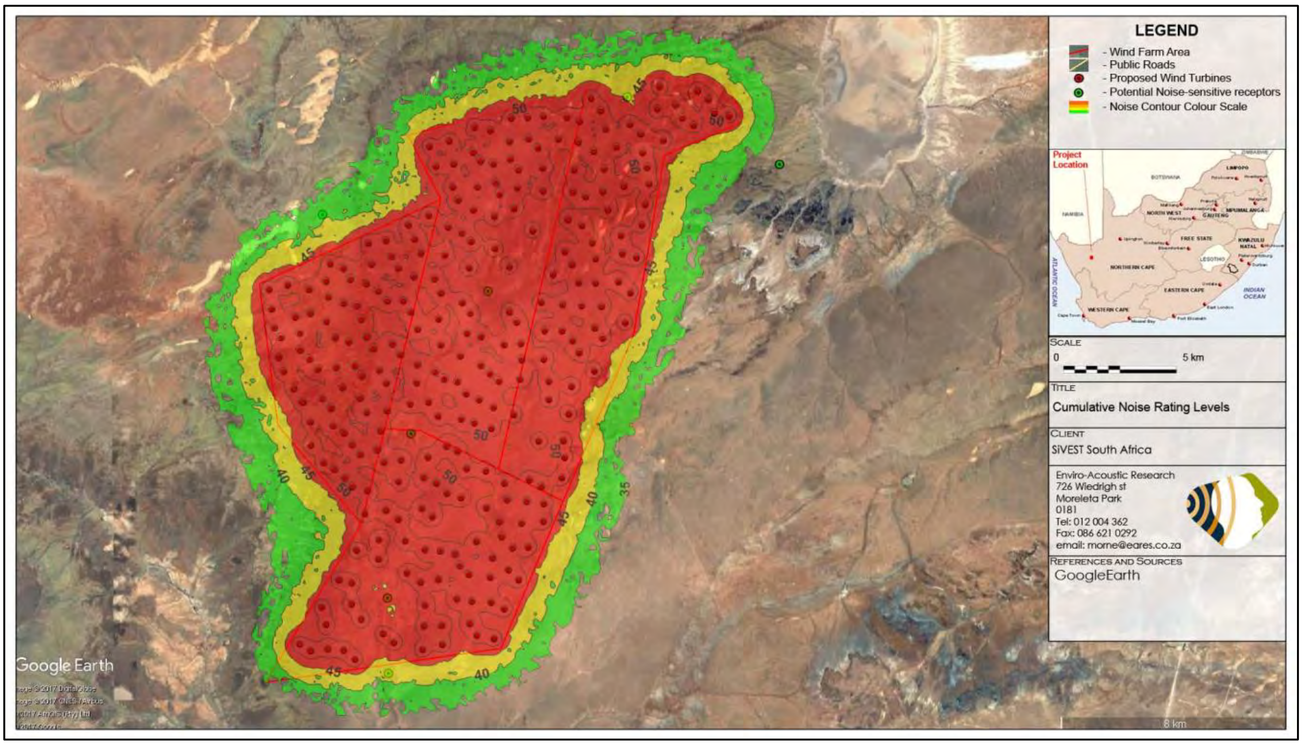



**Figure 122:** Projected conceptual cumulative noise rating levels during operation

There are a number of other proposed renewable projects in the area, including photovoltaic and wind energy projects. Due to the low risk of a noise impact from photovoltaic facilities, no noise impact assessments are conducted for such projects. Environmental noise impact assessments are conducted for wind energy facilities and the following reports were available for the various WEFs in the area:

| Date | Author | Title |
|---|---|---|
| December 2011 | M de Jager, MENCO | Noise Impact Study for Environmental Impact Assessment: Establishment of Wind Energy Facility on various farms North of Loeriesfontein, Northern Cape |

| | | |
|---|---|---|
| April 2015 | M de Jager, EARES | Proposed development of the Dwarsrug Wind Energy Facility near the town of Loeriesfontein, Northern Cape Province |
| January 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Kokerboom 1 wind energy facility North of Loeriesfontein, Northern Cape |
| June 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Kokerboom 2 wind energy facility North of Loeriesfontein, Northern Cape |
| June 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Kokerboom 3 wind energy facility North of Loeriesfontein, Northern Cape |
| August 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Graskoppies Wind Farm North of Loeriesfontein, Northern Cape |
| August 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Ithemba Wind Farm North of Loeriesfontein, Northern Cape |
| August 2017 | M de Jager, EARES | Environmental Noise Impact Assessment for the proposed Hartebeest Leegte Wind Farm North of Loeriesfontein, Western Cape |

Wind turbines generally have a cumulative impact on the acoustic environment when they are located closer than 2,000m from receptors that can experience a cumulative effect of the turbines of two or more developments. There is a slight potential for a cumulative noise impact due to the number of wind turbines in the project area (from the Graskoppies, Ithemba, !Xha Boom and Hartebeest Leegte WEFs) (see **Table 154**). Potential cumulative impacts were assessed and presented in **Table 103** (night-time assessment only) in **Section 9.2.6** of the DEIAr.

According to **Table 103**, an increase in sound levels at the dwellings of receptors at night due to cumulative noises is anticipated. The contribution from the !Xha Boom WF is insignificant (less than 1 d), but the cumulative effect of the number of wind turbines operating in the area may result in a maximum noise level of up to 46.7 dBA at NSD03. This is higher than the recommended 45 dBA night-time noise limit (as set by the International Finance Corporation for a night-time residential use). There is a potential for a cumulative impact and mitigation measures and required should the owner will use this property for residential purposes. These are included in **Table 103**.

The proposed wind farm will be too far from the Loeriesfontein and Dwarsrug Wind Farms for cumulative noises to be of any concern. If the distance between the wind turbines of two wind farms are further than 4,000m, cumulative noise impacts are non-existent. This is illustrated in **Figure 123** below.

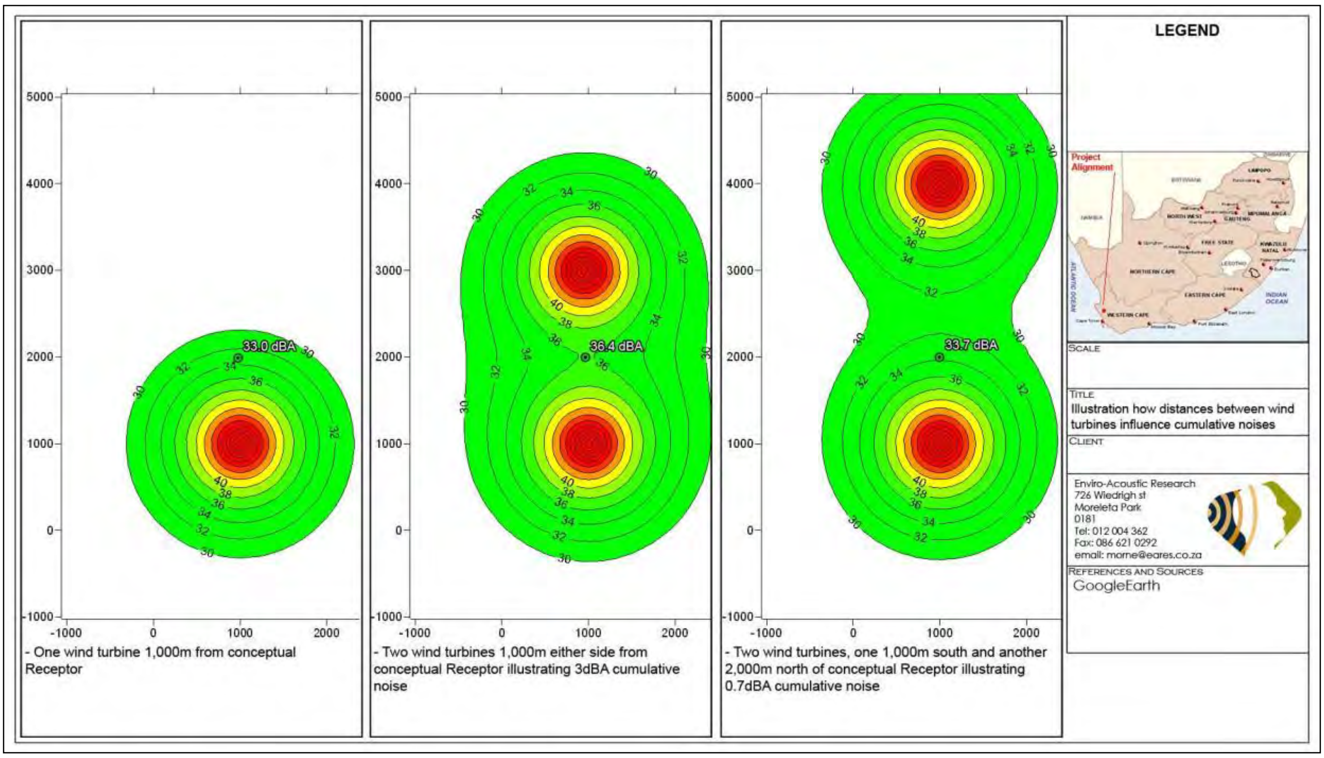



**Figure 123:** Effect of distance between wind turbines – potential cumulative noise levels

## 10.7 Visual Impacts

The other renewable energy facilities being proposed nearby and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, if constructed. As previously mentioned, the height of the proposed development in combination with distance are critical factors when assessing visual impacts. It must be noted that for the purpose of this study, renewable energy developments within a 55km radius of the !Xha Boom Wind Farm application site were identified and mapped. The cumulative visual impact experienced by each potentially sensitive visual receptor will however depend on the number of proposed developments within viewing distance of the receptor location. Solar energy facilities are unlikely to be visible beyond 5km, while wind energy facilities are unlikely to be visible beyond 8km and as such the degree of visual impact on receptors beyond these distances would be considered to be insignificant.

The proposed renewable energy developments identified are indicated in **Table 150** and **Figure 121**.

The number of proposed developments that each receptor would be visually exposed to (i.e. the cumulative impact experienced at each site) is indicated in **Table 155** below. It should be noted that the impact at each receptor location is indicative of the 'worst case' scenario which assumes that all of the proposed facilities would be developed.

It should be noted that no layout information could be sourced for each proposed renewable energy facility during the time of this study. The distance of the potentially sensitive receptor locations from the actual layout could therefore not be utilised to determine whether the receptor is likely to be visually exposed to the development. As such, the distance from the farm / property on which each renewable energy development is proposed was used to calculate the cumulative visual impact.

Other factors affecting visibility, such as localised screening from trees or topographical undulations have not been factored into the cumulative impact assessment. Instead the assessment should be seen as a representation of the number of proposed renewable energy facilities likely to be visible from each potentially sensitive receptor location, if they were all constructed.

**Key**

| |
|---|
| Likely to be visually exposed to the proposed development (within viewing distance) |
| Limited visual exposure to the proposed development (not within viewing distance) |

**Table 155:** Cumulative visual impact from the potentially sensitive receptor locations identified within the study area

| PROPOSED RENEWABLE ENERGY FACILITY | DEVELOPER | POTENTIALLY SENSITIVE VISUAL RECEPTOR LOCATION | | | |
|---|---|---|---|---|---|
| | | VR 5 | VR 13 | VR 18 | VR 44 |
| Dwarsrug Wind Farm | Mainstream Renewable Power | | | | |
| Khobab Wind Farm | Mainstream Renewable Power | | | | |
| Loeriesfontein 2 Wind Farm | Mainstream Renewable Power | | | | |
| Graskoppies Wind Farm | Mainstream Renewable Power | ✓ | ✓ | ✓ | |
| Hartebeest Leegte Wind Farm | Mainstream Renewable Power | | ✓ | | ✓ |
| Ithemba Wind Farm | Mainstream Renewable Power | ✓ | ✓ | ✓ | |
| Loeriesfontein PV3 Solar Energy Facility | Mainstream Renewable Power | | | | |
| Hantam PV Solar Energy Facility | Solar Capital (Pty) Ltd | | | | |
| PV Solar Power Plant | BioTherm Energy | | | | |
| Kokerboom 1 Wind Farm | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | | | | |
| Kokerboom 2 Wind Farm | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | | | | |
| Kokerboom 3 Wind Farm | Business Venture Investments No. 1788 (Pty) Ltd (BVI) | | | | |
| Wind Farm | Mainstream Renewable Power | | | | |

As indicated in the table above, the greatest cumulative impact will be experienced from VR 13 as this potentially sensitive receptor location could potentially be visually exposed to the proposed Graskoppies, Hartebeest Leegte and Ithemba Wind Farms, in addition to the proposed !Xha Boom Wind Farm, should they all be constructed. In addition, VR 5 and VR 18 are expected to be visually exposed to the proposed Graskoppies and Ithemba Wind Farms should they all be constructed. It should be noted that VR 44 is only expected to be visually exposed to the proposed Hartebeest Leegte Wind Farm should this be constructed. As is evident in the table above, the proposed Graskoppies and Ithemba Wind Farms are expected to result in the greatest cumulative visual impacts as three (3) of the identified potentially visual receptor locations (namely VR 5, VR 13 and VR 18) could potentially be exposed to these wind farms should they all be constructed. However, as indicated in the table above, none of the potentially sensitive visual receptors are expected to be visually exposed to any of the other renewable energy developments proposed within a 55km radius should they all be constructed. As such, the identified potentially sensitive visual receptor locations are only expected to be visually exposed to the proposed Graskoppies, Hartebeest Leegte and Ithemba Wind Farms, should they all be constructed.

It should be noted that a literature review of visual impact assessments / studies which were undertaken for the other nearby renewable energy developments (both solar and wind) proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site was undertaken to ascertain any additional cumulative impacts that should be taken into consideration. Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012 and are therefore no longer publically available. The information (including visual impact specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding proposed renewable energy sites that were taken into account are shown in **Table 156** below.

It should be noted that **Table 156** is only a summary table which details the final significance ratings of the visual impact assessments / studies which were undertaken for the other nearby renewable energy developments. A more detailed table (i.e. **Table 20** in the Visual Impact Assessment Report), which includes the relevant impacts which were taken into consideration, proposed mitigation measures and significance rating of the impacts after mitigation, has however been provided in Appendix C of the Visual Impact Assessment Report and can be used should more information be required about the other renewable energy developments being proposed nearby.

**Table 156:** Literature Review - Summary of Final Significance Ratings of Other Visual Impact Assessments / Studies Undertaken for the Other nearby Proposed Renewable Energy Developments

| Project | EAP / VIA Specialist / Company that completed Impact Assessment | Impacts Significance Rating after Mitigation |
|---|---|---|
| Dwarsrug Wind Farm | Veronique Evans and Andrea Gibb of SiVEST Environmental Division | 1) Low negative;<br>2) Low negative;<br>3) Medium negative; and<br>4) Low negative. |
| Khobab Wind Farm | Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium; and<br>4) Negative medium. |

| | | |
|---|---|---|
| Loeriesfontein 2 Wind Farm | Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium; and<br>4) Negative medium. |
| Graskoppies Wind Farm | Kerry Schwartz, Stephan Jacobs and Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium;<br>4) Negative medium;<br>5) Negative low; and<br>6) Negative medium. |
| Hartebeest Leegte Wind Farm | Stephan Jacobs and Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium;<br>4) Negative medium;<br>5) Negative low; and<br>6) Negative medium. |
| Ithemba Wind Farm | Stephan Jacobs and Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium;<br>4) Negative medium;<br>5) Negative low; and<br>6) Negative medium. |
| Loeriesfontein PV3 Solar Energy Facility | Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative low; and<br>4) Negative low. |
| BioTherm PV Solar Power Plant | Alice McClure of Digby Wells Environmental | 1) Low;<br>2) Low; and<br>3) Low and Medium-Low. |
| Kokerboom 1 Wind Farm | Stephen Stead of Visual Resource Management (VRM) Africa | Since the Scoping Phase VIA Report did not assess the potential impacts associated with the proposed wind farm during construction and operation, post-mitigation significance scores have not been provided.<br><br><u>The following Post-Mitigation Significance scores are anticipated for the potential visual impacts to be assessed further during the EIA Phase:</u><br>1) Negative medium;<br>2) Negative very low; and<br>3) Negative very low. |

| | | |
|---|---|---|
| Kokerboom 2 Wind Farm | Stephen Stead of Visual Resource Management (VRM) Africa | Since the Scoping Phase VIA Report did not assess the potential impacts associated with the proposed wind farm during construction and operation, post-mitigation significance scores have not been provided.<br><br>The following Post-Mitigation Significance scores are anticipated for the potential visual impacts to be assessed further during the EIA Phase:<br>1) Negative medium;<br>2) Negative very low; and<br>3) Negative very low. |
| Kokerboom 3 Wind Farm | Stephen Stead of Visual Resource Management (VRM) Africa | Since the Scoping Phase VIA Report did not assess the potential impacts associated with the proposed wind farm during construction and operation, post-mitigation significance scores have not been provided.<br><br>The following Post-Mitigation Significance scores are anticipated for the potential visual impacts to be assessed further during the EIA Phase:<br>1) Negative medium;<br>2) Negative very low; and<br>3) Negative very low. |
| Mainstream Wind Farm | Andrea Gibb of SiVEST Environmental Division | 1) Negative low;<br>2) Negative low;<br>3) Negative medium; and<br>4) Negative medium. |

In terms of the literature review undertaken on the above visual specialist reports, it can be noted that the findings of the other specialist studies identified similar impacts for each of the other renewable energy developments mentioned above. This is mainly due to the fact that SiVEST was appointed as the specialist to undertake the visual impact assessments for the majority of the other renewable energy developments being proposed within a 55km radius of the !Xha Boom Wind Farm application site (i.e. the Dwarsrug, Khobab, Loeriesfontein 2, Graskoppies, Hartebeest Leegte and Ithemba Wind Farms, as well as the Loeriesfontein PV3 Solar Energy Facility). As such, these visual specialist studies are considered to be in line with this VIA as they have identified and assessed the same impacts and have also provided similar recommendations and/or mitigation measures. The identified impacts 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 on sensitive and potentially sensitive visual receptors and the visual impacts on the visual quality of the landscape and sense of place.

It should however be noted that some of the visual specialist studies undertaken by SiVEST for the other nearby renewable energy developments (such as for the Khobab and Loeriesfontein 2 Wind Farms, as well as the Loeriesfontein PV3 Solar Energy Facility) assessed both day-time and night–time visual impacts during construction and operation, something which this VIA report has not done. This VIA report has however described the visual character of the study area at night-time and has also adequately discussed the potential night-time visual impacts that are expected as a result of the construction and operation of the proposed !Xha Boom Wind Farm (section 6.3 of the Visual Impact Assessment Report). SiVEST are therefore of the opinion that the visual specialist studies that were reviewed are in line with this VIA report as the visual impacts which were identified and assessed are similar to those identified in this VIA. As such, this VIA is deemed to have adequately defined, identified and assessed the cumulative visual impacts which could arise as a result of the development of the other renewable energy developments (both wind and solar) being proposed and/or constructed within a 55km radius of the !Xha Boom Wind Farm application site.

As previously mentioned, the visual impact assessment undertaken for the proposed !Xha Boom Wind Farm has provided recommendations and/or mitigation measures which are in-line with those recommended in the other visual specialist studies. In addition, the other visual impact assessments which were reviewed have also provided similar recommendations and/or mitigation measures to this report. As such, the recommendations and/or mitigation measures provided in this VIA report are considered to be sufficient to reduce the visual impacts experienced within the study area. Additionally, recommendations and/or mitigation measures which have been not been considered in this VIA will be considered and implemented in this report accordingly, should they be deemed necessary. Should all of the suggested recommendations and/or mitigation measures be implemented, it is anticipated that the visual impacts associated with the renewable energy developments could be mitigated to acceptable levels. This will also reduce the significance of the identified visual impacts and will aid in reducing the cumulative impacts experienced as a result of the other renewable energy facilities being proposed and/or constructed within a 55km radius of the !Xha Boom Wind Farm application site. This was evident during the review of the other specialist studies as the significance rating for all of the identified impacts were deemed to be of medium to low negative significance after the implementation of mitigation measures. It should also be noted that none of the impacts identified in the other visual specialist studies were deemed to be of high significance after the implementation of mitigation measures. Additionally, with the correct mitigation and integrating planning, the significance rating of the cumulative impacts will be relatively low due to the nature of the study area.

It should be noted that the visual impact assessment undertaken for the proposed Dwarsrug Wind Farm recommended that turbines should be repaired promptly in the operation phase, as they are considered more visually appealing when the blades are rotating (or at work). In addition, it was also recommended that 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 chaotic landscapes made up of diverse colours, textures and patterns. Additionally, as previously mentioned, some of the visual specialist studies undertaken by SiVEST for the other nearby renewable energy developments have identified and assessed both day-time and night–time visual impacts which are anticipated during construction and operation and have also provided recommendations and/or mitigation measures for these impacts. In addition, the significance rating for these day-time and night-time visual impacts were deemed to be of medium to low negative significance after the implementation of mitigation measures. The recommendations and/or mitigation measures provided for the above-mentioned day-time and night-time visual impacts are however similar to those provided in this VIA. The recommendations and/or mitigation measures provided in this report are thus considered to be sufficient to reduce the visual impacts experienced within the study area. The only additional recommendations and/or mitigation measures which should be considered with regards to the identified day-time and night-time visual impacts include limiting construction activities to day-time hours in order to prevent night lighting during construction and not locating any wind turbines or PV panels within 500m from an existing farmstead / homestead / dwelling. However, based on the findings of the field-based investigation for this VIA, a minimum of 500m buffer zone was applied to the potentially sensitive visual receptors (i.e. farmstead / homesteads / dwellings) identified within the proposed !Xha Boom Wind Farm development area or application site. It must also be noted that Mainstream applies a 1km buffer which is preferable. As such, this recommendation / mitigation measure has been adequately addressed.

The visual specialist for the 70MW BioTherm PV Solar Power Plant proposed on Portion 5 of the Farm Kleine Rooiberg No. 227 has identified specific visual impacts which are expected during the decommissioning of the proposed PV plant. These include potential impacts on the aesthetics of the landscape around the town of Loeriesfontein, including the positive visual impacts of rehabilitating the land after decommissioning. As such it has been recommended that, should decommissioning be required, the infrastructure should be demolished and removed as quickly and efficiently as possible. In addition, best practice rehabilitation methods should be adopted. It was also recommended that a representative sample of indigenous plant species should be selected and planted during remediation and rehabilitation and that the possible tourism aspect of the solar PV power plant should be explored and promoted. The visual specialist studies undertaken for the other renewable energy developments being proposed and/or constructed within a 55km radius of the !Xha Boom Wind Farm application site have however not undertaken a detailed assessment of the visual impacts which are expected during the decommissioning of a renewable energy development and have only stated that visual impacts anticipated during decommissioning are potentially similar to those during the construction phase. As such, the above-mentioned recommendations / mitigation measures associated with the decommissioning phase should be considered for this project and could potentially be implemented should the proposed !Xha Boom Wind Farm need to be decommissioned in the future. In addition, it is also recommended that Mainstream explore and promote the possible tourism aspect of the proposed !Xha Boom Wind Farm. This could have a positive influence for the study area as it is not typically valued or utilised for its tourism potential. With regards to cumulative impacts, it was stated that despite the successive visual impact that the solar panels will potentially create, the cumulative impact is likely to be negligible due to the visual context. All of the proposed project sites are situated in a remote landscape and are a fair distance form any human settlements.

