SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

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

Draft Scoping Report

DEA Reference: **To be announced**
Issue Date: 21 June 2017
Version No.: **1**
Project No.: 13622

Date:	21 June 2017
Document Title:	Proposed Construction of the Xha! Boom Wind Farm near Loeriesfontein, Northern Cape Province: Draft Scoping Report
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Version Number:	**1**
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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"

Refer to **Appendix 8A** for the full list of coordinates.

TITLE DEEDS: These will be included in the FSR in **Appendix 8B**.

PHOTOGRAPHS OF SITE:

General Characteristics of the study area

TYPE OF TECHNOLOGY: Wind Turbines and associated infrastructure

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

SURFACE AREA TO BE COVERED: The total area of the application site is 3804 hectares. The total buildable area for the proposed Wind Farm is 1897.20 hectares. 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 400m^2 (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 000m^2. The administration and warehouse buildings will have a footprint of approximately 5 000m². Internal access roads with a maximum width of 20 m 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 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

[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 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 to confirming this will be included in the Final Scoping Report (FSR).

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:

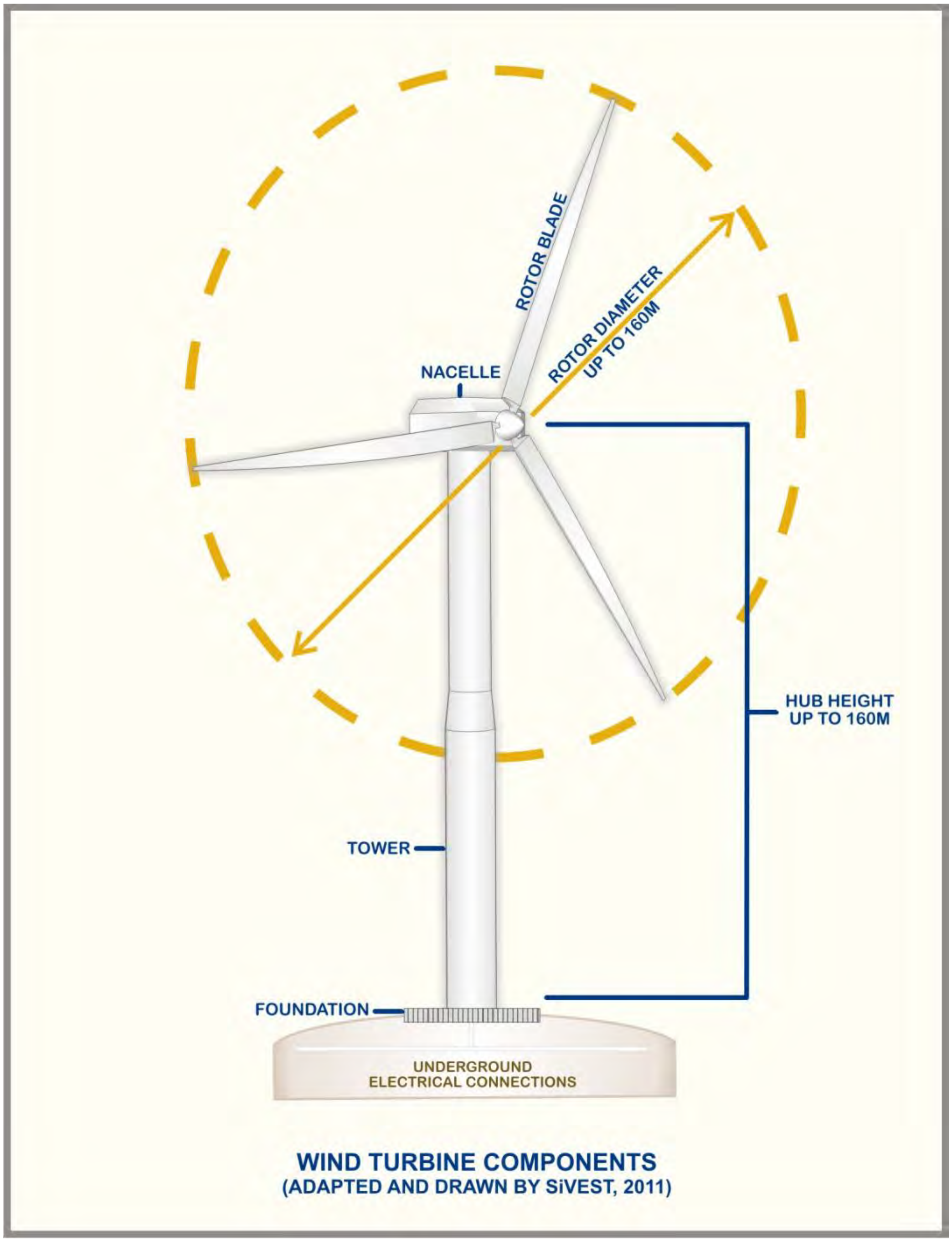

Figure i. Example of a Wind Turbine.

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 25m, and will be approximately 3m deep. The 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.

EXPORT CAPACITY: The project will have a maximum export capacity up to 235MW

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

SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

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

DRAFT SCOPING 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.

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).

The proposed development requires Environmental Authorisation (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 the 8th of December 2014, and as amended on 7th 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.

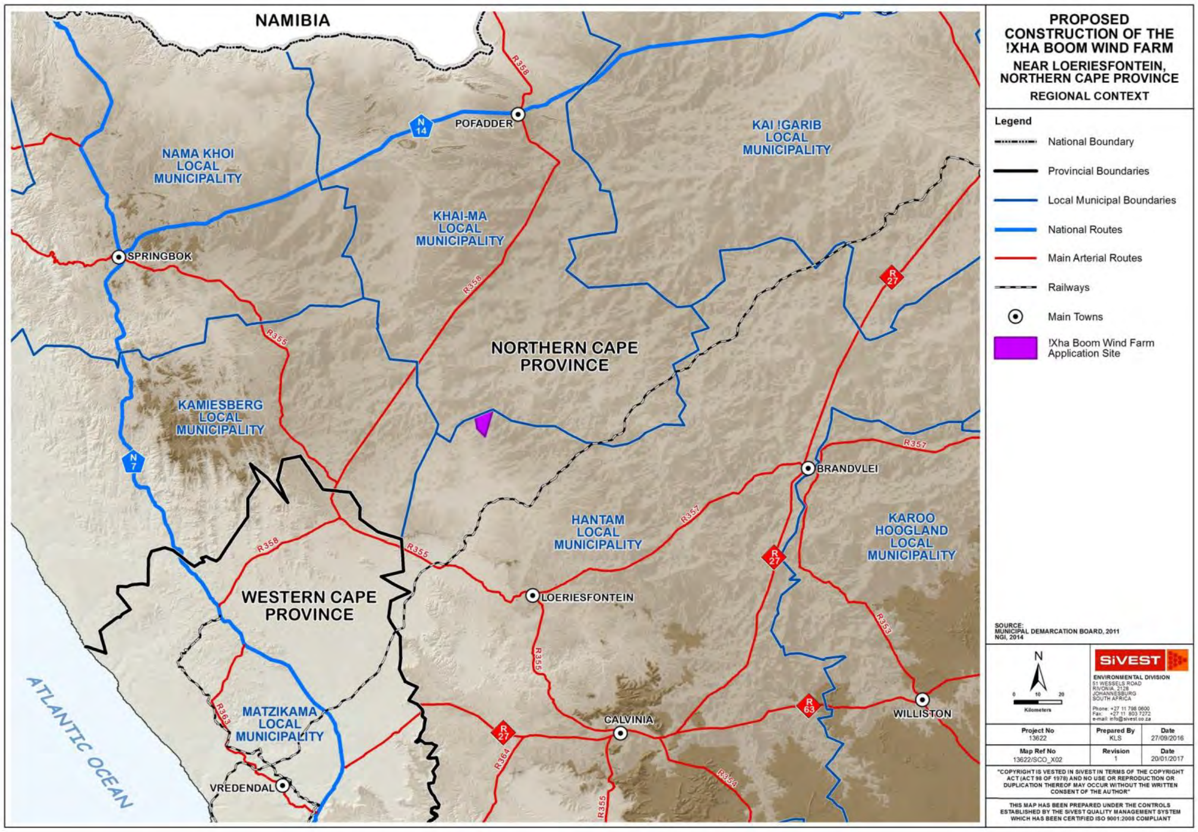

Figure ii: Regional context for the proposed Xha! Boom Wind Farm

Xha! BOOM WIND FARM: APPLICATION SITE		
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Refer to **Appendix 8A** for the full project coordinates.

The following assessments were conducted during the Scoping Phase to identify and assess the issues associated with the proposed development:

- Biodiversity Assessment;
- 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 to the Square Kilometre Array (SKA)

These studies were also undertaken to inform the impact assessment to take place in the EIA phase of the proposed development. In the Scoping Phase the specialists assessed the entire proposed development area (Entire part of Portion 2 of the Farm Georg's Vley No. 217), during the EIA phase the specialist reports will assess specific impacts of the proposed turbine locations and wind farm infrastructure in detail.

Based on the scoping studies which were conducted, a few potentially sensitive sites have been identified within the study area. These have informed the preliminary assessment of layout alternatives which are included in **Chapter 7** and will be further assessed during the EIA phase. The table below summarises the specialist findings of the Scoping Report for the entire project.

Biodiversity	The Xha! Boom Wind Farm consists largely of arid grassland or low open shrubland on flat plains and gently sloping hills that are low sensitivity, with few species of conservation concern. Development in these areas would generate low impacts of local significance only. The only sensitive feature present at the site are some minor drainage lines in the south and some rocky outcrops along the transitional area between the grasslands of the east and the arid shrubland of the west. These however occupy a small proportion of the site and these can easily be avoided by the final layout of the development. Cumulative impacts as a result of the development are likely to be relatively low as the footprint of the development is quite low and the intensity of development in the wider area is still low despite the fact that a node of renewable energy is developing around the Helios substation. In addition, there are no specific features of the Xha! Boom development area which would indicate that it is more important than the surrounding area for faunal movement or landscape connectivity. The contribution of

	the Xha! Boom development to cumulative impact is thus likely to be relatively low and would operate at a local scale only. With the application of relatively simple 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 apparent reasons that it should not proceed to the EIA phase.
Avifauna	Information on the micro habitat level was obtained through a pre-construction monitoring programme which was conducted over four seasons between November 2015 and December 2016. The proposed Mainstream Xha! Boom Wind Farm will have a variety of impacts on avifauna which range from low to high. 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. 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. 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. 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. The electrocution of priority species on the internal MV power lines is rated as a potentially medium impact which could be reduced to low through the use of bird friendly designs. 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 Wind Farm 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. 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. *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 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. Met Mast monitoring system indicates the highest amount of bat passes, followed by Short Mast 3. 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. Short Mast 1 had no data for the months of April, June, and July 2016 due to system failures. 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, and 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. A sensitivity map was drawn up indicating potential roosting and foraging habitat which is included in **Chapter 5.9 Section 5.9.4** of this report. The Moderate bat sensitivity areas and associated buffer zones must be prioritised during operational monitoring and preferably be avoided during turbine placement, if another feasible option is available. There are however no turbines located within moderate sensitivity areas. 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. Turbines located within high sensitivity areas and their buffers must be moved out of high sensitivity areas and buffers or removed from the layout. 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. Mitigation is expected to be implemented, if necessary, once the turbines become operational. The proposed mitigation measures include, but are not limited to the following:

	▪ Adhere to the sensitivity map during turbine placement. Blasting should be minimised and used only when necessary. A Bat Specialist should be consulted before blasting of a rocky cliff face or rocky cavernous area. The mitigation measures will reduce the impact that blasting and earthworks will have on the environmental parameter, through avoiding sensitive areas. ▪ Avoid areas of moderate and high bat sensitivity and their buffers. Adhere to operational mitigation measures described in Section 7 of this report. 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). Unless required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors. This mitigation measure will reduce the likelihood of certain bat species being favoured. ▪ 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 an experienced vegetation succession specialist. This mitigation measure will reduce the degree of habitat loss. The proposed mitigation described above and in **Section 6.3.3** of this report, follows the precautionary approach strongly and therefore the mitigations will be adjusted and refined during a post-construction bat monitoring study.
Surface water	Findings from the database assessment showed that there is only one (1) natural depression wetland. This wetland is not considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). Aside from the wetland, two (2) non-perennial watercourses were identified in the Northern Cape ENPAT (2000) database. No other watercourses were identified from the NFEPA (2011) database. No other surface water resources were identified from the available databases. In terms of the desktop delineation exercise, the following surface water resources were identified: ▪ Two (2) Depression Wetlands; ▪ Three (3) Major Drainage Line (drainage lines with channel width >5m); ▪ Two hundred and thirty, six (236) Drainage Lines (drainage lines with a channel width <5m). Between the database findings and the desktop delineation information, the identified features are to be earmarked for groundtruthing in the fieldwork phase. A refinement of the surface water resources will be undertaken in the impact phase pending the fieldwork findings. A provisional buffer zone of 50m has been implemented at this stage for all surface water resources. Pending the results of the in-field

	groundtruthing and verification exercise, the buffer zone may be increased or decreased depending on the assessment findings. A comparative assessment was undertaken to determine the environmentally preferred alternative (from a surface water perspective) for the proposed substation. Based on the comparative assessment, the preferred alternative site for the proposed substation was Substation Option 1. In terms of NEMA (1998) and the EIA Regulations (2014), as no specific layout is available at this time, it is provisionally identified that Activities 12 and 19 of Government Notice 983 Listing Notice 1 are identified that may be triggered thereby requiring Environmental Authorisation (EA). In terms of the National Water Act (NWA) (1998), it has been identified that there are a number of surface water resources which may be affected and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. The applicability of these environmental activities and water uses can ultimately only be confirmed once a more detailed layout is available. 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. The considerable distance (9km) and separation by two watersheds between the proposed development and the Kokerboom 2 Wind Farm mean that it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm. 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. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.
Soils and Agricultural Potential	The key findings of the Soils and Agricultural Potential scoping study are: ▪ Soils across the site are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms. ▪ The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils. ▪ As a result of these limitations, the site is unsuitable for cultivation and agricultural land use is limited to low intensity grazing.

	▪ The land capability is classified as Class 7 - non-arable, low potential grazing land. The site has a very low grazing capacity of 45 hectares per large stock unit. ▪ There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development. ▪ The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance 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. ▪ Six potential negative impacts of the development on agricultural resources and productivity were identified as: o Loss of agricultural land use caused by direct occupation of land by the energy facilities' footprint. o Soil Erosion caused by alteration of the surface characteristics. o Generation of dust caused by alteration of the surface characteristics. o Loss of topsoil in disturbed areas, causing a decline in soil fertility. o Degradation of surrounding grazing land due to vehicle trampling. o Soil contamination from hydrocarbon spills during construction. ▪ Two potential positive impacts of the development on agricultural resources and productivity were identified as: o 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. o Increased security against stock theft due to the presence of the energy facility. ▪ All impacts were assessed as having low significance. ▪ 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. ▪ Despite any cumulative regional impact that may occur, 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. ▪ There are no conditions resulting from this assessment that need to be included in the environmental authorisation. ▪ There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts.
Noise	The Noise Scoping 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 and operating wind turbines.

	The construction of access roads as well as construction traffic may increase the noise levels sufficiently to result in noise impacts of medium significance. Mitigation measures are available and easy to implement to reduce the potential significance of the noise impact to low. The potential noise impact of operational activities is of a low significance, similarly the potential cumulative noise effect when all the surrounding wind turbines are operating is of low significance. There is a high confidence in the finding of this report, and with the implementation of the mitigation measures there exists a low potential for a noise impact. An additional noise impact assessment is not required for the EIA phase, as it will not provide additional information, however the turbine layout put forward in the plan of study will need to be reassessed and the cumulative impacts will need to be further investigated. During the Environmental Impact Assessment (EIA) phase the noise models will be redone based on the revised turbine layout that takes the sensitive areas into account. Based on the layout assessed in the Scoping Phase it was concluded that the project can be authorised (subject to the implementation of the mitigation measures agreeable with the identified receptors) from a noise perspective.
Visual	A scoping-level study has been conducted to identify the potential visual impact and issues related to the development of the Xha! Boom Wind Farm near Loeriesfontein, in the Northern Cape Province. The study area has a largely natural, untransformed visual character although there are several renewable energy developments (solar and wind) proposed within relatively close proximity to the proposed wind farm. These facilities and their associated infrastructure, will significantly alter the visual character and baseline in the study area once constructed and make it appear to have a more industrial-type visual character. The proposed wind farm development is likely to visually influence only one (1) farmstead / homestead identified within the visual assessment zone, therefore this is regarded as a potentially sensitive visual receptor location. The sensitivity of the receptor locations will need to be confirmed through further assessment in the next phase of the study. The nature of the visual impacts associated with a development of this size on the receptors in the study area could be significant. An overall impact rating was also conducted as part of the Scoping Phase in order to allow the visual impact to be assessed alongside other environmental parameters. The assessment revealed that overall the proposed Xha! Boom Wind Farm is expected to have a low visual impact during construction and a medium visual impact during operation, with relatively few mitigation measures available. In addition, the

	infrastructure associated with the proposed Xha! Boom Wind Farm would have a low visual impact during construction and a low visual impact during operation. Further assessment will however be required in the EIA-phase to investigate the sensitivity of the receptor locations to visual impacts associated with the proposed development and to quantify the impacts that would result.
Heritage	The Heritage Scoping Report (HSR) completed in October 2016 has shown that the proposed Xha! Boom site to be developed as a Wind Farm may have heritage resources present on the property. This has been confirmed through archival research, evaluation of aerial photography of the sites and field work. 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. The design process and methodology followed by the developer for this project will enable the heritage assessment to provide input into the proposed layouts before the impact assessment. This resulted in cognisance being taken of the positions of the heritage resources and thus the reduction of impacts at an early design phase. The mitigation measures proposed is a follows: **Pre-Construction** 1. A detailed walk down of the final approved layout will be required before construction commence; 2. 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. 3. A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations. **Palaeontology** The proposed Xha! Boom wind farm development is 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. However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the Environmental Control Officer (ECO) responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert South African Heritage Research Agency (SAHRA) so that appropriate mitigation

	(*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist. The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. **Comparative Assessment of Alternatives** A comparative assessment of the preferred substation position has shown that from a heritage perspective both area considered as good options. Substation Option 1 is however preferred as Substation Option 2 will impact on a low significance heritage find. **Cumulative Impact** 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.
Socio-economic	Relevant national, provincial and local government policies reveal that the development of Renewable Energy (RE) technologies is strongly supported both: ▪ At the national level, developing an RE sector is supported with respect to the need to diversify and expand energy supply ▪ At the provincial and local level, RE sector development support is premised on the prioritisation of regional economic stimulation as well as the creation of employment opportunities for the benefit of local people. The socio-economic impacts associated with the proposed development include, but are not limited to the following: ▪ Increased production and temporary stimulation of GDP-R; ▪ Skills development due to the creation of new employment opportunities; ▪ Increased household income and improved standard of living; ▪ Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (EDP); ▪ Increase in government revenue due to the capital investment; ▪ Change in demographics due to migration of workers from other areas and influx of jobseekers; ▪ Increase in social pathologies associated with the influx of migrant labourers and job-seekers to the area; ▪ Added pressure on basic services and social and economic infrastructure; ▪ Establishment of the informal hospitality industry due to increased demand for accommodation;

	▪ Sustainable increase in GDP of the national and local economies through operation and maintenance activities; ▪ Sustainable increase in government revenue stream; ▪ Creation of long term employment in local and national economies through operation and maintenance activities; ▪ Skills development due to the creation of new sustainable employment opportunities; ▪ Increased household income; ▪ Improved standard of living of households directly or indirectly benefiting from created employment opportunities; and ▪ Improved access to basic services and community services. The overall consideration of the favourable alignment of local, regional and national policy with the proposed project as well as the complementary nature of wind farms and the current land use of the project site is evidence that no fatal flaws are present from the socio-economic perspective. Considering all the potential socio-economic impacts for both the construction and operational phase, with respect to the substation, there is no differentiation that can be made regarding the potentially ensued socio-economic effects as they will remain the same regardless of the sub-station site alternative chosen.
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. 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.
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 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. 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. 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.
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. 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. 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 TH100A Acciona turbines are installed[2]. This shown by the 10dB to 20dB higher path loss for Xha! Boom compared to Garob.

[2] Please note that the EMI and RFI studies were based on worst case scenario turbines. Due to technology improvements a dffirent turbine may be used for the proposed development. However this would be subject to the same EMI and RFI studies.

	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. 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 the above mentioned studies, the Scoping Report has identified several aspects that warrant further investigation in the EIA Phase. These are as follows:

- Biodiversity Assessment;
- Avifauna Assessment;
- Bat Assessment;
- Surface Water Impact Assessment;
- Soils and Agricultural Potential Assessment;
- Noise Assessment
- Visual Impact Assessment;
- Heritage Assessment; and
- Socio-economic Impact Assessment.

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SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

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

DRAFT SCOPING REPORT

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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.

Historical Period: Since the arrival of the white settlers - c. AD 1840 - in this part of the country

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
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
WETFEPA	- Wetland Freshwater Priority Areas
WF	- Wind Farm
WMA	- Water Management Area
WTG	- Wind Turbine Generator

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

DRAFT SCOPING 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 (**Figure 1**). The proposed development will consist of a 235MW maximum export capacity wind farm referred to as Xha! Boom Wind Farm. In addition, the overall objective of the project is to generate electricity to feed into the National Grid. SiVEST Environmental Division have subsequently been appointed 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.

Additionally, Mainstream are proposing to construct the associated on-site Xha! Boom substation and power line, both with a capacity of up to 132kV. This associated electrical infrastructure will require a separate Environmental Authorisation 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 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).

The proposed development requires Environmental Authorisation 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 National Environmental Management Act (NEMA), which came into effect on the 8th of December 2014, and as amended on 7th 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.

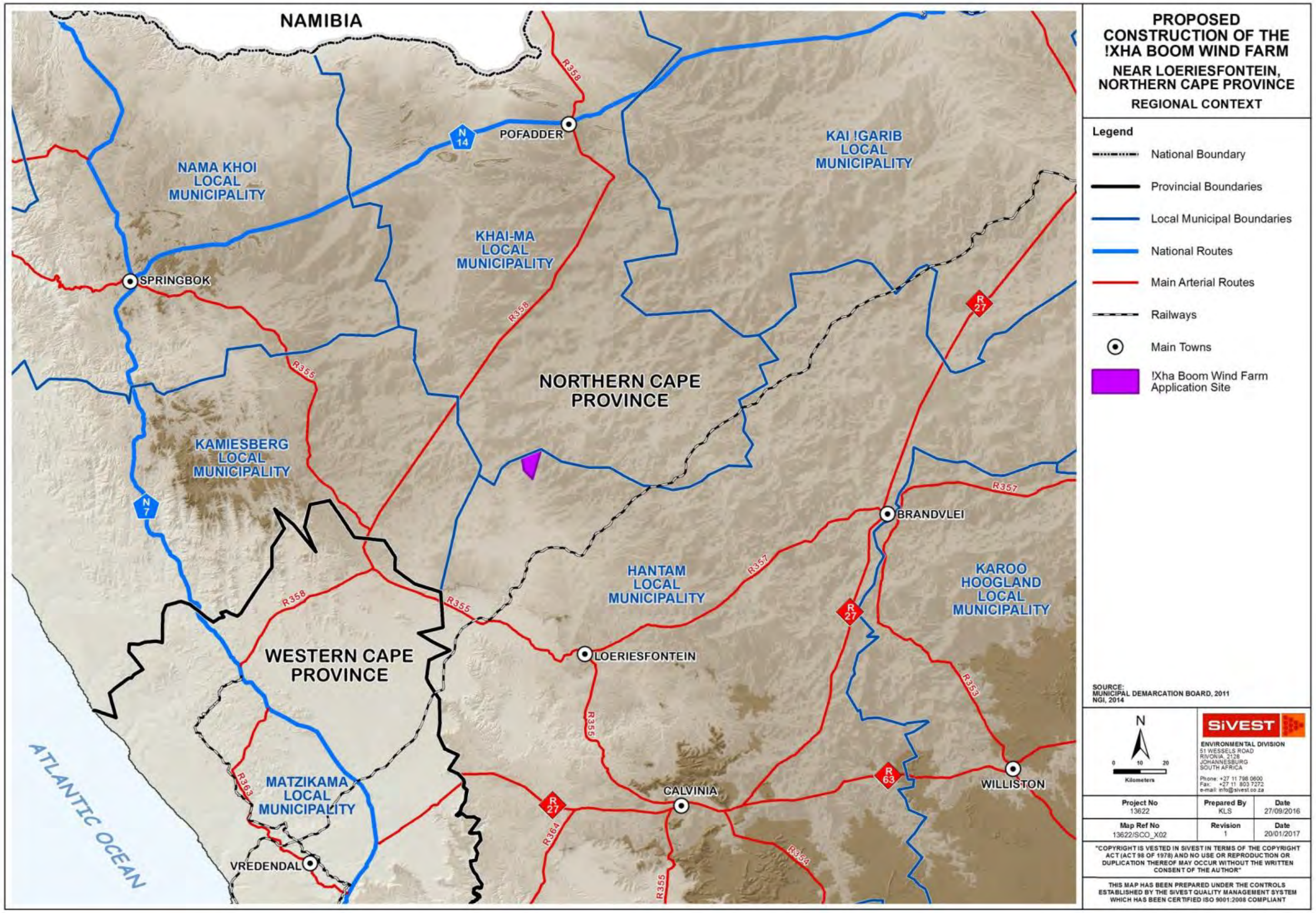


Figure 1: Regional context for the proposed Xha! Boom Wind Farm and associated infrastructure.