It should be noted that the proposed Kokerboom 1, 2 and 3 Wind Farm projects were only in the scoping phase when the Visual Impact Assessment Report was compiled and thus detailed impact assessments with regards to the potential impacts expected to be associated with the three (3) proposed wind farms were not avialable. The VIA reports for the three (3) proposed Kokerboom Wind Farms have rather identified anticipated potential impacts, opportunities and constraints associated with the respective proposed Kokerboom Wind Farms and potential visual impacts to be assessed further during the EIA Phase of the respective Kokerboom Wind Farm projects. The potential visual impacts which will be assessed further during the EIA phase include loss of natural landscapes during the construction phase, visual impacts caused by lighting during the operation phase and unsightly litter on site during the operation phase. As such, the visual impacts which will be assessed further during the EIA phase are similar to those identified in this report. Should any additional significant visual impacts be identified during the EIA phase of the three (3) proposed Kokerboom Wind Farm projects, these should be considered for this VIA and potentially be implemented. Additionally, the predominant visual issue of concern for the three (3) proposed Kokerboom Wind Farm projects is the potential for regional cumulative impacts. Due to the uniformity of the landscape, the combined wind turbines have the potential to generate an interesting wind turbine landscape that can be visually impressive. However, the potential massing effect would need to be further evaluated during the impact assessment phase. In light of the above, no specific mitigation measures and/or recommendations have been included in the scoping phase VIA reports. It is assumed that specific mitigation measures and/or recommendations will be investigated and provided in the EIA Phase when the potential visual impacts are assessed further. Some recommendations / mitigation measures were however provided for the potential visual impacts which will be assessed further during the EIA Phase. These recommendations / mitigation measures are similar to those provided in this VIA and thus the recommendations and/or mitigation measures provided in this report are considered to be sufficient to reduce the visual impacts experienced within the study area. It should however be noted that the VIA for the proposed Kokerboom 3 Wind Farm has preliminarily recommended that a spatial buffer be maintained to the west of the Nuwepos road in order to reduce visual massing effects as seen from the gravel road users. Although the area is remote and currently limited in traffic with no proximate tourist destinations, the combined wind farm landscape could create an interesting attraction. However, for this to take place the massing effects should be reduced as much as possible increasing the visual appeal and spatial landscape patterning of the wind farm landscape. In this regards, a setback from the gravel road is proposed. The possibility of following a similar construction setback, which mirrors the Khohab WEF configuration from the gravel road, should be investigated. This setback also reduces the massing effects created by the combined views of the Kokerboom 3 and Loeriesfontein Wind Farms. It is therefore recommended that the above-mentioned mitigation measure pertaining to the setback from the gravel road be considered and implemented for the proposed !Xha Boom Wind Farm.

In light of the above, this VIA is deemed to have clearly defined the identified cumulative impacts, and has indicated how the recommendations, mitigation measures and conclusions of the other visual impact specialist reports have been taken into consideration when drafting this VIA report.

## 10.8 Heritage and Palaeontology Impacts

This section evaluates the possible cumulative impacts on heritage resources with the addition of the !Xha Boom WEF. The cumulative impact on heritage resources evaluated a 30-kilometer radius (**Figure 121**). It must further be noted that the evaluation is based on available heritage studies and cannot take the findings of outstanding studies on current ongoing EIA's in consideration.

The following must be considered in the analysis of the cumulative effect of development on heritage resources:

- **Fixed datum or dataset:** There is no comprehensive heritage data set for the Loeriesfontein region and thus we cannot quantify how much of a specific cultural heritage element is present in the region. The region has never been covered by a heritage resources study that can account for all heritage resources. Further to this none of the heritage studies conducted can with certainty state that all heritage resources within the study area has been identified and evaluated ;
- **Defined thresholds**: The value judgement on the significance of a heritage site will vary from individual too individual and between interest groups. Thus implicating that heritage resources' significance can and does change over time. And so will the tipping threshold for impacts on a certain type of heritage resource;
- **Threshold crossing**: In the absence of a comprehensive dataset or heritage inventory of the entire region we will never be able to quantify or set a threshold to determine at what stage the impact from developments on heritage resources has reached or is reaching the danger level or excludes the new development on this basis. (Godwin, 2011)

Keeping the above shortcomings in mind, the methodology in evaluating cumulative impacts on heritage resources will be followed for the Impact Assessment phase.

The analysis of the competed studies as listed below (**Figure 121**), taking in to account the findings and recommendation of each of the nine evaluated HIA's.

- MORRIS, DAVID. 2007. Archaeological Specialist input with respect to the upgrading railway infrastructure on the Sishen-Saldahna ore line in the vicinity of Loop 7a near Loeriesfontein. McGregor Museum.
- FOURIE, WOUTER. 2011. Heritage Impact Assessment for the proposed Solar Project on the farm Kaalspruit, Loeriesfontein. PGS Heritage and Grave Relocation Consultants.
- ALMOND, J.E. 2011. Palaeontological Desktop Study for the Proposed Mainstream Wind Farm Near Loeriesfontein, Namaqua District Municipality, Northern Cape Province.
- VAN SCHALKWYK, J. 2011. Heritage Impact Assessment for the proposed establishment of a wind farm and PV facility by Mainstream Renewable Power in the Loeriesfontein Region, Northern Cape Province.
- VAN DER WALT, JACO. 2012. Archaeological Impact Assessment for the proposed Hantam PV Solar Energy Facility on the farm Narosies 228, Loeriesfontein, Northern Cape Province.
- WEBLEY, L & HALKETT, D. 2012. Heritage Impact Assessment: Proposed Loeriesfontein Photo-Voltaic Solar Power Plant On Portion 5 of the Farm Klein Rooiberg 227, Northern Cape Province.
- MORRIS, DAVID. 2013. Specialist Input for the Environmental Basic Assessment and Environmental Management Program for the Khobab Wind Energy Facility: Power Line Route Options, Access Road and Substation Positions.

- ORTON, JAYSON. 2014. Heritage Impact Assessment for the proposed re-alignment of the authorized 132kV Power Line for the Loeriesfontein 2 WEF, Calvinia Magisterial District, Northern Cape.
- Fourie, W. 2015. Heritage Impact Assessment for the proposed establishment of the Dwarsrug wind farm and PV facility in the Loeriesfontein Region, Northern Cape Province.

It the Heritage Specialist's considered opinion that the additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate.

- **<u>Palaeontology:</u>**

The cumulative effect of the development of the proposed construction of the proposed !Xha Boom Wind Farm near Loeriesfontein in the Northern Cape is considered to be low. This is as a result of the broader Loeriesfontein area not having numerous well preserved fossils.

## 10.9 Socio-Economic Impacts

### *10.9.1 Existing and Planned Developments in the area*

In recent years, developers of various renewable energy projects have taken a notable interest in the area where the !Xha Boom Wind Farm is proposed to be established. A likely contributing factor to this, is linked to the wind and solar energy potential of the region. Such developments, whether they are approved or are only at the proposal stage, need to be taken into consideration as they have a potential to create numerous positive or negative socio-economic impacts.

Positive impacts include the creation of employment opportunities, training and skills development, increased household income and standard of living as well as the potential for the creation of local business opportunities which have the capacity to stimulate the local economy. Negative cumulative socio-economic impacts include the possibility of altering the sense of place, an increase in social pathologies due to the influx of migrant workers and jobseekers thus exacerbating the pressure on basic services and social infrastructure. Projects near the proposed project site for the !Xha Boom Wind Farm are depicted in **Figure 124** below, two of the projects (Loeriesfontein 2 and Khobab wind farms are under construction whilst the third project (Solar Capital PV facility) has received authorisation and approval under the REIPPPP.

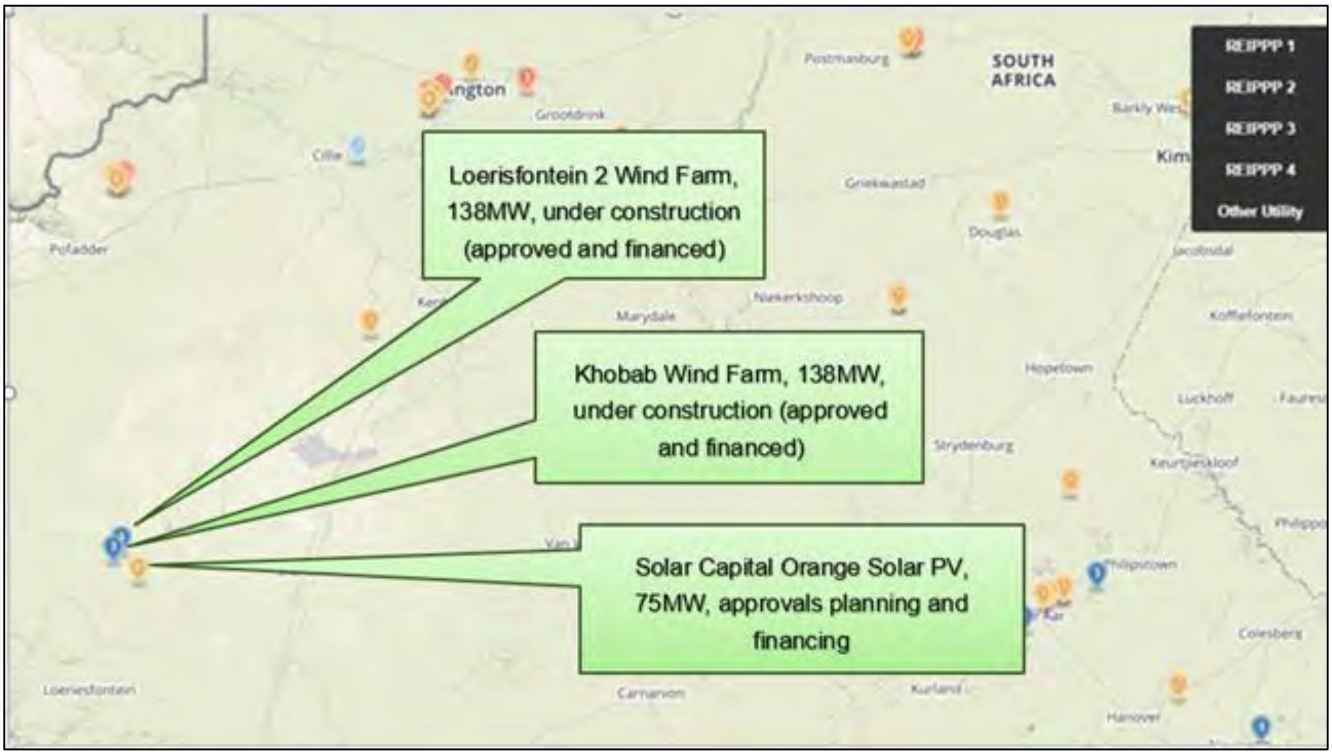



**Figure 124:** Map for approved for construction renewable energy projects in the area as part of the REIPPPP

In the event that there is an addition to the currently existing projects depicted above, both positive and negative socio-economic impacts will be aggravated. As can be seen in **Table 150**, five out of the eleven projects proposed to be built near the !Xha Boom Wind Farm have received authorisation. This means that the likelihood of their construction is high implying a significant cumulative impact to follow.

The projects mentioned in **Table 150** are illustrated in **Figure 121**, which also assist in identifying their locations in relation to the proposed !Xha Boom Wind Farm. The Khobab and Loeriesfontein 2 wind farms have been under construction since the year 2015 whilst the rest of the projects are yet to begin construction. Due to the fact that the timelines of the projects that have already received environmental authorisation and those that are currently under investigation are uncertain, two possible extreme scenarios could be foreseen assuming that all of these projects are implemented at a certain point in time in the future. The first scenario is premised on the assumption that all the projects will be developed at the same time, whilst the second extreme scenario would be that all projects are developed one after another. From the quantitative impacts perspective, both scenarios will lead to the same impact on the GDP-R, employment, and household income; however, they may have a different effect on the standard of living and the social pathologies of the local community due to the level of concentration of the potential impacts that could be created at any given point in time. The difference will lie in whether the impacts become concentrated (generated over a short period of time), or they all take place at the same time. Seeing that it is impossible to conclude with certainty, which of these options would be realised, for the purposes of this study, it is assumed that project are built at the same time.

### 10.9.2 Literature Review Sources

The following documents were reviewed in relation to the above-mentioned projects to identify the potential cumulative effect of the proposed development considering the existing and planned projects in the area.

**Table 157:** Reviewed literature concerning the selected developments in the area

| Development | Reviewed Report | Author | Date of Release |
|---|---|---|---|
| Dwarsrug Wind Farm | Socio-economic Impact Study | Urban-Econ Development Economists | May 2015 |
| Khobab Wind Farm | Socio-economic Impact Assessment Report | Master-Q Research | 2 May 2012 |
| Loeriesfontein 2 Wind Farm | Socio-economic Impact Assessment Report | Master-Q Research | 2 May 2012 |
| Graskoppies Wind Farm | Socio-economic Impact Assessment Report | Urban-Econ Development Economists | November 2016 |
| Hartebeest Leegte Wind Farm | Socio-economic Impact Assessment Report | Urban-Econ Development Economists | November 2016 |
| Ithemba Wind Farm | Socio-economic Impact Assessment Report | Urban-Econ Development Economists | November 2016 |
| Hantam PV Solar Energy Facility | Not Available | N/A | N/A |
| PV Solar Power Plant | Draft Environmental Management Programme | Digby Wells | 15 September 2015 |
| Kokerboom 1 Wind Farm | Final Scoping Report | Aurecon | December 2016 |
| Kokerboom 2 Wind Farm | Final Scoping Report | Aurecon | December 2016 |
| Kokerboom 3 Wind Farm | Final Scoping Report | Aurecon | December 2016 |
| Wind Farm | Socio-economic Impact Assessment Report | Master-Q Research | 2 May 2012 |

### 10.9.3 Identification of Cumulative Effects

The following table summarises the key socio-economic impacts that were identified and analysed by other specialists for the above-mentioned projects. The table indicates the rating of the identified socioeconomic impacts as proposed by the other specialists in their respective studies, and based on the combination of these ratings indicates the importance of the socio-economic impact from a cumulative effect perspective. Only cumulative effects that are expected to reach high importance level are included in further analysis.

**Table 158:** Reviewed literature concerning similar developments and impact rating

| Capital | Environmental Parameter | Description/Impact | Rating by Specialist | Identified Importance |
|---|---|---|---|---|
| **Natural Capital** | Agricultural activities in zone of influence | **Dwarsrug wind Farm**: Impact on agricultural activities on the directly affected farms due to movement of vehicles and workers, and established infrastructure. | Low negative | Low-medium negative |
| | | **Kokerboom 1, 2 & 3 wind farms**: Transforming the land to industrial use will result in the loss of agricultural land. | Low negative | |
| | Access to resources for Sustainable livelihood | **Loeriesfontein PV3 Solar Energy Facility, Wind farm, Khobab wind farm, Loeriesfontein 2 wind farm:** Site access and clearance of land can result in long term loss of land, resulting in a change in access to resources to sustain livelihoods. | Low negative | |
| **Human Capital** | Temporary employment creation | **Dwarsrug wind Farm:** The establishment of the wind farm will create employment opportunities from direct, indirect and induced impacts. | Low positive | Medium-high positive |
| | | **Khobab & Loeriesfontein 2 wind farms:** Unemployed residents will benefit from being trained and receiving employment | | |
| | | **Loeriesfontein PV3 Solar Energy Facility and Wind Farm:** It is estimated that the development will create a few temporary jobs | | |
| | | **Graskoppies, Hartebeest Leegte, Ithemba, Kokerboom 1, 2 & 3 wind farms:** During the establishment of a wind farm, large numbers of workers are required for the duration of the construction phase. | Medium positive | |
| **Social capital** | Skills development | **Dwarsrug wind Farm:** Long terms skills transfer & skills development will take place as a | Medium positive | Medium-high positive |

| | | | | |
|---|---|---|---|---|
| | | result of the establishment of the project. | | |
| | | **Graskoppies, Hartebeest Leegte & Ithemba wind farms:**<br>Skills development can be expected to be enhanced as those who will receive employment will either be improving an existing skill or acquiring a new skill. | High positive | |
| | | **Khobab & Loeriesfontein 2 wind farms:**<br>The developer is most likely to include foreign experts to encourage knowledge transfer. | Low positive | |
| | | **Kokerboom 1, 2 & 3 wind farms:**<br>There are many unemployed individuals who will benefit from being trained in a specific skill and employed. | Medium positive | |
| | Investment in local community | **Dwarsrug wind farm:**<br>Project owners are required to spend a portion of their turnover on the upliftment of the community where the project is located. | Medium positive | High positive |
| | | **Graskoppies, Harteeest Leegte & Ithemba wind farms:**<br>Part of the IPPPP; project owners are required to allocate a percentage of the projects' revenue towards community development. | High positive | |
| | Demographic Changes | **Graskoppies, Hartebeest Leegte, Ithemba & Dwarsrug wind farms:**<br>An influx in migrant workers and increase in jobseekers is expected to ensue. | Medium negative | Medium negative |
| | | **Kokerboom 1, 2 & 3 Wind farms:**<br>The establishment of these wind farms present attractive job opportunities. | Low negative | |
| | Social pathologies | **Dwarsrug wind farm:**<br>Increase in foot traffic results in an increase in social ills such as poor health, substance abuse, prostitution etc. | Medium negative | Medium-high negative |

| | | | | |
|---|---|---|---|---|
| | | **Graskoppies, Hartebeest Leegte & Ithemba wind farms:** The increase in the number of construction workers is expected to cause a further increase in social pathologies. | High negative | |
| **Cultural & Spiritual Capital** | Socio-cultural: Health and Safety | **Khobab & Loeriesfontein 2 wind farm:** Construction workers employed by the developer increase the average no. of men in the vicinity thus increasing the incidence of communicable diseases. | High negative | High negative |
| | | **Kokerboom 1,2 & 3 Wind farms:** Impact of heavy vehicles including damage to roads, safety and health. | Low negative | |
| **Physical Capital** | Sustainable increase in production & Temporary stimulation of GDP-R | **Dwarsrug, Graskoppies, Hartebeest Leegte & Ithemba wind farms:** The initial capital injection will set of a range of value adding activities resulting in the stimulation of GDP-R and long term production. | High positive | High positive |
| | Added pressure on infrastructure | **Graskoppies, Hartebeest Leegte, Ithemba & Dwarsrug wind farms:** An increase in the number of people in Loeriesfontein, could create additional pressure on the local municipality and aggravate service provision related challenges. | Medium negative | Medium negative |
| **Financial Capital** | Establishment of informal hospitality industry | **Graskoppies, Hartebeest Leegte & Ithemba wind farms:** Formation of informal hospitality industry as a result of the increased demand for accommodation. | Medium positive | Medium positive |
| | Increased household income & standard of living | **Dwarsrug wind farm:** New jobs that will be created will result in increased household income for benefitting individuals. | High positive | High positive |
| | | **Graskoppies, Hartebeest Leegte & Ithemba wind farms:** Increase in household income expected to accrue due to job creation as well as skills development. | Low positive | |
| | Increase in | **Dwarsrug wind farm:** | Low positive | |

| | | | | |
|---|---|---|---|---|
| **Political & Institutional Capital** | government revenue | Government obtains its revenue by collecting taxes and rates from the country's citizen's and business. | | Medium positive |
| | | **Graskoppies, Hartebeest Leegte & Ithemba wind farms:** Government obtains its revenue from collecting taxes and rates from the country's residents and business. | Medium positive | |
| | | **Wind Farm & Loeriesfontein PV3 Solar Energy Facility:** Increased central and local tax income. | Low positive | |

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). In light of the above, and considering the range of socioeconomic impacts predicted to ensue as a result of other planned developments in the area, only one negative cumulative effect was identified, which is expected to be of major importance and concern in the context of this project. This cumulative effect is the envisaged changes to health and safety (specifically infectious diseases such as STI's including HIV/AIDS) of the local communities, and specifically the residents of the town of Loeriesfontein. The assessment of this cumulative effect is provided in **Table 136** in **Section 9.2.9** of the DEIAr.

After the review of the identified impacts as outlined in other specialist reports for the considered developments in the area, major cumulative issues were determined, which were analysed and rated in **Table 136** in **Section 9.2.9** of the DEIAr.

#### *10.9.4 Ranking of Cumulative Effects*

**Table 136** in **Section 9.2.9** of the DEIAr provides the rating of positive and negative cumulative effects identified to be associated with the proposed project and considering the impacts that are expected to be exerted by other proposed developments in the area. According to **Table 136**, the main cumulative impact anticipated from a socio-economic perspective includes negative health-related cumulative impacts. The establishment of two (2) renewable energy projects in the area has had a negative effect on the health of the local community, as was revealed during the interviews. This was attributed to the influx of construction workers and in-migration of jobseekers. Considering the number of other projects that could be developed in the area, the situation could be exacerbated both in terms of the magnitude, as well as the duration. Health-related impacts that are envisaged include drug abuse, alcohol abuse, spread of communicable diseases, and unwanted pregnancies. The above mentioned cumulative impact was rated as having medium negative significance, however, this can be reduced to a low negative impact after the implementation of the relevant recommendations and/or mitigation measures provided in the Socio-Economic Impact Assessment Report.

## 10.10 Path Loss and Risk Assessment (SKA) Impacts

The Karoo area is ideally suited for the installation and commissioning of renewable energy projects, but is also host to the Department of Science and Technology's SKA radio telescope project. Due to the sensitivity of the telescope receivers, there is a risk that unintentional emissions from the systems and associated equipment associated with renewable energy projects will desensitize or saturate the SKA receivers resulting in interference to celestial observations and/or data loss. Such interference is typically referred to as 'Radio Frequency Interference' (or 'RFI').

The cumulative impact assessment is included as a stand-alone report / document and is included along with the Path Loss and Risk Assessment Report in **Appendix 9C** in the DEIAr.