1.1 Objectives of the Scoping Phase

The NEMA EIA Regulations (GN. R. 982) state that the objective of the Scoping Phase is to:

(a) identify the relevant policies and legislation relevant to the activity;
(b) motivate 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 and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
(e) identify the key issues to be addressed in the assessment phase;
(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and
(g) identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

A Scoping Report must contain the information that is necessary for a proper understanding of the process, informing all preferred alternatives, including location alternatives, the scope of the assessment, and the consultation process to be undertaken through the environmental impact assessment process. The content requirements for a Scoping Report (as provided in Appendix 2 of the EIA Regulations 2014), as well as details of which section of the report fulfils these requirements, are shown in **Table 1** below.

Table 1: Content requirements for a Scoping Report

Content Requirements	Applicable Section
(a) details of- (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;	Details of the EAP and full project team are included in **section 1.4** on **page 5**. The expertise (including curriculum vitae) of the EAP and full project team are include in **Appendix 2**.
(b) the location of the activity, including- (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name;	The location (including 21 digit Surveyor General codes) of the proposed project is detailed on **page *i*** of the report, as well as in **section 5.2** on **page 38**.

(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	
(c) a plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is- (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (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 5.1** on **page 37**, and the site locality is shown in **section 5.2** on **page 38**. Additionally, all project maps are included in **Appendix 5**. Coordinates are shown on **page *i*** of the report, as well as in **section 5.2** on **page 38**. Additionally, all coordinates are included in **Appendix 8A**.
(d) a description of the scope of the proposed activity, including- (i) all listed and specified activities triggered; (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 3.1.2** on **page 16**. The technical project description is included in **section 2** on **page 8**. 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 proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process;	A description of all legal requirements and guidelines is provided in **section 3** on **page 15**. This includes key legal and administrative requirements as well as key development strategies and guidelines.
(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** on **page 33**.
(h) a full description of the process followed to reach the proposed preferred activity, site and location within the site, including - (i) details of all the alternatives considered; (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; (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;	A description of the alternatives considered in terms of the Regulations is included in **section 2.3** on **page 13**. A preliminary assessment of layout alternatives is included in **section 6.4.1** on **page 216**. The public participation process followed is detailed in **section 8** on **page 239**. Additionally, all public participation documents are included in **Appendix 7**. This will include a

(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; (v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated; (vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; (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; (viii) the possible mitigation measures that could be applied and level of residual risk; (ix) the outcome of the site selection matrix; (x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such and (xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity;	summary of issues raised by I&AP's, and the responses to their comments. A full description of the environmental attributes within the application site is included in **section 5** on **page 37**. The impacts and risks associated with each alternative are assessed in **section 6.4.1** on **page 216**. The methodology used in identifying the impacts and risks associated with each alternative is included in **section 6.4.1** on **page 216**. The positive and negative impacts that the proposed activity will have on the environment are discussed in **section 6.2** on **page 126**. Potential mitigation measures are included in **section 6.3** on **page 202**. The outcome of the site selection matrix is included in **section 4.4** on **page 34**. The inclusion of alternatives is discussed in **section 2.3** on **page 13**, and in **section 6.4.1** on **page 216**. A concluding statement indicating the preferred alternatives is contained in **section 6.4.1** on **page 216**.
(i) a plan of study for undertaking the environmental impact assessment process to be undertaken, including- (i) a description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity; (ii) a description of the aspects to be assessed as part of the environmental impact assessment process; (iii) aspects to be assessed by specialists; (iv) a description of the proposed method of assessing the environmental aspects, including a description of the proposed method of assessing the environmental aspects including aspects to be assessed by specialists; (v) a description of the proposed method of assessing duration and significance; (vi) an indication of the stages at which the competent authority will be consulted;	The plan of study for the EIA phase is included in **section 11** on **page 274.** A description of alternatives to be considered is included in **section 11.8** on **page 293**. A summary of the aspects to be assessed is included in **section 11.1** on **page 274** and in **section 11.3** on **page 275**. The description of the proposed EIA phase methodology is in **section 11.3** on **page 275**. An indication of planned authority consultation is contained in **section 11.2** on **page 275**. The particulars of the planned public participation process are included in **section 11.10** on **page 295**. All

(vii) particulars of the public participation process that will be conducted during the environmental impact assessment process; and (viii) a description of the tasks that will be undertaken as part of the environmental impact assessment process; (ix) identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored.	tasks to be undertaken during the EIA phase are described in **section 11** on **page 274**. Detailed mitigation measures will be included in the EIA phase of the project, following detailed specialist studies, as indicated in **section 11.9** on **page 295**.
(j) an undertaking under oath or affirmation by the EAP in relation to- (i) the correctness of the information provided in the report; (ii) the inclusion of comments and inputs from stakeholders and interested and affected parties; and (iii) 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;	The EAP affirmation is included in **Appendix 3**.
(k) an undertaking under oath or affirmation by the EAP in relation to the level of agreement between the EAP and interested and affected parties (I&APs) on the plan of study for undertaking the environmental impact assessment;	The plan of study will be included within this DSR which will be made available for review and comment by I&APs. Should any I&APs identify any issues or concerns with respect to the plan of study for undertaking the EIA, it will be updated accordingly.
(l) where applicable, any specific information required by the competent authority; and	At this stage there is no specific information required by the competent authority. However a record of authority consultation is kept in **section 1.3** on **page 5**, and should there be any specific information requested, this will be detailed in the same section.
(m) 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.

1.2 Specialist Studies

Specialist studies have been conducted in terms of the stipulations contained within **Appendix 6** of the 2014 NEMA EIA regulations.

The following specialist studies have been conducted to assess the site:

- Biodiversity Assessment;
- Avifauna Assessment (including pre-construction monitoring);
- Bat Assessment (including pre-construction monitoring);
- Surface Water Impact Assessment;
- Soils and Agricultural Potential Assessment;
- Noise Impact Assessment;
- Visual Impact Assessment;
- Heritage Assessment;
- Socio-economic Assessment;
- Geotechnical Assessment;
- Traffic Impact Assessment; and
- Path Loss and Risk Assessment to the SKA.

These studies have been used to identify issues at a scoping level and will be supplemented with more site specific studies during the EIA phase of the project. Key issues relating to the proposed site are discussed below in **Section 5**.

1.3 Decision-Making Authority Consultation

The National Department of Environmental Affairs (DEA) is the competent authority on this project. As such, an application for Environmental Authorisation (EA) for the proposed development will be submitted to DEA on the 21st of June 2017. A proof of payment, details of the EAP and declaration of interest, a project schedule, details of landowners, and locality map form part of the application form and will be submitted accordingly on the same date. This DSR will be submitted to the DEA on the same day that the application is submitted and following the allocation of the DEA reference number this will be included in the FSR.

1.4 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 Scoping Report are detailed in
Table 2 below.

Table 2: Project Team

Name and Organisation	Role
Andrea Gibb – SiVEST	EAP and Visual
Stephan Jacobs – SiVEST	Environmental Consultant, Visual and Public Participation Practitioner

Name and Organisation	Role
Simon Todd – Simon Todd Consulting	Biodiversity
Chris van Rooyen – Chris van Rooyen Consulting	Avifauna
Werner Marais – Animalia	Bats
Shaun Taylor – SiVEST	Surface Water
Johann Lanz	Agricultural Potential
Morné De Jager – Enviro Acoustic Research (EAR)	Noise
Wouter Fourie – PGS	Heritage
Elena Broughton – Urban-Econ Development Economists	Socio-economic
Nicolene Venter – Imaginative Africa	Senior Public Participation Practitioner
Kerry Schwartz – SiVEST	GIS, Mapping and Visual
Glen Randall – 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 NEMA (2014), the details and level of expertise of the persons who prepared the DSR are provided in **Table 3** below.

Table 3: Expertise of the EAP

Environmental Practitioner	SiVEST (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 (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.

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

1.5 Draft Scoping Report Structure

This Draft Scoping Report (DSR) is structured as follows:

- **Chapter 1** introduces the project and explains the objectives of the Scoping Phase. The chapter also outlines the relevance of the Equator Principles as well as the IFC Performance Standards and points out the specialist studies for the project. It describes the authority consultation thus far. Furthermore, the chapter discusses the experience of the Environmental Assessment Practitioners (EAP), including specialists, who have contributed to the report.
- **Chapter 2** presents the technical description of the project, including a description of alternatives being considered.
- **Chapter 3** expands on the relevant legal ramifications applicable to the project and describes relevant development strategies and guidelines.
- **Chapter 4** provides explanation to the need and desirability of the proposed project.
- **Chapter 5** provides a description of the region in which the proposed development is intended to be located. Although the chapter provides a broad overview of the region, it is also specific to the application. It contains descriptions of the site and the specialist studies are also summarised.
- **Chapter 6** identifies potential impacts associated with the proposed wind farm. The chapter further identifies these impacts per specialist study and discusses potential cumulative impacts.
- **Chapter 7** discusses layout alternatives, including how they relate to sensitive areas identified by specialists and provides a preliminary comparison of alternatives.
- **Chapter 8** describes the Public Participation Process (PPP) undertaken during the Scoping Phase and tables issues and concerns raised by Interested and Affected Parties (I&APs).
- **Chapter 9** provides an assessment of the report in terms of the Equator Principles.
- **Chapter 10** provides a conclusion to the DSR and recommendations to be addressed in further assessment.
- **Chapter 11** describes the environmental impact reporting phase of the EIA (i.e. the way forward for this study and includes the Plan of Study for EIA).
- **Chapter 12** lists references indicated in the DSR.

2 TECHNICAL 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 70 turbines, each with a generation capacity between 3 and 5MW. 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 area of the project infrastructure has not been determined and will be determined during the EIA phase, however the total extent of the development area is approximately 3804 hectares. The total buildable area for the proposed Wind Farm is 1897.20 hectares. During the Scoping Phase the entire development area has been assessed in order to inform the preliminary comparison of layout alternatives for the wind farm. These layout alternatives have been discussed in **Chapter 7** and are presented in the Plan of Study for the EIA Phase (**Chapter 11**).

2.1 Project Location

The proposed wind farm is located approximately 68km north of Loeriesfontein in the Northern Cape Province, within the Hantam Local Municipality.

The study area is on the following property:

- Entire part of Portion 2 of the Farm Georg's Vley No. 217.

The project site has been identified by Mainstream based on wind resource, grid connection suitability, competition, flat topography, land availability and site access. The buildable area of the site will however be determined by sensitive areas identified during the EIA.

The proposed development location is shown in the locality map (Figure 2) below.

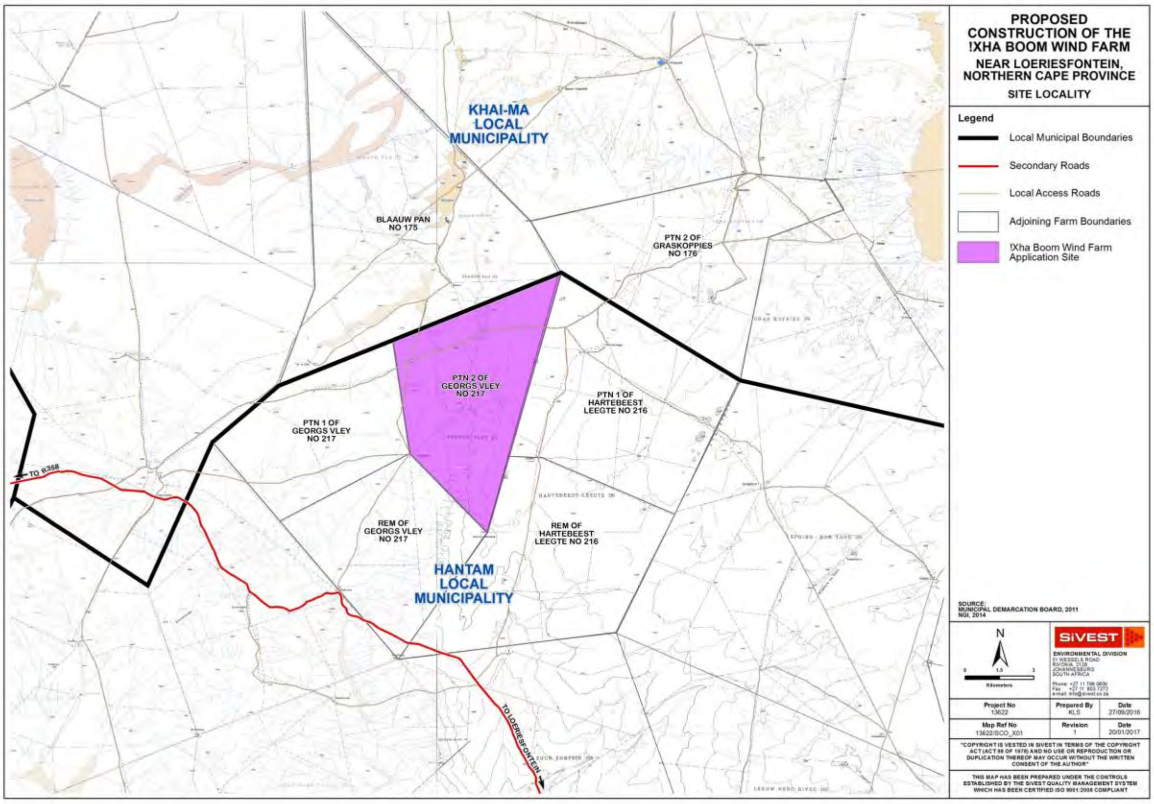


Figure 2: Proposed Xha! Boom Wind Farm site locality map

2.2 Wind Farm Technical details

The key technical details and infrastructure required is presented in the table below (**Table 4**).

Table 4: Xha! Boom Wind Farm summary

Project Name	**DEA Reference**	**Farm name and area**	**Technical details and infrastructure necessary for the proposed project**
Xha! Boom Wind Farm	To be announced	▪ Entire part of Portion 2 of the Farm Georg's Vley No.217 Development Area: 3804 ha Total Buildable Area 1897.20 ha	▪ Up to **70 wind turbines**, between 3 and 5MW, with a maximum export capacity up to 235MW. ▪ Wind turbines will have a hub height of up to 160m and a rotor diameter of up to 160m^3. ▪ **132kV on-site Xha! Boom IPP Substation** ▪ The turbines will be connected via **medium voltage cables** to the proposed 132kV on-site Xha! Boom IPP Substation. ▪ 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. ▪ A temporary construction **lay down area.** ▪ A **hard standing area / platform** per turbine. ▪ The **operations and maintenance buildings**, including an on-site spares storage building, a workshop and an operations building. ▪ **Fencing** (if required) will be up to 5m where required and will be either mesh or palisade.

The key components of the project are detailed below.

2.2.1 Turbines

The total amount of developable area is approximately 3804 hectares. The total buildable area for the proposed Wind Farm is 1897.20 hectares. 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[3] (**Figure 3**). 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 70 wind turbines constructed with a capacity up to 235MW. The electrical generation capacity for each turbine will range between 3MW and 5MW, 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.

[3] 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 to confirming this will be included in the Final Scoping Report (FSR).

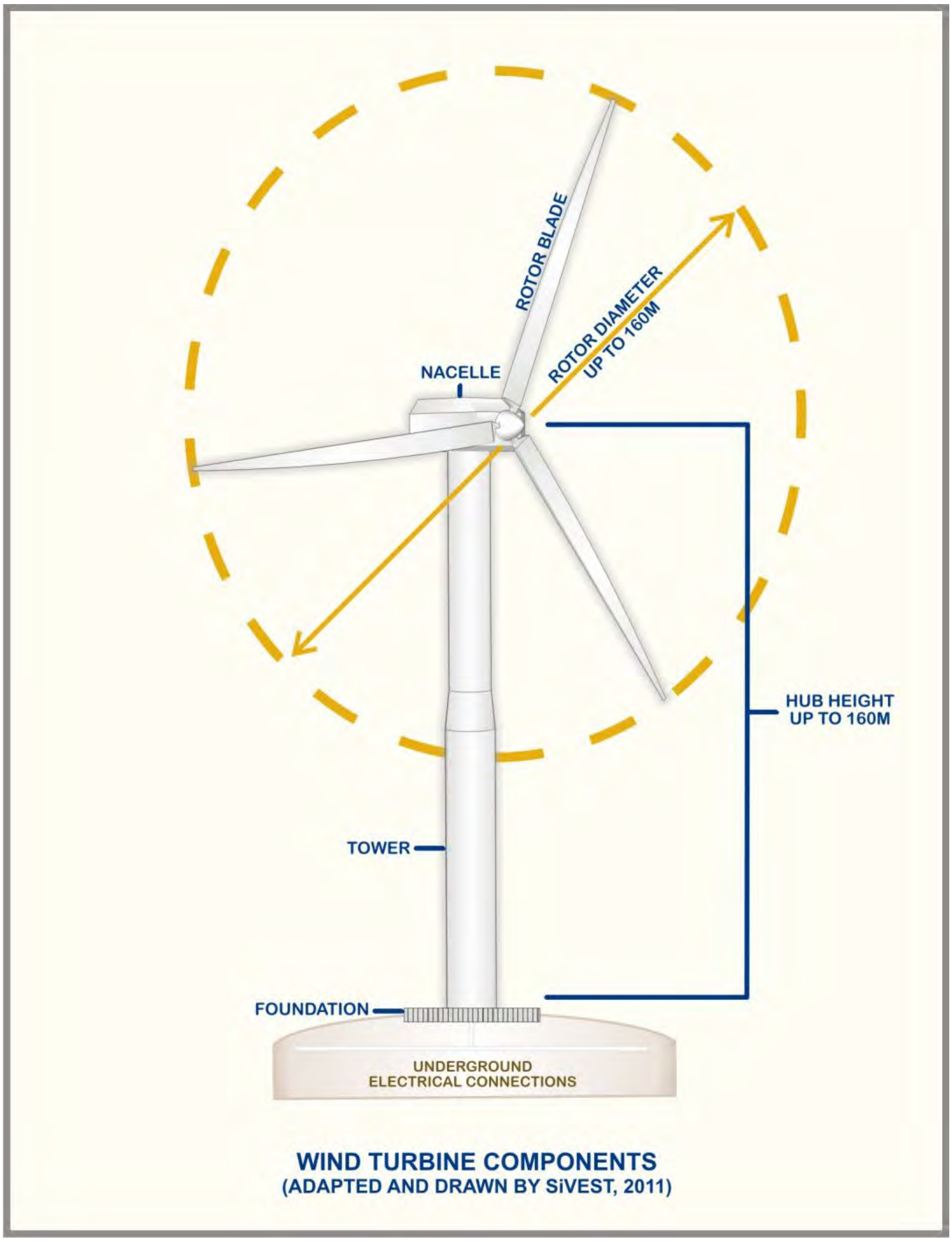


Figure 3: Typical Components of a Wind Turbine

2.2.2 Electrical Connections

The wind turbines will be connected (**Figure 4**) to the proposed 132kV on-site Xha! Boom 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 practise and SANS requirements.

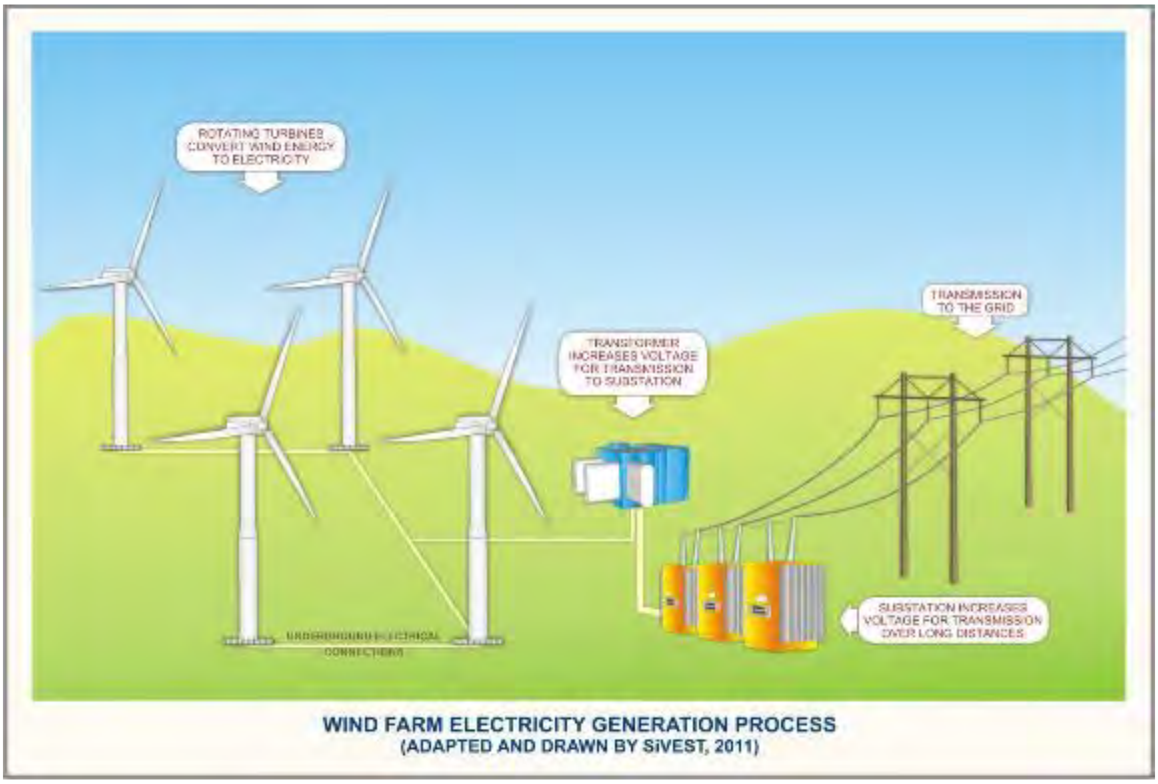


Figure 4: Conceptual Wind Farm Electricity Generation Process showing Electrical Connections

2.2.3 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.

2.2.4 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.

2.2.5 Operation and Maintenance 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.

2.2.6 Other Associated Infrastructure

Other infrastructure includes the following:

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

2.3 Alternatives

As per Chapter 1 of the EIA regulations (2014), feasible and reasonable alternatives are required to be considered during the EIA process. Alternatives are defined as "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 this alternatives is discussed in relation to the proposed project in the sections below.

2.3.1 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 the R358 or the N1 to Loeriesfontein.

The site is therefore considered highly suitable for the proposed development and no other locations are being considered.

2.3.2 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.

2.3.3 The design or layout of the activity;

Design or layout alternatives are being considered in the EIA process. 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 (**Chapter 7**). These layouts will be extensively investigated in the EIA phase of the project (see the plan of study for the EIA phase in **Chapter 11** of the DSR). At this stage, the design and layout alternatives include; alternative locations for the proposed 132kV on-site substation.

It should be noted that the layout alternatives for the EIA phase will be based on both environmental constraints and design factors. The findings of the specialist studies and sensitivity mapping will be used to inform the layout of the proposed facility within the preferred site during the EIA phase. The layout will be assessed by the specialists in their respective specialist studies which will be included in the EIA Report.

As part of the EIA, the buildable area of is 1897.20 hectares and will be assessed by the specialists and considered during the EIA phase. Based on the sensitivity mapping within the buildable area, the preferred location and layout for the wind farm and associated infrastructure will avoid the sensitive features identified by the specialists. The area that excludes these sensitive features will be considered to be the Development Envelope for this project and no development may occur outside this envelope. Based on the boundaries of the Development Envelope, a site layout will be determined for this project (i.e. the placement of the wind turbines within the Development Envelope).