### *10.10.1 Area of Interest*

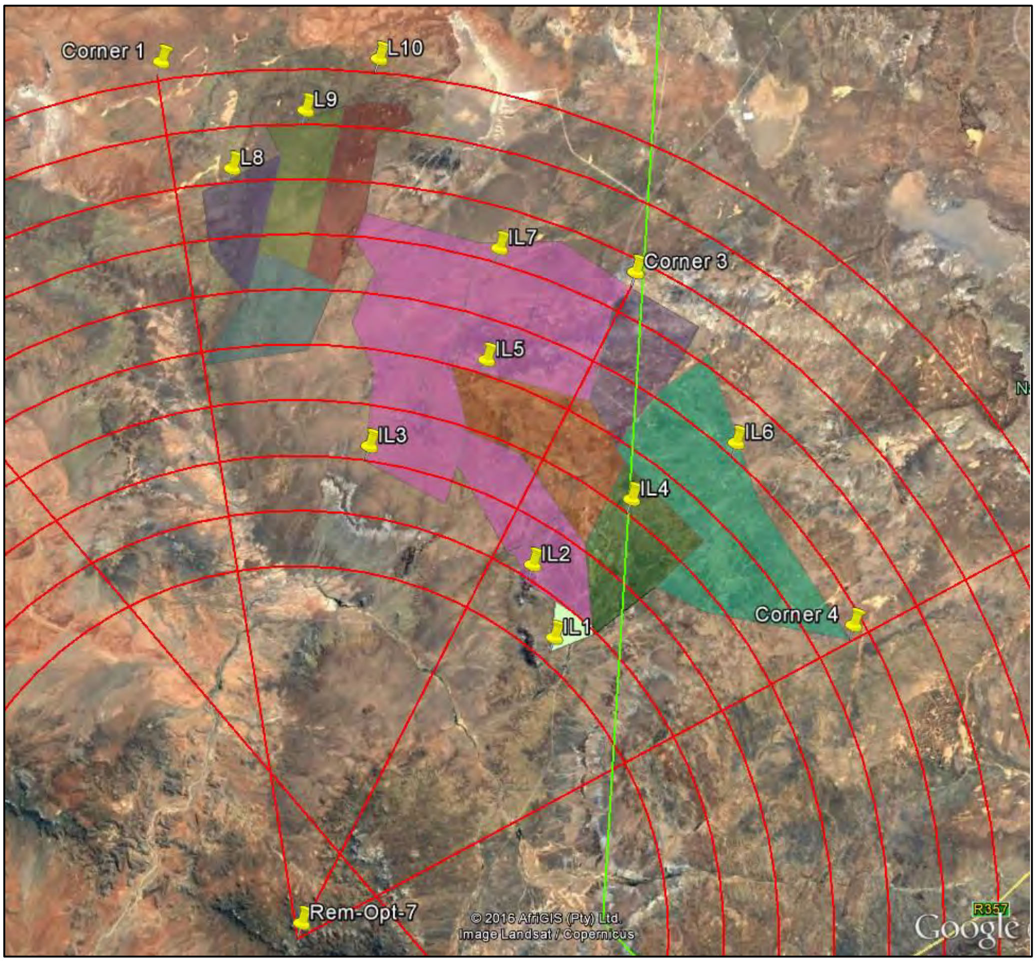



**Figure 125:** Windfarm areas considered for REM OPT 7 evaluation

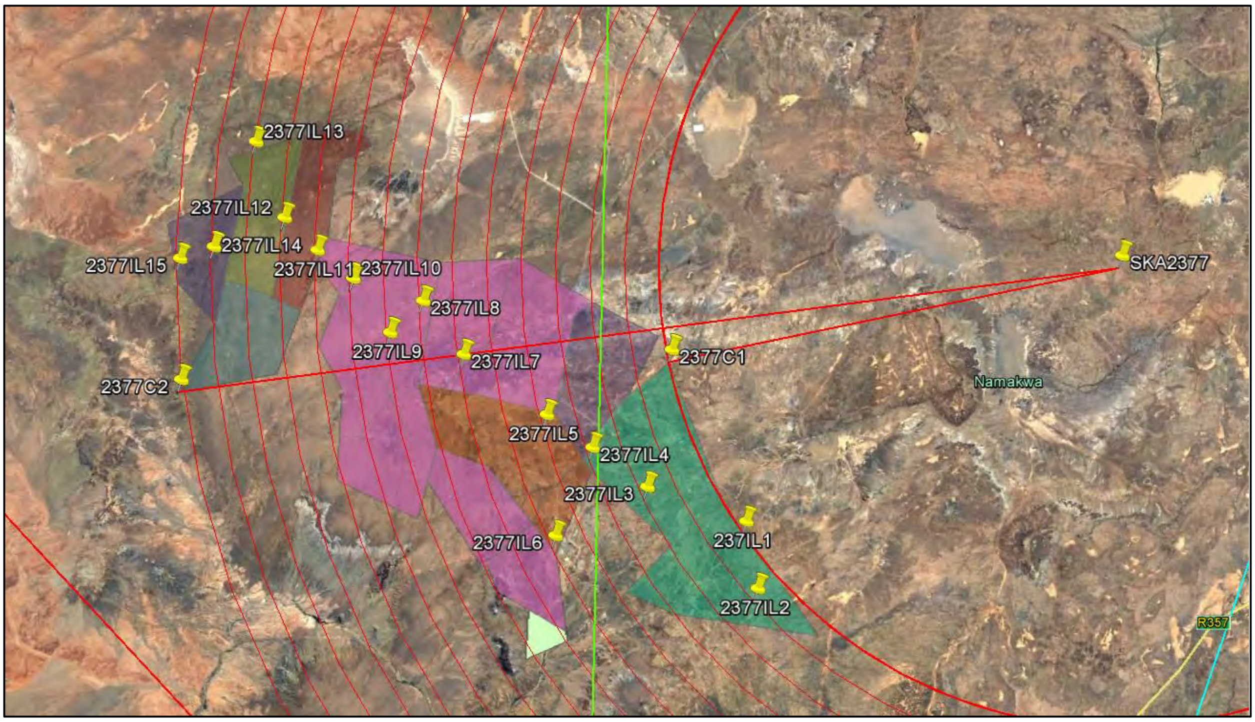



**Figure 126:** Windfarm areas considered for SKA ID 2377 evaluation

**Table 159:** Windfarm capacity and number of turbines

| Development | Current status of EIA/development | Capacity | No. Turbines |
|---|---|---|---|
| Dwarsrug Wind Farm | Environmental Authorisation issued | 140MW | 70 |
| Khobab Wind Farm | Environmental Authorisation issued/Approved under RE IPPPP | 140MW | 61 |
| Loeriesfontein 2 Wind Farm | Environmental Authorisation issued/Approved under RE IPPPP | 140MW | 61 |
| ACED Kokerboom 1 Wind Farm | EIA ongoing | 240MW | 60 |
| ACED Kokerboom 2 Wind Farm | EIA ongoing | 240MW | 60 |
| Graskoppies Wind Farm | EIA ongoing | 140MW | 47 |
| Hartebeest Leegte | EIA ongoing | 140MW | 47 |
| Ithemba Wind Farm | EIA ongoing | 140MW | 47 |
| !Xha Boom Wind Farm | EIA ongoing | 140MW | 47 |

*10.10.2 Calculation Information*

A total of 500 mitigated Acciona model AW 125/3000 turbines with a 150m hub height was used for the NTIA TM-89-139 calculations with an inner ring of 30km and outer ring of 70km. This resulted in 10 rings with a spacing of 4.44km between rings.

Path loss was calculated with SPLAT! at 500MHz. Where the software reported parameters that were out of range, the ITU-R Recommendation P.452-15 model as contained in SEAMCAT was used.

*10.10.3 Data Comparisons*

The following factors have an impact on cumulative emissions:

- Number of emitters (emitter density)
- Path loss due to distance and topography

To avoid tedious path loss calculations for 500 emitters and the exact location of each emitter not being known, the NTIA TM-89-139 “Rings” method was used to calculate the expected cumulative amplitude. The source amplitude of all emitters was assumed to be Acciona mitigated. The levels are described in: ITC Services CP 1609/16: EMISSION CONTROL PLAN THE AW125 TH100A WTG [2]. Path loss was calculated for each of the rings at the calculated distance from the receiver.

The following definitions apply to Business areas (City), Residential areas, Rural areas and quiet rural areas:

Business areas: any area where the predominant usage throughout the area is for any type of business e.g. stores, offices, industrial parks, large shopping centers, main streets or highways etc.

Residential areas (urban or suburban): any area used predominantly for single or multiple dwellings with a density of at least two single family units per 4046 square meter (1 acre) and no large or busy highways.

Rural areas: primarily agricultural or similar purpose with no more than one dwelling per 20234 square meter (5 acres).

The statistical cumulative figure of 10*Log N where N = number of emitters is an overly conservative approach when the emitter number is >63 units. (18dB).

- **NTIA TM-89-139 [2]**

The 500MHz calculation for the REM Opt 7 location showed an expected increase of 17.9dB when comparing one emitter to 500 emitters and 18.3dB for the SKA ID 2377 location.

- **ITU-R P.372-13: Radion Noise**

When comparing the City (high emitter density) with residential and rural data from *ITU-R P.372-13 Table 3: Outdoor man-made noise measurements in Europe (2006-2007)*, the median noise figure increase for the City environment compared with the residential environment is shown in **Figure 127** below. The City median noise figure compared with the residential noise figure as measured in Japan (2009-2011) is also included. Added to **Figure 127** is the Hag et al model (*Naval Ocean System Centre: Techniques for estimating the effects of man-made radio noise on distributed military systems [3]*) that is in line with the measured values presented.

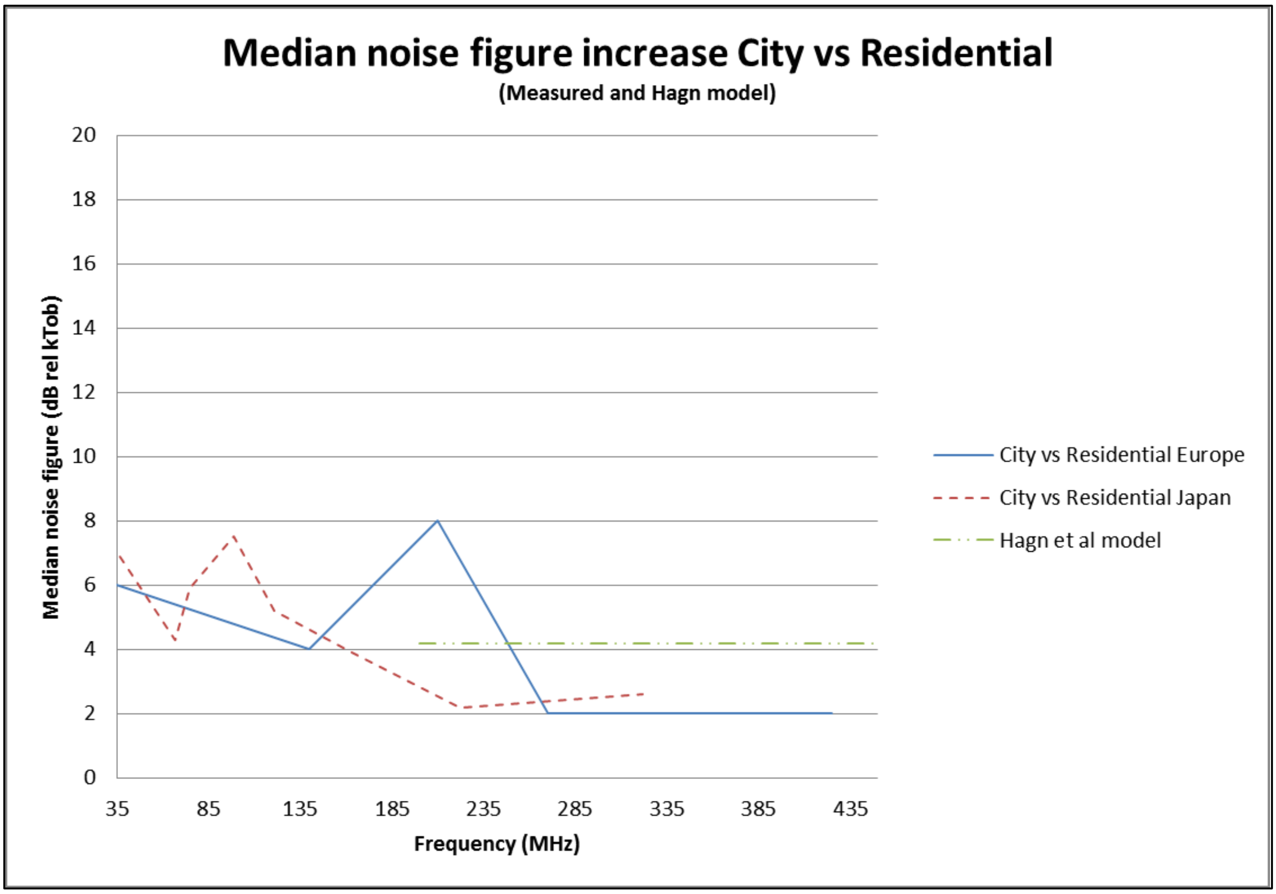



**Figure 127:** Man-made noise measured results (ITU-R P.372-13 Table 3 and Table 4, Hagn eq 8 and 9)

- <u>**Measured Urban, Suburban, Airport and Rural Ambient Emissions**</u>

The emitter density in rural areas is much lower than the urban environment. The urban environment ambient level are the highest as expected, however the increase in the measured bands is <10dB for both vertical and horizontal polarisation as shown in: *World meteorological Organization: Results of Ambient RF environment and noise floor measurements taken in the U.S. in 2004 and 2005 [4]*.

Figure 38 compares the ambient noise levels of each of the sites from an environmental perspective. (The radial axis represents the measured frequency band. The circular axis represents the ambient noise level.)

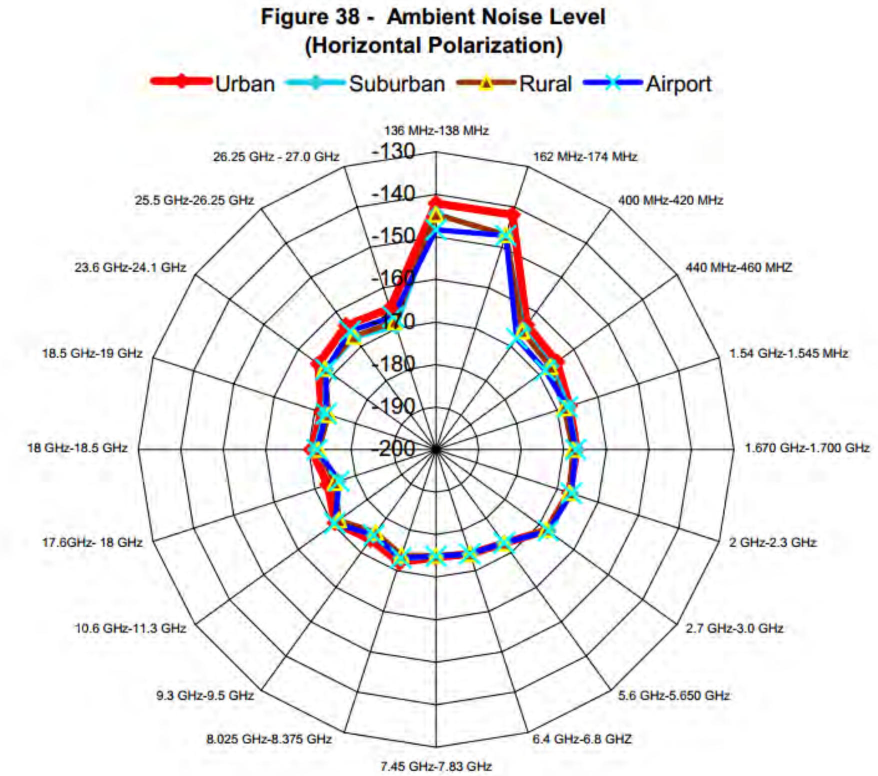



**Figure 128:** Measured ambient data comparison – Horizontal polarization

Figure 43 compares the ambient noise levels of each of the sites from an environmental perspective. (The radial axis represents the measured frequency band. The circular axis represents the ambient noise level.)

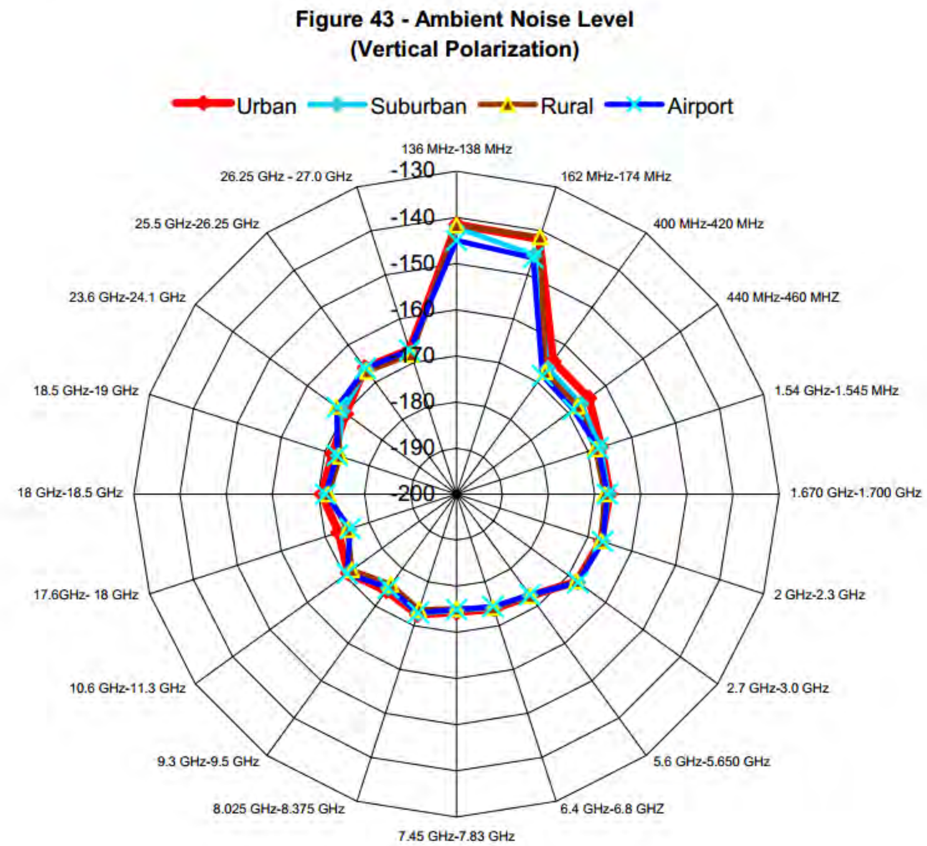



**Figure 129:** Measured ambient data comparison – Vertical polarization

- **<u>Mobile Communication Radio Base Stations</u>**

From *"Comparative international analysis of radiofrequency exposure surveys of mobile communication radio base stations"* it was noted that the installation of more base stations did not result in a marked increase in ambient RF levels as shown in **Figure 130** below. Although often quoted when investigating cumulative effect of multiple sources, it cannot be used as a case study for wind turbine generators as the service quality that consumers expect requires certain signal strength and the signal strength is regulated by the service providers. This would be a driving factor from industry to maintain ambient levels. The base station density per square kilometer is also less than the WTG sites.

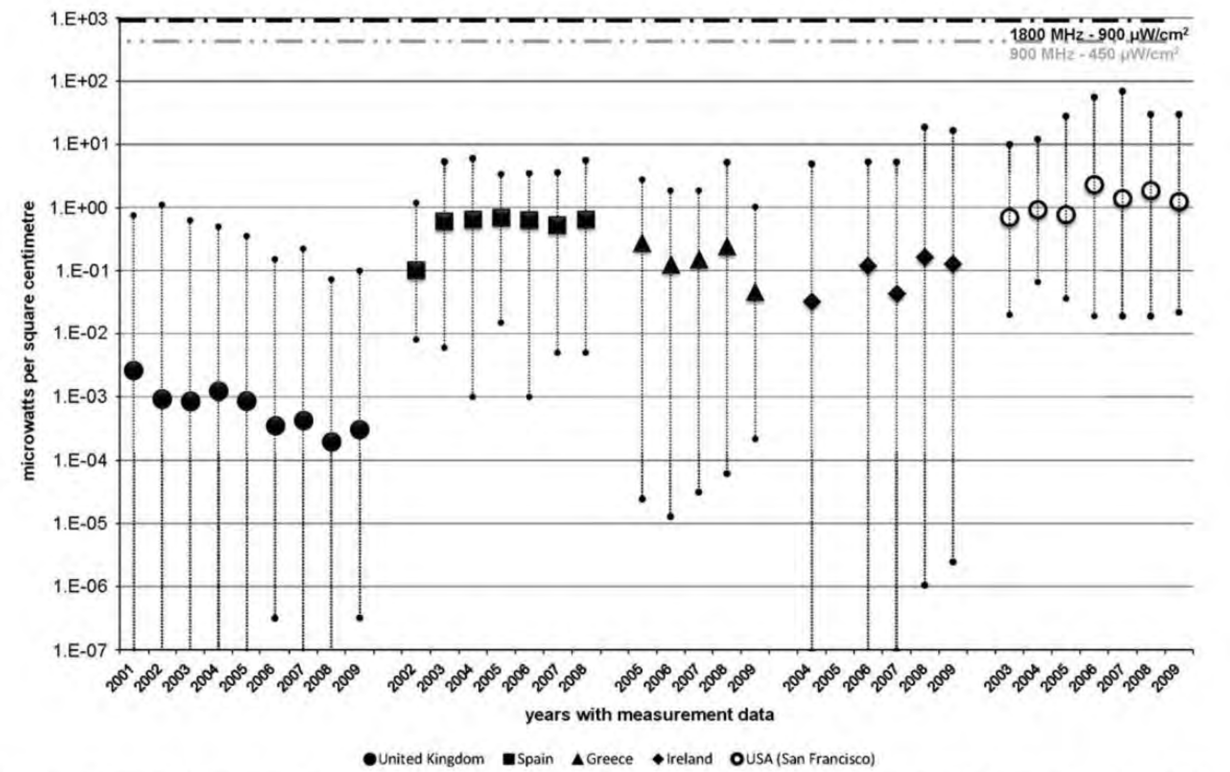



**Figure 2.** Minimum (●), maximum (●) and average of the narrowband measurements for the UK (●), Spain (■), Greece (▲) and Ireland (◆); and the broadband measurements for the US (○), with the year of measurement data on the horizontal axis. Note that not all years were available in all countries. For comparison, the ICNIRP reference level for the public at 900 MHz and 1800 MHz are included.

**Figure 130:** Comparison of ambient data for different years in different countries

*10.10.4 Conclusion*

- The NITIA TM-89-139 calculation of 17.9dB (REM OPT 7 location) and 18.4dB (SKA ID 2377 location) to be added to the emissions from a single unit to allow for the cumulative effect of 500 units appears to be conservative when compare to general man-made noise data (<10dB increase measured at various locations).
- The >60 degree beamwidth assumed during the NITIA TM-89-139 calculations will result in over estimation of the cumulative effect due to a higher number of emitters in the beamwidth.
- The 40dB mitigation is a borderline figure when considering all the adjacent projects resulting in a relatively high emitter density

# 11 DESCRIPTION AND COMPARATIVE ASSESSMENT OF ALTERNATIVES

Prior to the submission of the DEIAr, Mainstream intended to construct 70 turbines on the proposed !Xha Boom Wind Farm site. This number of turbines provided flexibility in that turbines between 3MW and 5MW could be considered. Various environmental specialists assessed the site during the scoping phase. Their assessments encompassed the entire proposed development site and included the identification of sensitive areas. These sensitive areas were used during the scoping phase to perform a preliminary comparison of layout alternatives. These layouts were then extensively investigated in the EIA phase of the project and the sensitive areas identified in the EIA phase are indicated below.

Two (2) alternative locations for the proposed 132kV on-site IPP Substation[8] were comparatively assessed by the specialists during the scoping phase. However, based on the findings from the various specialist scoping phase assessments it was recommended within the approved Plan of Study for the EIA phase that only on-site IPP Substation Option 1 be taken through to the EIA phase. As such, only on-site IPP Substation Option 1 was assessed by the various specialists during the EIA phase and a comparative assessment of alternatives for the on-site IPP substation site was thus subsequently not undertaken during the EIA phase.

The 70 turbine layout alternatives which has taken the EIA phase environmental sensitivities into account is provided in **Figure 131** below.