It is important to note that 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 Development Envelope 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 will assess the larger area (i.e. the buildable area) and identify sensitivities, which will be avoided in the siting of the proposed infrastructure within the Development Envelope. The Development Envelope is considered to be a "box" in which the project components can be constructed at whichever location without requiring an additional assessment or change in impact significance. Any changes to the layout within the boundaries of the Development Envelope following the issuing of the EA (should it be granted) will therefore be considered to be non-substantive.

2.3.4 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.

2.3.5 The operational aspects of the activity;

No operational alternatives were assessed in the EIA.

2.4 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.

3 LEGAL REQUIREMENTS AND GUIDELINES

3.1 Key Legal and Administrative Requirements Relating to the Proposed Development

3.1.1 National Environmental Management Act No. 107 of 1998 – NEMA EIA Requirements

The National Environmental Management Act (Act No. 107 of 1998) was promulgated in 1998 but has since been amended on several occasions from this date. 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 December 2014 (Government Gazette No. 38282 of 4th December 2014).

Activities that may significantly affect the environment must be considered, investigated and assessed prior to implementation.

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

3.1.2 NEMA EIA Regulations (2014)

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation, the result being that NEMA now governs the EIA process with the said promulgation of EIA Regulations in December 2014 (Government Gazette No. 38282 of 04 December 2014). This EIA has therefore been undertaken in accordance with the NEMA EIA 2014 Regulations which are contained in four Government Notices (GN R 982, 983, 984, and 985) which came into effect on 8th December 2014.

In terms of these Regulations, a full Environmental Impact Assessment is required for the proposed development based on triggered activities. However, several activities which trigger a basic assessment were also identified and need 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 the 8thth December 2014, as amended on 7th April 2017 are of relevance to the project in question. All of the Listed Activities identified in terms of Sections 24(2) and 24D include:

Table 5: 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-*	**An on-site IPP substation will be constructed as part of the proposed wind farm. The proposed**

	(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts	**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:* *ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs-* *(a) within a watercourse;* *(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 Surface Water Scoping Study identified two (2) Depression Wetlands, three (3) Major Drainage Line (drainage lines with channel width >5m) and two hundred and thirty, six (236) Drainage Lines (drainage lines with a channel width <5m). As a result, the layout of the proposed development will likely fall within 32m of surface water features. These surface water features will be identified during the EIA phase.**
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;* *But excluding where such infilling, depositing, dredging, excavation, removal or moving-* *(a) will occur behind a development setback;* *(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;* *(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.*	**The Scoping Phase surface water assessment revealed that there are surface water features located within the development area. The Surface Water Scoping Study identified two (2) Depression Wetlands, three (3) Major Drainage Line (drainage lines with channel width >5m) and two hundred and thirty, six (236) Drainage Lines (drainage lines with a 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-* *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:* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* *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 -* *(ii) where no reserve exists, where the existing road is wider than 8 metres –* *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 –* *(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-* *(i) the undertaking of a linear activity; or* *(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 lon-site substation, O&M building, internal access roads and other associated infrastructure.**

3.1.3 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);
- 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 Plant;
  - Wind Farm;
  - Hydropower Station; and
  - Photovoltaic Power Plant.

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

3.1.4 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).

3.1.5 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.

3.1.6 National Water Act No. 36 of 1998, as amended

The National Water Act (NWA) No 36 of 1998 was promulgated on the 20th 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.

3.1.7 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 Biodiversity 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. This study will be undertaken during the project.

The NEMBA is relevant to the proposed project as the construction of the wind farm and other components (such as the substation) 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.

3.1.8 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.

3.1.9 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.

3.1.10 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 a 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.

3.1.11 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.

3.1.12 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 wind farm.

3.1.13 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 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 photovoltaic energy facility 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 Civil Aviation Authority (CAA) will be consulted and the required approvals will be obtained.

3.1.14 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.

3.1.15 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 border line figure when considering all the adjacent projects resulting in a relatively high emitter density.

The SKA has provided initial comments and will also be provided with the opportunity to comment on the DSR and on the ITC report. SKA comments on the ITC reports and the DSR will be included in the updated C&RR which will be included in the FSR. The Topographical Analysis Assessment and the Path Loss and Risk Assessment Reports are included in **Appendix 8C** [4].

3.1.16 Additional Relevant Legislation

- Occupational Health and Safety 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)

3.2 Key Development Strategies and Guidelines

3.2.1 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.

[4] Please note that the EMI and RFI studies were based on worst case scenario turbines. Due to technology improvements a dffirent turbine may be used for the proposed development. However this would be subject to the same EMI and RFI studies.

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.

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.

3.2.2 Draft Integrated Energy Plan for the Republic of South Africa, 2016

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 plants 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.
- 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.

3.2.3 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.

3.2.4 Renewable Energy Independent Power Producer Procurement Program (REIPPPP)

(The following information was extracted from the Eskom website: Guide to Independent Power Procurement (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)
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 2050.

Table 6: Government Energy Plans up until 2050 in terms of the updated IRP 2016

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)
iii. Negotiation with the preferred bidder(s).

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

3.2.5 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, both in terms of 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.

3.2.6 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 makes reference 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.

3.2.7 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).

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).

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 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 are confirming average wind speeds between 7 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.

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.

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 farms are currently used for agricultural purposes, specifically commercial sheep farming. The proposed development is not envisioned to impact farming activities after the construction phase had been completed. The site is therefore considered to be suitable from a land use perspective.

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 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).

It should be noted that the IDPs and SDFs for both the Hantam and Khai-Ma LMs have been assessed above in **section 3.2** and included in this section as the Khai-Ma LM is also located within close proximity to the project site and is thus expected to be impacted to a degree. Based on the above reviewed IDPs and SDF's, it is evident that the proposed project fits well with the plans to diversify the provincial, district and local economies through investment in renewable energy projects.

5 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.

5.1 Regional Locality

The proposed development will be located approximately 68km north of Loeriesfontein, within the Hantam Local Municipality in the Northern Cape Province (**Figure 5**). The proposed wind farm will be accessed by the N7 towards Kliprand via the R358 regional road or via the N1 to Loeriesfontein which lies south of the site. The centre point and corner co-ordinates for the development site are included in **Table 7**.

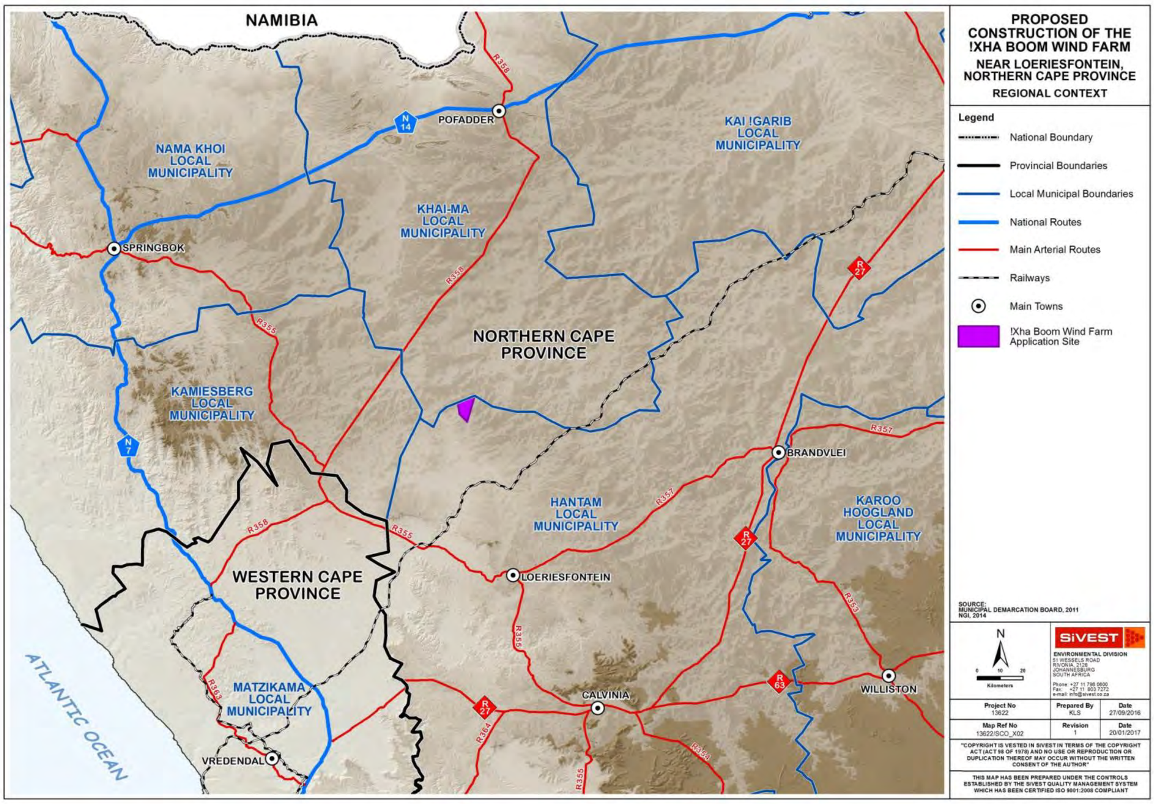


Figure 5: Regional Study Area.

5.2 Study Site Description

The site that is proposed for the Xha! Boom Wind Farm near Loeriesfontein is located on the following farm(s):

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

Table 7: Application Site Location

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"

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

The application site as shown on the locality map below has a total developable area of approximately 3804 hectares (**Figure 6**). The entire application site has been assessed during the scoping phase, however, the 235MW wind farm layout will require only a portion of the area. The farm is currently used for agricultural purposes, specifically commercial sheep farming, and the wind farm is not envisioned to affect agricultural activities after the construction phase had been completed.

Preliminary layouts are discussed in **Chapter 7** of the DSR and are presented in the EIA plan of study in **Chapter 11** of this report. These will be assessed in detail during the EIA phase, and refined to avoid sensitive areas as required.

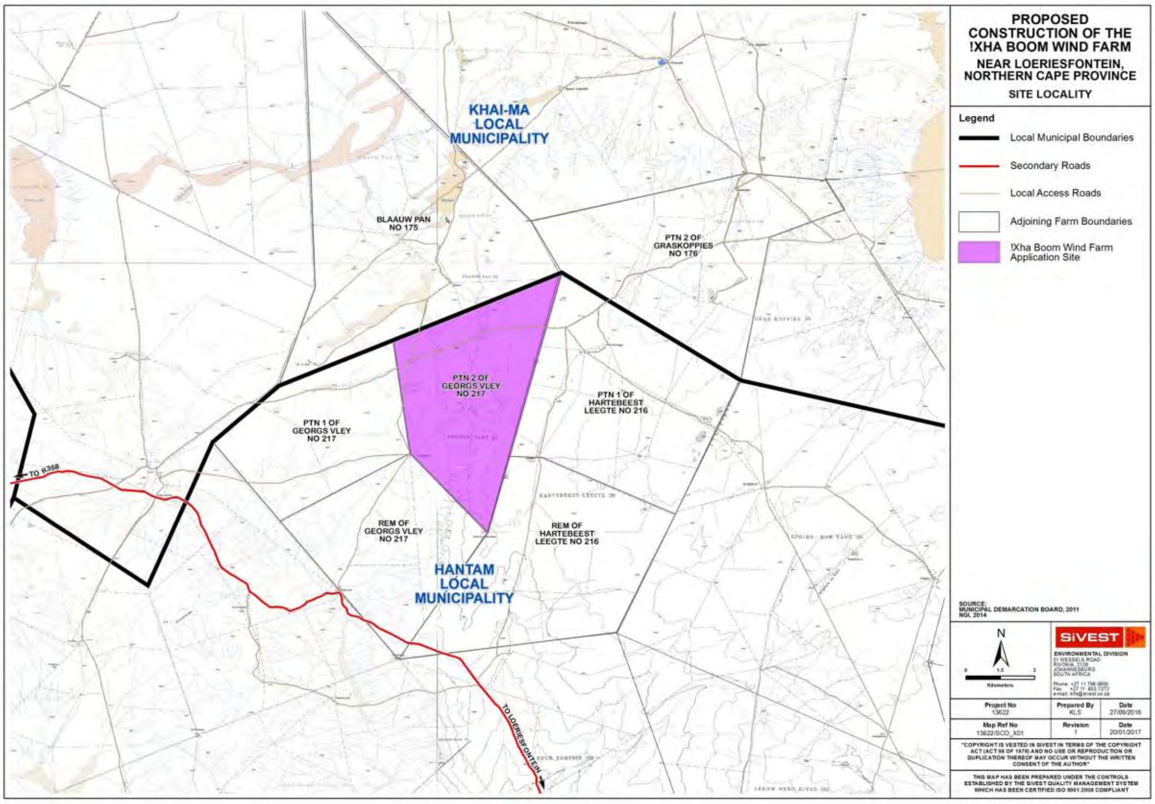


Figure 6: Site locality

5.3 Topography

The topography of the study site and surrounds is shown below (**Figure 7**). 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 eastern section 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 application site.

The degree of slope of the site and surrounding area are shown in **Figure 8**.

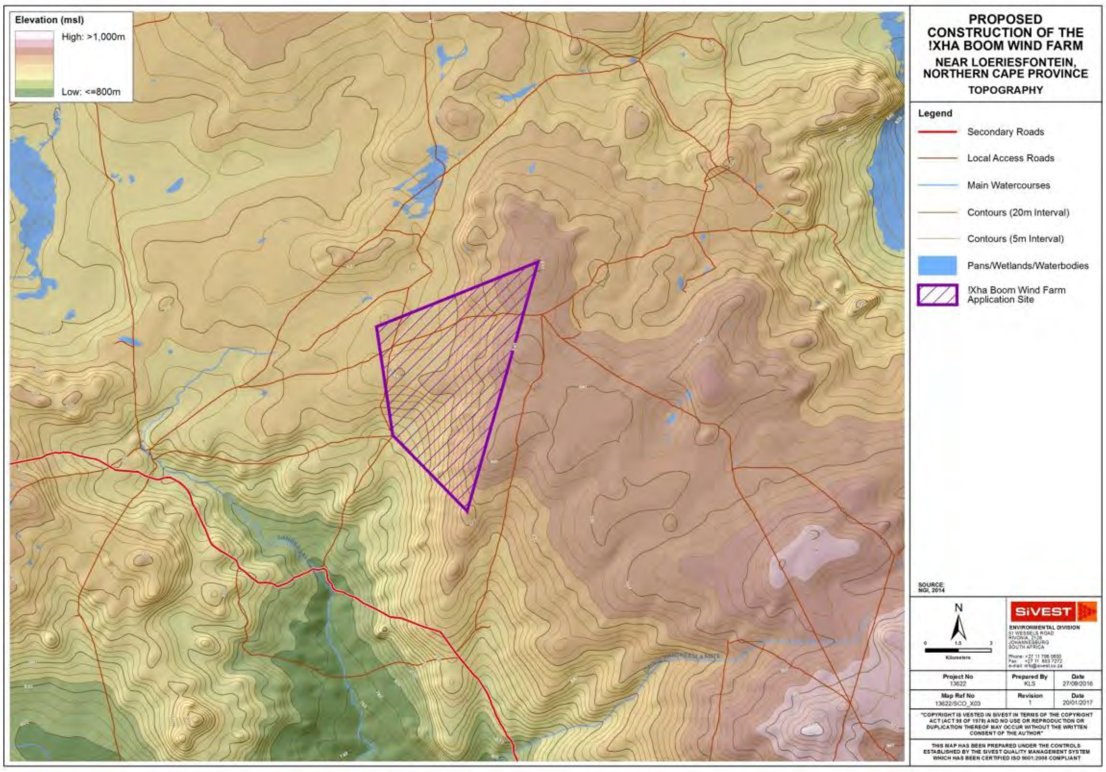


Figure 7: Topography of the study area.

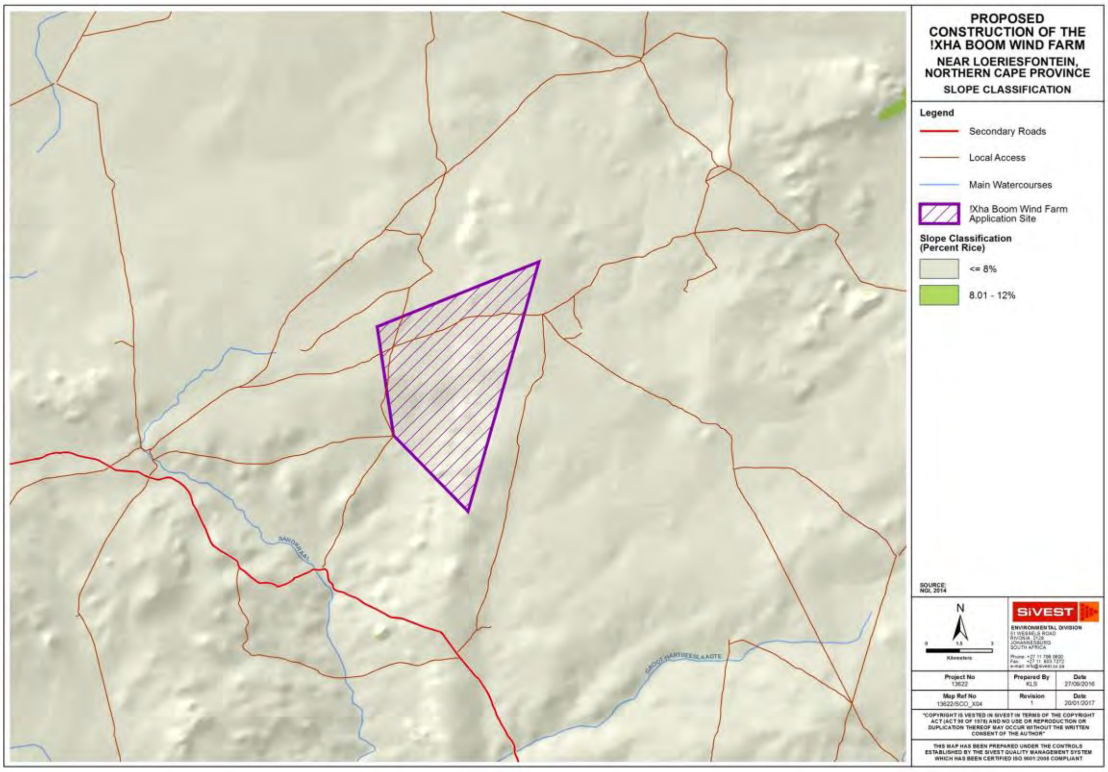


Figure 8: Degree of slope in region of the study area.

5.4 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 9**.

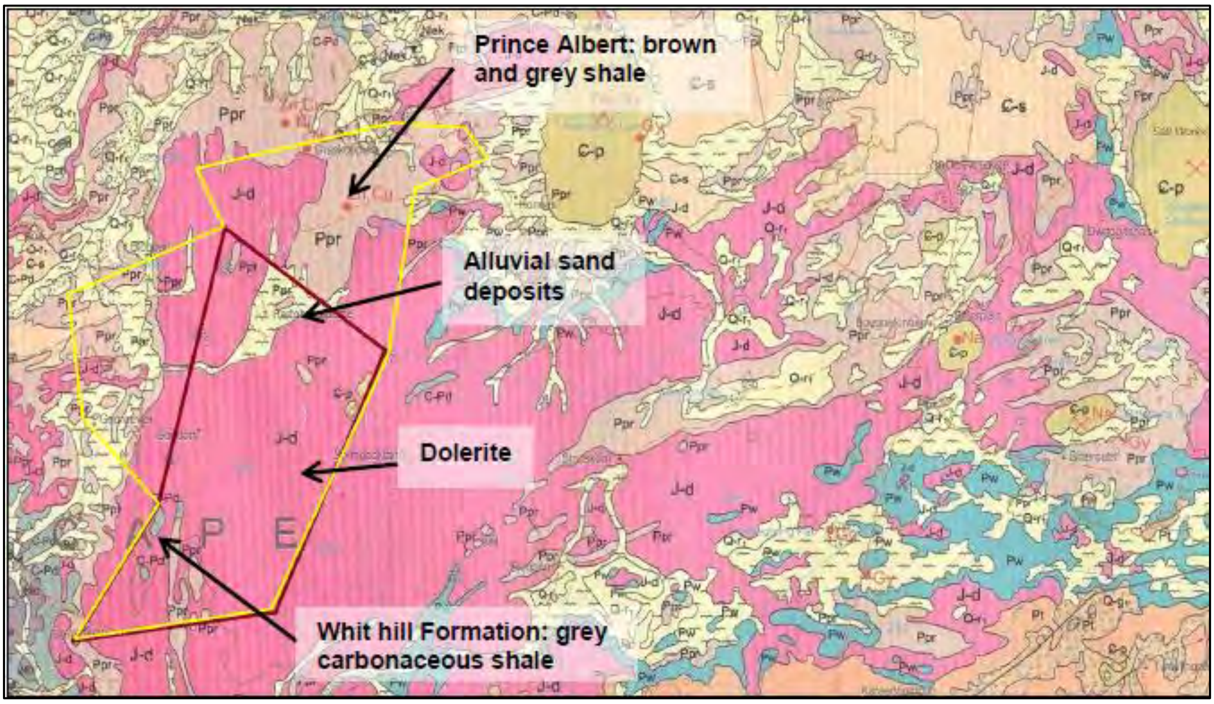


Figure 9: Loeriesfontein 3018 Geological Map for the study area

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 in the north, but with the exception of a couple of borrow pits within the dolerite sill, no mining has occurred on site.

5.5 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.

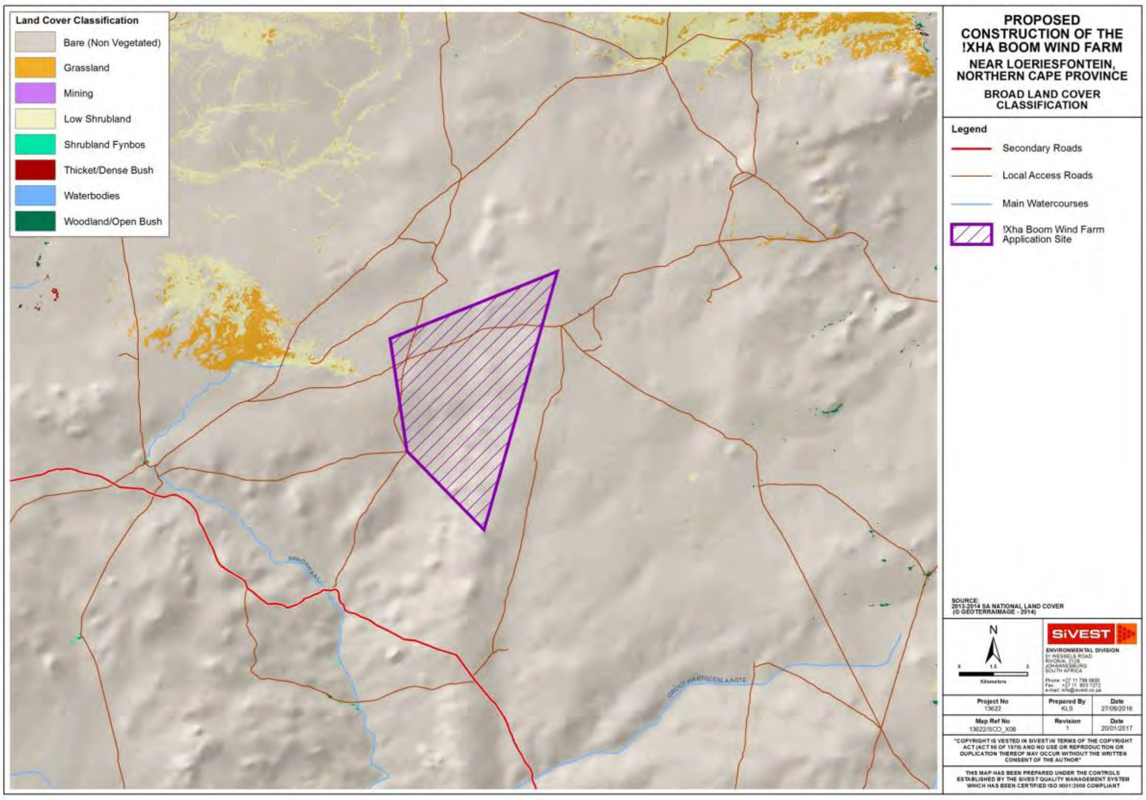


Figure 10: Land use in the region of the study area.

Figure 11: Typical view of the sheep farming activities which are dominant within the study 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 application site. This pan is however located outside 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.

5.6 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 13**. 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 8**). 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.