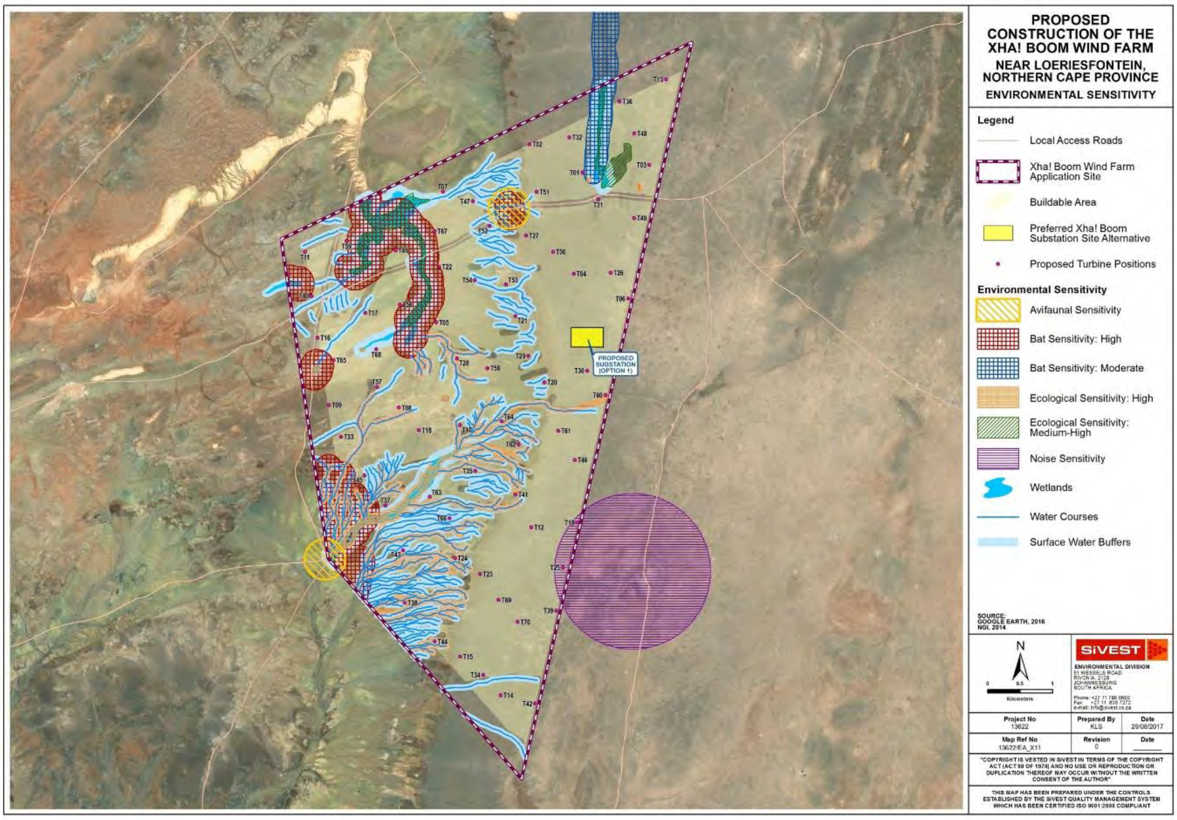



**Figure 131:** Proposed !Xha Boom 70 Turbine Layout Alternatives and EIA Phase Environmental Sensitivity

However, in order to ensure that the proposed wind farm development avoids the EIA phase sensitive areas and does not result in significant environmental impacts, an alternative turbine layout was put forward for assessment with the total number of turbines being reduced to 47. In light of the above, the range of the proposed turbines has been amended to range between 4MW and 8MW. This is deemed to be acceptable considering the fact that Mainstream will not be changing any of the assessed turbine

[8] The O&M buildings and laydown areas will also fall within the proposed on-site substation sites and have therefore been assessed

parameters. The proposed hub height, rotor diameter and max MW will remain the same. This design amendment was done taking the environmental considerations into account. In an attempt to show that the new proposed 47 turbine layout will result in lower / fewer environmental impacts and will ultimately be preferred to the 70 turbine layout from an environmental perspective, the new proposed 47 turbine layout was compared to the previously assessed 70 turbine layout by the specialists during the EIA phase (prior to the submission of the DEIAr) and assessed as a design alternative. As such, the new 47 turbine layout and previously assessed 70 turbine layout were included as design alternatives and comparatively assessed in the EIA phase. In light of the above, the specialists were requested to compile letters commenting on the environmental impact of the final proposed 47 turbine layout. The specialist comment letters included the following information:

- Comparative assessment of the new 47 turbine layout versus the previously assessed 70 turbine layout;
- Indication of whether or not the 47 turbine layout avoids all sensitive areas;
- Indication of whether or not the reduction in turbines is favourable (in terms of impacts etc.);
- Any additional recommendations and/or mitigations measures which need to be implemented as a result of the new turbine layout,
- Any recommendations and/or mitigation measures provided in the impact phase specialist reports which are no longer applicable and can be excluded / removed and state as such); and
- A final environmental impact statement.

The specialist comment letters on the final proposed 47 turbine layout are included along with the respective impact phase specialist reports in **Appendix 6.**

Based on the above-mentioned specialist comment letters on the final turbine layout, the new proposed 47 turbine layout, using larger turbine capacity, was deemed to be the preferred design alternative from an environmental perspective when compared to the previously assessed 70 turbine layout, with a smaller individual capacity. As previously mentioned, only on-site IPP Substation Option 1 was assessed by the various specialists during the EIA phase and a comparative assessment of alternatives for the on-site IPP substation site was thus subsequently not undertaken. Based on the sensitivity mapping and revisions to the layout, the preferred layout for the wind farm and associated infrastructure has avoided the sensitive features identified by the specialists.These EIA phase layout alternatives have been extensively investigated. The highly sensitive areas identified by each specialist study in relation to the EIA phase layout alternatives are presented in **Figure 132** below. Each of these alternatives were comparatively assessed in terms of the findings from the specialist studies conducted during the EIA.

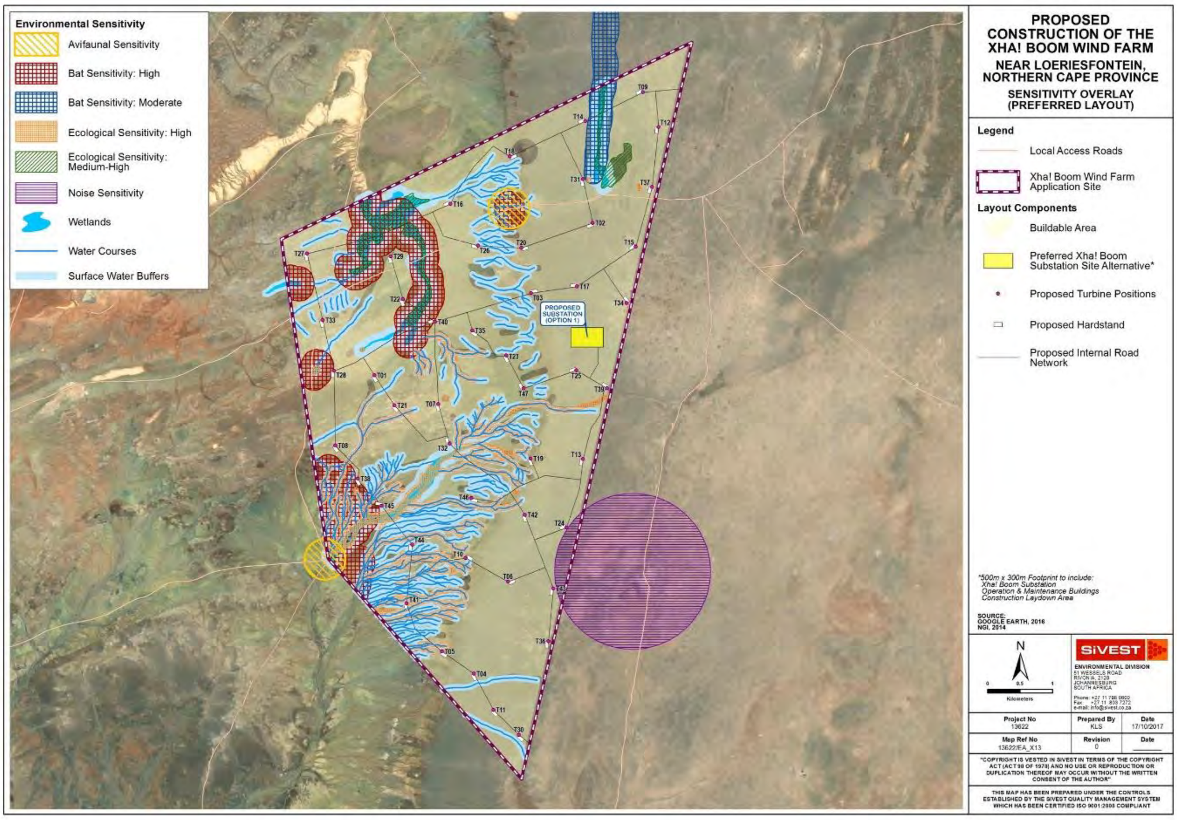



**Figure 132:** Proposed EIA Phase 47 wind turbine layout alternatives in relation to sensitive areas

Additionally, several no-go areas were also identified by some of the specialists and were subsequently incorporated into the EIA phase layout. As a result of the no-go areas, the layout proposed had to be amended slightly in order to avoid these areas. The preferred layout from an environmental perspective is presented in **Figure 133** below.

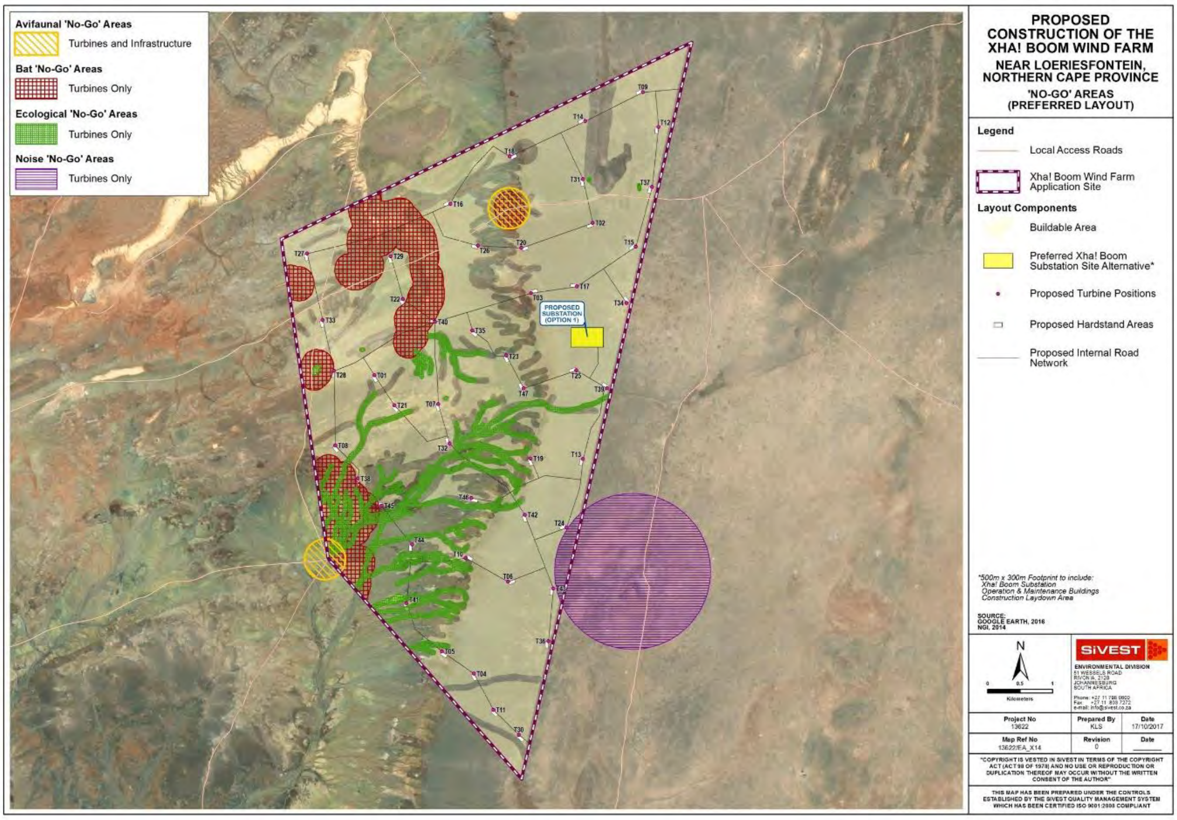



**Figure 133:** Proposed EIA Phase 47 turbine layout alternatives in relation to no-go areas

**Table 160** below highlights the reasons provided by the specialists for preferring the 47 turbine layout over the 70 turbine layout.

**Key**

| | |
|---|---|
| **PREFERRED** | The alternative will result in a low impact / reduce the impact |
| **FAVOURABLE** | The impact will be relatively insignificant |
| **NOT PREFERRED** | The alternative will result in a high impact / increase the impact |
| **NO PREFERENCE** | The alternative will result in equal impacts |

**Table 160:** Alternatives Assessment summarising the reasons provided by the specialists for preferring the 47 turbine layout over the 70 turbine layout

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| **47 TURBINE LAYOUT** | | |
| Biodiversity | PREFERRED | The reduction in the number of turbines from 70 down to 47 is seen as positive as this will reduce noise as well as the overall turbine footprint from the development. In addition, the location of the turbines is considered acceptable and no turbines are located in areas considered to be no-go areas or areas of high sensitivity. As such, the 47 turbine |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| | | layout is preferred when compared to the 70 turbine layout. |
| Avifauna | PREFERRED | The new turbine layout represents a 32.8% reduction in the number of turbines. This is a positive development from a bird impact assessment perspective, as it reduces the risk of priority species collisions and reduces the potential displacement impact of habitat fragmentation. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Bats | PREFERRED | The 47 turbine layout is favourable since it avoids all High and Moderate bat sensitivities and their buffers. Additionally, the presence of less turbines lowers the probability of mortality impacts on bat populations in the greater area. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Surface Water | PREFERRED | Overall, whilst the capacity change of wind turbines from 2 – 5MW to 4 – 8MW, and the change in materials to be used for the wind turbines have no discernible impact on surface water resources, the change in number and distribution of wind turbines have generally resulted in a slight increase in overall construction phase potential impact. However, mitigation measures have been stipulated which will reduce the impact to a low level. Despite the fact that the change in turbine layout will result in an increase in the construction phase potential impacts, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Soils and Agricultural Potential | PREFERRED | Because of the low impacts of the development on agriculture, there is no significant difference between the assessments of the new 47 turbine layout vs the old 70 turbine layout. Although the assessment for a reduction in turbines is not significantly different in terms of the assessment categories, there is nevertheless a very small difference and the reduced turbines is preferred because it has a lower footprint on agricultural land. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Noise | PREFERRED | The latest layout locates the wind turbines further from the closest potential noise-sensitive receptors, |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| | | at the same time reducing the number of wind turbines within a distance of 2,000m from these receptors. This change in the layout will have a definite benefit in terms of acoustics, further reducing the projected noise levels. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Visual | PREFERRED | The reduction in the number of turbines from 70 to 47 results in fewer visible turbines and turbines that are more widely dispersed across the site. This will reduce the visual contrast and visual intrusion of the wind farm development. In addition, with fewer turbines on the site, there will be fewer new light sources and thus the night time impacts resulting from the wind farm will be reduced. The new turbine layout is considered acceptable as none of the turbines are located in areas considered to be visually sensitive and only one turbine is located in closer proximity to the potentially sensitive visual receptors than previously determined. The decrease in the distance between the receptor (VR44) and the nearest turbine (T30) is however not significant enough to change the impact rating applied to this receptor. Changes in turbine range will have no visual implications as the hub height and rotor diameter of the turbines will remain the same. In addition, the changes in the material proposed for the turbine towers are not considered to be visually significant. Thus, from a visual impact perpective, the reduction in the number of turbines is seen as favourable. |
| Heritage and Palaeontology | PREFERRED | The redesign of the turbine layout has resulted in the moving of turbine positions away from the identified heritage resources. The reduction of turbines and change in layout will also result in a reduction in foot print area and thus a reduction in the possibility of disturbing unidentified heritage resources. The additional hardstand areas is off set by the reduction in turbines and will show and overall footprint reduction. This will inevitably result in a reduction of the overall impact of the WEF on heritage resources. It is the specialist's considered opinion that the change in design layout will not have an additional negative impact by the proposed |

| ENVIRONMENTAL ASPECT | PREFERENCE | CONCERNS / IMPACT SUMMARY |
|---|---|---|
| | | WEF on heritage resources. If at all it will result in a reduction of the projected impact as contained in the HIA for the project. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |
| Socio-economic | PREFERRED | Some changes to the socio-economic impacts identified to ensue during construction may take place, which include the temporary employment creation, skills development and training, change in sense of place as well as the impact on production and GDP. However, the expected changes to the assessment categories for these impacts will be insignificant and will not affect the overall rating of these impacts. In addition, the reduced number of wind turbines to be included in the project is also likely to be more acceptable by the affected parties due to the lower chances and smaller areas of veld that may be impacted by construction activities. Although the number of turbines to be built will be reduced, the local municipality is still expected to benefit from the proposed development due to its small economic base and a large unemployment rate. As such, the 47 turbine layout is preferred when compared to the 70 turbine layout. |

As depicted in **Table 160** above, the new proposed 47 turbine layout was clearly selected as the preferred alternative when compared to the previously assessed 70 turbine layout as per the specialist comment letters on the final layout. The new proposed 47 turbine layout in combination with on-site IPP Substation Option 1 should therefore be considered and authorised by the DEA. It should be noted that the extent of the proposed on-site IPP substation site has been reduced in order to avoid the identified environmentally sensitive areas. In addition, the shorter distance to the connecting linking substation[9] is expected to result in this on-site substation site alternative being preferred. From a technical perspective, the shorter distance between the on-site substation and the linking substations reduces the amount of electrical losses experienced, which is also preferred.

It is important to note that no fatal flaws were identified and the layout avoids all no-go areas and therefore both of the alternatives mentioned above are considered to be acceptable, although not necessarily preferable from an environmental perspective. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in **Figure 134**.

As previously mentioned, several no-go areas were also identified by some of the specialists and were subsequently incorporated into the EIA phase layout. As a result of the no-go areas, the site layout was

[9] The connecting linking substation is being assessed as part of a separate Basic Assessment (BA) process

amended and the number of turbines were reduced in order to avoid these areas. The preferred site layout in relation to the no-go areas identified by the specialists are indicated in **Figure 135**.

Refer to **Appendix 9** for the coordinates of the preferred site layout.

It should be noted that micro-siting may be required within the development area during the detailed design phase to avoid any additional sensitive areas. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction. In addition should the layout change subsequent to the issuing of an EA (should such authorisation be granted), any alternative layout or revisions to the layout occurring within the boundaries of the buildable area would not be regarded as a change to the scope of work or the findings of the impact assessments undertaken during the EIA Phase. This is based on the understanding that the specialists have assessed the larger area (i.e. the application site) in detail and all identified sensitive areas have been excluded from this area. Therefore, moving the components within the buildable area would not change the impact significance. Any changes to the layout within the boundaries of the buildable area following the issuing of the EA (should it be granted) will therefore be considered to be non-substantive.

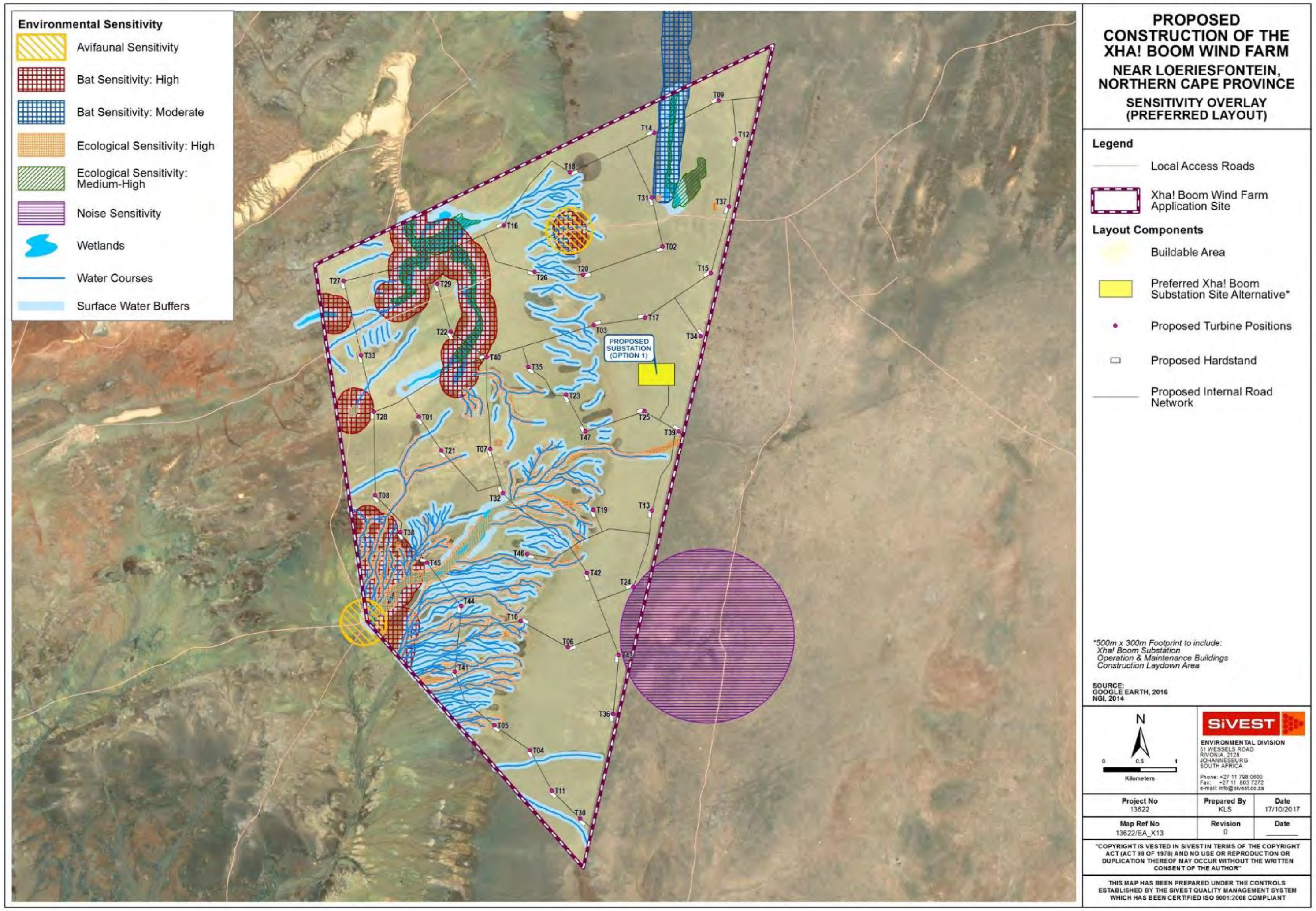



**Figure 134:** Preferred 47 Turbine Site Layout in relation to Sensitive Areas

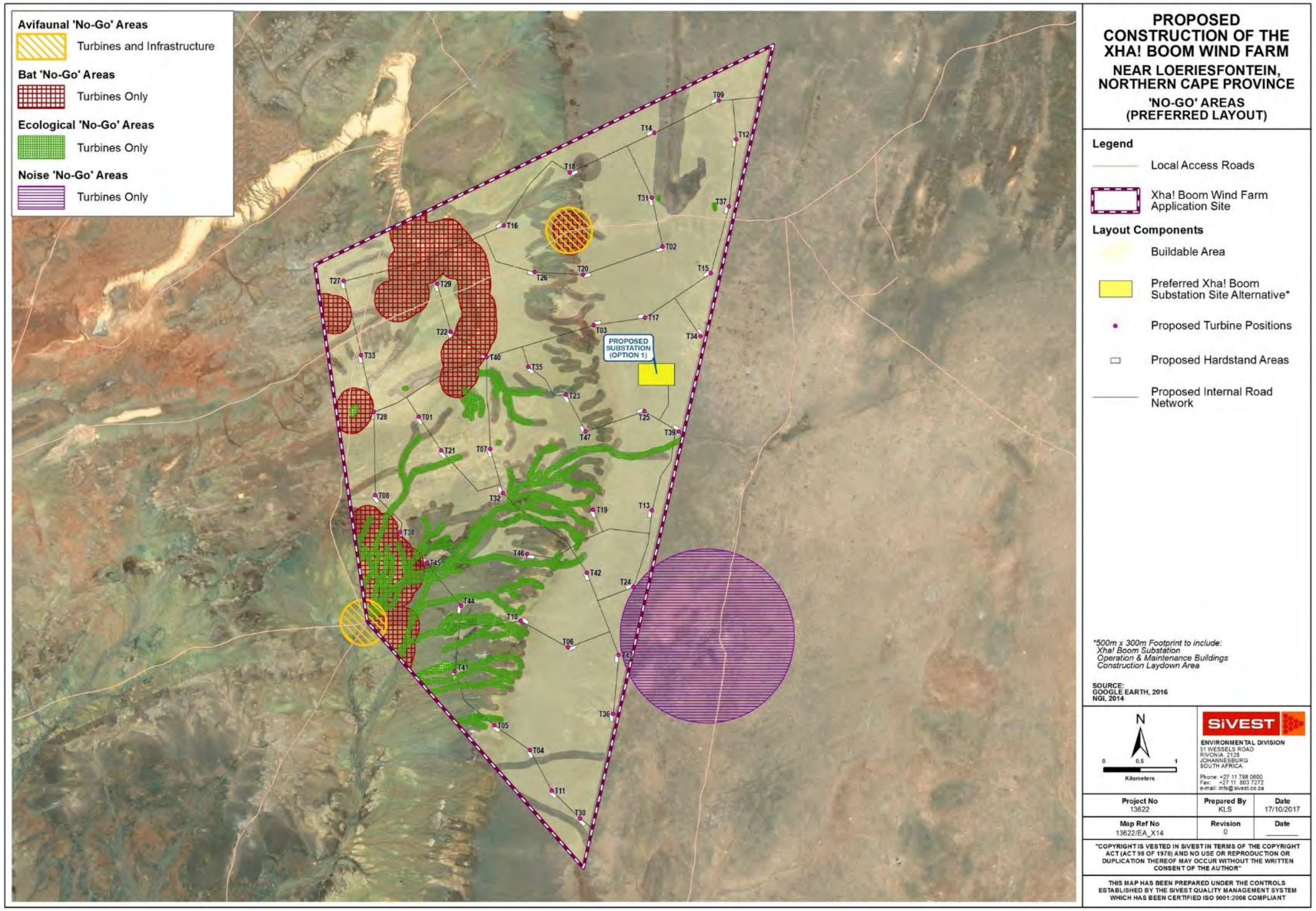



**Figure 135:** Preferred 47 Turbine Site Layout in relation to No-go Areas

It is important to note that the preferred site layout provided above is only the EIA phase layout and therefore not the final layout for the proposed development. This is due to the following reasons:

- The technology is constantly changing where higher yielding a more efficient turbines are being bought into the marked and as a result the Developer cannot commit to a specific turbine, and associated layout, at this stage.
- The EPC Contractor has not been appointed and hence the turbine manufacture is unknown. The EPC contractor is only appointed once the project has been selected as a Preferred Bidder.
- The final turbine manufacturer is unknown and hence the final turbine generation capacity is unknown. The turbine generation capacity directly determines how many turbines will be present in the project area. The wind farm will consist of up to a maximum of 47 wind turbines. However, the generation capacity of each may vary between 4MW and 8MW. At a later stage, depending on the final design, the number of wind turbines may decrease in numbers but will not exceed the maximum of 47 wind turbines.
- The relocation, adding or removing of a single wind turbine has an impact on the entire wind farm. With a single change a new yield assessment and model must be conducted to determine the highest yielding layout. Hence a facility with 50 turbines will have a completely different layout to a facility with 70 turbines. The EPC contractor may also insist on their own optimised layout for the facility.
- If surrounding wind projects are bid and selected as Preferred Bidders before the !Xha Boom Wind Farm, then the adjacent wind projects final layouts may include turbines on the boundary of the facility and hence these neighbouring turbines will have to be considered into the final !Xha Boom Wind Farm layout once it has been selected as a Preferred Bidder.
- As the turbine positions are still not final the road and ancillary infrastructure layouts are also subjected to change.

It should also be noted that the specialist sensitivities and no-go areas will be incorporated into the layout design when completing the final layout.

## 11.1 No-go Alternative

The option of not implementing the activity, or **the 'no-go' alternative, is considered in the EIA**. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although wind power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind energy facility would be detrimental to the mandate that the government has set to promote the implementation of renewable energy. It is a suitable sustainable solution to the energy crisis and this project would contribute to addressing the problem. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

Although the negative impacts identified would not occur if the project did not go ahead, the socio economic benefits of the proposed project should not be overlooked. The No-Go alternative has thus been eliminated due to the fact that the identified environmental impacts can be suitably mitigated and that by not building the project, the socio-economic benefits would be lost.

# 12 SPECIALIST RECOMMENDATIONS AND MITIGATION MEASURES

## 12.1 Mitigation Measures

It should be noted that the following mitigation measures are applicable for the revised 47 turbine layout which Mainstream are now proposing to construct. Based on the specialist review of the new proposed 47 turbine layout, some of the mitigation measures proposed for the previously assessed 70 turbine layout were no longer deemed to be acceptable and have thus been removed and/or replaced. In addition, some additional mitigation measures have also been included for some of the specialist assessments, where required.

### *12.1.1 Biodiversity*

- Placement of turbines within the High Sensitivity areas and drainage lines should be avoided.
- Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are avoided where possible.
- Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible.
- Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development.
- A large proportion of the impact of the development stems from the access roads and the number of roads should be reduced to the minimum possible and routes should also be adjusted to avoid areas of high sensitivity as far as possible, as informed by a preconstruction walk-though survey.
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes topics such as no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
- 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.
- Preconstruction walk-through of the facility to identify areas of faunal sensitivity.
- 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.
- The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site.
- No fires should be allowed within the site as there is a risk of runaway veld fires.
- No fuelwood collection should be allowed on-site.
- No dogs or cats should be allowed on site apart from that of the landowners.

- 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.
- 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.
- No unauthorized persons should be allowed onto the site and site access should be strictly controlled
- 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.
- All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and snakes which are often persecuted out of fear or superstition.
- Management of the site should take place within the context of an Open Space Management Plan.
- Any potentially dangerous fauna such snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden by anyone except landowners or other individuals with the appropriate permits and permissions where required.
- 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.
- If parts of the facility such as the substation are to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences as they do not move away when electrocuted but rather adopt defensive behavior and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside.
- 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 shrubs and grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow.
- 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. Problem woody species such as Prosopis are already present in the area and are likely to increase rapidly if not controlled.

- 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 using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.
- No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped.
- All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan, and as per the agreements with the land owners concerned.
- Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decommissioning activities.
- Any roads that will not be rehabilitated should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.
- There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as a result of the disturbance, and if they do, to immediately implement erosion control measures.
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
- All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.
- Wherever excavation is necessary for decommissioning, 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 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.
- Minimise the development footprint within the high sensitivity areas.
- There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora.
- All disturbed areas that are not used such as excess road widths, should be rehabilitated with locally occurring shrubs and grasses after construction to reduce the overall footprint of the development.

#### *12.1.2 Avifauna*

- Restric 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.
- 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 as they serve as focal points for bird activity.
- A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place.
- Post-construction monitoring should be implemented to make comparisons with baseline conditions possible.
- If densities of key priority species are proven to be significantly reduced due to the operation of the wind farm, the management of the wind farm must be engaged to devise ways of reducing the impact on these species.
- Operational activities should be restricted to the plant area. Maintenance staff should not be allowed to access other parts of the property unless it is necessary for wind farm related work.
- Formal monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the best practice guidelines (as an absolute minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in year 5, and again every five years thereafter).
- The minimum turbine tip height should ideally be no less than 50m to reduce the risk of Red Lark mortality during display flight activity.
- As an absolute minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the results of the monitoring through a process of adaptive management.
- Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including selective curtailment of problem turbines during high risk periods if need be.
- If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations).
- Lighting of the wind farm (for example security lights) should be kept to a minimum, and lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).
- The avifaunal specialist must approve the powerline design to ensure that bird-friendly structures are used.

#### *12.1.3 Bats*

General mitigation measures include the following:

- Adhere to the sensitivity map during turbine placement.
- If a bat roost is discovered close to a turbine position during construction, and if blasting is required, a bat specialist should be consulted before the blasting occurs.
- Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles.
- Damaged areas not required after construction should be rehabilitated by a vegetation succession specialist.
- Adhere to the sensitivity maps. Avoid areas of high bat sensitivity and their buffers as well as preferably avoid areas of Moderate bat sensitivity and their buffers.

- Adhere to operational mitigation measures described in Section 1 of the Bat specialist's comment letter on the final turbine layout.
- An operational phase bat monitoring study must be implemented as soon as the facility has been constructed.
- Utilize lights with wavelengths that attract less insects (low thermal/infrared signature).
- If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors.
- Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or large vehicles and keep to designated roads with all large vehicles.
- Damaged areas not required after decommissioning should be rehabilitated by a vegetation succession specialist.
- The high sensitivity waterways, valleys and other features can serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several WEF's in an area. Therefore adhere to recommended mitigation measures for this project. It is essential that project specific mitigations be applied and adhered to for each project, as there is no overarching mitigation that can be recommended on a regional level due to habitat and ecological differences between project sites.
- Adhere to the sensitivity map during any possible further turbine layout revisions.

**PROPOSED INITIAL MITIGATION MEASURES AND DETAILS**

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area, and should be considered as the initial method of mitigation.

The table below is based on the passive data collected. It infers mitigation be applied (only when needed as described above) during the peak activity periods and times specified in the table, and when the advised wind speed and temperature ranges are prevailing simultaneously, considering conditions in which 80% of bat activity occurred (normalised data). Bat activity at 80m height were used, with wind speed data at 61m and temperature data at 40m.

**Table 161:** The periods and weather conditions for implementation of mitigation, when needed as described above

| **Specific conditions of mitigation implementation** | |
|---|---|
| Peak activity (times to implement curtailment/ mitigation) | Met Mast (80m): 15 – 25 January over the time of sunset – 01:00 |
| Environmental conditions in which to implement curtailment/ mitigation | Met Mast (80m): Wind speed below 7m/s *and* Temperature above 18°C |
| Peak activity (times to implement curtailment/ mitigation) | Met Mast (80m): 25 August – 30 November over the time of sunset – 00:00 |

| Environmental conditions in which to implement curtailment/ mitigation | Met Mast (80m): Wind speed below 8m/s (non-normalised data used) *and* Temperature above 14°C |
|---|---|

Mitigation options include curtailment, blade feathering, blade lock, acoustic deterrents or light lures.

- **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.

- **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 RPMs below cut-in speed when no electricity is being produced.

- **Feathering or Feathered:**

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.

- **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 stay locked or 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.

- **Acoustic deterrents:**

Are a developing technology and will need further investigation closer to time of wind farm operation, opportunities to test such devices may be available during operation of the facility.

- **Light lures:**

Refer to the concept where strong lights are placed on the periphery (or only a few sides) of the wind farm to lure insects and therefore bats away from the turbines. However, the long term effects on bat populations and local ecology of this method is unknown.

- **<u>Habitat modification:</u>**

With the aim of augmenting bat habitat around the wind farm in an effort to lure bats away from turbines, is not recommended. Such a method can be adversely intrusive on other fauna and flora and the ecology of the areas being modified. Additionally, it is unknown whether such a method may actually increase the bat numbers of the broader area, causing them to move into the wind farm site due to resource pressure.

Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds and cut-in 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 curtailment be applied from the start of operation at Level 3 on all turbines for every night from dusk until dawn, from 1 August to 30 April every year (thus months of May, June and July are excluded).

Should robust and scientifically defendable data gathered during the operational study phase reveal higher bat mortalities than currently anticipated, the mitigations in **Table 161** should be applied to the turbines identified as causing the highest impacts. Such curtailment specified in **Table 161** will have to be at a maximum of Level 5.

### *12.1.4 Surface Water*

- **Designation of Highly Sensitive Areas**

  The wetlands and drainage lines must be designated as "highly sensitive" and any impact must be limited to the minimum possible extent. All wetlands and drainage lines must be visibly demarcated prior to construction activities taking place where construction is within 50m of any delineated surface water resource. The demarcation of wetlands and drainage lines must be visible and last for the duration of the construction activities.

- **Establishment of Internal Road Crossing Areas**
  For general access to the various components of the wind farm, existing roads are to be used as far as possible. No roads are to be routed through any wetlands (including buffer zones). Additionally, roads should not be planned through any drainage lines and the associated buffer zones. Where this is not possible however, and where no other access exists to the desired construction areas, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly.

  A single access route or internal road access area is then to be established before construction takes place, if required. This should be planned to cross perpendicularly through any drainage line(s). For wetlands, the internal road access area must be planned for minimal impact on wetlands (i.e. shortest route, not routed through the core of the wetlands, minimal destruction of habitat etc.). The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings and / or similar design crossings using the stream / wetland bed as part of the road can be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to access proposed construction areas during construction the construction phase only. Where the access route will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, this design should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing and / or similar design crossings, little to no modification of the stream banks or wetland will be required where banks are low (approximately 1,2m) for drainage lines or topography is flat for wetlands, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line(s) and / or wetland(s). However, where modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction.

  For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line and / or wetland beds. The weak substrate layer will need to be excavated an infilled by the rock or gravel material to the same level of the original drainage line or wetland bed. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support.

Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction.

In general, the width of the internal road access area must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The internal road access area must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings, vegetation should not be totally cleared across the entire internal road access area. Rather, only the vehicle tracks should be cleared. Remaining vegetation can be kept trimmed to below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated.

Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary and permanent ford crossings. Additionally, rehabilitation will need to take place if and where required.

Overall, no wetlands and or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road access areas are only permissible after rainfall events once flows have ceased.

Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the internal road access area of the wetland and drainage line areas due soil instability factors.

Construction workers are only allowed in the designated internal road access maintenance areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation.

- **Control of Alien and Invasive Vegetation in Surface Water Resources**
  Control of alien and invasive vegetation within surface water resources will be required. Where alien and invasive vegetation encroachment / colonization takes place, these areas are to be cleared as soon as practically possible. Clearing should take place by means of mechanical removal, either by physically pulling or slashing and clearing of unwanted alien and invasive vegetation near or within the surface water resources. Monitoring of alien and invasive vegetation should be undertaken in accordance with the environmental compliance monitoring during the construction phase.

- **Avoidance of Direct Impact to Delineated Surface Water Resources**
  The lay-down area or any other permanent building structure (including wind turbines) must not be placed directly within any of the identified and delineated wetlands and / or drainage lines.

- **Emergency Measures**

Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons and variable winds that the region experiences, it is recommended that a fire management and emergency plan is compiled. A suitably qualified health and safety officer must compile the fire management and emergency plan for the operation and maintenance phase of the project.

- **Post-construction Rehabilitation**
  Rehabilitation of the internal road access areas will be required post-construction. Ideally, the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation can re-establish where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped.

- **Buffer Zone Specific Mitigation Measures**
  During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as “sensitive” and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is within 50m. The demarcation of the buffer zones must be visible and last for the duration of the construction activities.

  The buffer zone areas are also to be included as part of the internal road crossing areas through the surface water resources.

  All wind turbine hardstand areas within buffer zones are to be lined at the edges with grass blocks or similar run-off energy dissipating soft structures to prevent siltation within drainage lines downstream during construction. For the operation phase, permanent run-off dissipating structures are to be implemented as part of the stormwater designs and management plan.

  See above for same access internal road crossing area mitigation measures to be implemented within buffer zones.

- **Preventing Increased Run-off, Erosion and Sedimentation Impacts**
  Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future.

  An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.

  In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to prevent erosion in susceptible construction areas during the construction phase. Grass blocks on the perimeter of the wind turbine hard stand areas or similar soft engineering structures can also be used to reduce run-off and onset of erosion. Wind turbine locations that are in close proximity to the buffer zones of the surface water resources which will require such measures include the hardstand areas of wind turbines T10, T16, T19, T30, T 41, T44, T45 and T46.

Where required more permanent structures such as attenuation ponds and gabions can be constructed if needs be, however this is unlikely given the study area. All impacted areas are to be adequately sloped to prevent the onset of erosion.

Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated above) are to be implemented as and where required.

- **Preventing Soil and Water Contamination**
  No vehicles are to be allowed in the highly sensitive and sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles and machinery are not to be allowed into any drainage sensitive and highly sensitive areas.

  All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive and sensitive areas.

  Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available and fire extinguishers.

  Storage areas for fuel, oil, paints and other hazardous substance are not to be stored directly within surface water resources or the associated buffer zones. These substances must also be contained in bunded areas with a capacity of at least 110%.

  No “long drop” toilets are allowed on the construction site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must not be placed directly within any surface water resource(s) or the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills.

  No cement mixing is to take place in any surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive and sensitive areas.

- **Preventing Impacts to Fauna Associated with Drainage lines and Wetlands**
  No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The

appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed, may not be killed. Additionally, these animals are to be relocated outside the RoW or construction areas, within relative close proximity where they were found.

- **Minimising Vehicle Damage to the Surface Water Resources**
  Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones.

  Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as stormwater flow pipes, culverts, culvert bridges etc.) be submitted to the relevant environmental and water departments for approval prior to construction.

  Internal access and services roads authorised in sensitive areas will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall the roads will need to be checked for erosion. Rehabilitation measures will need to be employed should erosion be identified.

- **Erosion Management**
  Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the surface water resources. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland / aquatic specialist must be obtained in this respect should this be required.

  Control of erosion on the construction site in general must be managed through implementation of an erosion management plan. Erosion and subsequent sedimentation of surface water resources are considered significant impacts in terms of the proposed development that must be managed adequately throughout the operation of the proposed development.

- **Stormwater Management**
  Any hardstand area or building within 50m proximity to a surface water resource and the associated buffer zone must have energy dissipating structures in an appropriate location to prevent increased run-off entering adjacent areas or surface water resources. This can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example).

  A suitable operational storm water management plan should be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering adjacent areas or surface water resources, thereby also preventing erosion. This must be submitted to the relevant environmental and water authority for approval, if undertaken.

- Other recommendations include the following:
  - All surface water resources and buffer zones must be avoided as far as practically possible in the layouts (including road access and service roads) to be designed in order to minimise and potentially avoid potential impacts as far as possible.
  - Where it is not possible to avoid impacts to surface water resources as a result of roads, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
  - All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.
  - With implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding road design) and therefore, may by environmentally authorised.

#### *12.1.5 Soils and Agricultural Potential*

- Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion from occurring there. This should be in place and maintained during all phases of the development.
- 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 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.
- Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land.
- During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.
- Erosion must be controlled where necessary on topsoiled areas.
- Minimize road footprint and control vehicle access on approved roads only.
- Control dust as per standard construction site measures which may include damping down with water or other appropriate and effective dust control measures. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site.
- Implement effective spillage and waste management system.

#### *12.1.6 Noise*

- Ensure that noise as a component is included in the induction of employees and contractors, and how their activities and actions can impact on residents in the area (reverse alarms and reversing close to dwellings, driving fast past residential dwellings at night, maintenance of equipment). All contractors and employees should receive this induction.

- Good public relations are essential. At all stages surrounding receptors should be informed about the sound generated by wind turbines. The information presented to stakeholders should be factual and should not set unrealistic expectations. It is counterproductive to suggest that the wind turbines will be inaudible, or to use vague terms like “quiet”. Modern wind turbines produce a sound due to the aerodynamic interaction of the wind with the turbine blades, audible as a “swoosh”, which can be heard at some distance from the turbines. The magnitude of the sound will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Similarly, potential annoyance levels have been linked to visibility and audibility. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the wind turbines and the ambient background sound level and character.
- Community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. Wind projects offer a benefit to the environment and the energy supply for the greater population, and offer economic benefits to the land owners leasing installation sites to the wind farm. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the wind farm, to ensure they do not feel that advantage have been taken of them.
- The developer must implement a line of communication (i.e. a help line where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The Wind Energy Facility should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or perforations or slits in the blades. Problems of this nature can be corrected quickly, and it is in the developer’s interest to do so.
- Confirm with the residents in the area when they will be using their dwellings. Plan construction activities close to their dwellings when they are not at their houses. Construct the access roads close to their dwellings during a period when receptors are not using their dwellings.
- Locate contractors camp and storage areas at locations where construction traffic will pass occupied dwellings minimally.
- Relocate access roads further from houses. To minimize noise levels below a low significance ensure that roads (or grid lines) are further than 220m from dwellings used for residential purposes during the construction period if only daytime construction activities are proposed. Due to the low ambient sound levels, it is highly recommended that no construction activities are allowed within 580m from occupied dwellings if night-time construction activities are anticipated. This includes construction of roads, power lines or construction of wind turbines.
- Ideally, do not allow construction traffic to drive past dwellings used for residential purposes at night. If people, material or equipment must be moved at night, no traffic should be allowed closer than 250m from receptors. Minimize night-time traffic as much as possible. If significant traffic (more than 10 vehicles per hour) is anticipated at night, access roads must be located further than 580m from receptors.
- Ensure equivalent A-weighted noise levels below 45 dBA at potentially sensitive receptors.
- Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA.
- Prevent the generation of disturbing or nuisance noises.
- Ensuring compliance with the National Noise Control Regulations.
- Prevent the generation of nuisance noises.

- Ensure acceptable noise levels at surrounding stakeholders and potentially sensitive receptors (less than 45 dBA at night).
- If a valid and reasonable complaint is registered relating to the operation of the facility additional noise monitoring should be undertaken as recommended by an acoustic consultant.

**Special conditions that should be included in the Environmental Authorization:**

- The potential noise impact must again be evaluated should the layout be changed where any wind turbines are located closer than 1,000m from a confirmed NSD.
- The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000m from location where construction activities are taking place or operational wind turbine.
- No access roads should be developed closer than 250m from dwellings that will be occupied during the construction period.

*12.1.7 Visual*

- Carefully plan to reduce the construction period.
- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.
- Maintain a neat construction site by removing rubble and waste materials regularly.
- Make use of existing gravel access roads where possible.
- Due to the fact that the access roads are to be used infrequently by internal contractors, dust suppression may not be viable in the long term. The developer should consider making use of a tarred construction road or a road with less chance of generating dust.
- All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid, where possible.
- Limit the number of vehicles and trucks travelling to and from the proposed sites, where possible.
- Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place.
- Ensure that dust suppression techniques are implemented on all soil stockpiles.
- Temporarily fence-off the construction sites (for the duration of the construction period).
- 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.
- Light fittings for security at night should reflect the light toward the ground and prevent light spill.
- The operation and maintenance buildings should not be illuminated at night.
- If overhead power lines are required, align power lines to run parallel to existing power lines and other linear features, where possible.
- Bury cables underground where possible.
- The operation and maintenance building should be painted with natural tones that fit with the surrounding environment. Non-reflective surfaces should be utilised where possible.
- Select the alternatives that will have the least impact on visual receptors.
- Turbines should be painted plain white, as this is a less industrial colour (Vissering, 2011). Bright colours or obvious logos should not be permitted.
- Turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011).