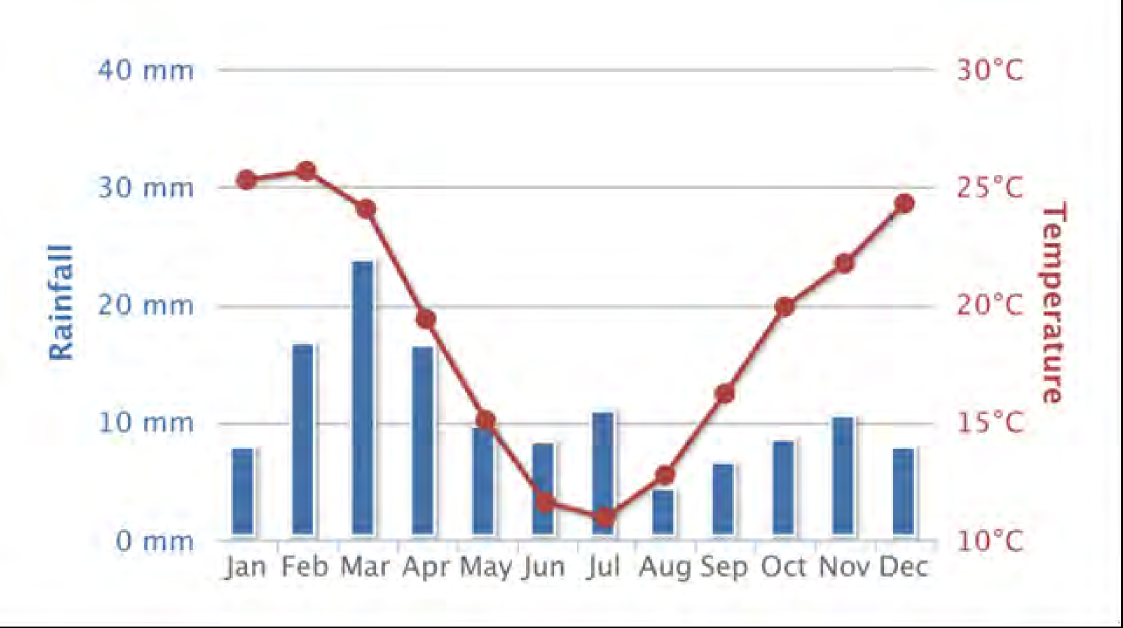


Figure 13: Average monthly temperature and rainfall for the site from 1990-2012 (The World Bank Climate Change Knowledge Portal, undated).

Table 8: 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

5.7 Biodiversity

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 Scoping Report is to describe and detail the ecological features of the proposed site; provide a preliminary assessment of the ecological sensitivity of the site and identify the likely impacts that may be associated with the development of the site as a wind energy farm.

5.7.1 Broad-scale vegetation patterns

The national vegetation map (Mucina & Rutherford 2006) for the study area is depicted below in **Figure 14**. 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 desertic 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 thunder storms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Threatened. There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed by Mucina and Rutherford as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum subsp oliverorum* are listed as being endemic to the vegetation type.

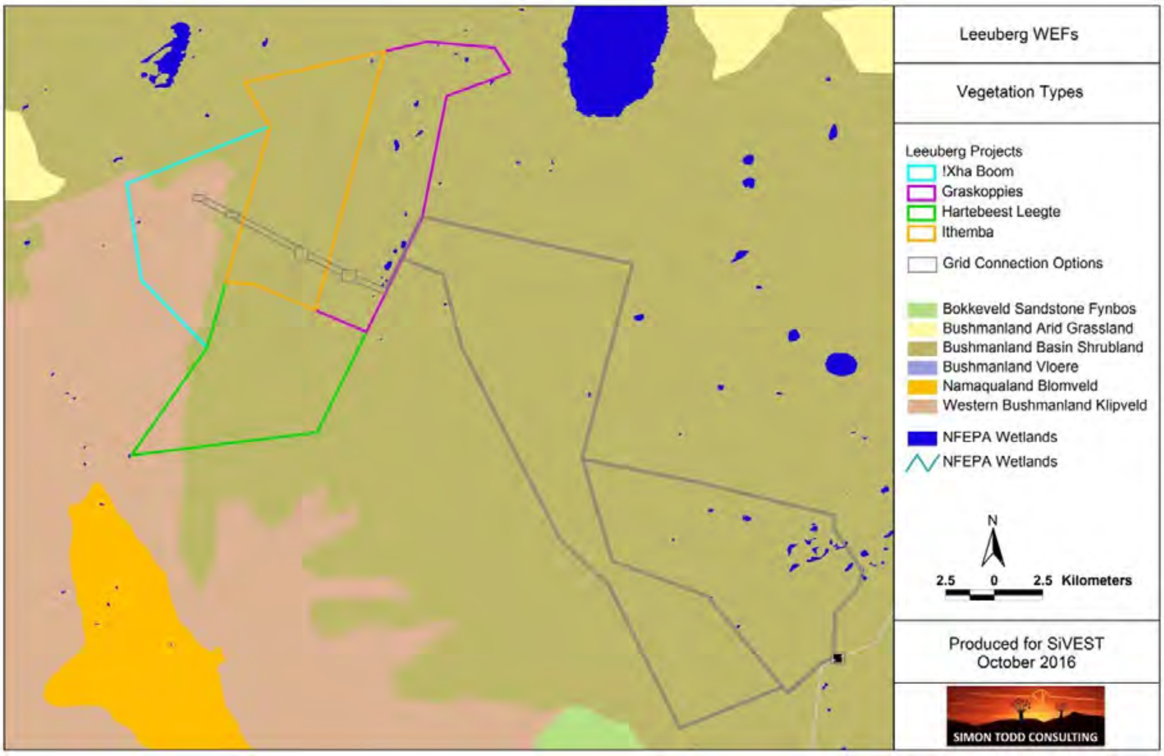


Figure 14: The national vegetation map (Mucina & Rutherford, 2006) for the study area. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel *et al.* 2011) are also depicted.

5.7.2 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 15: 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*.

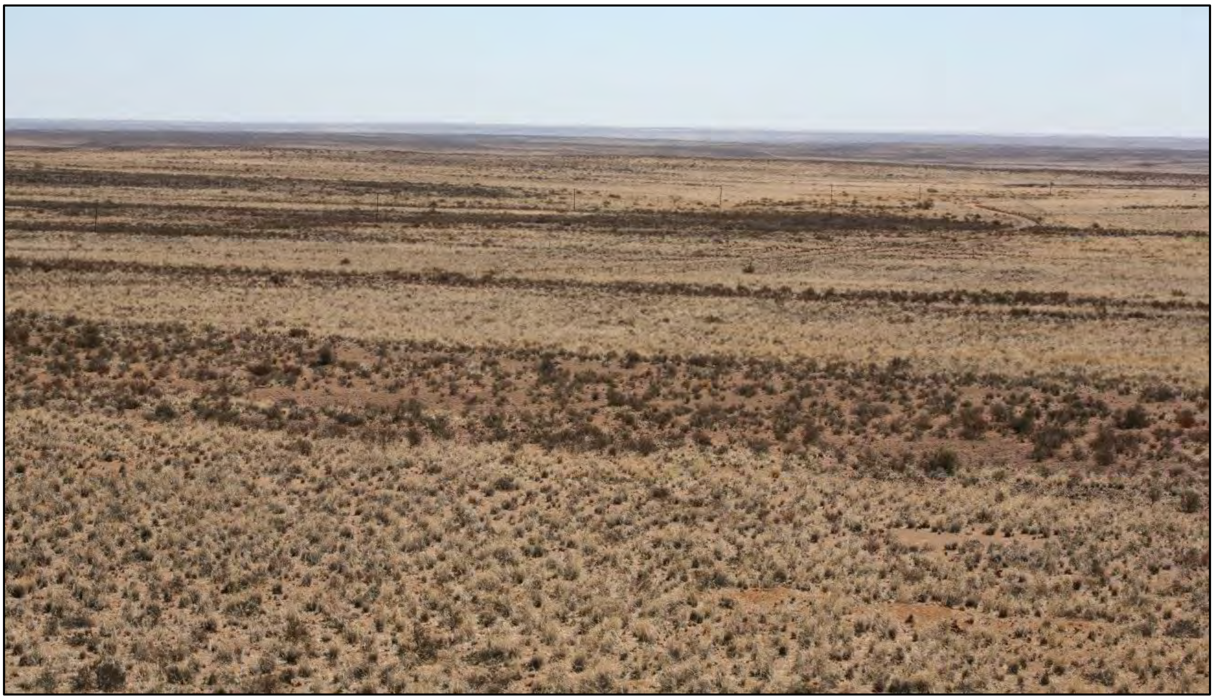


Figure 16: The eastern margin of the Xha! Boom site consists of open plains of Bushmandland Arid Grassland, interspersed with more shrubby areas of Bushmanland Basin Shrubland. These areas are not considered sensitive as the diversity is low and there are few species of concern present.

Figure 17: 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.

5.7.3 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).

5.7.4 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. The southwestern corner of the site projects a little way into an Ecological Support Area but if there is any development in this area it would not significantly impact the ecological functioning of the CBA. 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 18**), 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.

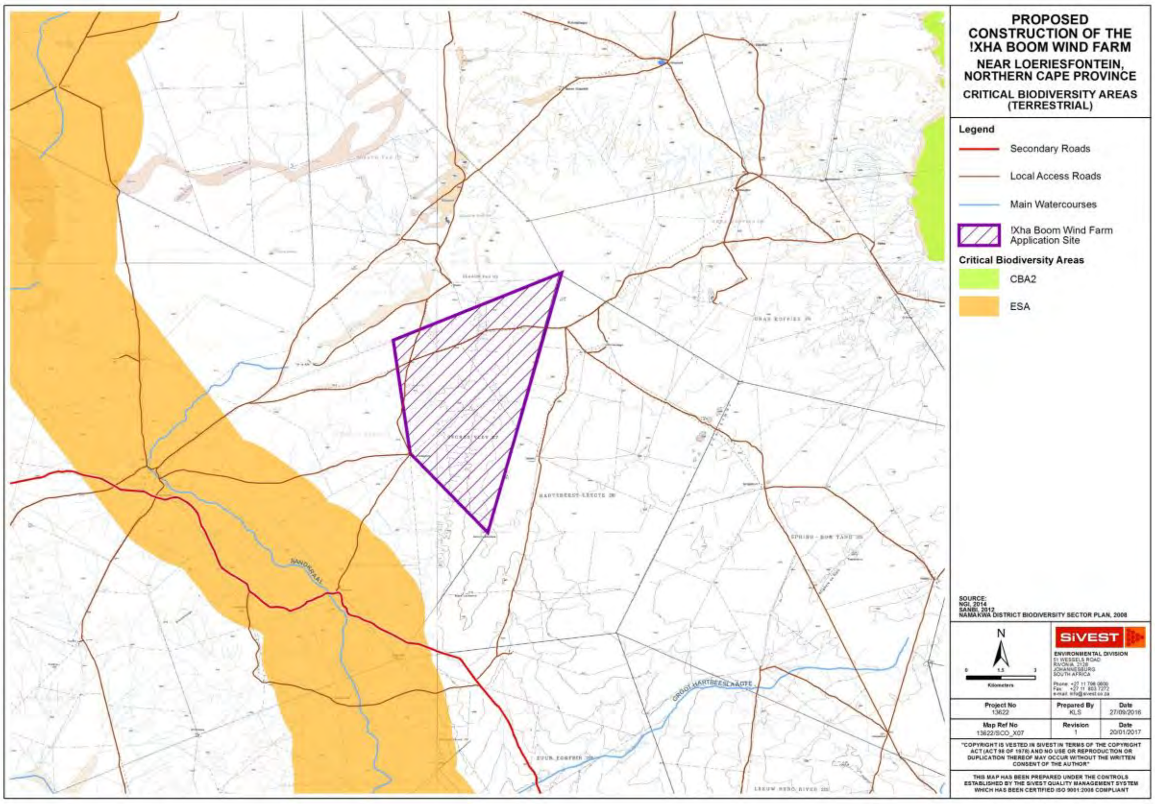


Figure 18: Extract of the Northern Cape Conservation Plan for the study area, showing that there are no CBAs within the Xha! Boom site.

5.7.5 Faunal communities

Mammals

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

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

Reptiles

The site lies in or near the distribution range of at least 40 reptile species (**Appendix 3** 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*, the 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*. 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 19: 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.

5.7.6 Xha! Boom sensitivity assessment

The draft sensitivity map for the study area is depicted below in **Figure 20**. The vast majority of the site consists of arid shrublands or arid grasslands on open plains that are not considered highly sensitive.

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.

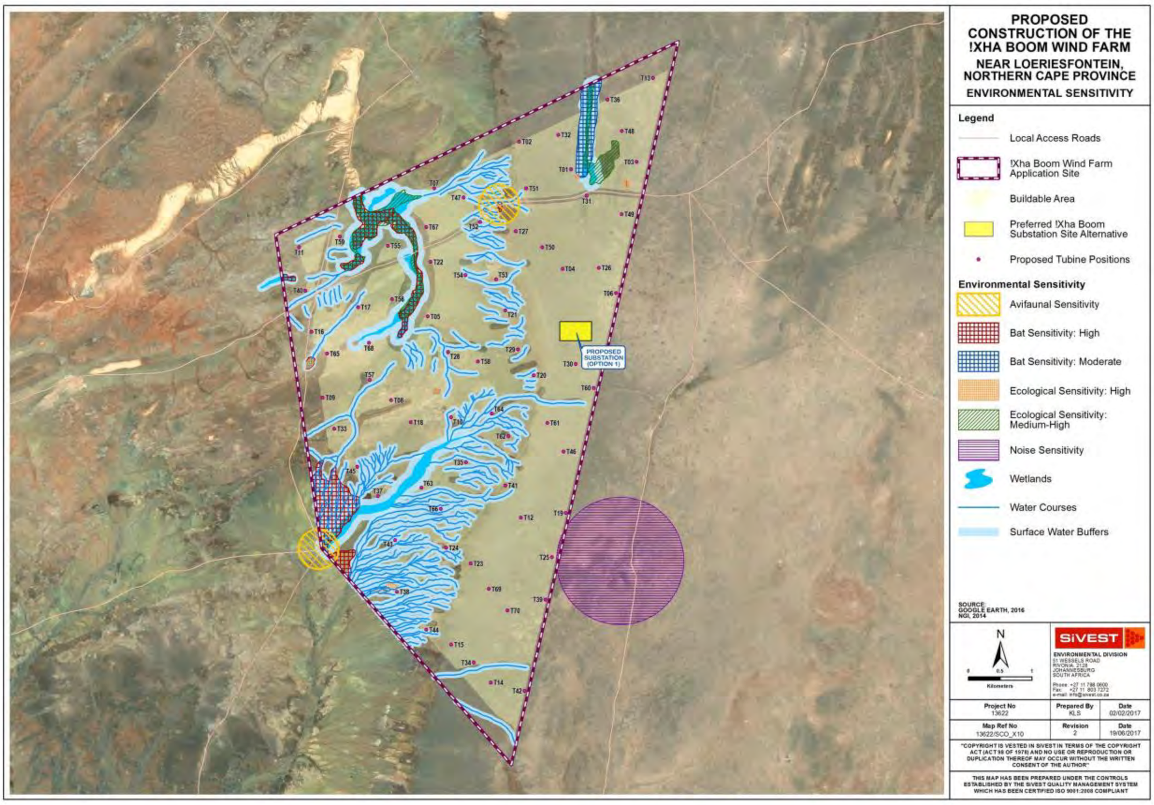


Figure 20: Draft sensitivity map for the Xha! Boom study area and the larger Leeuwberg site. The majority of the site is arid grassland or low open shrublands of low sensitivity.

5.8 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.

5.8.1 Description of the Affected Environment

5.8.1.1 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 21km north-east of the development area, and a series of small pans, known as Die Soutkomme, approximately 7km 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.

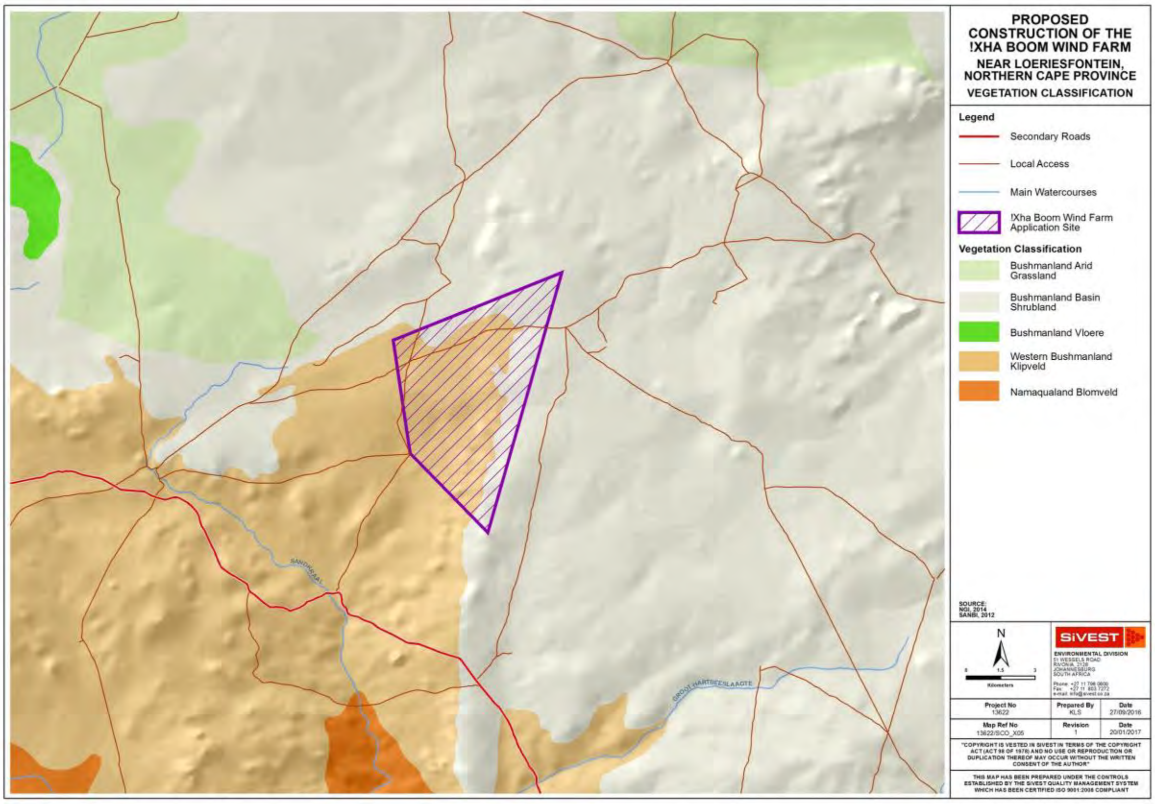


Figure 21: Vegetation types in the greater study area, indicating the homogenous character of the habitat at the proposed Xha! Boom Wind farms (Mucina & Rutherford 2006).

5.8.1.2 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 22**.

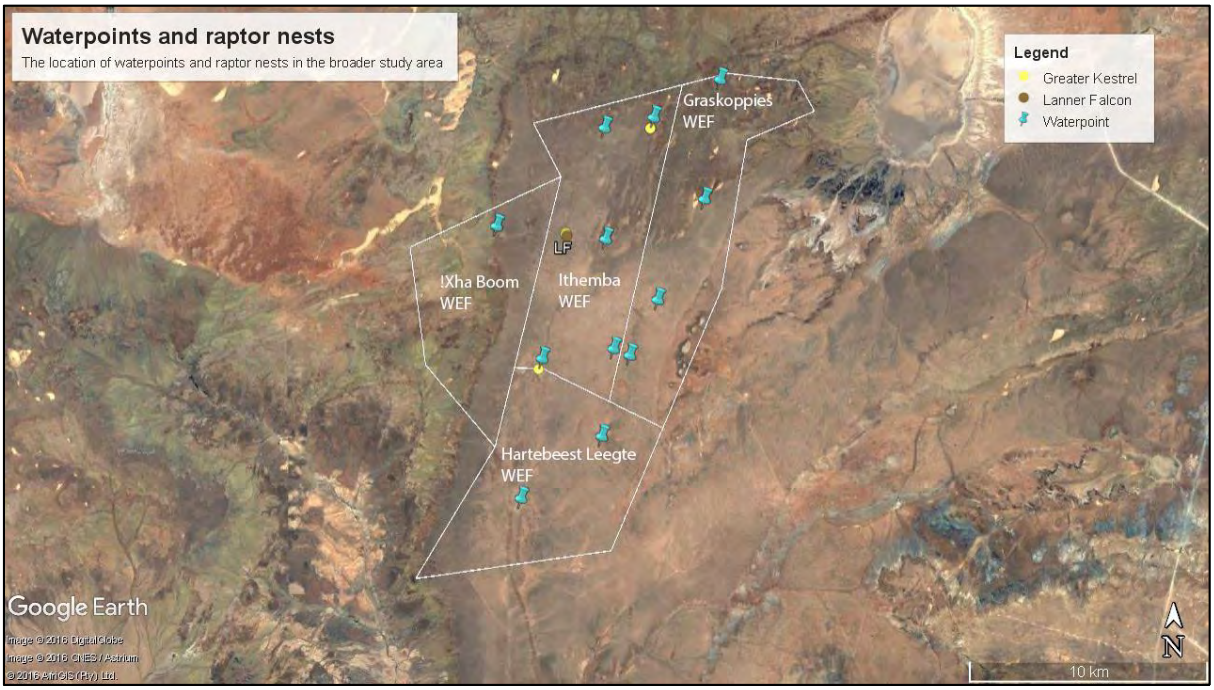


Figure 22: Location of water points and raptor nests in the greater area.

5.8.2 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.

- **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.

Table 9 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 9: 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 threatened 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	Ct, Cp, Dd,

							may be an inhibiting factor.	
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	Ct, Ep

							was recorded drinking at a water trough.	
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

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
Yellow-billed Kite	*Milvus aegyptius*		Least concern	0		x	Confirmed. May visit water points sporadically.	Ct
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, perhaps once a decade during which the pan will contain standing water for a short period.	Ct
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

5.9 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.

5.9.1 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 21**).

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 Sequance 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 10** below.

Table 10: 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 21** above for vegetation units present on the study area (Mucina and Rutherford 2006).

5.9.2 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 11: 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

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

There are three 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.

5.9.4 Sensitivity Map

Figure 23 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 12**) 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. Turbines located within high sensitivity areas and their buffers must be moved out of high bat sensitivities or removed from the turbine layout. If turbines are located within the Moderate Bat Sensitivity zone or buffer zone, they must receive special attention and preference for post-construction monitoring and implementation of mitigations during the operational phase.

Table 12: 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.

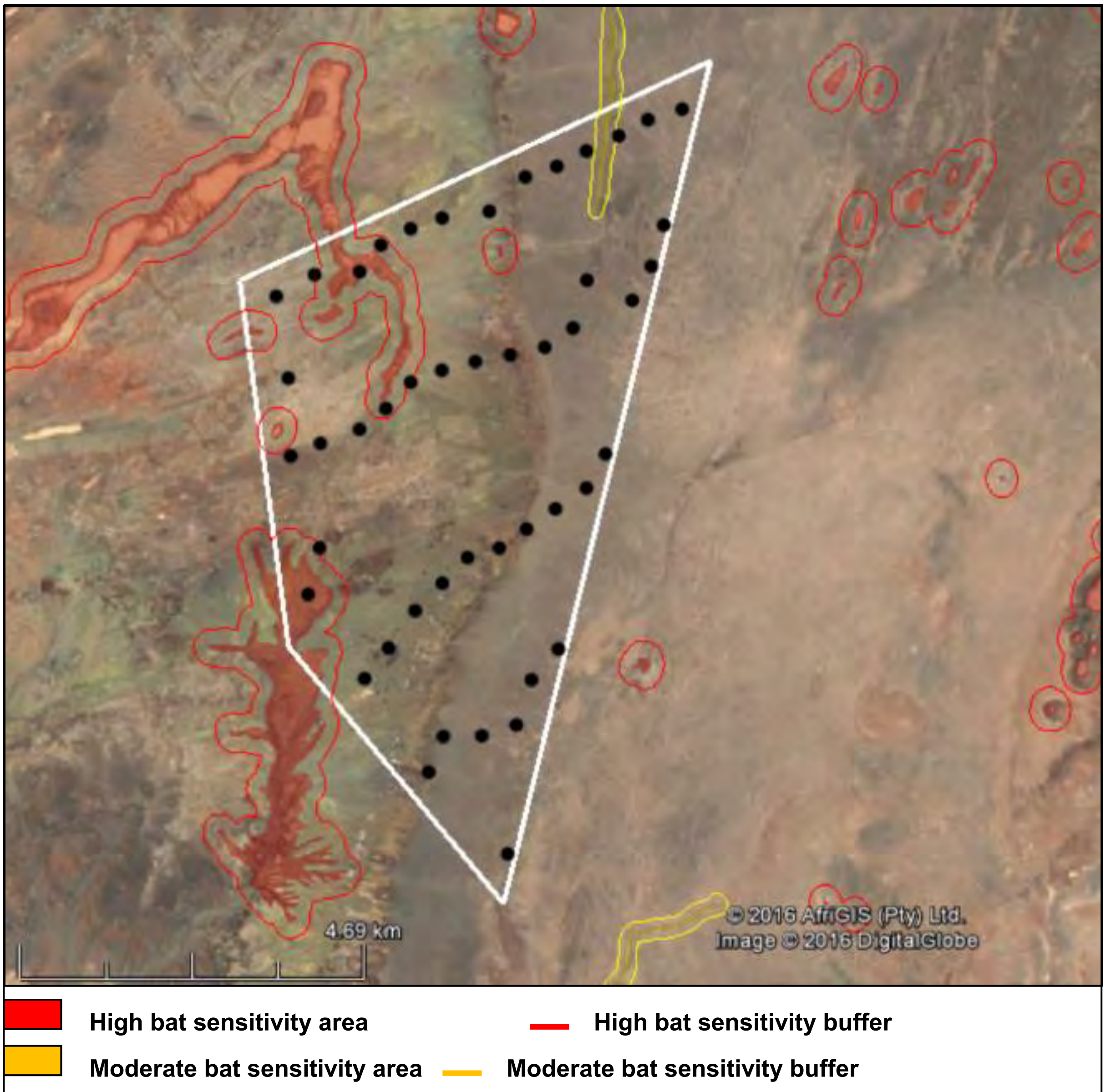


Figure 23: Bat sensitivity map of the study area

5.10 Surface Water

The Surface Water Assessment was conducted by Shaun Taylor of SiVEST. The full report is included in **Appendix 6D**. The environmental baseline from a surface water perspective is presented below.