- 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.
- 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.

#### *12.1.8 Heritage and Palaeontology*

**Pre-Construction**

- A walk down of the final layout to determine if any significant sites will be affected.
- Monitor find spot areas if construction is going to take place through them.
- A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. Possible surface collections for sites with a medium to high significance as well as conducting a watching brief by heritage practitioner during the construction phase.

**Palaeontology**

- In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.
- However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably in situ) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.
- The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.
- Recommended mitigation of the inevitable damage and destruction of fossil within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a professional palaeontologist. This work should take place after initial vegetation clearance has taken place but before the ground is levelled for construction

**Chance Finds**

- Any heritage features of significance identified during this walk down will require formal mitigation or where possible a slight change in design could accommodate such resources.
- A walk down of the final approved layout will be required before construction commence.
- A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations.

*12.1.9 Socio-economic*

- Drafting legal and binding enforcements stipulating that majority of the unskilled positions in the project where possible be allocated to local labourers.
- Where possible, subcontract to local construction companies.
- Consultation with local authorities is essential so as to manage job creation expectations and ensure that all eligible workers in the primary study area are informed of the opportunities.
- Where possible, ensure that the local community members are prioritised for the allocation of the created jobs.
- To improve the chances of skills development during the construction phase, contractors are encouraged to provide learner-ships and encourage further knowledge sharing.
- Contracts ensuring that knowledge sharing and on-the-job training should be enforced as a condition for the development of the project.
- Recruit local labour as far as possible so as to ensure that the benefits accrue to local households within the community
- Employ labour-intensive methods as far as feasible in the construction phase.
- It is recommended that the proponent/project owner establishes a relationship with the local authorities such as the Hantam LM so as to ensure that the SED & ED initiative that are invested into are aligned with the particular and relevant needs of the Loeriesfontein or similar rural community/ies.
- It is also advisory to engage with the other project developers in the area and, where possible and feasible, coordinate the efforts and spending on community projects to ensure a balanced improvement in the standard of living of local residents and a holistic partnership-based approach to resolving local social ills.
- The government should find a way to monitor and evaluate the compliance of the proponent to the requirement of investing into a local community.
- Developers should be open to local recruitment processes and be willing to offer some skills transfer during this phase of the project to ensure maximum local labour procurement. This will decrease the likelihood of an influx of migrant workers.
- Assist local communities crippled by high levels of drug and alcohol abuse through remedial intervention and awareness programs
- Introduce awareness campaigns for workers on the dangers of substance abuse
- Place more emphasis on the role of and need of a social worker in the area
- Engage with the local authorities to inform them on the timeframes of the project and possible risks from a service delivery perspective.
- Where possible, assist the local municipality in ensuring that the quality of the social and economic infrastructure does not deteriorate by making use of social responsibility allocations.
- Where possible, ensure that the created jobs are acquired by local people.
- Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.
- Contracts ensuring that knowledge sharing and on-the-job training should be enforced as a condition for the development of the project.
- To ensure that skills are adequately acquired, ensure that there are additional training programmes held during the construction phase to prepare them for the next phase; operational.
- Consultation with local authorities is essential so as to manage job creation expectations and ensure that all eligible workers in the primary study area are informed of the opportunities.

- Raising awareness among construction workers on health issues, including HIV/AIDS.
- Introduce alcohol testing on a weekly basis for construction workers.
- Developing a Code of Conduct for all employees related to the project, which includes no tolerance of activities such as alcohol and drug abuse.
- Initiating the education campaign among the local community (inpartnership with the community members already active in the area) focusing on alcohol abuse, drug abuse, HIV/AIDS, STDs, etc. prior the start of construction and maintaining these throughout the project's duration.
- Recruitment should be done following a transparent approach and adequately communicated in the area to limit the chances of people staying for longer period in hope of finding a job.
- Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.
- Movement of construction workers on and off construction site must be closely monitored and managed.
- Prior construction, rules and regulations regarding presence of construction workers on site need to be devised in consultation with the land owners of directly affected and adjacent properties.
- During construction, the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided. Penalties for not adhering to the rules should be communicated and enforced.
- Manage workers to ensure that they are only on site during the reasonable working hours.
- Adhere to the mitigations measures proposed by other environmental specialists (noise, visual, etc.).
- Ensure the mitigation measure proposed to limit the influx of people and the prolonged negative effects of the migrants staying in the community after the construction are implemented.
- Engage with the local municipality to discuss the potential impact on local road quality, social infrastructure, and demand for accommodation, as well as possible mitigation measures.
- The project developer should appoint a service provider or local NGO to develop, implement and manage an STI & HIV/AIDS prevention programme and other educational campaigns. The service provider or NGO should specialise in these fields and should have sufficient experience with similar work.
- The prevention programme and educational campaigns should extend to the local community and should pay special attention to vulnerable groups such as women and youth.
- The project developer should engage with other companies planning to establish renewable energy facilities in the area to optimise their efforts in educating the local community and implementing preventative programmes.
- The project proponent should provide learnerships to locals apart from the on-the-job training for employed individuals. This will address the issues of the reduced employment and skills development opportunities by increasing the chances of local labour to receive employment when a similar development is established in the region.
- It is advisable that investment into skills development of the local community occurs prior the start of project's operations. A such it is recommended that training provided by the project proponent should not only be limited to the people receiving formal employment, but also those who desire to receive such skills. This will ensure that the local labour has a competitive advantage over job-seekers from outside areas.

*12.1.10 Geotechical*

- Material for construction purposes must where possible be sourced from site to reduce costs;
- Water should be stored on site so that it can be readily available for use.
- A detailed Geotechnical and Electrical investigation will be required.
- A detailed soil chemical analysis and soil resistivity test will also be required.

*12.1.11 Traffic*

Even though the traffic generated would not be significant, the following requirements should still be met by the developer during the construction phase:

- All abnormal loads must be transport under a permit;
- A route study be undertaken to confirm the most appropriate route to site;
- Dust suppression techniques should be utilised to reduce the impact on air quality for the surrounding area;
- A Traffic Management Plan must be prepared once the Project advances to the detailed design phase. This plan should ensure that vehicles arrive in a dispersed manner throughout the day to reduce the impact to other road users. The plan should also promote the use of car sharing, especially from Loeriesfontein and the construction camp. Methods to improve driver safety should also be outlined, e.g. the use of speed cameras or Average Speed Over Distance (ASOD) cameras along particular sections such as the R358 to Loeriesfontein.

*12.1.12 Electromagnetic Interference Path Loss and Risk Assessment (SKA)*

- To verify overall windfarm emissions, ambient measurements should be done at the new site before construction starts. Tests points should be carefully selected based on test equipment sensitivity with the objective to observe the increase in ambient emissions as construction progresses.
- Final site tests will be done on completion of the project to confirm the radiated emission levels. Although not anticipated, proper mitigation measures on identified emitters will be studied and implemented if final test shows emissions exceeding the SKA threshold.

As mentioned, a different turbine will be used for the proposed development. This turbine would have to be subjected to the same EMI and RFI studies. More accurate EMI and RFI studies will thus be required and undertaken when a final turbine has been selected and the layout finalised. Prior to construction a new path loss and risk assessment will also be undertaken based on a final layout, using a worst case scenario turbine and approved by the SKA before any turbines are installed on the proposed site. A letter from ICT confirming this has been included in **Appendix 9C**. It should be noted that these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, Mainstream have suggested that the DEA include a condition that further modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process.

# 13 ENVIRONMENTAL MONITORING AND AUDITING

The Environmental Management Programme (EMPr) becomes a tool by which compliance on the proposed site can be measured against. In order to utilise this tool, environmental monitoring needs to take place with regular audits against the EMPr to ensure that all aspects are attended to.

Environmental monitoring establishes benchmarks to judge the nature and magnitude of potential environmental and social impacts.

Some of the key parameters for monitoring and auditing of the proposed project include the following inter alia:

- Soil erosion and siltation.
- Oil spillages
- Dust and gaseous emissions.
- Water quality
- Noise and vibration
- Change in biodiversity
- Socio-economic change
- Land use changes.

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable responses to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the EMPr.

Environmental monitoring will be carried out to ensure that all construction activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/environmental requirements. This person will maintain regular contact with the local / district Environmental Officers. The contractor and proponent will have a responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the preconstruction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment. The following aspects will be subject to monitoring:

- Encroachment into sensitive areas
- Maintenance of project footprint
- Vegetation maintenance around project work sites, workshops and camps
- Health and Safety

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the Contractor at work sites during construction, under the direction and guidance of the Supervision Consultant who is responsible for reporting the monitoring to the implementing agencies. It is not the Contractor's responsibility to monitor land acquisition and compensation issues. It is recommended that the Contractor employ local full time qualified environmental inspectors for the duration of the Contract. The Supervision Consultant should include the services of an independent environmental and monitoring specialist on a part time basis as part of their team.

Environmental monitoring is also an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measure, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time.

Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

The Draft EMPr is included in **Appendix 8**.

# 14 COMPLIANCE WITH WORLD BANK STANDARDS AND EQUATOR PRINCIPLES

This report has been prepared to comply with various environmental legislation as well as World Bank Standards (IFC Guidelines) and the Equator Principles. Thus in order to ensure compliance with these, a checklist has been compiled to ensure that all aspects of these guidelines have been taken into account when compiling this document. **Table 162** below indicates that all applicable performance standards have been complied with.

The Equator Principles are a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. A number of banks, exchanges and organisations worldwide have adopted the Principles as requirements to be undertaken for project funding on application and approval. Furthermore, certain funding institutions have not formally adopted the Principles, but require clients to be compliant with them in order to qualify for loans. The Equator Principles are summarised below:

**Principle 1: Review and Categorisation**
When a project is proposed for financing, the Equator Principles Funding Institution ("EPFI") will categorise the project based on the magnitude of its potential environmental and social impacts and risks.

**Principle 2: Environmental and Social Assessment**
For each project assessed as being either Category A or Category B, the client / borrower must conduct a Social and Environmental Assessment ("Assessment") process to address the relevant impacts and risks of the proposed project. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

**Principle 3: Applicable Environmental and Social Standards**
The Assessment will refer to the applicable IFC Performance Standards and applicable Industry Specific Environmental, Health, and Safety (EHS) Guidelines.

**Principle 4: Environmental and Social Management System and Equator Principles Action Plan**
The client / borrower must prepare an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) must be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree to an Equator Principles Action Plan to outline gaps and commitments.

**Principle 5: Stakeholder Engagement**
For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups.

**Principle 6: Grievance Mechanism**
The EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies.

**Principle 7: Independent Review**
For all Category A projects and, as appropriate, for Category B projects, an independent social or environmental expert not directly associated with the borrower must review the Assessment, AP and consultation process documentations in order to assist the EPFIs due diligence, and assess Equator Principles compliance.

**Principle 8: Covenants**
An important strength of the Principles is the incorporation of covenants linked to compliance. For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. For Category A and B projects, the client / borrower will covenant in financing documentation:

- To comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and

- To provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and

- To decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.

**Principle 9: Independent Monitoring and Reporting**
To ensure ongoing monitoring and reporting over the life of the loan, EPFIs will, for all Category A projects, and as appropriate, for Category B projects, require appointment of an independent environmental and/or social expert, or require that the borrower to retain qualified and experienced external experts to verify its monitoring information, which would be shared with EPFIs.

**Principle 10: Reporting and Transparency**
For all Category A and, as appropriate, Category B Projects:

- The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online.
- The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of $CO_2$ equivalent annually.

Although this report is not written in terms of the Equator Principles (EPs), it fully acknowledges that EPs will need to be complied with should funding for the project be required. In general, the following documentation will need to be considered in that regard:

- The “Equator Principles” 2013
- International Finance Corporations Performance Standards on Social and Environment, IFC, January 2012, namely:
    - Performance Standard 1: Social and Environmental Assessment and Management Systems
    - Performance Standard 2: Labour and Working Conditions
    - Performance Standard 3: Pollution Prevention and Abatement
    - Performance Standard 4: Community Health, Safety and Security
    - Performance Standard 5: Land Acquisition and Involuntary Resettlement
    - Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
    - Performance Standard 7: Indigenous Peoples
    - Performance Standard 8: Cultural Heritage

- International Finance Corporation – World Bank Guidelines, General EHS Guidelines 2007.

EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. These EHS Guidelines are applied as required by the World Bank’s respective policies and standards. These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors.

- The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

The performance standards which have not been addressed at this stage as indicated in **Table 162** below will be addressed at a later stage when the proponent has reached financial closure. Therefore, the compliance level is partially compliant at this stage. It is important to note that the project proponent is committed to achieving compliance with the EPs.

The coding key is as follows:

| Compliance level | | | |
|---|---|---|---|
| Clear | | | |
| Not assessed/determined | Not compliant | Partially compliant | Compliant |

**Appendix 1** includes the IFC Performance Standards on Environmental and Social Sustainability.

**Table 162:** Compliance with Equator Principles

| **Principles** | **Compliance Level** | **Reference** |
|---|---|---|
| **General, Performance Standard 1 Environmental & Social Reporting** | | |
| 1. Baseline Information | | Refer to **Chapter 2** – Technical Details and **Chapter 6** – Description of the receiving environment |
| 2. Alternatives (Assessment of alternatives) | | Refer to **Section 5.2** and **Chapter 11** |
| 3. Impacts and risks | | Refer to **Chapters 9** and **10** |
| 4. Global impacts | | N/A |
| 5. Legal requirements | | Refer to **Chapter 1, Section 1.3** for legal requirements and guidelines |
| 6. Transboundary | | N/A |
| 7. Disadvantaged / vulnerable groups | | Refer to **Section 8.9** |
| 8. Third party | | Refer to **Section 8.9** |
| 9. Mitigation measures | | Addressed in **Section 9** and **12**. These will be addressed as part of the EMPr |
| 10. Documentation of Assessment Process | | Refer to **Section 9** |
| 11. Action Plans | | Partially addressed in **Section 15.** No major Action Plans required as mostly generic mitigation measures have been required. |
| 12. Organisational capacity | | Refer to **Appendix 1** |
| 13. Training | | Refer to **Appendix 1** |

| Principles | Compliance Level | Reference |
|---|---|---|
| 14. Grievance mechanism | | Refer to **Appendix 1**. The proponent will commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project. |
| 15. Report content | | **Chapter 1, Section 1.1** |
| **Performance Standard 2, Labour & Working Conditions** | | |
| 1. Human Resource Policy | | Refer to **Appendix 1**. The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project. |
| 2. Working relationship | | Refer to **Appendix 1**. |
| 3. Working conditions with and terms of employment | | Refer to **Appendix 1**. |
| 4. Workers organisation | | Refer to **Appendix 1**. |
| 5. Non-discrimination and equal opportunities | | Refer to **Appendix 1**. Partly addressed in **Section 8.9** as part of the Socio-economic assessment. This issue will also be addressed as part of the EMPr |
| 6. Grievance mechanism | | Refer to **Appendix 1**. To be addressed as part of the EMPr |
| 7. Occupational Health and Safety | | Refer to **Appendix 1**. To be addressed as part of the EMPr |
| 8. Non-employee workers | | Refer to **Appendix 1**. To be addressed as part of the EMPr |
| 9. Supply Chain | | Refer to **Appendix 1**. To be addressed as part of the EMPr |
| 10. Labour Assessment Component of a Social and Environmental Assessment | | Refer to **Appendix 1**. To be addressed as part of the EMPr |
| **Performance Standard 3, Pollution** | | |
| 1. Pollution Prevention, Resource Conservation and Energy Efficiency | | Refer to EMPr in **Appendix 8**. |
| 2. Wastes | | Refer to EMPr in **Appendix 8**. |

| Principles | Compliance Level | Reference |
|---|---|---|
| 3. Hazardous material | | Refer to EMPr in **Appendix 8**. |
| 4. Dangerous substances | | Refer to EMPr in **Appendix 8**. |
| 5. Emergence preparedness and response | | Refer to EMPr in **Appendix 8**. The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project. |
| 6. Technical guidance – ambient considerations | | Refer to **Appendix 1**. |
| 7. Greenhouse gas emissions | | N/A. No greenhouse gas emissions will result from the proposed development. |
| **Performance Standard 4, Health & Safety** | | |
| 1. Hazardous materials safety | | Refer to EMPr in **Appendix 8**. |
| 2. Environmental and natural resource issues | | Refer to **Sections 6** and **8.** |
| 3. Emergency preparedness and response | | Refer to EMPr in **Appendix 8**. The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project. |
| **Performance Standard 5, Land Acquisition** | | Refer to **Sections 4** and **5.** |
| **Performance Standard 6, Biodiversity** | | Refer to **Section 6.7**, S**ection 8.1** and **Section 9.2.1** which summarises the findings of the Biodiversity Impact Assessment Study |
| **Performance Standard 7, Indigenous People** | | Refer to **Sections 6.15** and **8.9** which detail the findings of the Socio-economic assessment. In addition, Section 7 describes public participation. |
| **Performance Standard 8, Cultural Heritage** | | Refer to **Section 8.9**. |

# 15 EVALUATION AND RECOMMENDATIONS

**Table 163** summarises the key recommendations for the environmental issues identified in the Draft Environmental Impact Assessment Report (DEIAr). In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this EIA (where practical and possible) have been included within an Environmental Management Programme (EMPr). This EMPr should form part of the contract with the contractors appointed to construct and maintain the proposed project. The EMPr would be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases (i.e. construction, operation and de-commissioning) of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.

A Draft EMPr is included with this DEIAr as **Appendix 8**.

It is also recommended that the process of communication and consultation with the community representatives is maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.

The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in **Figure 134**.

The preferred site layout in relation to the no-go areas identified by the specialists is indicated in **Figure 135**.

## 15.1 Summary of Findings

**Table 163:** Summary of findings and Recommendations

| Environmental Parameter | Summary of major findings | Recommendations |
|---|---|---|
| Biodiversity | The Xha! Boom Wind Farm consists largely of arid shrublands or grasslands on flat plains and gently sloping hills that are low sensitivity, with few species of conservation concern present. Development in these areas would generate low impacts of local significance only.<br><br>The only sensitive feature present at the site are some minor drainage lines in the southwest and some rocky outcrops along the transitional area between the grasslands of the east and the lower-lying Western Bushmanland Klipveld shrubland of the west. These more sensitive features occupy a small proportion of the site and would not be significantly affected by the development.<br><br>Due to the large number of proposed developments in the area, cumulative impacts are a potential concern. The total extent of habitat loss from all proposed developments in the area represents about 1% of the local area and less than 0.1% of the Bushmanland Basin Shrubland vegetation type. The analysis of cumulative impacts further indicates that the current developments in the area do not pose a risk of significantly impacting the national availability of the affected vegetation units or elevate them to a higher threat status. Overall cumulative impacts from all developments and the | The report concludes that with the application of the recommended mitigation and avoidance measures, the impact of the !Xha Boom Wind Farm can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the wind farm that cannot be reduced to an acceptable level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding. |

| | | |
|---|---|---|
| | contribution of the !Xha Boom Wind Farm to cumulative impact are seen as being acceptable and would remain of low overall significance. | |
| Avifauna | The proposed Mainstream !Xha Boom Wind Farm will have a variety of impacts on avifauna which range from low to high. The impacts are (1) displacement of priority species due to disturbance during construction phase (2) displacement of priority species due to habitat destruction during construction phase (3) displacement of priority species due to disturbance during operational phase (4), collisions of priority species with the turbines in the operational phase, and (5) electrocution of priority species on the internal MV powerlines.<br><br>Displacement of priority species due to disturbance during construction phase is likely to be a temporary medium negative impact, but can be reduced to low with the application of mitigation measures.<br><br>Displacement of priority species due to habitat destruction during construction phase is likely to be a medium negative impact and will remain so, despite the application of mitigation measures.<br><br>Displacement of priority species due to disturbance during the operational phase is likely to be of low significance and it could be further reduced through the application of mitigation measures, namely the restriction of operational activities to | Displacement of priority species due to disturbance during construction phase can be reduced to low with the application of the following mitigation measures:<br>▪ the restriction of construction activities to the construction footprint area, no access to the remainder of the property during the construction period,<br>▪ measures to control noise and dust,<br>▪ maximum use of existing access roads, and<br>▪ the implementation of a 300m exclusion zone around waterpoints.<br><br>Displacement of priority species due to habitat destruction during construction phase is likely to be a medium negative impact and will remain so, despite the application of mitigation measures. Mitigation measures comprise the following:<br>▪ the recommendations of the specialist ecological study must be strictly adhered to,<br>▪ maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum,<br>▪ a 300m exclusion zone should be implemented around the existing water points where no construction activity or disturbance should take place,<br>▪ post-construction monitoring should be implemented to make comparisons with baseline conditions |

| | | |
|---|---|---|
| | the plant area and no access to other parts of the property unless it is necessary for wind farm related work.<br><br>Collisions of priority species with the turbines in the operational phase are likely to be a high negative impact but it could be reduced to medium negative through the application of mitigation measures.<br><br>The electrocution of priority species on the internal MV powerlines is rated as a potentially medium impact which could be reduced to low through the use of bird friendly designs.<br><br>Finally, it is concluded that, after taking into account the expected impact of proposed renewable energy projects within a 40km radius around Helios MTS, that the cumulative impact of the proposed !Xha Boom WEF on priority avifauna, if appropriate mitigation is implemented, will range from minor to insignificant. | possible, and if densities of key priority species are proven to be significantly reduced due to the operation of the wind farm, the management of the wind farm must be engaged to devise ways of reducing the impact on these species.<br><br>Displacement of priority species due to disturbance during the operational phase could be further reduced through the application of mitigation measures, namely the restriction of operational activities to the plant area and no access to other parts of the property unless it is necessary for wind farm related work.<br><br>Collisions of priority species with the turbines in the operational phase could be reduced to medium negative through the application of the following mitigation measures:<br>▪ A 300m no-go buffer is proposed around water points as they serve as focal points for bird activity,<br>▪ formal monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the best practice guidelines (as an absolute minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in year 5, and again every five years thereafter),<br>▪ the minimum turbine tip height should ideally be no less than 50m to reduce the risk of Red Lark mortality during display flight activity, |

| | | |
|---|---|---|
| | | ▪ depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including selective curtailment of problem turbines during high risk periods if need be,<br>▪ if turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations),<br>▪ lighting of the wind farm (for example security lights) should be kept to a minimum, and lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).<br><br>The electrocution of priority species on the internal MV powerlines could be reduced to low through the use of bird friendly designs.<br><br>Finally, it is concluded that, after taking into account the expected impact of proposed renewable energy projects within a 40km radius around Helios MTS, that the cumulative impact of the proposed !Xha Boom WEF on priority avifauna, if appropriate mitigation is implemented, will range from minor to insignificant. |
| Bats | The site was visited over the period of November 2015 to December 2016 wherein data was collected from the five 10m mast and one meteorological mast, where after the systems were decommissioned. The long-term data was | General mitigation measures include the following:<br>▪ Adhere to the sensitivity map during turbine placement. |