5.10.1 Surface Water Database Information

In terms of the National ENPAT (2002) database, the proposed wind farm study site is completely within the Olifants / Doorn Water Management Area (WMA) (Figure 24). Moreover, the proposed development is therefore also within the Olifants – Cape Primary Catchment (Olifants / Doorn WMA). 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.

No other surface water resources were identified from the available databases.

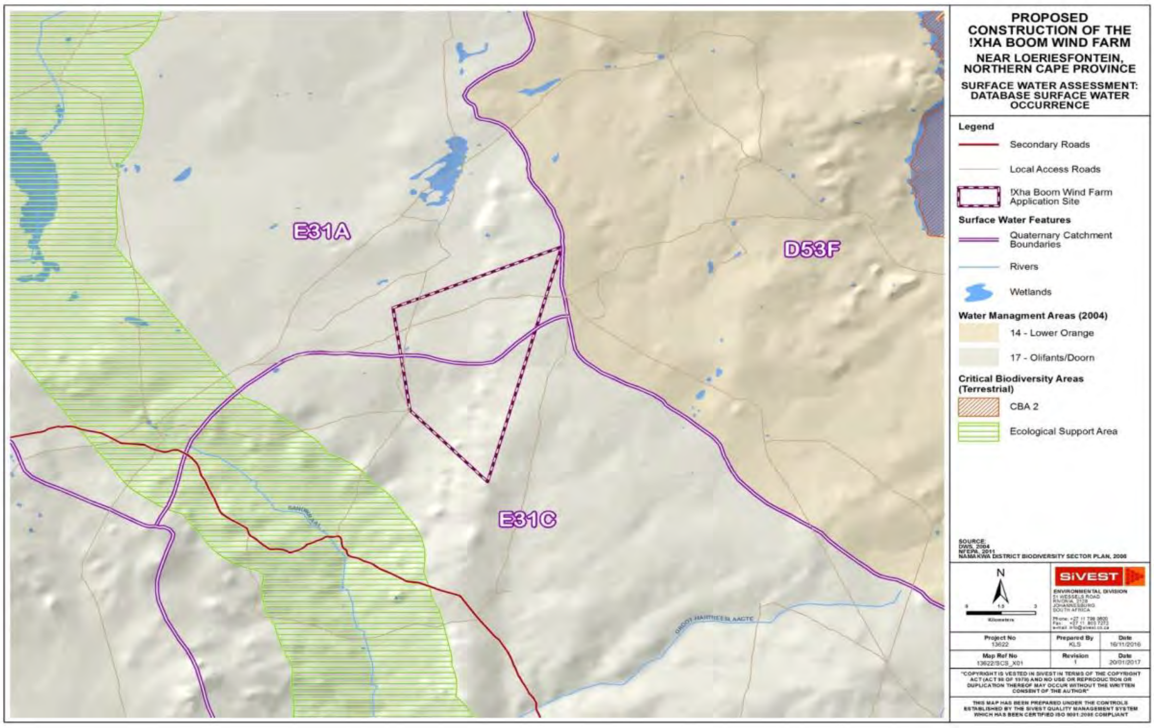


Figure 24: Database Surface Water Occurrence Map

5.10.2 Surface Water Desktop Delineation Information

A delineation exercise was undertaken using satellite imagery (Google Earth™) to demarcate the outer boundaries of any surface water resources identified at a desktop level. The 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, six (236) Drainage Lines (drainage lines with a channel width <5m).

The result are shown in Figure 25 below.

Between the database information and the desktop delineation information in, the features identified will be earmarked for groundtruthing in the fieldwork phase. A refinement of the surface water resources will be undertaken in the impact phase pending the fieldwork findings.

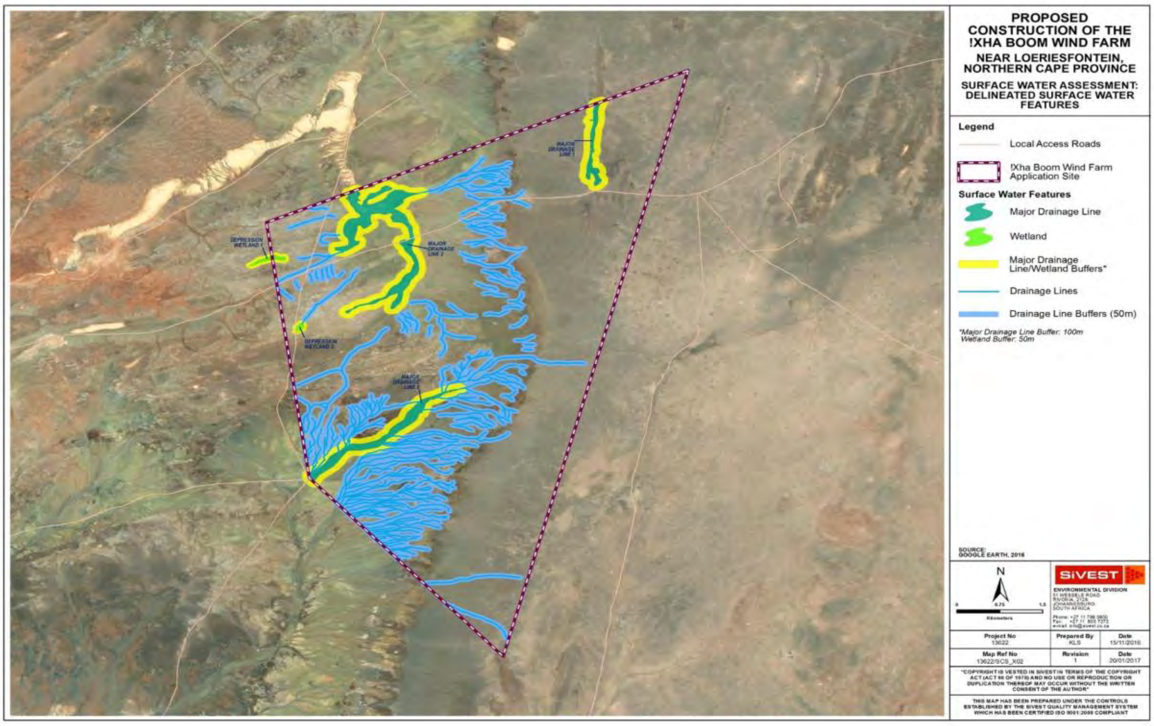


Figure 25: Desktop Delineation Map

5.11 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.

5.11.1 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 26**). 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 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.

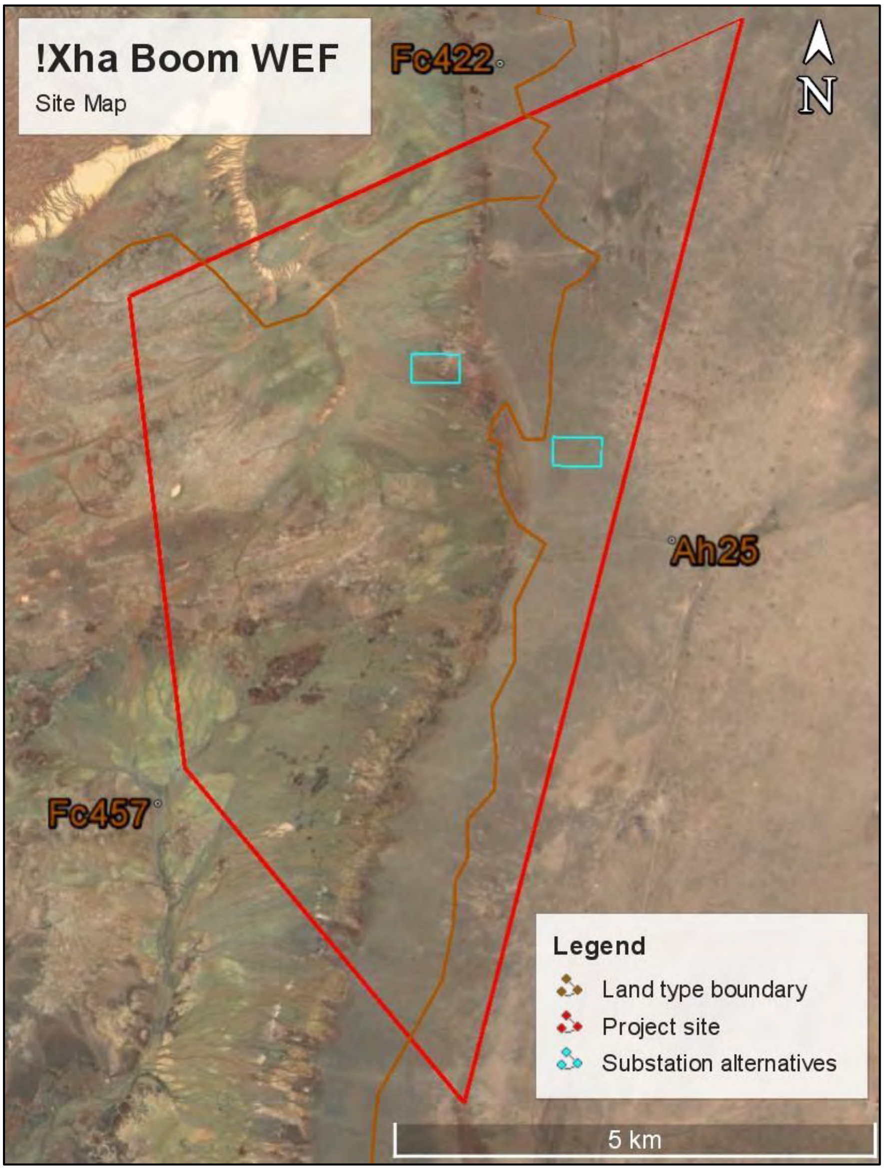


Figure 26: Satellite image map of the site showing the development area

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

5.11.2 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.

5.11.3 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 are no buildings on site.

5.11.4 Status of the land

As previously mentioned, the vegetation classification for the site is predominantly Western Bushmanland Klipveld, with a small amount of Bushmanland Basin Shrubland in the east. Refer to **Section 5.7.1** for the broadscale vegetation descriptions. Natural surface erosion, typical of sparsely vegetated, arid environments, is active but there is no evidence of excessive, accelerated erosion, or other land degradation. The land is classified as having a low to moderate water erosion hazard (class

5), and it is classified as susceptible to wind erosion (class 2b) because sands, as a soil textural class, are dominant.

5.11.5 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.

5.11.6 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.

5.12 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.

5.12.1 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.

- **Topography**

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.

- **Roads and rail roads**

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 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.

5.12.2 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 28** and **Table 13**). The statuses of these structures were confirmed by Mrs. Nicolene Venter of Imaginative Africa (Pty) Ltd after discussions with landowners.

Table 13: Status of identified potential noise-sensitive developments

Potential receptor	Status of the developments identified in Figure 28 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.

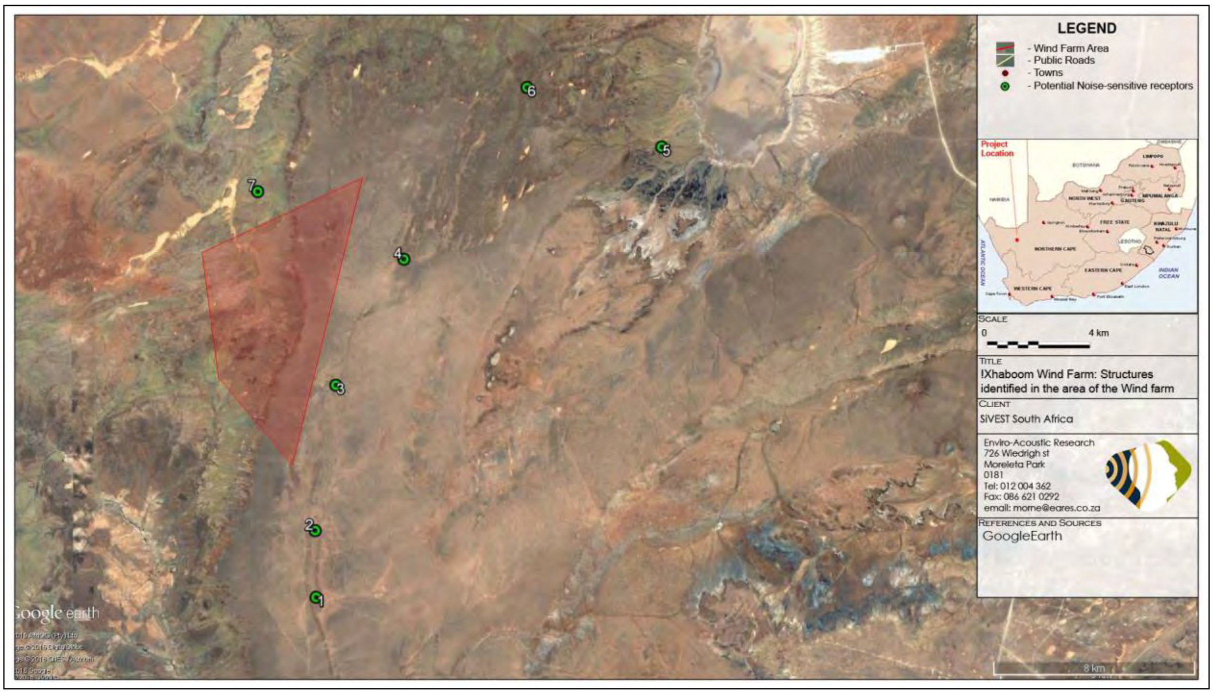


Figure 28: Aerial Image indicating identified potential Noise-sensitive developments identified during scoping

5.12.3 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 14** below.

Table 14: 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 15**. 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.

5.12.4 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.

5.12.5 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 15: 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	

5.13 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.

5.13.1 Topography

The flat terrain that occurs over most of the site results in generally wide-ranging vistas throughout the study area (**Figure 29**), 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 are thus not expected to have an effect on the visibility of the wind turbine structures. 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. Thus there would be very little shielding to lessen the visual impact of the wind turbines from any locally-occurring receptor locations.

Figure 29: Generally wide-ranging vistas found throughout the study area as a result of the flat terrain that occurs over most of the site.

5.13.2 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.

5.13.3 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 30**). 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 30: 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.

5.13.4 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 such as buildings, roads and other objects such as telephone or electrical infrastructure.

Most 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 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 31**). 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 31: 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 stopover 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):

i) "a landscape designed and created intentionally by man";
ii) an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The typical Karoo landscape consisting of wide open plains, and isolated relief, interspersed with isolated farmsteads, windmills and stock holding pens, is an important part of the cultural matrix of the South African environment. The Karoo farmstead is also a representation of how the harsh arid nature of the environment in this part of the country has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small 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.

5.13.5 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 16**), 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

ii) **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.

iii) **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 16: 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 owing 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. 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 29km to the east of the proposed Xha! Boom 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.

5.13.6 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.

Based on the above factors, a preliminary visual sensitivity map will be compiled and included in the EIA phase visual impact report.

It should be noted that a minimum of 500m buffer zone will typically be applied to any 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 visual receptors were identified within the proposed Xha! Boom Wind Farm development area. As such, the above-mentioned 500m 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.

5.13.7 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)

Only one (1) farmstead / homestead which houses a local farmer was identified within the study area. These dwellings are regarded as potentially sensitive visual receptors as it is located within a mostly rural setting and the proposed development will likely alter natural vistas experienced from this dwelling. 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.

Table 17 below provides details of the potentially sensitive places that have cultural and symbolic importance that were identified within the study area.

Table 17: Visual receptor locations potentially sensitive to the proposed Xha! Boom Wind Farm

Name		Distance from the proposed Xha! Boom Wind development area	Visual Impact Zone
VR5	Farmstead/Homestead	Approximately 7.4km	Low

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 32**). 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 32: 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 33** below.

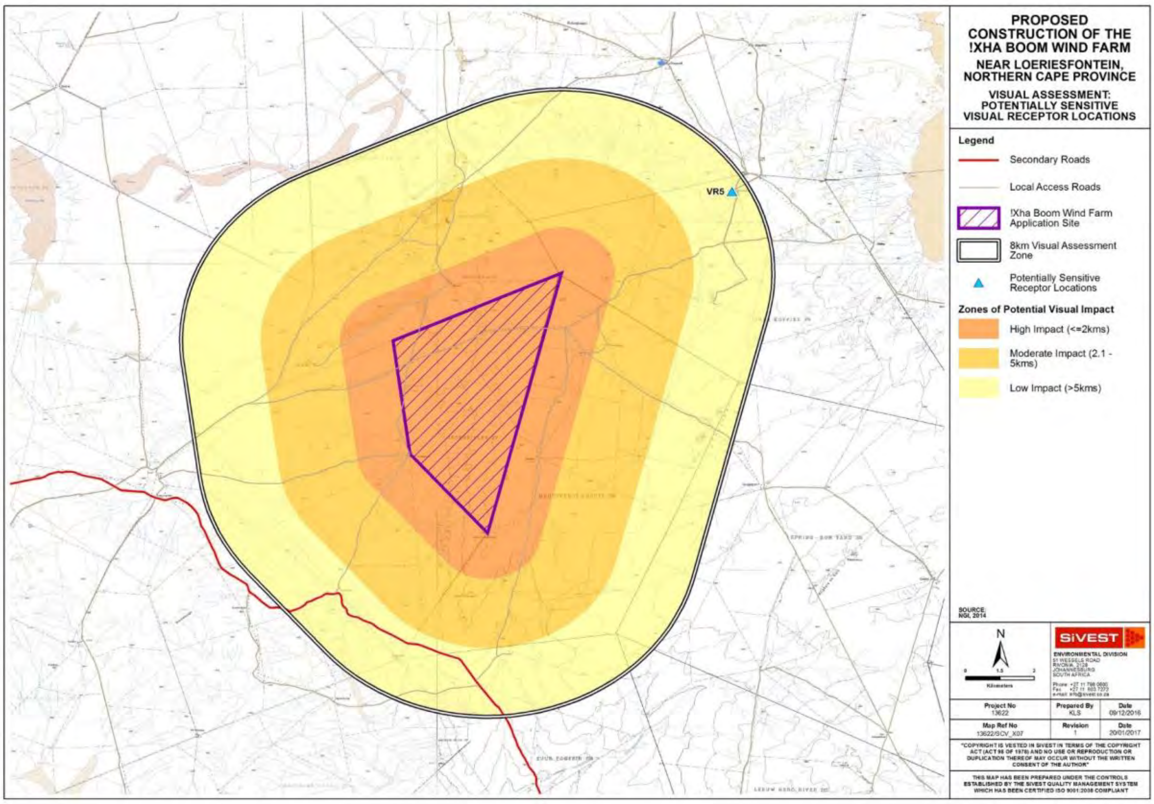


Figure 33: Potentially Sensitive Visual Receptors within the Study Area

5.14 Heritage

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.

5.14.1 Palaeontology

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.

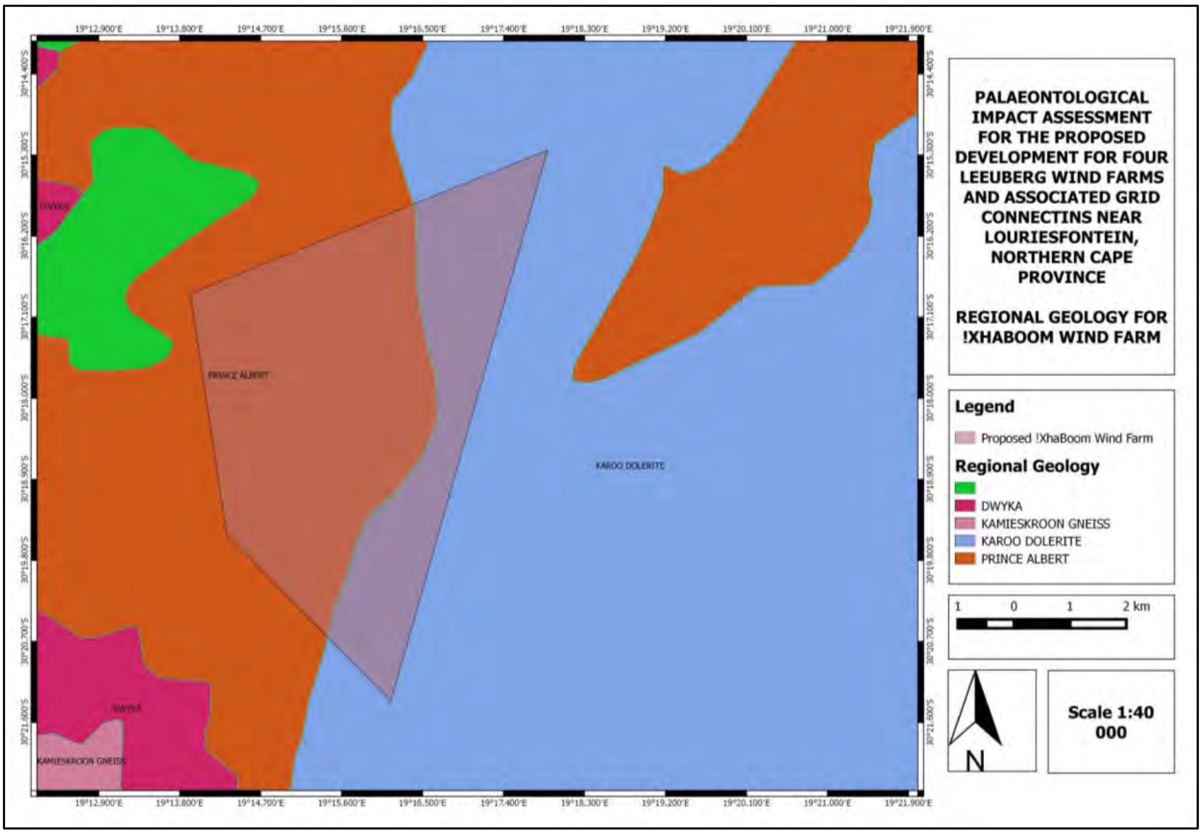


Figure 34: The surface geology of the proposed Xha! Boom Wind Farm near Loeriesfontein in the Northern Cape Province. The development footprint is underlain by Karoo Dolerite as well as the Prince Albert Formation of the Ecca Group

5.14.2 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.

5.14.3 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.

5.14.4 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.

5.14.5 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 18**.