| | | |
|---|---|---|
| | analysed by means of identifying the bat species detected by the monitoring systems and the periods of high bat activity.<br><br>A number of technical failures occurred with the monitoring systems. The failures should not compromise the study since an adequate amount of data was recorded during the 12 months.<br><br>*Tadarida aegyptiaca* is the most abundant bat species recorded by all systems. Common and abundant species, such as *Neoromicia capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis*, are of a larger value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species due to their higher numbers.<br><br>*Miniopterus natalensis* is the only migratory species detected on site. It was detected by all the monitoring systems, with Short Mast 3 detecting the highest number of passes. The results of the full 12 months monitoring study were analysed for the presence of a migratory event in order to determine whether the site is located within a migratory route. There were no signs and activity levels indicative of a migratory event however, an event may occur in the future and the Operational Phase Bat Monitoring Study must be designed such that a migratory event would be detected if it occurred.<br><br>Met Mast monitoring system indicates the highest amount of bat passes, followed by Short Mast 3. | ▪ If a bat roost is discovered close to a turbine position during construction, and if blasting is required, a bat specialist should be consulted before the blasting occurs.<br>▪ Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles.<br>▪ Damaged areas not required after construction should be rehabilitated by a vegetation succession specialist.<br>▪ Adhere to the sensitivity maps. Avoid areas of high bat sensitivity and their buffers as well as preferably avoid areas of Moderate bat sensitivity and their buffers.<br>▪ Adhere to operational mitigation measures described in Section 1 of the Bat specialist's comment letter on the final turbine layout.<br>▪ An operational phase bat monitoring study must be implemented as soon as the facility has been constructed.<br>▪ Utilize lights with wavelengths that attract less insects (low thermal/infrared signature).<br>▪ If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors.<br>▪ Adhere to the sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or large vehicles and keep to designated roads with all large vehicles. |

| | | |
|---|---|---|
| | The average nightly bat passes per month is used to show the general trend in bat activity across the different month of the year. All the masts show higher bat activity from January to April with predominant peaks for the month of March, except for Short Mast 4 which has a peak in January 2016, except for Short Mast 2 which was not recording during January as explained above. Bat activity decreased as the seasons changed into winter. An increase in bat activity, for all the monitoring systems, occurred again from August to November as the seasons changed from winter to spring.<br><br>A sensitivity map was drawn up indicating potential roosting and foraging habitat. The High Bat Sensitivity areas are expected to have elevated levels of bat activity and support greater bat diversity. High Bat Sensitivity areas are 'no – go' areas due to expected elevated rates of bat fatalities due to wind turbines. The layout has been amended by the proponent to ensure that no turbines are located within High or Moderate sensitivities or their buffers.<br><br>Peak activity times across the night and monitoring period were identified, as well as wind speed and temperature parameters during which most bat activity was detected. | ▪ Damaged areas not required after decommissioning should be rehabilitated by a vegetation succession specialist.<br>▪ It is essential that project specific mitigations be applied and adhered to for each project, as there is no overarching mitigation that can be recommended on a regional level due to habitat and ecological differences between project sites.<br>▪ Adhere to the sensitivity map during any possible further turbine layout revisions.<br><br>It is recommended that curtailment be applied from the start of operation at Level 3 on all turbines for every night from dusk until dawn, from 1 August to 30 April every year (thus months of May, June and July are excluded).<br><br>Should robust and scientifically defendable data gathered during the operational study phase reveal higher bat mortalities than currently anticipated, the mitigations in **Table 161** should be applied to the turbines identified as causing the highest impacts. Such curtailment specified in **Table 161** will have to be at a maximum of Level 5.<br><br>**Table 161** is based on the passive data collected. It infers mitigation be applied (only when needed as described in the table) during the peak activity periods and times specified in the table, and when the advised wind speed and temperature ranges are prevailing simultaneously, considering conditions in which 80% of bat activity |

| | | |
|---|---|---|
| | | occurred (normalised data). Bat activity at 80m height were used, with wind speed data at 61m and temperature data at 40m. |
| Surface Water | Findings from the fieldwork undertaken show that the following surface water resources were identified on the study site:<br>▪ Two (2) Depression Wetlands;<br>▪ Three (3) Major Drainage Lines (drainage lines with channel width >5m);<br>▪ Two hundred and thirty, seven (237) Drainage Lines (drainage lines with a channel width <5m).<br><br>An ecological buffer zone of 100m for major drainage lines and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied to protect the above surface water resources. These buffer zones have been implemented to provide additional safety against the potential direct and indirect impacts on the drivers (hydrology, soils, water quality, biota and habitat) of the hydrological systems that may occur in the construction and operation phases of the proposed development.<br><br>No comparative assessment was undertaken as no alternative layouts have been proposed.<br><br>It was identified that several potential impacts may affect the surface water resources within the proposed development area during the construction, operation and | General mitigation measure include the following:<br>▪ Designation of Highly Sensitive Areas.<br>▪ Establishment of Internal Road Crossing Areas.<br>▪ Control of Alien and Invasive Vegetation in Surface Water Resources<br>▪ Avoidance of Direct Impact to Delineated Surface Water Resources.<br>▪ Emergency Measures.<br>▪ Post-construction Rehabilitation.<br>▪ Buffer Zone Specific Mitigation Measures.<br><br>Specialist recommendations include the following:<br>▪ All surface water resources and buffer zones must be avoided as far as practically possible in the layouts (including road access and service roads) to be designed in order to minimise and potentially avoid potential impacts as far as possible.<br>▪ Where it is not possible to avoid impacts to surface water resources as a result of roads, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.<br>▪ All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources. |

| | | |
|---|---|---|
| | decommissioning phases as alluded to above. These include the following:<br>▪ Impacts to Surface Water Resources Habitat during construction;<br>▪ Impacts to the Geomorphology of Surface Water Resources during construction;<br>▪ Impacts to the Fauna associated with Surface Water Resources during construction;<br>▪ Impacts to the Geomorphology of Surface Water Resources during operation; and<br>▪ Impacts to the Hydrology of Surface Water Resources during operation.<br><br>It is not anticipated that the proposed development will need to be decommissioned. Should this need to take place, the same impacts as identified for the construction phase of the proposed development can be anticipated. Hence, the same impacts are expected to occur and the stipulated mitigation measures where relevant must be employed to minimise impacts.<br><br>Potential cumulative impacts were assessed given that numerous proposed and currently constructed renewable energy developments can be found in the surrounding area. As such, it was found that from a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding | ▪ With implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding road design) and therefore, may by environmentally authorised. |

| | | |
|---|---|---|
| | development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a considerable distance between the proposed development and the nearest surrounding development. The two sites are also separated by two low ridges that act as watersheds and occupy separate local catchments. Drainage from the proposed development is in a western direction, whilst drainage for the Kokerboom 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible due to distance from each project site and no site specific loss of surface water resources, as stated above.<br><br>In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2017), as no specific road layout was available at this time, it has been provisionally identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered | |

| | | |
|---|---|---|
| | due to potential direct impacts due to roads, thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that there are a number of surface water resources which may be affected by roads and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. Additionally however, if it can be determined that the proposed development will be associated with a LOW risk as per the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229), it may be possible that General Authorisation can be issued. The applicability of these water uses and the relevant licensing process can however only be confirmed once a more detailed layout containing road infrastructure is available. | |
| Soils and Agricultural Potential | The proposed development is on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed site is on land which is of extremely low agricultural potential, and which is only suitable as grazing land.<br><br>The key findings of this study are:<br><br>▪ Soils across the site are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms.<br>▪ The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils. | ▪ The following mitigation measures were recommended:<br>o Implement an effective system of storm water run-off control;<br>o Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas;<br>o Control dust through appropriate dust suppression methods;<br>o Strip and stockpile topsoil before disturbance and re-spread it on the surface as soon as possible after disturbance;<br>o Manage any sub-surface spoils from excavations in such a manner that they will not bury the topsoil of agricultural land; |

| | | |
|---|---|---|
| | ▪ As a result of these limitations, the site is unsuitable for cultivation and agricultural land use is limited to low intensity grazing.<br>▪ The land capability is classified as Class 7 - non-arable, low potential grazing land. The site has a very low grazing capacity of 45 hectares per large stock unit.<br>▪ There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.<br>▪ The significance of all agricultural impacts is kept low by two (2) important factors. The first is that the actual footprint of disturbance of the wind farm is very small in relation to the available grazing land. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing.<br>▪ Six (6) potential negative impacts of the development on agricultural resources and productivity were identified as:<br>o Loss of agricultural land use caused by direct occupation of land by the energy facilities' footprint.<br>o Soil Erosion caused by alteration of the surface characteristics.<br>o Generation of dust caused by alteration of the surface characteristics.<br>o Loss of topsoil in disturbed areas, causing a decline in soil fertility.<br>o Degradation of surrounding grazing land due to vehicle trampling. | o Minimise road footprint and control vehicle access on designated roads only; and<br>o Implement effective spillage and waste management system.<br><br>▪ There are no conditions resulting from this assessment that need to be included in the environmental authorisation. |

| | | |
|---|---|---|
| | - Soil contamination from hydrocarbon spills during construction.<br>▪ Two (2) potential positive impacts of the development on agricultural resources and productivity were identified as:<br>- Generation of additional land use income through renting land for energy generation which makes a positive contribution to farming cash flow and thereby improves the financial sustainability of farming on site.<br>- Increased security against stock theft due to the presence of the energy facility.<br>▪ All impacts were assessed as having low significance.<br>▪ Because of the low agricultural potential, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development. This includes cumulatve agricultural impact.<br>▪ Cumulative impact is also assessed as low. Furthermore it is 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.<br>▪ There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts. | |
| Noise | **Baseline Assessment:**<br>Daytime measured data indicate an area with elevated noise levels, but, considering the spectral data and sounds heard, | **Management and Mitigation of Noise Impact:**<br>There is a potential for a noise impact of medium significance during the construction phase due to the |

| | | |
|---|---|---|
| | these sounds are mainly due to natural activities (wind-induced). Night-time measurements indicated a very quiet environment, even with low winds (around 0 – 2 m/s). Considering the measurements, and measurements conducted in the last few years in similar environments, acceptable rating levels for the area would be typical of a rural noise district.<br><br>There is a high confidence in the ambient sound levels measured and the subsequent Rating Levels determined. For the purpose of this Environmental Noise Impact Assessment study, the strictest rating level (rural) will be used as defined in SANS 10103:2008 (35 dBA at night, 45 dBA during the day) for all the receptors living in the area.<br><br>**Need and Desirability of Project:**<br>The proposed project will not raise the noise levels at the potential noise-sensitive developments in the area. The project in addition will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa. People in the area that are not directly affected by increased noises will have a positive perception of the project and will see the need and desirability of the project.<br><br>**Findings of Assessment:** | development of access roads as well as construction traffic (especially at night). It will be easily mitigated if the access roads are planned further away from the potential noise-sensitive receptors, with the recommendations including amongst others:<br>▪ planning construction activities (road construction) close to the dwellings of potential noise-sensitive receptors during periods they are not using their dwellings for residential purposes;<br>▪ locating the contractors camp and storage areas at locations where construction traffic will pass occupied dwellings minimally;<br>▪ relocating access roads further from houses. To minimize noise levels below a low significance ensure that roads are further than 220m from dwellings used for residential purposes during the construction period if only daytime construction activities are proposed. Due to the low ambient sound levels, it is highly recommended that no construction activities are allowed within 580m from occupied dwellings if night-time construction activities are anticipated. This includes construction of roads, power line pylons or construction of wind turbines;<br>▪ ideally, do not allow construction traffic to drive past dwellings used for residential purposes at night. If people, material or equipment must be moved at night, no traffic should be allowed closer than 250m from receptors. Minimize night-time traffic as much as possible. If significant traffic (more than 10 vehicles per |

| | | |
|---|---|---|
| | This assessment indicates that the proposed project could have a noise impact on the surrounding area, as there are noise-sensitive developments within the (potential) area of acoustical influence of the construction activities.<br><br>The construction of access roads as well as construction traffic may increase the noise levels sufficiently to result in noise impacts of medium significance (especially at night). Mitigation measures are available and easy to implement to reduce the potential significance of the noise impact to low.<br><br>There is slight potential for a noise impact during the operational phase but this assessment determined the significance to be low.<br><br>**<u>Management and Mitigation of Noise Impact:</u>**<br>There is a potential for a noise impact of medium significance during the construction phase due to the development of access roads as well as construction traffic (especially at night). The operational noise impact would be of a low significance for all identified receptors in the vicinity of the !Xha Boom WF. Mitigation is not required, but due to the significant number of wind turbines operating in the area there exists a potential for cumulative noises. | hour) is anticipated at night, access roads must be located further than 580m from receptors.<br><br>**<u>Recommendations:</u>**<br>There is a high confidence in the findings of this report and the project can be authorized from a noise perspective, subject to the implementation of the recommendations contained in the Noise Impact Assessment Report. |
| Visual | Due to the dominant livestock (i.e. sheep) rearing practices and relatively limited human habitation in the surrounding area, no sensitive visual receptors (such as Guesthouses and other tourism facilities) were identified within the study area. It was however ascertained that the proposed !Xha | It is recommended that all mitigation measures should be implemented. |

| | | |
|---|---|---|
| | Boom Wind Farm development is likely to visually impact f our (4) farmsteads / homesteads identified within the visual assessment zone. These farmsteads / homesteads are used to house the local farmers as well as their farm workers and are thus regarded as potentially sensitive visual receptor locations, as the impact on them would be subjective and is relative to the perceptions of the viewer. Addtioanlly, there are no visually sensitive roads within the study area.<br><br>The impact assessment revealed that overall the proposed !Xha Boom Wind Farm is expected to have a low negative visual impact during construction (Pre-mitigation rating of -24) and a medium negative visual impact during operation (Pre-mitigation rating of -38), with relatively few mitigation measures available. In addition, the infrastructure associated with the proposed !Xha Boom Wind Farm would have a low negative visual impact during both construction (Pre-mitigation rating of -22) and operation (Pre-mitigation rating of -26). The impact assessment further revealed that the cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby would have a medium negative visual impact rating during both construction (Pre-mitigation rating of -32) and operation (Pre-mitigation rating of -40).<br><br>It should be noted that, based on the findings from the various specialist scoping phase assessments it was recommended that only Substation Option 1 be taken through to the EIA phase. As such, only Substation Option 1 | |

| | | |
|---|---|---|
| | was assessed during the EIA phase from a visual perspective and a comparative assessment of alternatives was thus not necessary.<br><br>Several renewable energy developments (both wind and solar) are being proposed within a 55km radius of the proposed !Xha Boom Wind Farm application site. A cumulative impact assessment, including a literature review of other other visual impact assessments / studies conducted for the other renewable energy developments being proposed and/or constructed in the area was undertaken. It was determined that the greatest cumulative impact will be experienced from VR 13 as this potentially sensitive receptor location could potentially be visually exposed to the proposed Graskoppies, Hartebeest Leegte and Ithemba Wind Farms, in addition to the proposed !Xha Boom Wind Farm, should they all be constructed. The literature review revealed that the mitigation measures and recommendations provided in this report are similar to those identified in the other visual impact assessments / studies and are therefore deemed to be acceptable. A few additional recommendations and/or mitigation measures have however been included by the other visual specialist assessments and have thus been considered and implemented in this report in order to ensure that all visual impacts are adequately investigated and addressed.<br><br>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. The visual impact of the proposed development on half the potentially sensitive visual receptors identified within the study area was rated as being medium, while the visual impact on the other half of the potentially sensitive visual receptors was rated as being high. 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. | |
| Heritage | The HSR completed in October 2016 has shown that the proposed !Xha Boom site to be developed as a WEF may have heritage resources present on the property. This has been confirmed through archival research and evaluation of aerial photography of the sites.<br><br>The subsequent field work completed for the October 2016, has confirmed the presence of 3 heritage resources as well as several areas with existing infrastructure such as fenced off camps, windmills and reservoirs.<br><br>No identified heritage resources are affected by the proposed WEF layout and the impact assessment tables are based on this fact.<br><br>The design process and methodology followed by the developer for this project will enabled the heritage assessment to provide input into the proposed layouts. This resulted in cognisance being taken of the positions of the | The mitigation measures proposed are as follows:<br><br>**<u>Pre-Construction:</u>**<br>4. A walk down of the final layout to determine if any significant sites will be affected.<br>5. Monitor find spot areas if construction is going to take place through them.<br>6. A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. Possible surface collections for sites with a medium to high significance as well as conducting a watching brief by heritage practitioner during the construction phase.<br><br>**<u>Palaeontology:</u>**<br>In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary. |

| | | |
|---|---|---|
| | heritage resources and thus the reduction of impacts at an early design phase.<br><br>**Palaeontology:**<br>In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.<br><br>**Cumulative Impact**<br>It is the heritage specialist's considered opinion that this additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate. | However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably in situ) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.<br><br>The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (e.g. museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. |
| Palaeontology (Desktop) | The development footprint is underlain by the Permo-Carboniferous Dwyka Group and Early to Middle Permian rocks of the lower part of the Ecca Group (Karoo Supergroup). This include the Prince Albert, Whitehill and Tierberg Formations (in order of decreasing age). Permian and Jurassic bedrocks are mantled with a range of superficial deposits, mostly Late Caenozoic (Quaternary to Recent) in age. The intrusive Karoo dolerites are of no direct palaeontological significance and the Late Caenozoic superficial deposits are generally of very low palaeontological sensitivity. | Pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary.<br><br>However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist. |

| | | |
|---|---|---|
| | The Dwyka Group is known for trace fossils, organic-walled microfossils, marine invertebrates fish and vascular plants. Fossil material of aquatic vertebrates (fish, mesosaurid reptiles,) invertebrates (*e.g.* crustaceans) and petrified wood is known from the Whitehill Formation. These fossils are more scarce in the Prince Albert and Tierberg Formations. However, fossils other than trace assemblages are generally scarce and most of the Dwyka and Ecca sediments are of low overall palaeontological sensitivity.<br><br>The proposed Leeuwberg wind farm development is thus unlikely to pose a substantial threat to local fossil heritage. In Palaeontological terms the significance is rated as LOW (negative). Consequently, pending the discovery of significant new fossil material here, no further specialist studies are considered to be necessary. | The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. |
| Socio-economic | Relevant national, provincial, and local government policies reveal that the development of RE technologies is strongly supported by government. It is seen as the means to diversify the energy mix in the country, achieve climate change commitments, and stimulate economic development in the country while creating new employment opportunities. Indeed, the assessment of the proposed project revealed that stimulation of the economy, job creation, increased household income, and growing government revenue are among the positive impacts that can ensue from the proposed project during both construction and operational phase. The local municipality is expected to benefit specifically from the proposed development due to its small | Considering that a number of other similar facilities has already been proposed for the establishment in the same local municipality, mitigation of the negative impacts of the project will need to be a prerequisite for its approval. This specifically refers to the mitigations measures proposed to address the potential negative impacts on health, social services, economic infrastructure and crime. |

| | | |
|---|---|---|
| | economic base and a large unemployment rate. However, the project is also expected to result in a number of negative socio-economic impacts, most of which will be applicable to the construction phase only, but could notably worsen the health of the local communities, reduce access to social services and economic infrastructure locally, and increase the incidence of social ills if not adequately mitigated.<br><br>The following positive and negative impacts are expected to take during the construction phase:<br>▪ Temporary employment creation (high +);<br>▪ Skills development and training (high +);<br>▪ Impact on health (medium -);<br>▪ Change in demographics due to migration (medium -);<br>▪ Increase in social pathologies (medium -);<br>▪ Investment in local community (high +);<br>▪ Impact on personal safety and stock theft (low -);<br>▪ Change in sense of place (low -);<br>▪ Temporary increase in production and temporary stimulation of GDP-R (high +);<br>▪ Demand for social facilities (low -);<br>▪ Added pressure on basic services (low -);<br>▪ Temporary increase in household income (medium +);<br>▪ Establishment of informal hospitality industry (medium +); and<br>▪ Temporary increase in government revenue (medium +).<br><br>The following positive and negative impacts are expected during the operation phase: | |

| | | |
|---|---|---|
| | ▪ Sustainable employment creation (low +);<br>▪ Skills development and training (low +);<br>▪ Sustainable increase in production and GDP (medium +);<br>▪ Sustainable increase in household income (low +); and<br>▪ Increase in government revenue (medium +).<br><br>Overall, considering the current knowledge of the socio-economic environment where the proposed project is to be developed and the envisaged socio-economic impacts that could be exerted by the facility during its construction and operation, it can be reasonably concluded that the project should be approved for the development. However, considering that a number of other similar facilities has already been proposed for the establishment in the same local municipality, mitigation of the negative impacts of the project will need to be a prerequisite for its approval. This specifically refers to the mitigations measures proposed to address the potential negative impacts on health, social services, economic infrastructure and crime. | |
| Geotechnical | From a geotechnical perspective, the major findings suggest that the site is relatively flat with local ridges associated with dolerite intrusions. The only prominent hill is Groot Rooiberg, on the southern site boundary. The water table is 10m below the ground level during the winter months and consequently the site is dry throughout the year.<br><br>From the available site information, conditions on the site are generally seen as favourable for the proposed development. | Greening interventions are recommended during construction of the wind farm. These include water and energy related interventions, material re-use and solid waste management. The site, being vacant, currently generates no solid waste and it is proposed that onsite composting, sorting and recycling will reduce the overall volume of waste being collected and removed from the site. |

| | | |
|---|---|---|
| | However precautionary measures for foundations will have to be incorporated in the design and construction of the proposed development due to the medium hard/ hard excavatability of hardpan (cemented) calcrete, soft rock shale, soft rock dolerite and hard rock shale. Also the instability of excavation side walls within fractured bedrock. | In addition, precautionary measures for foundations will have to be incorporated in the design and construction of the proposed development due to the medium hard/ hard excavatability of hardpan (cemented) calcrete, soft rock shale, soft rock dolerite and hard rock shale. Also the instability of excavation side walls within fractured bedrock.<br><br>The following recommendations were made:<br>▪ Material for construction purposes must be sourced from site to reduce costs;<br>▪ A detailed Geotechnical and Electrical investigation will be required.<br>▪ A detailed soil chemical analysis and soil resistivity test will also be required.<br>▪ It is recommended that the 400kV connection option be investigated further as a possible grid connection option. This option may be easier to implement although consultation with Eskom will be extensive given that it is a transmission backbone asset. |
| Traffic | Both the abnormal and legal vehicles were reviewed in terms of their type of activity; i.e. construction traffic, traffic associated with the transportation of the wind turbine components, or traffic associated with the transportation of materials, equipment and people. The key issues associated with the construction and operational phases of the project that will be assessed as part of the transport study include:<br><br>▪ Increase in traffic generation throughout the lifetime of the project; | The report recommends the primary access to the site to be via the R358 which links directly to the N7. This route is appropriate for both standard vehicles as well as abnormal vehicles carrying the wind turbine components.<br><br>Additionally, even though the traffic generated would not be significant, the following requirements should still be met by the developer during the construction phase:<br>▪ All abnormal loads must be transport under a permit; |