Table 18: 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

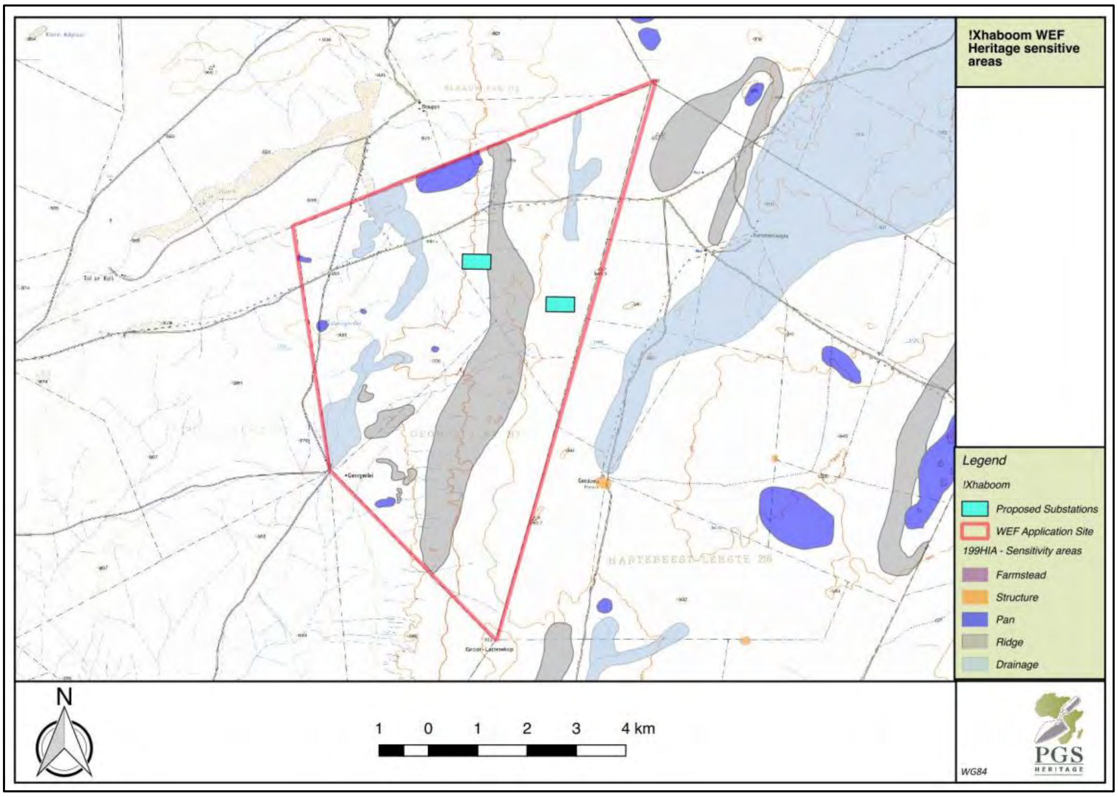


Figure 35: Possible heritage sensitive areas

5.15 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.

5.15.1 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.

- **<u>Spatial Context and Regional Linkages</u>**

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).

5.15.2 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).

5.15.3 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 19: 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** isn't 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 20: 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

5.15.4 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%).

5.15.5 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 21** 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 21: 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 22** below, employment percentages by skill level for the Local Municipalities (Hantam and Khai-Ma) are relatively similar to the districts skill level percentages.

Table 22: 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 23** 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 23: 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%**

5.15.6 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 24** 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 24: 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)

5.15.7 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.

5.15.8 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 25** 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 25: 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).

- **<u>Transport Infrastructure</u>**

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):

- Niewoudtville – 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

5.15.9 Profile of the Zone of Influence

The profile of the zone of influence section will investigate the various dynamics of the proposed site in order to ensure that the current land use activity does not conflict with the establishment of the proposed facility. If there are any conflicts identified, then they will be investigated further in the next phase.

▪ **<u>Land-use profile</u>**

The land is currently used for agricultural purposes, specifically commercial sheep farming. Due to the fact that sheep farming and wind farms can successfully coexist within the same land, it can be deduced that the proposed development is not expected to result in adverse effects on the current land use activities. The site is located approximately 75km away from the closest urban area and will be developed across the following farm portions (presented in below):

Table 26: 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

<u>Portion 1 of Hartebeest 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. The destruction of the veld and shrubs are however 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. 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.
- Dust needs to be controlled as the Merino sheep are especially affected by this.

<u>Portion 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 the main house. Owners therefore 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 are lost to jackal every year. The farm owner thus had hope that the wind turbines would drive jackal away. Jackal however quickly get used to the turbines.

5.15.10 Resources and land capability

The proposed study area is demarcated as agricultural land. Although the area is delineated for agricultural purposes, the land is also deemed non-arable with a very low grazing potential. As such, the grazing capacity for the area is low and is not suitable for arable farming; thus, making the region suitable for sheep farming which is a characteristic of the municipal area. A very small percentage (4%) of the Hantam region is considered to be high potential agricultural soils (Umsebe Development Planners, 2010), as a result of this the lack of water bodies as well as the lack of productivity in the area due to has also led to a very low Gross Domestic Product per hectare contribution.

5.15.11 Access to infrastructure

There is currently no national road that passes through the Hantam municipal area. Due to the influx of people and heavy load traffic in the Hantam LM as well as nearby towns, the main route (R27) in the area, which is also the only tarred road connecting Nieuwoudtville and Brandvlei via Loeriesfontein has been rapidly deteriorating and needs to be frequently maintained.

The project site for the proposed wind farm can be accessed through a small gravel access road that isn't wide enough to be traversed by large construction vehicles, which farm owners have expressed their desire for the road to be moved as it isn't far from one of the farm portions. With respect to water availability in the area, consultations with farm owners revealed that the affected farm portions do not have any direct access to water as it is a scarce resource in the area. To prevent water shortage impacts, some farmers in the area have reservoirs within their property or use water tanks to store water.

5.16 Preliminary Geotechnical Assessment

The Preliminary Geotechnical Assessment was conducted by Glen Randall of SMEC. The full report is included in **Appendix 8D**. 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.

5.16.1 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 36: General aerial view (During dry season)

5.16.2 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 37** below.

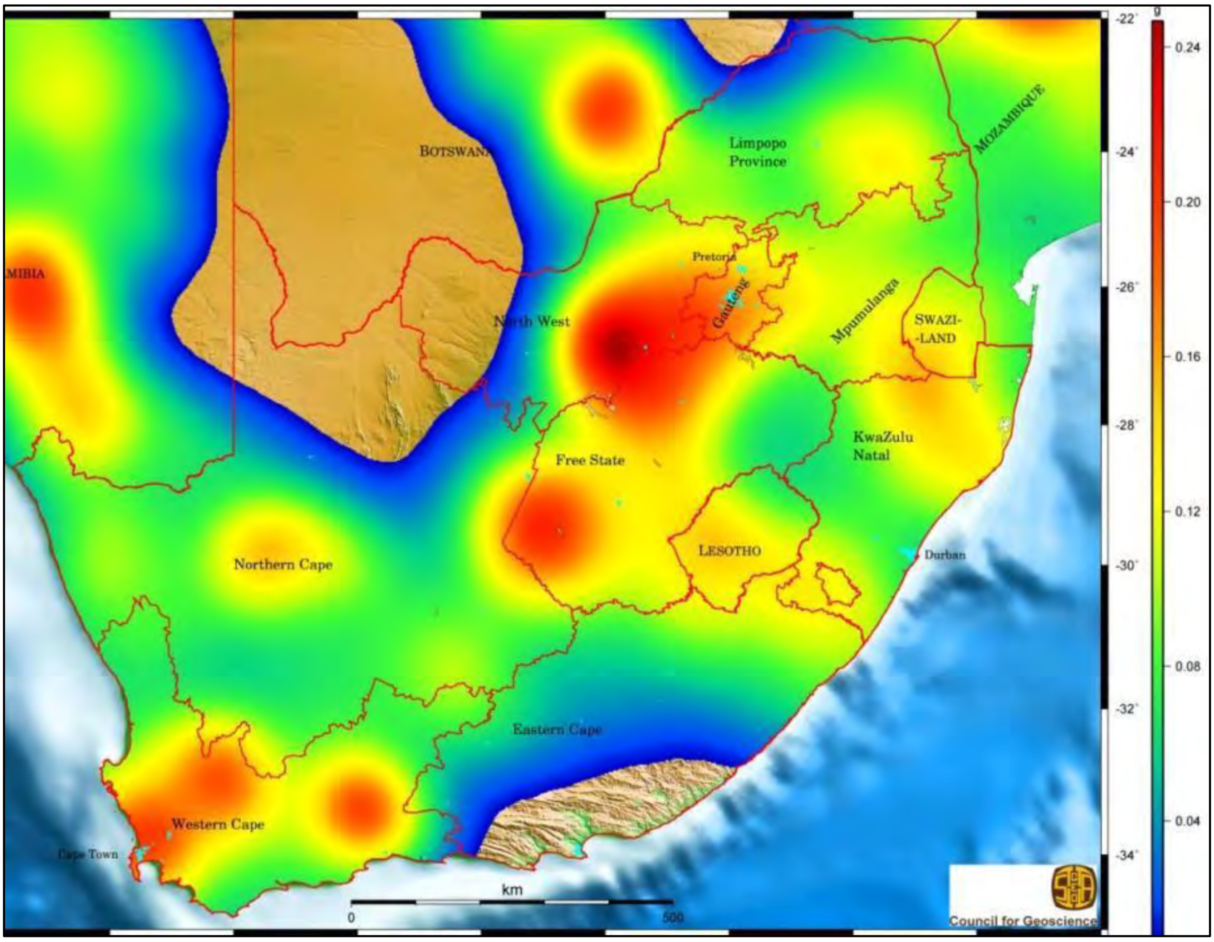


Figure 37: Seismic Hazard map of South Africa

5.16.3 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 38** below:

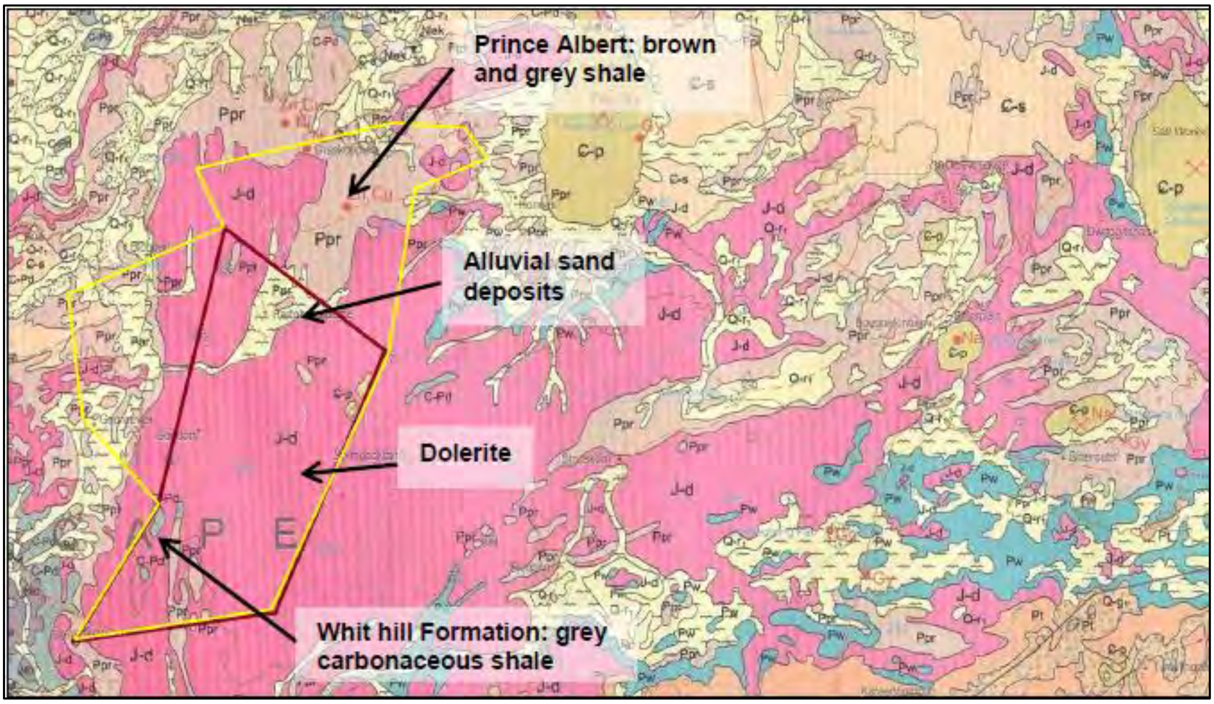


Figure 38: Extract from Loeriesfontein 3018 Geological Map

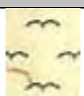
Breccia Pipes, associated with hydrothermal activity, caused by the dolerite intrusions, are found within the area, especially within the southern portion of the site. These pipes comprise baked and dislocated shale and mudstone, locally with breccia (shattered re-cemented blocks). Gas vugs and fractures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

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

5.16.4 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 38** above, are summarised in **Table 27** below:

Table 27: 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. 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. 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. 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. 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. Refusal of the excavator is generally expected between 0.3-1.5m below surface.

5.16.5 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 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.

- **<u>Foundations</u>**

Founding conditions are seen as relatively favourable on the site, with excavatability seen as the main concern.

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 on or near a tailings dam.

5.16.6 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.

5.16.7 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.

5.17 Traffic Impact Assessment

The Traffic Impact Assessment was conducted by Glen Randall of SMEC. The full report is included in **Appendix 8E**. The environmental baseline from a socio-economic 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.

5.17.1 Existing Traffic Conditions

Table 28 below shows a summary of the roads and road segments affected by the LWEF project.

Table 28: 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 29 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 29: 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)

5.18 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 8C**. 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 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.

5.18.1 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.

5.18.2 EMC Analysis

- **Site Location**

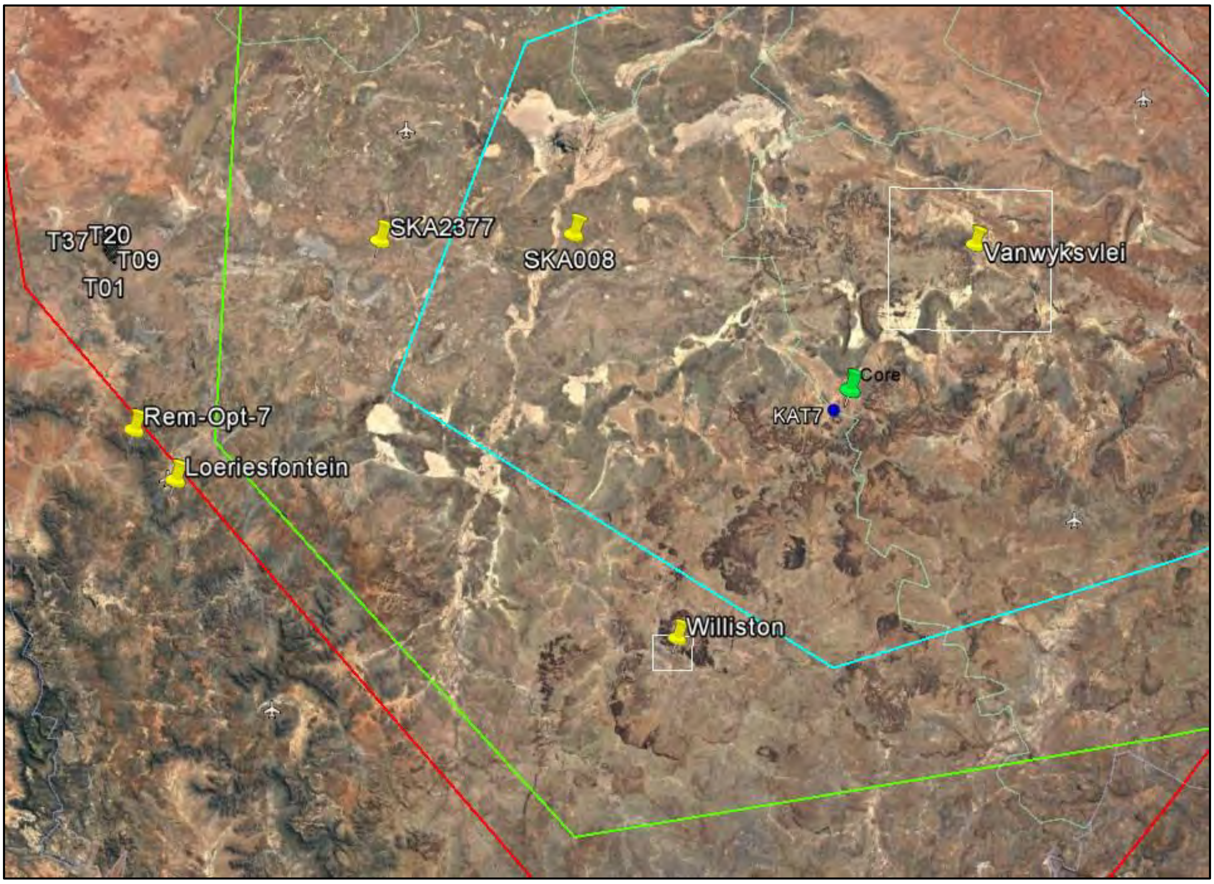


Figure 39: Area map showing Xha! Boom locations relative to SKA

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 40: Local map showing nearest two SKA locations

Table 30: Xha! Boom 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

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.

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.

6 ENVIRONMENTAL ISSUES, POTENTIAL IMPACTS AND CUMULATIVE IMPACTS

6.1 Methodology for Assessing Impacts

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

6.1.1 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 113**.

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.

6.1.2 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).

- 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 31: Description of terms

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.

6.2 Identification of Potential Impacts

The proposed development is likely to result in a variety of positive and negative impacts. Moreover, the proposed development could potentially result in collective and long term impacts more commonly known as cumulative impacts. A cumulative impact is 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.

The Scoping Report assists in the identification of these potential and cumulative impacts, which will then be assessed at a more detailed level during the EIA stage.

Moreover, further details associated with the construction and operation of the various activities (as listed in the Project Description) in light of the above types of impacts that become available later in the EIA process will be discussed in detail in the EIA Phase.

The impacts that have been identified as being potentially significant are elaborated on in the sub-sections below.

6.2.1 Biodiversity Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the biodiversity assessment.

Table 32: Impacts on vegetation and protected plant species

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.
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 to return to their former state.
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.
Intensity/magnitude	The intensity of the impact would be moderate to high, depending on where and how much vegetation was cleared.
Significance rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a low level.

	2	2
Extent	4	4
Probability	2	2
Reversibility	2	1
Irreplaceable loss	3	3
Duration	3	2
Cumulative effect	3	2
Intensity/magnitude	-48 (medium negative)	-28 (low negative)
Significance rating	2	2
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Minimise development footprint within sensitive areas and ensure that final development layout takes account of areas identified as sensitive. 2) Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible.	

Table 33: Impacts on fauna during construction and operation

IMPACTS ON FAUNA DURING CONSTRUCTION AND OPERATION	
Environmental parameter	Faunal impacts due to construction and operation 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. During operation, noise and human activity will generate some disturbance for fauna.
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	This impact is largely reversible and it is only habitat loss that 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 noise generated by the turbines.
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	As construction would be relatively short duration but of moderate to high intensity. During operation, impacts will be reduced but of long-duration. 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	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: 1) Avoid sensitive faunal habitats such as drainage lines. 2) A variety of avoidance and mitigation measures to reduce impact on fauna will need to be implemented during construction, including limiting impacts from construction staff and the operation of construction vehicles.	

Table 34: Impacts on increased soil erosion risk

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 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 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.	
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: 1) Soil erosion plan to be part of the EMP. 2) Rehabilitation of eroded areas on a regular basis.	

Table 35: Loss of Alien Plant Invasion

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: 1) Alien management plan to be part of the EMP. 2) Regular alien clearing where invasion occurs.

6.2.2 Avifauna Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the avifaunal assessment.

Displaced due to disturbance

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 (*Ardeotis kori*) and Ludwig's Bustard (*Neotis ludwigii*), 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. It is necessary to implement exclusion zones around the nests of the priority species recorded breeding in the development site, namely Greater Kestrel (*Falco rupicoloides*) and Lanner Falcon (*Falco biarmicus*).

Habitat transformation

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

Table 36: Impacts associated with displacement of priority avifauna due to disturbance during construction phase

AVIFAUNA	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during **construction** phase

AVIFAUNA		
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.	
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.	

AVIFAUNA	
	• Do not allow any access to the remainder of the property during the construction period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place. • A 300m exclusion zone must be implemented around all Greater Kestrel nests. • A 500m exclusion zone must be implemented around the active Lanner Falcon nest.

Table 37: Impacts associated with the displacement of priority species due to habitat destruction during construction phase.

AVIFAUNA	
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.
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.

AVIFAUNA		
	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. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place. • A 300m exclusion zone must be implemented around all Greater Kestrel nests. • A 500m exclusion zone must be implemented around the active Lanner Falcon nest. • 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.	

Table 38: Impacts associated with the Avifauna displacement of priority species due to disturbance during operational phase

AVIFAUNA	
Environmental Parameter	Displacement of priority species due to disturbance during **operational** phase
Issue/Impact/Environmental Effect/Nature	The impact will only affect the site.
Extent	Probable. The impact may occur (between a 50% to 75% chance of occurrence).
Probability	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.

AVIFAUNA		
Reversibility	Marginal loss of resources. Habituation is likely for some species after the construction phase, especially smaller species.	
Irreplaceable loss of resources	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.	
Duration	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).	
Cumulative effect	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.	
Intensity/magnitude	Low significance.	
Significance Rating	Displacement of priority species due to disturbance during **operational** phase	
	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 39: Impacts associated with collisions of priority species with the turbines in the operational phase.

AVIFAUNA	
Environmental Parameter	Avifauna
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

AVIFAUNA		
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 as they serve as focal points for bird activity. ▪ A 300m exclusion zone must be implemented around all Greater Kestrel nests. ▪ A 500m exclusion zone must be implemented around the active Lanner Falcon nest. ▪ 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	

AVIFAUNA	
	patterns post-construction, and (b) to search for carcasses at turbines. ▪ 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. ▪ The minimum turbine tip height should 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. ▪ 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. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).

<u>Xha! Boom Wind Farm</u>

The species most at risk of electrocution on the internal overhead MV power line 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.

Table 40: Impacts associated with mortality of priority species due to electrocution on the internal MV lines in the operational phase.

AVIFAUNA	
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	Completely reversible. Mitigation measures could eliminate the risk

AVIFAUNA		
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 power lines could cause mortality of some priority species.	
Significance Rating	Medium significance.	
	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 power line design to ensure that bird-friendly structures are used.	

6.2.3 Bat Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the bat assessment.

- Construction Phase

Table 41: Impacts on destruction of bats roots due to earthworks and blasting

BATS	
Environmental Parameter	Bat populations will be impacted upon through earthworks and blasting close to bat roosts.

BATS		
Issue/Impact/Environmental Effect/Nature	Earthworks and blasting close to bat roosts will negatively affect bat populations through high mortality, which in effect will cause a decrease in bat population numbers.	
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	There is a probable chance of the impact occurring.	
Reversibility	Blasting occurring at bat roosts will cause damage to the bat population in the area. Depending on the extent, the impact is reversible however, recovery of the roost numbers would take place over several generations and many years.	
Irreplaceable loss of resources	If blasting and earthworks occurs close to a bat roost, it will be destroyed and lost.	
Duration	The impact will be of short duration, as blasting and earthworks will only occur during construction phase.	
Cumulative effect	Moderate effect, as the destruction of the bat roosts impact the population numbers within the area which in effect may impact the insect numbers.	
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 will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	2
Duration	1	1
Cumulative effect	3	1
Intensity/magnitude	4	2
Significance rating	- 68 (high negative)	- 16 (low negative)
Mitigation measures	Adhere to the sensitivity map during turbine placement. Blasting should be minimised and used only when necessary. A Bat Specialist should be consulted before blasting of a rocky cliff face or rocky cavernous area. The mitigation measures will reduce the impact blasting and earthworks will have on the environmental parameter, through avoiding sensitive areas.	

Table 42: Impacts on loss of foraging habitat

BATS	
Environmental Parameter	Loss of foraging habitat within the site boundaries.

BATS	
Issue/Impact/Environmental Effect/Nature	Loss of foraging habitat. Some minimal foraging habitat will be permanently 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 will be partly reversed with some mitigation measures, especially in more sensitive areas. Minimal foraging habitat will be permanently lost.
Irreplaceable loss of resources	In areas where vegetation is removed for roads and turbines, there will be a loss of habitat resources, but the scale is small.
Duration	The impact will be of a long duration, past the operational phase of the development.
Cumulative effect	Low effect, the removal of habitat will cause a decrease in the number of bat numbers and insect numbers within the site boundaries.
Intensity/magnitude	Removal of foraging grounds may negatively impact the population and system, but most likely on a small scale since foraging distances are usually large for insectivorous bat species.
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	3	1
Irreplaceable loss	3	2
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 30 (medium negative)	- 8 (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 an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.	

- Operational Phase

Table 43: Impacts of bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration)

BATS		
Environmental Parameter	Impact on bat population numbers.	
Issue/Impact/Environmental Effect/Nature	Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration). If the impact is too severe (e.g. in the case of no mitigation) local bat populations may not recover from mortalities.	
Extent	The impact will be contained within the boundaries of the development site.	
Probability	There is a definite chance of the impact occurring.	
Reversibility	The impact will occur throughout the lifespan of the wind facility. Population numbers may take very long to recover. Population and diversity genetics may be permanently altered.	
Irreplaceable loss of resources	Bat population numbers will decrease in the area.	
Duration	The impact will be of long duration, 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	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	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. These impacts could be considered "fatal flaws".	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	4	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	4	2
Significance rating	- 76 (very high negative)	- 26 (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 7 of this report. An operational phase bat monitoring study must be implemented as soon as the facility has been constructed.	

Table 44: Impacts of artificial lighting

BATS	
Environmental Parameter	Impact on bat populations and diversity.
Issue/Impact/Environmental Effect/Nature	During operation, strong 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 to 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 favor only certain species.
Extent	Artificial lighting will be contained within the boundaries of the development site.
Probability	There is a probable chance of the impact occurring.
Reversibility	On completion of the operational phase, the artificial lighting will be removed, whereby certain bat species won't be favoured in the area.
Irreplaceable loss of resources	No
Duration	The impact will be of a long-term duration, the lifespan of the development. It will take some time to reverse the impact.
Cumulative effect	During operational phase, strong artificial lights used at the work environment during night time will attract insects and thereby also bats. However only certain species of bats will readily forage around strong lights, whereas others avoid such lights even if there is insect prey available. This can draw insect prey away from other natural areas and thereby artificially favour certain species, affecting bat diversity in the area.
Intensity/magnitude	Artificial lighting in the area will change the diversity of the bat species in the area. This will negatively affect the system.
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	3	2
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	- 30 (medium negative)	- 8 (low negative)

BATS	
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. The mitigation measures will reduce the likelihood of certain bat species being favored.

- Decommissioning phase

Table 45: Impacts of loss of foraging habitat

BATS		
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 permanently lost by decommissioning of the facility.	
Extent	Loss of foraging habitat will be contained within the boundaries of the facility site.	
Probability	There is a probable chance of the impact occurring.	
Reversibility	Depending on the degree of habitat loss, it will be partly reversed with some mitigation measures, especially in more sensitive areas.	
Irreplaceable loss of resources	In areas where vegetation is removed there will be a loss of habitat resources.	
Duration	The impact will be of a long duration	
Cumulative effect	Low effect, as the removal of habitat will cause a decrease in the number of bat numbers and insect numbers within the site boundaries.	
Intensity/magnitude	Removal of foraging grounds may negatively impact the population and system, but most likely on a small scale since foraging distances are usually large for insectivorous bat species.	
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	3	1
Irreplaceable loss	3	2
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 30 (medium negative)	- 8 (low negative)

BATS	
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 an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.

6.2.4 Surface Water Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the surface water assessment.

- Pre- construction Phase

A construction lay-down area is likely to be required for the proposed development. The location of the construction lay-down area will be important as placing this area in a wetland or any other surface water resource is likely to result in direct negative physical impacts. Direct negative impacts can include vegetation clearing and degradation, and soil compaction impacts due to temporary structures and vehicle movement. Impacts related to worker ingress and the degradation of wetlands or any other surface water resource may similarly result. Potential contamination and pollution impacts from stored oils, fuels, and other hazardous substances or materials are also a possibility. Where site clearing may be required in the wetland or any other surface water resource in order for the lay-down area to be established, this will result in the clearance/removal of vegetation at the surface leaving the exposed soils of the wetland(s) or surface water resource vulnerable to erosion and sedimentation impacts. Indirect impacts can also be anticipated in the form of sedimentation and increased run-off which can induce erosion, should the location of the construction lay-down area be within close proximity (32m) to the wetlands and / or watercourses.

Table 46: Impacts associated with the Construction Lay-down Area directly in or in close proximity to Surface Water Resources

SURFACE WATER	
Environmental Parameter	Depression wetlands and drainage lines
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area directly in or within close proximity to surface water resources
Extent	Site
Probability	Probable
Reversibility	Partly reversible
Irreplaceable loss of resources	Marginal loss of resources
Duration	Medium term
Cumulative effect	Low cumulative Impact

Intensity/magnitude	High	
Significance Rating	Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the potential impact can be reduced greatly.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	3	1
Significance rating	-36 (medium negative)	- 6 (low negative)
Mitigation measures	**Location of the Lay-down Area** – The location of the lay-down area must not be within 50m of any of the identified surface water resources. Therefore, the location of the construction lay-down area must not be within any of the associated buffer zones by implication. Additionally, the storage of materials and machinery must also not be within 50m of any of the identified surface water resources.	

- Construction Phase

Construction vehicles (heavy and light) are likely to require access to the proposed development. Potential negative impacts can include the need to travel into or through surface water resources, thereby resulting in physical degradation. Moreover, leaks or spills of oils, fluids and/or fuels from vehicles and machinery in general, or during re-fuelling, or servicing in the surface water resources, are a possibility. Should any leakage or spillage occur in and / or near the surface water resources, potential soil / water contamination can result. Fuels and oils also pose a fire risk not only to the surface water resources, but also neighbouring areas.

Table 47: Impact Rating for Construction Vehicle and Machinery Degradation Impacts to Surface Water Resources

SURFACE WATER	
Environmental Parameter	Depression wetlands and drainage lines
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to surface water resources
Extent	Site
Probability	Probable
Reversibility	Partly reversible
Irreplaceable loss of resources	Marginal loss of resources

Duration	Medium term	
Cumulative effect	Medium cumulative Impact	
Intensity/magnitude	High	
Significance Rating	Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced further slightly.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	3	2
Intensity/magnitude	3	3
Significance rating	- 39 (medium negative)	- 36 (medium negative)
Mitigation measures	**Preventing Physical Degradation of Surface Water Resources** – Surface water resources are to be designated as "highly sensitive areas". Vehicle access is not to be allowed in the highly sensitive areas. Internal access roads are not to be routed in any surface water resources. Should this be required, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly. **Limiting Damage to Surface Water Resources** – Ideally, to minimise any impact to surface water resources, the proposed development (including buildings, wind turbines and all associated infrastructure) should seek to avoid all surface water resources as far as possible. Where this is not possible a single access route or "Right of Way" (RoW) is to be established through or in the desired construction area in the surface water resource(s). The environmentally authorized and license permitted construction area is to be demarcated and made visible. The establishment of the RoW likewise must be demarcated and made visible. The width of the RoW must be limited to the width of the vehicles required to enter the surface water resource (no more than a 3m width). An area around the locations of the proposed development	

	buildings, wind turbines and any other associated infrastructure will be required in order for construction vehicles and machinery to operate/manoeuvre, only where required. This too must be limited to the smallest possible area and made visible by means of demarcation. Where crossings are required, only vehicle tracks should be made through the surface water resources. No crossings however are to be made through the natural depression wetlands. RoW areas through surface water resources should not be completely cleared of vegetation, only the tracks should be cleared. Vegetation should otherwise be trimmed appropriately such that vehicles can move through RoW areas adequately. No structures will need to be placed in the RoW crossing areas through surface water resources since these systems are ephemeral. No bog mats or gravel running tracks would therefore be required. No surface water resources are to be crossed during or directly after a rainfall event. Construction workers are only allowed in the designated construction areas of the proposed development and not into the surrounding surface water resources. Highly sensitive areas are to be clearly demarcated prior to the commencement of construction and no access beyond these areas is to be allowed unless in RoW areas. **Preventing Soil Contamination** – No vehicles are to be allowed in the highly 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 are not to be allowed into surface water resources. 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 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, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby surface water resources.

The possibility of human degradation to the surface water resources is unlikely to occur during the construction phase, since construction activities are not likely to take place in close proximity to surface water resources given the limited number of surface water resources identified. Nonetheless, human degradation there is a small chance of this impact occurring which could take place in the form of physical / direct degradation such as lighting fires (purposefully or accidentally) in or near to surface water resources. Usage of the surface water resources for sanitation purposes may take place resulting in pollution of the surface water resources. The surface water resources may also be utilised as a source of water for domestic use, building and general cleaning purposes.

Fauna and avi-fauna associated with surface water resources are often hunted, trapped, killed or eaten. This impact must be prevented. Finally, flora associated with surface water resources may need to be cleared or removed for building storage purposes which can result in a loss of resources.

Table 48: Impact Rating for Human Degradation of Flora and Fauna associated with Surface Water Resources

SURFACE WATER		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Human degradation to fauna and flora associated with surface water resources	
Extent	Site	
Probability	Probable	
Reversibility	Completely reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Short 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 further reduced to a low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1

Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	3	2
Significance rating	-30 (medium negative)	- 14 (low negative)
Mitigation measures	**Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction and RoW areas where the environmental authorisation and the relevant water use license is obtained where and if required. The highly sensitive areas are to be clearly demarcated no access into these areas are to be allowed unless authorised. 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 therefore 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, within relative close proximity where they were found. No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from any surface water resource(s) where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. No water is to be abstracted unless a water use license is granted for specific quantities for a specific water resource. No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a	

	designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive areas. Appropriate safety measures as stipulated above must be implemented. No cement mixing is to take place in a 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 areas.

It may be required that wind turbines, associated buildings and infrastructure are to be located within the identified surface water resources. As a result, foundations and hard stand areas will need to be laid for the wind turbines. Additionally, foundations will need to be established for the various buildings, structures and infrastructure. Where the placement of the foundations and hard stand areas extend into the surface water resource areas, the excavation of potential soils are likely to affect the functionality of these hydrological systems. Functionality may be affected in terms of hydrogeomorphic functionality. Moreover, the implementation of the foundations will result in a relatively permanent structure, meaning that the area occupied by the foundation will ultimately result in a degree of permanent habitat and soil loss.

Table 49: Impact Rating for Degradation and Removal of Vegetation and Soils associated with Surface Water Resources

SURFACE WATER		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with surface water resources	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Very High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low impact to a medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1

Probability	3	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	4	3
Significance rating	- 60 (High negative)	- 42 (medium negative)
Mitigation measures	**Strategic Positioning of Wind Turbines, Buildings and other Linear Infrastructure** – Preferably all wind turbines, buildings and infrastructure should be placed at least 50m from any surface water resource as far as practically possible. This will significantly reduce the potential impact on surface water resources. Where this is not possible, more intense mitigation measures will be required as stipulated below. **Obtaining Relevant Authorisations and Licenses** – Before any construction or removal of soils and vegetation in any delineated surface water resources is undertaken, the relevant water use license and environmental authorisation is to be obtained and conditions adhered to. **Limiting Damage to Surface Water Resources** – Construction must be limited to the authorized RoW areas where applicable. **Limiting Removal of Excavated Soils** – Should the necessary authorisations (water use license, environmental authorisation etc.) be obtained for the proposed development to be placed in surface water resources, excavated topsoils should be stockpiled separately from subsoils so that it can be replaced in the correct order for rehabilitation purposes post-construction. Soils removed from surface water resources must only be removed if absolutely required. Furthermore, any removed soils and vegetation that are not required should be taken to a registered landfill site that has sufficient capacity to assimilate the spoil. The topsoil is to be used for rehabilitation purposes and should not be removed unless there is surplus that cannot be utilised. It is important that when the soils are re-instated, the subsoils are to be backfilled first followed by the	

	topsoil. The topsoil contains the natural seedbank from which the affected surface water resources or the associated buffer zone can naturally rehabilitate. Where the soils are excavated from the sensitive areas, it is preferable for them to be stockpiled adjacent to the excavation pit to limit vehicle and any other movement activities around the excavation areas. **Preventing Pollution Impacts** – 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 of the surface water resource. Importantly, no mixing of cement directly on the surface is allowed in the construction and RoW areas in surface water resources. **Protection of Stockpiled Soils** – Stockpiled soils will need to be protected from wind and water erosion. Stockpiled soils are not to exceed a 3m height and are to be bunded by suitable materials. Stacked bricks surrounding the stockpiled soils can be adopted. Alternatively, wooden planks pegged around the stockpiled soils can be used. **Rehabilitation of RoW Areas** – Ideally, the affected RoW zones in the sensitive areas must be re-instated with the soils removed from the surface water resource(s), and 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.

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly 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 distinct possibility. A further impact due to erosion and storm water run-off impacts is increased sedimentation to surface water resources.

Deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Table 50: Impact Rating for Increased Storm Water Run-off, Erosion and Sedimentation Impacts

SURFACE WATER		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Increased storm water run-off, erosion and increased sedimentation impacting on surface water resources	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Very high*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level to a medium level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	3	3
Intensity/magnitude	4	3
Significance rating	- 56 (high negative)	- 39 (medium negative)
Mitigation measures	**Preventing Increased Run-off 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. Grass blocks on the perimeter of the wind turbine hard stand areas and building structure footprints can also be used to reduce run-off and onset of erosion. 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.

- Operational Phase

Vehicle access may be required to construction areas for 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

Table 51: Impact of Vehicle Damage to Surface Water Resources

SURFACE WATER	
Environmental Parameter	Depression wetlands and drainage lines
Issue/Impact/Environmental Effect/Nature	Vehicle compaction damage to surface water resources
Extent	*Local*
Probability	*Define*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Marginal loss of resources*
Duration	*Long term*
Cumulative effect	*Medium cumulative impact*
Intensity/magnitude	*Very high*

Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low negative impact to a medium negative impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	4	3
Significance rating	- 64 (high negative)	-42 (medium negative)
Mitigation measures	**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. 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.	

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. Additionally, where regular movement from vehicles flatten the ground surface making it a preferential flow path for storm water, sediment transportation from hardened gravel surfaces via run-off for internal access and service roads can result in increased sedimentation. In general, flat and hard surfaces aid with the acceleration and generation of run-off which can impact on nearby surface water resources through the onset of erosion, as well as by means of increased sedimentation.

Table 52: Storm-water Run-off Impacts to Surface Water Resources

SURFACE WATER		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Impermeable and hardened surfaces creating accelerated and increased run-off, consequent erosion and increased sedimentation	
Extent	Local	
Probability	Definite	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Long term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	very high	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a moderate level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1 2	1 2
Probability	3 4	2 3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	1 3
Intensity/magnitude	3 4	1 3
Significance rating	- 64 (high negative)	- 45 (medium negative)
Mitigation measures	Any hardstand area or building within 50m proximity to a surface water resource 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).	

	Alternatively, a suitable operational storm water management plan can 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 Phase

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.

6.2.5 Soils and Agricultural Potential Impacts

The following potential impacts have been identified for the proposed wind power facility development and will be further investigated in the EIA phase of the soils and agricultural potential assessment.

Table 53: Summary of Loss of agricultural land use

LOSS OF AGRICULTURAL LAND USE	
Environmental Parameter	Agricultural land (grazing)
Impact	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.
Extent (E)	Site
Probability (P)	Definite
Reversibility (R)	Partly reversible
Irreplaceable loss of resources (I)	Marginal
Duration (D)	Long term
Cumulative effect (C)	Low

LOSS OF AGRICULTURAL LAND USE		
Intensity/magnitude (M)	Low	
Significance Rating	Low negative.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	n/a
Probability	4	n/a
Reversibility	2	n/a
Irreplaceable loss	2	n/a
Duration	3	n/a
Cumulative effect	2	n/a
Intensity/magnitude	1	n/a
Significance rating	**-14 (low negative)**	**n/a**
Mitigation measures	None Possible	

Table 54: Summary of Generation of additional land use income impacts

GENERATION OF ADDITIONAL LAND USE INCOME		
Environmental Parameter	Farm economic sustainability	
Impact	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.	
Extent (E)	Site	
Probability (P)	Definite	
Reversibility (R)	Completely reversible	
Irreplaceable loss of resources (I)	No Loss	
Duration (D)	Long term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Low	
Significance Rating	Low positive	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	n/a
Probability	4	n/a

GENERATION OF ADDITIONAL LAND USE INCOME		
Reversibility	1	n/a
Irreplaceable loss	1	n/a
Duration	3	n/a
Cumulative effect	1	n/a
Intensity/magnitude	1	n/a
Significance rating	**11 (low positive)**	**n/a**
Mitigation measures	None possible	

Table 55: Summary of Erosion due to alteration of the land surface run-off characteristic impacts

EROSION DUE TO ALTERATION OF THE LAND SURFACE RUN-OFF CHARACTERISTICS		
Environmental Parameter	Soil	
Impact	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.	
Extent (E)	Site	
Probability (P)	Probable	
Reversibility (R)	Partly reversible	
Irreplaceable loss of resources (I)	Marginal	
Duration (D)	Long term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Medium	
Significance Rating	Low negative	
	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	1	1
Intensity/magnitude	2	1
Significance rating	- **24 (low negative)**	**-11 (low negative)**

EROSION DUE TO ALTERATION OF THE LAND SURFACE RUN-OFF CHARACTERISTICS	
Mitigation measures	▪ 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.

Table 56: Summary of farm security risk

FARM SECURITY		
Environmental Parameter	Farm security	
Impact	Increased security against stock theft due to the presence of the energy facility and its personnel	
Extent (E)	Site	
Probability (P)	Probable	
Reversibility (R)	Completely reversible	
Irreplaceable loss of resources (I)	No loss	
Duration (D)	Long term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Low	
Significance Rating	Low negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	n/a
Probability	3	n/a
Reversibility	1	n/a
Irreplaceable loss	1	n/a
Duration	3	n/a
Cumulative effect	1	n/a
Intensity/magnitude	1	n/a
Significance rating	- **10 (low negative)**	**n/a**
Mitigation measures	None Possible	

Table 57: Summary of Loss of topsoil caused by poor topsoil management construction phase impacts

LOSS OF TOPSOIL CAUSED BY POOR TOPSOIL MANAGEMENT	
Environmental Parameter	Soil

LOSS OF TOPSOIL CAUSED BY POOR TOPSOIL MANAGEMENT		
Impact	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.	
Extent (E)	Site	
Probability (P)	Probable	
Reversibility (R)	Partly reversible	
Irreplaceable loss of resources (I)	Marginal	
Duration (D)	Long term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Medium	
Significance Rating	Low negative	
	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	1	1
Intensity/magnitude	2	1
Significance rating	- **24 (low negative)**	- **11 (low negative)**
Mitigation measures	▪ 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.	

Table 58: Summary of degradation of veld impacts

DEGRADATION OF VELD IMPACTS		
Environmental Parameter	Veld vegetation (grazing)	
Impact	Degradation of veld vegetation beyond the direct development footprint caused by trampling due to vehicle passage, and deposition of dust.	
Extent (E)	Site	
Probability (P)	Possible	
Reversibility (R)	Partly reversible	
Irreplaceable loss of resources (I)	Marginal	
Duration (D)	Medium term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Low	
Significance Rating	Low negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	- **10 (low negative)**	- **9 (low negative)**
Mitigation measures	▪ Minimize road footprint and control vehicle access on approved roads only. ▪ Control dust as per standard construction site practice.	

Table 59: Summary of dust generation impacts

DUST GENERATION	
Environmental Parameter	Air quality
Impact	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.
Extent (E)	Site
Probability (P)	Possible
Reversibility (R)	Partly reversible

DUST GENERATION		
Irreplaceable loss of resources (I)	Marginal	
Duration (D)	Medium term	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Low	
Significance Rating	Low negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	- **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 60: Summary of soil contamination impacts

SOIL CONTAMINATION	
Environmental Parameter	Soil
Impact	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.
Extent (E)	Site
Probability (P)	Possible
Reversibility (R)	Partly reversible
Irreplaceable loss of resources (I)	Marginal
Duration (D)	Long term
Cumulative effect (C)	Negligible

SOIL CONTAMINATION		
Intensity/magnitude (M)	Low	
Significance Rating	Low negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	- **10 (low negative)**	- **9 (low negative)**
Mitigation measures	▪ Implement effective spillage and waste management system.	

6.2.6 Noise Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the noise assessment.

Table 61: Summary of potential impacts of noise during construction (day time) and upgrade) of access roads and other infrastructure

NOISE	
Environmental Parameter	Construction of the access roads and grid infrastructure during the day
Issue/Impact/Environmental Effect/Nature	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. Considering the location of current roads, there may be an access road (if accessing from the south) approximately 880m from NSD06, 600m from NSD01 and 160m from NSD03. It passes very close to NSD02. 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

NOISE		
	during the year, this assessment will assume that the dwellings will be used for residential purposes during the construction phase.	
Extent (E)	The impact will only affect residences on site.	
Probability (P)	Definite	
Reversibility (R)	Completely reversible. Construction noise ceases once infrastructure is in place.	
Irreplaceable loss of resources (I)	None	
Duration (D)	Short term.	
Cumulative effect (C)	Negligible	
Intensity/magnitude (M)	Very high	
Significance Rating	Medium	
	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	▪ 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. ▪ Construct the access roads 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. Develop a separate road or upgrade an existing access road to the contractor's camp to minimise traffic past residents.	

Table 62: Noise Impact Assessment – Night-time Construction (and upgrade) of access roads and other infrastructure

NOISE	
Environmental Parameter	Construction of the access roads and grid infrastructure at night

NOISE		
Issue/Impact/Environmental Effect/Nature	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. The route of the access roads or grid infrastructure was not defined but could go past structures. Considering the location of current roads, there may be an access road (if accessing from the south) approximately 880m from NSD06, 600m from NSD01 and 160m from NSD03. It passes very close to NSD02. 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	Site	
Probability	Definite	
Reversibility	Completely	
Irreplaceable loss of resources	None	
Duration	Short	
Cumulative effect	Negligible	
Intensity/magnitude	Very high	
Significance Rating	Medium	
	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)**

NOISE	
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 includes construction of roads, power lines or construction of wind turbines. ▪ Construct the access roads 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. Develop a separate road or upgrade an existing access road to the contractor's camp to minimise traffic past residents.

Table 63: Noise Impact Assessment – Daytime Construction Traffic

NOISE	
Environmental Parameter	Construction traffic passing residential dwellings during the day
Issue/Impact/Environmental Effect/Nature	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. Considering the location of current roads, there may be an access road (if accessing from the south) approximately 880m from NSD06, 600m from NSD01 and 160m from NSD03. It passes very close to NSD02. 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	Site
Probability	Probable
Reversibility	Completely
Irreplaceable loss of resources	None
Duration	Medium

NOISE		
Cumulative effect	Negligible	
Intensity/magnitude	High	
Significance Rating	Medium	
	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	3	1
Significance rating	- **27 (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 64: Noise Impact Assessment – Night-time Construction Traffic

NOISE	
Environmental Parameter	Construction traffic passing residential dwellings at night
Issue/Impact/Environmental Effect/Nature	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. Considering the location of current roads, there may be an access road (if accessing from the south) approximately 880m from NSD06, 600m from NSD01 and 160m from NSD03. It passes very close to NSD02. 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 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	Site

NOISE		
Probability	Definite	
Reversibility	Completely	
Irreplaceable loss of resources	None	
Duration	Medium	
Cumulative effect	Negligible	
Intensity/magnitude	Very high	
Significance Rating	Medium	
	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. ▪ If significant traffic is anticipated at night, access roads must be located further than 580m from receptors. ▪ 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 or upgrade an existing access road to the contractor's camp to minimise traffic past residents. ▪ 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 65: Noise Impact Assessment – Daytime Construction of other infrastructure

NOISE	
Environmental Parameter	Construction activities of other infrastructure such as the sub-stations and overhead lines during the day

NOISE	
Issue/Impact/Environmental Effect/Nature	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 may be associated with construction activities and these noises may be intrusive and increase annoyance with the project. NSD06 is further than 1,000m from any of the substations or routes where the overhead power lines will be constructed.
Extent	Site
Probability	Unlikely
Reversibility	Completely
Irreplaceable loss of resources	None
Duration	Short
Cumulative effect	Negligible
Intensity/magnitude	Low
Significance Rating	Low

	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	- **6 (low negative)**	- **6 (low negative)**
Mitigation measures	▪ Mitigation not required as the locations were the infrastructure will be constructed is too far from the potential noise-*sensitive* receptor.	

Table 66: Noise Impact Assessment – Night-time Construction of other infrastructure

NOISE	
Environmental Parameter	Construction of other infrastructure such as the sub-stations and overhead lines at night
Issue/Impact/Environmental Effect/Nature	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

NOISE		
	and these noises may be intrusive and increase 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. NSD06 is further than 1,000m from any of the substations or routes where the overhead power lines will be constructed. Risks of a noise impact from these construction activities are very low.	
Extent	Site	
Probability	Unlikely	
Reversibility	Completely	
Irreplaceable loss of resources	None	
Duration	Short	
Cumulative effect	Negligible	
Intensity/magnitude	Low	
Significance Rating	Low	
	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	- **6 (low negative)**	- **6 (low negative)**
Mitigation measures	Mitigation not required as the locations were the infrastructure will be constructed is too far from the potential noise-sensitive receptor.	