| | | |
|---|---|---|
| | ▪ Increase in road maintenance required; and<br>▪ Ability to transport wind turbine components to site safely and efficiently.<br><br>With regards to transport, an assessment was undertaken to determine the impact that the proposed wind farm will have on the operation of the existing road network, both during construction and post completion. It is anticipated that during construction up to 100 vehicles will travel to the site in the morning peak hour, the majority travelling from the proposed construction camp along the R358. In addition, other transportation aspects relating to the proposed project, including access, internal circulation and abnormal vehicle transportation were investigated and form part of this report.<br><br>In summary, the access route (option 4) via the R358 in combination with the N7 is the preferred route both for abnormal vehicles as well as other legal vehicles. Legal vehicle have the added option to utilise the DR2972 (option 2) as an alternative, although allowing multiple site entrances adds additional security/operational complications which might not be desirable. | ▪ A route study be undertaken to confirm the most appropriate route to site;<br>▪ Dust suppression techniques should be utilised to reduce the impact on air quality for the surrounding area;<br>▪ A Traffic Management Plan must be prepared once the Project advances to the preliminary phase. This plan should ensure that vehicles arrive in a dispersed manner throughout the day to reduce the impact to other road users. The plan should also promote the use of car sharing, especially from Loeriesfontein and the construction camp. Methods to improve driver safety should also be outlined, e.g. the use of speed cameras or Average Speed Over Distance (ASOD) cameras along particular sections such as the R358 to Loeriesfontein. |
| Radiation Emissions (SKA) | In order to determine whether the planned wind farm development could have any influence on the Square Kilometre Array (SKA), Mainstream requested a risk evaluation of the planned development to SKA activities. This risk assessment assumes the use of 47 Acciona AW 125 TH100A turbines within the !Xha Boom development and will be compared to known radiated emission data from | To verify overall wind farm emissions, ambient measurements should be done at the new site before construction starts. Tests points should be carefully selected based on test equipment sensitivity with the objective to observe the increase in ambient emissions as construction progresses. Final site tests will be done on completion of the project to confirm the radiated emission |

| | | |
|---|---|---|
| | the AW125 TH100A Acciona WTG as presented in the Acciona Control Plan. The Acciona AW 125 TH 100A is the model within the AW 3000 platform that will be evaluated for this project. This assessment will be updated based on additional measurement results and design information as it becomes available.<br><br>The intent of this evaluation is to ensure that the !Xha Boom facility poses a low risk of detrimental impact on the SKA by using known radiated emission amplitudes of the Acciona AW3000/125 TH100 50Hz wind turbine. Specific mitigation measures to be implemented on the AW3000/125 TH100 50Hz wind turbine in order to achieve 40 dB of attenuation has been reviewed and agreed by SKA South Africa as described in the Acciona Control Plan.<br><br>The current Emission Control Plan for the AW125 TH100A WTG provides for a 40dB reduction in radiated emissions to ensure the cumulative emission level of previously assessed wind farms where the Acciona AW 125 TH100A WTG will be used is within the requirements of SKA. This requirement is based on measurements on the Acciona AW 125 TH100A WTG at the Gouda facility in South Africa and Barosoain wind farm, Navarra, Spain. Two WTG locations (WTG 1 and WTG 36) and two SKA installations (Rem Opt 7 and SKA 2377) were used for the evaluation. Due to natural terrain barriers and the 52.6km distance between !Xha Boom and Rem-opt 7, the closest SKA unit, no degradation of performance is expected when the mitigated AW 125 | levels. Although not anticipated, proper mitigation measures on identified emitters will be studied and implemented if final test shows emissions exceeding the SKA threshold. |

| | | |
|---|---|---|
| | TH100A Acciona turbines are installed[10]. This shown by the 10dB to 20dB higher path loss for !Xha Boom compared to Garob.<br><br>The Karoo area is ideally suited for the installation and commissioning of renewable energy projects, but is also host to the Department of Science and Technology's SKA radio telescope project. Due to the sensitivity of the telescope receivers, there is a risk that unintentional emissions from the systems and associated equipment associated with renewable energy projects will desensitize or saturate the SKA receivers resulting in interference to celestial observations and/or data loss. Such interference is typically referred to as 'Radio Frequency Interference' (or 'RFI'). The NITIA TM-89-139 calculation of 17.9dB (REM OPT 7 location) and 18.4dB (SKA ID 2377 location) to be added to the emissions from a single unit to allow for the cumulative effect of 500 units appears to be conservative when compare to general man-made noise data (<10dB increase measured at various locations). The >60 degree beamwidth assumed during the NITIA TM-89-139 calculations will result in over estimation of the cumulative effect due to a higher number of emitters in the beamwidth. The 40dB mitigation is a border line figure when considering all the adjacent projects resulting in a relatively high emitter density. | |

[10] Please note that the Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI) studies were based on the currently available worst case scenario turbines. Due to technology improvements a different turbine will be used for the proposed development. The chosen turbine would have to be subjected to the same EMI and RFI studies. As previously mentioned, these studies can only be undertaken once Mainstream have selected a final turbine and have undertaken the final modelling. As such, it is recommended that the DEA include a condition that final modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process as has been done to date.

| | | |
|---|---|---|
| | It should be noted that the specialist was requested to compile a letter which details the impacts associated with the change in the proposed turbine dimensions from a hub height of up to 150m and rotor diameter of up to 150m, to a hub height of up to 160m and a rotor diameter of up to 160m from an SKA perspective.<br><br>According to the specialist, the risk of interference between wind turbines and the SKA radio telescope is primarily a function of the following factors:<br>▪ Radiated emission amplitude from turbine;<br>▪ Turbine hub height;<br>▪ Number of turbines;<br>▪ Distance between turbine and SKA infrastructure; and<br>▪ Terrain between the turbine and the SKA infrastructure (line of sight or natural barriers between the installations).<br><br>The dB increase in the electromagnetic noise by increasing the number of turbines from 47 units to 70 units can be estimated with the standard 10 x Log (N), where N is the number of turbines, formula as a reasonable assumption. Changing the number of turbines from 47 to 70 will therefor result in a 13.6dB increase in electromagnetic noise.<br><br>Increasing the turbine hub height could result in the nacelle being elevated above the natural terrain barriers that provided a shield between the turbine and the SKA infrastructure at a lower hub height. The change in | |

| | | |
|---|---|---|
| | interference risk profile will have to be re-evaluated if the nacelle height is different from the initial proposed height to verify the line of sight/ terrain shielding conditions.<br><br>Further studies would in any case be required at a later stage once a final turbine type has been confirmed, at this stage all these uncertainties would be clarified. | |

A summary of the impact rating of the proposed development according to each environmental aspect are provided in **Table 164** - **Table 166** below.

It should be noted some of the specialists have amended the impact ratings of their original assessments (for the previously assessed 70 turbine layout) based on the review of the revised 47 turbine layout which Mainstream are now proposing to construct. As such, the impact rating tables below provide impact ratings which are based on the revised 47 turbine layout. These ratings provided below might therefore differ slightly to those provided in the impact rating tables in **Section 9.2** of the DEIAr.

**Key**

| | |
|---|---|
| **LOW NEGATIVE** | **LOW POSITIVE** |
| **MEDIUM NEGATIVE** | **MEDIUM POSITIVE** |
| **HIGH NEGATIVE** | **HIGH POSITIVE** |

**Table 164:** Impact rating summary for the proposed !Xha Boom Wind Farm during the construction phase

| Environmental Aspect | Environmental Impacts | Impact Rating without Mitigation | Impact Rating with Mitigation |
|---|---|---|---|
| Biodiversity | Impacts on vegetation and protected plant species | - 48 (medium negative) | -28 (low negative) |
| | Impacts on fauna due to construction phase activities | -45 (medium negative) | -26 (low negative) |
| | Cumulative impacts and loss of broad-scale connectivity | -30 (medium negative) | -26 (low negative) |
| Avifauna | Displacement of priority species due to disturbance during construction phase | -39 (medium negative) | -18 (low negative) |
| | Displacement of priority species due to habitat destruction during construction phase | -32 (medium negative) | -30 (medium negative) |
| Bats | Destruction of bat roosts due to earthworks and blasting | - 26 (low negative) | - 7 (low negative) |
| | Loss of foraging habitat | - 28 (low negative) | - 9 (low negative) |
| Surface Water | Impacts associated with the degradation of drainage lines (loss of riparian habitat) | - 45 (medium negative) | - 28 (low negative) |
| | Impacts to the Geomorphology of Surface Water Resources | -45 (medium negative) | - 28 (low negative) |
| | Impacts to the Soil and Water Contamination Impacts to Surface Water Resources | - 42 (medium negative) | - 26 (low negative) |
| | Impacts to the Fauna associated with Surface Water Resources | - 22 (low negative) | - 6 (low negative) |
| Soils and Agricultural Potential | Loss of Agricultural Land (Grazing) | - 14 (low negative) | N/A |
| | Farm Economic Sustainability | + 11 (low positive) | N/A |
| | Erosion due to alteration of the land surface run-off characteristics | - 24 (low negative) | - 11 (low negative) |
| | Increased security against stock theft due to the presence of the energy facility and its personnel. | - 10 (low negative) | N/A |
| | Loss of topsoil caused by poor topsoil management during construction related soil profile disturbance | - 24 (low negative) | - 11 (low negative) |

| | | | |
|---|---|---|---|
| | Degradation of veld vegetation beyond the direct development footprint caused by trampling due to vehicle passage, and deposition of dust | - 10 (low negative) | - 9 (low negative) |
| | Impact on Air Quality due to Dust Generation | - 10 (low negative) | - 9 (low negative) |
| | Soil contamination | - 10 (low negative) | - 9 (low negative) |
| | Cumulative loss of agricultural land use (Grazing) | - 15 (low negative) | N/A |
| Noise | Daytime Construction (and Upgrade) of access roads and other infrastructure | - 32 (medium negative) | - 6 (low negative) |
| | Night-time Construction (and Upgrade) of access roads and other infrastructure | - 36 (medium negative) | - 6 (low negative) |
| | Daytime Construction Traffic | - 36 (medium negative) | - 7 (low negative) |
| | Night-time Construction Traffic | - 40 (medium negative) | - 7 (low negative) |
| | Daytime Construction of Wind Turbines and other infrastructure | - 7 (medium negative) | - 6 (low negative) |
| | Night-time Construction of Wind Turbines and other infrastructure | - 7 (low negative) | - 6 (low negative) |
| | Construction of the onsite substation (both options) | - 8 (low negative) | - 8 (low negative) |
| Visual | Visual impacts of the proposed !Xha Boom Wind Farm during construction | - 24 (low negative) | - 20 (low negative) |
| | Visual impacts of the infrastructure associated with the !Xha Boom Wind Farm during construction | - 22 (low negative) | - 20 (low negative) |
| | Cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby during construction | - 32 (medium negative) | - 24 (low negative) |
| Heritage and Palaeontology | Impact on the Palaeontology Heritage (fossils) of the development footprint | - 28 (low negative) | - 6 (low negative) |
| | Impact on the Archaeological Resources | - 40 (medium negative) | - 16 (low negative) |
| | Impact on Chance Finds (unidentified heritage structures) | - 34 (medium negative) | - 17 (low negative) |

| | | | |
|---|---|---|---|
| Socio-economic | Employment creation during construction phase | + 36 (medium positive) | + 52 (high positive) |
| | Skills development during construction phase | + 48 (medium positive) | + 54 (high positive) |
| | Impact on health during construction | - 42 (medium negative) | - 39 (medium negative) |
| | Impact of loss of farm labour to the construction phase | - 32 (medium negative) | - 30 (medium negative) |
| | Increase in social pathologies associated with the influx of migrant labourers and jobseekers to the area | - 48 (medium negative) | - 30 (medium negative) |
| | Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED) | + 45 (medium positive) | + 45 (medium positive) |
| | Impact on personal safety and security during construction | - 26 (low negative) | - 20 (low negative) |
| | Change in sense of place during construction | - 24 (low negative) | - 24 (low negative) |
| | Increased production & temporary stimulation of GDP-R during construction | + 56 (high positive) | + 56 (high positive) |
| | Increased demand for social facilities during construction | - 28 (low negative) | - 26 (low negative) |
| | Added pressure on basic services during construction | - 28 (low negative) | - 26 (low negative) |
| | Temporary increase in household income and improved standard of living during construction | + 26 (low positive) | + 39 (medium positive) |
| | Establishment of informal hospitality industry due to increased demand for accommodation | + 45 (medium positive) | + 45 (medium positive) |
| | Temporary increase in tax revenue for government during construction | + 30 (medium positive) | + 30 (medium positive) |
| | Negative health-related cumulative impacts | - 42 (medium negative) | - 28 (low negative) |
| Geotechnical | Foundation Excavatability - Hardpan calcrete / soft rock shale encountered during excavation | - 8 (low negative) | -6 (low negative) |
| | Foundation Excavatability - Dolerite rock / hard rock shale encountered during excavation | - 44 (medium negative) | - 14 (low negative) |
| | Foundation Excavatability - Instability of excavation side walls within fractured bedrock | - 12 (low negative) | - 6 (low negative) |

| | | | |
|---|---|---|---|
| Traffic | Impact due to various alternatives to access site | -24 (low negative) | - 6 (low negative) |
| | Increase in number of abnormally sized vehicles travelling along N7 and R358 | -30 (medium negative) | -8 (low negative) |
| | Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment | - 14 (low negative) | -6 (low negative) |
| | Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads | - 56 (high negative) | - 52 (high negative) |
| | Change in quality of surface condition of the roads | +8 (low positive) | + 7 (low positive) |
| | Cumulative Impact - Increase in traffic | - 10 (low negative) | - 6 (low negative) |

**Table 165:** Impact rating summary for the proposed !Xha Boom Wind Farm during the operational phase

| Environmental Aspect | Environmental Impacts | Impact Rating without Mitigation | Impact Rating with Mitigation |
|---|---|---|---|
| Biodiversity | Faunal impacts due to operational activities | -42 (medium negative) | -26 (low negative) |
| | Increased Erosion Risk | -39 (medium negative) | -12 (low negative) |
| | Alien plant invasion risk | -42 (medium negative) | -12 (low negative) |
| | Cumulative impacts and loss of broad-scale connectivity | -30 (medium negative) | -26 (low negative) |
| Avifauna | Displacement of priority species due to disturbance during operational phase | -26 (low negative) | -24 (low negative) |
| | Collisions of priority species with the turbines in the operational phase | -45 (medium negative) | -30 (medium negative) |
| | Mortality of priority species due to electrocution on the internal MV lines in the operational phase | -42 (medium negative) | -11 (low negative) |
| Bats | Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration) | - 57 (high negative) | - 28 (low negative) |

| | | | |
|---|---|---|---|
| | Artificial lighting | - 51 (high negative) | - 8 (low negative) |
| | Cumulative bat mortalities due to direct blade impact or barotrauma during foraging (resident and migrating bats affected). | - 57 (high negative) | - 30 (medium negative) |
| Surface Water | Impacts to the Geomorphology of Surface Water Resources | - 48 (medium negative) | - 28 (low negative) |
| Soils and Agricultural Potential | Loss of Agricultural Land (Grazing) | - 14 (low negative) | N/A |
| | Farm Economic Sustainability | + 11 (low positive) | N/A |
| | Erosion due to alteration of the land surface run-off characteristics | - 24 (low negative) | - 11 (low negative) |
| | Increased security against stock theft due to the presence of the energy facility and its personnel. | - 10 (low negative) | N/A |
| | Cumulative loss of agricultural land use (Grazing) | - 15 (low negative) | N/A |
| Noise | Operation of Wind Farm – Daytime | - 8 (low negative) | - 6 (low negative) |
| | Operational Activities – Night-time | - 24 (low negative) | - 9 (low negative) |
| | Operation of the onsite substation (both options) | - 8 (low negative) | - 8 (low negative) |
| | Cumulative noise levels for Leeuwberg Wind Energy Facility – Night-time | - 24 (low negative) | - 9 (low negative) |
| Visual | Visual impacts of the proposed !Xha Boom Wind Farm during operation | - 38 (medium negative) | - 36 (medium negative) |
| | Visual impacts of the infrastructure associated with the !Xha Boom Wind Farm during operation | - 26 (low negative) | - 13 (low negative) |
| | Cumulative visual impacts as a result of the renewable energy developments (including associated infrastructure) proposed nearby during operation | - 40 (medium negative) | - 36 (medium negative) |
| Heritage and Palaeontology | Cumulative Impacts on Heritage Resources | - 18 (medium negative) | - 18 (low negative) |

| | | | |
|---|---|---|---|
| Socio-Economic | Creation of long-term employment in local and national economies through operation and maintenance activities | + 28 (low positive) | + 28 (low positive) |
| | Skills development during the operations phase | + 18 (low positive) | + 19 (low positive) |
| | Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED) | + 45 (medium positive) | + 45 (medium positive) |
| | Change in sense of place during operations | - 26 (low negative) | - 24 (low negative) |
| | Sustainable increase in production and GDP-R of the national and local economies through operation and maintenance activities | + 40 (medium positive) | +40 (medium positive) |
| | Added pressure on basic services during operation | - 28 (low negative) | - 26 (low negative) |
| | Sustainable increase in household income and improved standard of living during operations | + 13 (low positive) | + 13 (low positive) |
| | Sustainable increase in tax revenue for government during operations | + 32 (high positive) | + 32 (high positive) |
| | Negative health-related cumulative impacts | - 42 (medium negative) | - 28 (low negative) |
| Traffic | Increase in traffic | - 12 (low negative) | - 8 (low negative) |
| | Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads | - 56 (high negative) | - 30 (medium negative) |
| | Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment | - 30 (medium negative) | - 7 (low negative) |
| | Change in quality of surface condition of the roads | - 8 (low negative) | - 6 (low negative) |
| | Cumulative Impact - Increase in traffic | - 10 (low negative) | - 6 (low negative) |

**Table 166:** Impact rating summary for the proposed !Xha Boom Wind Farm during the decommissioning phase

| Environmental Aspect | Environmental Impacts | Impact Rating without Mitigation | Impact Rating with Mitigation |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Biodiversity | Impacts on fauna due to decommissioning phase activities | -36 (medium negative) | -20 (low negative) |
| | Increased Erosion Risk due to Decommissioning | -39 (medium negative) | -12 (low negative) |
| | Alien plant invasion risk following decommissioning | -42 (medium negative) | -12 (low negative) |
| Bats | Loss of foraging habitat | - 24 (low negative) | - 7 (low negative) |
| Soils and Agricultural Potential | Loss of Agricultural Land (Grazing) | - 14 (low negative) | N/A |
| | Farm Economic Sustainability | + 11 (low positive) | N/A |
| | Erosion due to alteration of the land surface run-off characteristics | - 24 (low negative) | - 11 (low negative) |
| | Increased security against stock theft due to the presence of the energy facility and its personnel | - 10 (low negative) | N/A |

## 15.2 Conclusion and Environmental Impact Statement

The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed !Xha Boom. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures to reduce impacts. These are included within the EMPr to ensure that these areas receive special attention.

It was determined during the EIA that the proposed project will result in limited potential negative impacts and certain positive impacts. A preferred layout has been identified which is less environmentally sensitive and will result in the least environmental impact.

A detailed public participation process was followed during the EIA process which conforms to the public consultation requirements as stipulated in the EIA Regulations, 2014. In addition, all issues raised by I&APs will be captured in the FEIAr and where possible, mitigation measures provided in the EMPr to address these concerns.

As sustainable development requires all relevant factors to be considered, including the principles contained in section 2 of NEMA, the DEIAr has strived to demonstrate that where impacts were identified, these have been considered in the determination of the preferred layout.

It should be noted that micro-siting may be required within the development area during the detailed design phase to avoid any additional sensitive areas, and any new palaeontological outcrops. In addition, the final wind turbine layout will be determined during the detailed design phase. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Furthermroe, it is the opinion of the EAP, that based on the findings of the EIA that the proposed development should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- Due to the fact that the final modelling will have to be done again once the final turbine has been chosen, as well as the fact that the EMI and RFI studies can only be re-done once a final turbine has been chosen, it is recommended that the DEA include a condition that final modelling and EMI and RFI studies be undertaken once the final turbine has been chosen. Mainstream will continue to engage with SKA accordingly throughout this process as has been done to date.
- All feasible and practical mitigation measures recommended by the various specialists must be implemented.

- All micro siting of the turbines and associated infrastructure must be repositioned within the authorised buildable area and must exclude all no-go areas identified by the specialists.
- Where applicable monitoring should be undertaken to evaluate the success of the mitigation measures recommended by the various specialists.
- Final EMPr should be approved by DEA prior to construction.
- The final layouts should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST, as the EAP, is therefore of the view that:

- An environmentally preferred substation site, as well as an O&M building site has been identified which is less environmentally sensitive compared to the alternative sites considered throughout the EIA process.
- The new revised 47 turbine layout has been deemed to be preferred when compared to the originally proposed 70 turbine layout, based on assessments undertaken by the specialists (**Section 11**). As such, the reduction in the number of proposed turbines is deemed to be beneficial from an environmental perspective.
- With regards to access to the proposed site, it was deemed that Option 3 would be the preferred option according to the Traffic Assessment.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.

The date on which the activity will commence cannot be determined at this stage as they are based on the timeframes dictated by the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) bid windows. The date of the next round of bid submissions has not yet been announced. The construction of the !Xha Boom Wind Farm and associated infrastructure is dependent on being selected as a preferred bidder. The project will therefore require an environmental authorisation of at least 5 years.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

# 16 REFERENCES


- 2017. Palaeontological Desktop Impact Assessment for the Proposed Development of Four Leeuwberg Wind Farms and Basic Assessments for the Associated Grid Connection near Loeriesfontein, Northern Cape Province: Banzai Environmental.
- Broughton, E., and Nkata, Z., 2017: Environmental Impact Assessment for !Xha Boom Wind Farm: Socio-economic Impact Study. Urban Econ Development Economists.
- Burger, D., 2017. 12 Month Pre-Construction Bat Activity Monitoring Study for the proposed !Xha Boom Wind Energy Facility, Northern Cape. Animalia Zoological & Ecological Consultation.
- De Jager, M. 2017: "Environmental Noise Impact Assessment for the proposed !Xha Boom Wind Farm North of Loeriesfontein, Northern Cape". Enviro-Acoustic Research, Pretoria.
- Fouche, C., 2017. Path Loss and Risk Assessment Report for !Xha Boom Based on the Emission Control Plan for the Acciona AW125 TH100A WTG. Interference Testing and Consultancy Services (ITC).
- Fouche, C., 2017. Evaluation Report: Cumulative Effect of Leeuwberg and Adjacent Wind Farms. Interference Testing and Consultancy Services (ITC).
- Fourie, W., 2017: !Xha Boom Wind Energy Facility (WEF): Heritage Impact Report. PGS Heritage.
- Jacobs, S., and Gibb, A., 2017: Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province: Visual Impact Assessment Report – Impact Phase, SiVEST. Rivonia.
- Lanz, J., 2017. Agricultural and Soils Impact Assessment for the proposed !Xha Boom Wind Farm and Associated Infrastructure near Loeriesfontein, Northern Cape: Eia Phase Report.
- Papathanasiou, S., 2017. Leeuwberg Wind Farm Preliminary Engineering Services Report. SMEC South Africa. For: Mainstream Renewable Power South Africa.
- Randall, G., 2017. Leeuwberg Farm Preliminary Engineering Services Report: Transportation Study. SMEC Soth Africa. For: Mainstream Renewable Power South Africa.
- Taylor, S., 2017: Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province: Surface Water Impact Assessment Report. SiVEST. Rivonia.
- Todd, S., 2017. !Xha Boom Wind Farm near Loeriesfontein: Fauna & Flora Specialist EIA Report. Simon Todd Consulting. For: Mainstream Renewable Power South Africa.
- Van Rooyen, C., 2017. Bird Impact Assessment Study: !Xha Boom Wind Energy Facility. Chris van Rooyen Consulting.

**SiVEST Environmental Division**
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Andrea Gibb
Cell No.: +27 72 587 6525
Email: andreag@sivest.co.za