Table 67: Noise Impact Assessment – Daytime Construction of Wind Turbines

NOISE	
Environmental Parameter	Construction activities of the Wind Turbine Generators and other infrastructure during the day
Issue/Impact/Environmental Effect/Nature	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

NOISE	
	and these noises may be intrusive and increase annoyance with the project. NSD06 are approximately 870m from two locations where wind turbines are located. Construction noise levels are projected at 39.2 dBA. There are no other receptors close to the locations where wind turbines will be constructed.
Extent	Site
Probability	Unlikely
Reversibility	Completely
Irreplaceable loss of resources	None
Duration	Short
Cumulative effect	Negligible
Intensity/magnitude	Low
Significance Rating	Low

	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	- **6 (low 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 68: Noise Impact Assessment – Night-time Construction of Wind Turbines

NOISE	
Environmental Parameter	Construction of the Wind Turbine Generators and other infrastructure at night
Issue/Impact/Environmental Effect/Nature	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. The

NOISE	
	route of the access roads or grid infrastructure was not defined but could go past structures. NSD06 is approximately 870m from two locations where wind turbines are proposed. Construction noise levels are projected at 39.2 dBA. There are no other receptors close to the locations where wind turbines will be constructed.
Extent	Site
Probability	Unlikely
Reversibility	Completely
Irreplaceable loss of resources	None
Duration	Short
Cumulative effect	Negligible
Intensity/magnitude	Low
Significance Rating	Low

	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	- **6 (low negative)**	- **6 (low negative)**
Mitigation measures	▪ The residential dwelling is seldom used and the developer can ensure that the construction of Wind Turbines will take place during a period when the owners are not using the property.	

Table 69: Impact Assessment: Operation of Wind Farm – Daytime

NOISE	
Environmental Parameter	Noise from operating wind turbines.
Issue/Impact/Environmental Effect/Nature	Increase in sound levels at the dwellings of receptors at night. Operating wind turbines will generate noises of approximately 40 dBA at NSD06.
Extent	Site

NOISE		
Probability	Unlikely	
Reversibility	Completely	
Irreplaceable loss of resources	None	
Duration	Long	
Cumulative effect	Negligible	
Intensity/magnitude	Low	
Significance Rating	Low	
	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	▪ Mitigation not required as the potential daytime noise impact would be insignificant.	

Table 70: Impact Assessment: Operation of Wind Farm – Night-time

NOISE	
Environmental Parameter	Noise from operating wind turbines.
Issue/Impact/Environmental Effect/Nature	Increase in sound levels at the dwellings of receptors at night. Operating wind turbines will generate noises of approximately 40 dBA at NSD06.
Extent	Site
Probability	Possible
Reversibility	Completely
Irreplaceable loss of resources	None
Duration	Long
Cumulative effect	Negligible

NOISE		
Intensity/magnitude	Low	
Significance Rating	High	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	3	1
Significance rating	- **27 (medium negative)**	- **8 (low negative)**
Mitigation measures	Mitigation not required as the potential night-time noise impact would be insignificant.	

6.2.7 Visual Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the visual assessment.

Table 71: Rating of visual impacts of the proposed Xha! Boom Wind Farm during construction

VISUAL	
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 gravel roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. 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 **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. ▪ 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. ▪ Ensure that dust suppression techniques are implemented on all access roads.	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

Table 72: Rating of visual impacts of the infrastructure associated with the proposed Xha! Boom Wind Farm during construction

VISUAL	
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 the gravel roads and the resultant dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. In addition, temporarily stockpiling 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 **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. ▪ 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. ▪ Ensure that dust suppression techniques are implemented on all access roads

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

- Operation

Table 73: Rating of visual impacts of the proposed Xha! Boom Wind Farm during operation

VISUAL	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The proposed 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 farm via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the proposed wind farm 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 **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. ▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ Ensure that dust suppression techniques are implemented on all access roads	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

Table 74: Rating of visual impacts of the infrastructure associated with the proposed Xha! Boom Wind Farm during operation

VISUAL	
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 farm 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. 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 **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. ▪ The operations 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 impacts, 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. ▪ Ensure that dust suppression techniques are implemented on all access roads. ▪ 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.*

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

6.2.8 Heritage Impacts

The following potential impacts have been identified for the proposed wind farm development and will be further investigated in the EIA phase of the heritage assessment.

Table 75: Impact rating - Palaeontology

HERITAGE	
Environmental Parameter	Impact on the Palaeontology Heritage (fossils) of the development footprint
Issue/Impact/Environmental Effect/Nature	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. This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase.
Extent	The Xha! Boom 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.
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. 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. 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 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 deposits. 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 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. Not deemed necessary as the Allanridge Formation is unfossiliferous.

Table 76: Impact rating – Archaeological resources

ARCHAEOLOGY	
Environmental Parameter	Stone Age resources
Issue/Impact/Environmental Effect/Nature	Archaeological finds have been identified during the fieldwork having low archaeological significance. 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. ▪ 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.	

Table 77: Impact rating – chance finds

CHANCE FINDS	
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 1000m2
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)
Mitigation measures	▪ A walk down of the final approved layout will be required before construction commence; ▪ 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 management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations.	

6.2.9 Socio-economic Impacts

The following potential impacts have been identified for the proposed wind farm and will be further investigated in the EIA phase of the socio-economic assessment.

- Construction

Table 78: Increased production and temporary stimulation of GDP-R

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 majority of inputs (with the exception of the cell and blades) will be produced in 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.	
Probability	The impact will certainly occur (>75% chance of occurrence).	
Reversibility	Once capital is spent, impact is irreversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	The impact will last during construction (± 2 years), which will be extended to a short-term period.	
Cumulative effect	Establishment of similar projects will multiply the positive impact therefore cumulative impact is high.	
Intensity/magnitude	Impact at a national level will be high.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a significant positive impact at the national level. **After mitigation measures:** No viable 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	1	1
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	**+54 (High positive)**	**+54 (High positive)**
Mitigation measures	No mitigation measures exist.	

Table 79: 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, large numbers of workers are required for the duration of the construction phase.
Extent	The impact will affect the local community and district.
Probability	The impact will certainly occur (>75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	The impact will last during construction (± 2 years), which will be extended to a short-term period.
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 significant positive effects. **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	1	1
Cumulative effect	4	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 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.	

Table 80: Impact of skills development due to the creation of new employment opportunities

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	Impact will affect the district and local communities.
Probability	The impact will certainly occur (>75% chance of occurrence).
Reversibility	The impact is irreversible.
Irreplaceable loss of resources	The impact will not result in the loss of any resources.
Duration	The impact will have a permanent effect on the employed individuals as the acquired skills and necessary knowledge will

	have already been acquired and will remain with the relevant workers.	
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 percentages indicate 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. **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	4
Intensity/magnitude	3	3
Significance rating	+51 (High positive)	+57 (High positive)
Mitigation measures	• Contracts ensuring that on-the-job training is included and enforced as a condition for the development of this project. • To improve the chances of skills development during the construction phase, contractors are encouraged to provide learner-ships and encourage further knowledge sharing.	

Table 81: Impact of Increased household income and improved standard of living

Environmental Parameter	Household income: the result of a household member engaging in economic activity; has a direct link to the standards of living. Currently just over half of the residents of the Hantam LM generate an income less than R3 200.
Issue/Impact/Environmental Effect/Nature	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.
Probability	The impact will certainly occur (>75% chance of occurrence).
Reversibility	The impact is reversible as the income will only be earned for the duration of the construction period.
Irreplaceable loss of resources	The impact will not result in the loss of any resources
Duration	The impact will last during construction (± 2 years), which will be extended to a short-term period.

Cumulative effect	With the potential development of similar renewable projects in the area, the number of jobs created through multiplier effects will increase leading to increased household income.	
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 impact.	
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. **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 • Employ labour-intensive methods as far as feasible in the construction phase • Where possible, sub-contract to local companies	

Table 82: Impact of 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	SED and ED initiatives, as part of the Independent Power Producer Procurement Programme (IPPPP); project owners are required to allocate a certain percentage of the projects' revenue towards community development. As such, the developer aims on investing R450 000 in nearby communities through several community development initiatives.
Extent	The impact will affect the local district.
Probability	Investing into the local economy is a government requirement therefore the impact will certainly occur (>75% chance of occurrence).

Reversibility	Once the investments are injected into the economy, it can be assumed that the impact will be irreversible.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
Duration	This impact is rated as medium term as it will take place during the pre-construction and construction phase of the project.	
Cumulative effect	The base-town for several of the other projects in the area is Loeriesfontein as well, thus the cumulative impact is high.	
Intensity/magnitude	The local district as well as Loeriesfontein town is in need of an economic stimulus therefore benefits from the investment will have a high intensity impact.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a significant positive effect. **After mitigation measures:** After viable mitigation measures are implemented, the anticipated impact will have a significant positive effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	3	4
Significance rating	+51 (High positive)	+68 (High positive)
Mitigation measures	• 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. • The government should find a way to monitor and evaluate the compliance of the proponent to the requirement of investing into a local community.	

Table 83: Impact of Increase in government revenue due to the capital investment

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 increase in employment opportunities and disposable income has a direct influence on the increase in the tax base as a result of investment on the proposed project. The increased tax revenue also implies that large sum of money to be spent on improving the service delivery of the local district.
Extent	The impact will affect the entire country.
Probability	The impact will certainly occur (>75% chance of occurrence).

Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	The impact will last during construction (± 2 years), which will be extended to a short-term period.	
Cumulative effect	Considering surrounding renewable energy products, the cumulative impact could potentially be high	
Intensity/magnitude	At a national level, the impact (increase in government revenue) will have a medium impact and at this stage, government revenue will not be as large as when the wind farm becomes operational	
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 (Medium positive)
Mitigation measures	No mitigation measures exist.	

Table 84: 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 naturally established, 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 job-seekers 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.
Probability	The impact will certainly occur (>75% chance of occurrence).
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 be partly reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.

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.	
Cumulative effect	Considering other renewable energy projects that are situated in the area, the impact would result in a significant cumulative effect as it might attract several other migrant workers	
Intensity/magnitude	The male population is expected to increase in the area thus affecting the demographics of the area thus resulting in an impact of a medium intensity.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will result in a medium negative effect. **After mitigation measures:** Considering the proposed mitigation measures, the intensity of the impact has remained 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	3
Intensity/magnitude	2	1
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. This will decrease the likelihood of an influx of migrant workers.	

Table 85: Impact of Increase in social pathologies associated with the influx of migrant labourers and job-seekers 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 job-seekers and will involve the migration of construction workers to either the site or the surrounding 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.
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).

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 party reversible.	
Irreplaceable loss of resources	This impact will most likely result in a moderate increase in the stock theft therefore this impact is rated to possibly result in a marginal loss of resources.	
Duration	In the event that migrant workers remain in the area after the construction period, the impact is rated as long term.	
Cumulative effect	Considering the other renewable projects in the area, the cumulative impact of increased social pathologies is expected to be high.	
Intensity/magnitude	The increase in social pathologies is most likely to jeopardise the integrity of the area resulting in a medium intensity effect.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have highly negative effects and will require significant mitigation measures to achieve an acceptable level of impact. **After mitigation measures:** The anticipated impact will be reduced to a medium negative effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	-51 (High negative)	-30 (Medium negative)
Mitigation measures	• 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	

Table 86: Impact of added pressure on basic services and social and economic infrastructure

Environmental Parameter	Basic services and social and economic infrastructure, water provision and adequate housing.
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 put pressure on the local

	municipality to ensure that the services are not further deteriorated.
Extent	The impact will affect the local district
Probability	The impact will certainly occur (>75% chance of occurrence).
Reversibility	The impact is partly reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
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.
Cumulative effect	The demand for basic services and infrastructure is most likely to increase as more similar developments appear in the area, thus the cumulative impact is high.
Intensity/magnitude	With the municipality already experiencing backlogs in housing and like services, the impact is rated as a medium-sized effect.
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a medium negative effect and will require moderate mitigation measures. **After mitigation measures:** The anticipated impact will be reduced to a low negative effect.

	Pre-mitigation impact rating	Pre-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	2	2
Significance rating	-30 (Medium negative)	-30 (Medium 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. • 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 87: 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	The impact will affect the local area or district.	
Probability	The impact will certainly occur (>75% chance of occurrence).	
Reversibility	Considering projects similar to this one, some migrant workers and job-seekers might remain in the area therefore the impact is partly reversible.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
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.	
Cumulative effect	In consideration of projects of a similar nature, the cumulative impact is rated as high.	
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.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a medium negative effect and will require moderate mitigation measures. **After mitigation measures:** No mitigation measures exist.	
	Pre-mitigation impact rating	Pre-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	No mitigation measures exist.	

- Operation

Table 88: Impact of sustainable increase in GDP 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.	
Probability	The impact will certainly occur (>75% chance of occurrence).	
Reversibility	The impact is irreversible as one cannot 'un-do' production.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
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.	
Cumulative effect	In consideration of the other planned project for the area, the cumulative impact could be high.	
Intensity/magnitude	The impact will alter the economy of the entire community; it will therefore, result in a medium-sized effect.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a moderate positive effect. **After mitigation measures:** No mitigation measures exist to increase the intensity of the impact.	
	Pre-mitigation impact rating	**Pre-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	No mitigation measures exist	

Table 89: Sustainable increase in government revenue stream

Environmental Parameter	Government revenue: through the operations of the project, a contribution will be made to the government revenue which will indirectly improve the provision of basic services to the population.
Issue/Impact/Environmental Effect/Nature	The impact will mostly take place when there is an increase in the amount of tax on the salaries of salaries and wages of people, as well as payment of company taxes.
Extent	The impact will affect the entire country.
Probability	The impact will certainly occur.
Reversibility	Government will collect money in the form of tax and will utilise the injection to improve the socio-economic standards of the population, for this reason; the impact is rated as irreversible.
Irreplaceable loss of resources	The impact will not result in the loss of any resources.
Duration	The impact is rated as long term as it will last for the entire operational life of the development; therefore, rated as long term.
Cumulative effect	Considering the projects that are to be developed in the area, the tax revenue will increase. The impact could be a medium-sized effect.

Intensity/magnitude	The impact will potentially alter the living conditions of the population through government investment; thus, the impact is of a medium-sized intensity.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have high positive effects. **After mitigation measures:** No mitigation measures exist to increase the intensity of the impact.	
	Pre-mitigation impact rating	**Pre-mitigation impact rating**
Extent	4	4
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	+57 (High positive)	+57 (High positive)
Mitigation measures	No mitigation measures exist.	

Table 90: Impact of 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, several people will receive employment.	
Extent	Will affect the local area and district.	
Probability	The impact will certainly occur (>75% chance of occurrence).	
Reversibility	The employment is expected to last for the entire life span of the project upon which the impact is rated as barely irreversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	The impact and its effects is expected to last for the entire operational life of the development resulting in a long-term effect.	
Cumulative effect	The cumulative impact of the project is expected to be high as a number of people in the Hantam economy will receive long term employment.	
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 moderate positive effects. **After mitigation measures:** The anticipated impact will have highly significant positive effects.	
	Pre-mitigation impact rating	**Pre-mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	3	3

Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	+34 (Medium positive)	+34 (Medium positive)
Mitigation measures	Where possible, ensure that the created jobs are acquired by local people.	

Table 91: Impact of skills development due to the creation of new sustainable employment opportunities

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.	
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.	
Reversibility	The impact irreversible as once skilled are gained, they cannot be lost.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
Duration	Considering the duration of the phase, impact will be long term.	
Cumulative effect	The cumulative impact is rated as medium-sized as the rest of the skills will arise from other projects.	
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	**Pre-mitigation impact rating**
Extent	4	4
Probability	3	3
Reversibility	4	4
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	1	1
Significance rating	+18 (Low positive)	+18 (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. • 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.

Table 92: Increased household income

<table>
<tr><td>Environmental Parameter</td><td colspan="2">Household income: the result of a households' member engaging in economic activity which has a direct link of the living standards of a household.</td></tr>
<tr><td>Issue/Impact/Environmental Effect/Nature</td><td colspan="2">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.</td></tr>
<tr><td>Extent</td><td colspan="2">The impact will affect the local area and district.</td></tr>
<tr><td>Probability</td><td colspan="2">The impact will certainly occur (>75% chance of occurrence).</td></tr>
<tr><td>Reversibility</td><td colspan="2">The impact is irreversible.</td></tr>
<tr><td>Irreplaceable loss of resources</td><td colspan="2">The impact will not result in the loss of any resources.</td></tr>
<tr><td>Duration</td><td colspan="2">The impact will be relevant for the entire life span of the project, long term.</td></tr>
<tr><td>Cumulative effect</td><td colspan="2">Based on the current size of the district and local area, the cumulative impact is expected to be high.</td></tr>
<tr><td>Intensity/magnitude</td><td colspan="2">In Loeriesfontein, employment is currently dominated by the informal sector opportunities, thus the provision of sustainable jobs will significantly improve the living standards of local residents.</td></tr>
<tr><td>Significance Rating</td><td colspan="2">Prior to mitigation measures: The anticipated impact will have significant positive effects.
After mitigation measures: The intensity of the impact remains the same at a significant positive effect.</td></tr>
<tr><td></td><td>Pre-mitigation impact rating</td><td>Pre-mitigation impact rating</td></tr>
<tr><td>Extent</td><td>2</td><td>2</td></tr>
<tr><td>Probability</td><td>4</td><td>4</td></tr>
<tr><td>Reversibility</td><td>4</td><td>4</td></tr>
<tr><td>Irreplaceable loss</td><td>1</td><td>1</td></tr>
<tr><td>Duration</td><td>3</td><td>3</td></tr>
<tr><td>Cumulative effect</td><td>4</td><td>4</td></tr>
<tr><td>Intensity/magnitude</td><td>3</td><td>3</td></tr>
<tr><td>Significance rating</td><td>+54 (High positive)</td><td>+54 (High positive)</td></tr>
<tr><td>Mitigation measures</td><td colspan="2">Ensure that local labour is procured to maximise benefit to the local households.</td></tr>
</table>

Table 93: Impact of 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	SED and ED initiatives, as part of the Independent Power Producer Procurement Programme (IPPPP); project owners are required to allocate a certain percentage of the projects' revenue towards community development.	
Extent	The impact will affect the local district.	
Probability	Investing into the local economy is a government requirement therefore the impact will certainly occur (>75% chance of occurrence).	
Reversibility	Once the investments are injected into the economy, it can be assumed that the impact will be irreversible.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
Duration	This impact is rated as long term as it will take place annually for the duration of the project.	
Cumulative effect	The base-town for several of the other projects in the area is Loeriesfontein as well, thus the cumulative impact is high.	
Intensity/magnitude	The local district as well as Loeriesfontein town is in need of an economic stimulus therefore benefits from the investment will have a high intensity impact.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a significant positive effect. **After mitigation measures:** After viable mitigation measures are implemented, the anticipated impact will have a significant positive effect.	
	Pre-mitigation impact rating	**Pre-mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	+54 (High positive)	+54 (High positive)
Mitigation measures	• 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 and wider reaching communities. • The government should find a way to monitor and evaluate the compliance of the proponent to the requirement of investing into a local community.	

Table 94: Impact of Improved standard of living of households directly or indirectly benefiting from created employment opportunities

Environmental Parameter	Improved standard of living.	
Issue/Impact/Environmental Effect/Nature	During the construction and operational phase of the project, indirect employment opportunities are created through the provision of services such as transport as well as accommodation which indirectly improves the living standards of the locals.	
Extent	The impact will affect the local area or district.	
Probability	This impact will certainly occur (>75% chance of occurrence).	
Reversibility	During the operational phase, people are expected to receive employment for the duration of the project thus the impact is barely reversible.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
Duration	The impact is expected to last for the entire operational life of the project.	
Cumulative effect	With the development of similar projects in the area, the cumulative impact could be high.	
Intensity/magnitude	Indirect employment opportunities can play a role in alleviating the high unemployment rate in Loeriesfontein town, therefore the intensity of the impact is of a medium-sized effect.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a moderate positive effect. **After mitigation measures:** After the implementation of ensuring that residents of the local community are employed, the anticipated impact will have significant positive effects.	
	Pre-mitigation impact rating	**Pre-mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	3	3
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	+34 (Medium positive)	+34 (Medium positive)
Mitigation measures	• Ensure that local labour is procured to maximise the benefit to the local households. • 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 95: Impact of improved access to basic services and community services

Environmental Parameter	Access to basic services.

Issue/Impact/Environmental Effect/Nature	The project will allocate a certain percentage of its revenue toward community development for the duration of its operational life. This will assist in addressing currently existing backlogs in the community and will therefore improve the access of the people to basic and community services.	
Extent	The impact will affect the local area or district.	
Probability	This impact will certainly occur (>75% chance of occurrence).	
Reversibility	The impact is irreversible.	
Irreplaceable loss of resources	The impact will not result in the loss of any resources.	
Duration	The impact is expected to last for the entire operational life of the project.	
Cumulative effect	With the development of similar projects in the area, the cumulative impact could be high.	
Intensity/magnitude	The amount of funds that will be injected into the local community will be on an annual basis and this will result in a significantly high intensity of the impact.	
Significance Rating	**Prior to mitigation measures:** The anticipated impact will have a significant positive effect. **After mitigation measures:** No mitigation measures exist that can improve the intensity of the impact.	
	Pre-mitigation impact rating	**Pre-mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	+54 (High positive)	+54 (High positive)
Mitigation measures	No mitigation measures exist.	

6.3 Identification of Mitigation Measures

6.3.1 Biodiversity

- Minimise development footprint within sensitive areas and ensure that final development layout takes account of areas identified as sensitive.
- Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible.
- Avoid sensitive faunal habitats such as drainage lines.
- A variety of avoidance and mitigation measures to reduce impact on fauna will need to be implemented during construction, including limiting impacts from construction staff and the operation of construction vehicles.
- Soil erosion plan to be part of the EMP.

- Rehabilitation of eroded areas on a regular basis.
- Alien management plan to be part of the EMP.
- Regular alien clearing where invasion occurs.
- 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.
- Specific avoidance and mitigation may be required to reduce the impact on certain habitats of limited extent and high ecological or conservation significance

6.3.2 Avifauna

- Restrict the construction activities to the construction footprint area.
- Do not allow any access to the remainder of the property during the construction period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- A 300m exclusion zone should be implemented around the existing water points and pans where no construction activity or disturbance should take place.
- The recommendations of the specialist ecological study must be strictly adhered to.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- 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.
- A 300m no-go buffer is proposed around water points and pans as they serve as focal points for bird activity.
- 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.
- 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.
- The minimum turbine tip height should 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.
- 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. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).
- The avifaunal specialist must approve the power line design to ensure that bird-friendly structures are used.

6.3.3 Bats

- Adhere to the sensitivity map during turbine placement. Blasting should be minimised and used only when necessary. A Bat Specialist should be consulted before blasting of a rocky cliff face or rocky cavernous area. The mitigation measures will reduce the impact blasting and earthworks will have on the environmental parameter, through avoiding sensitive areas.
- 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 7 of this report. 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. The mitigation measures will reduce the likelihood of certain bat species being favoured.
- 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 an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.

6.3.4 Surface Water

- **Location of the Lay-down Area** – The location of the lay-down area must not be within 50m of any of the identified surface water resources. Therefore, the location of the construction lay-down area must not be within any of the associated buffer zones by implication. Additionally, the storage of materials and machinery must also not be within 50m of any of the identified surface water resources.

- **Preventing Physical Degradation of Surface Water Resources** – Surface water resources are to be designated as “highly sensitive areas”. Vehicle access is not to be allowed in the highly sensitive areas. Internal access roads are not to be routed in any surface water resources. Should this be required, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly.

- **Limiting Damage to Surface Water Resources** – Ideally, to minimise any impact to surface water resources, the proposed development (including buildings, wind turbines and all associated infrastructure) should seek to avoid all surface water resources as far as possible.

  Where this is not possible a single access route or "Right of Way" (RoW) is to be established through or in the desired construction area in the surface water resource(s). The environmentally authorized and license permitted construction area is to be demarcated and made visible. The establishment of the RoW likewise must be demarcated and made visible. The width of the RoW must be limited to the width of the vehicles required to enter the surface water resource (no more than a 3m width). An area around the locations of the proposed development buildings, wind turbines and any other associated infrastructure will be required in order for construction vehicles and machinery to operate/maneuver, only where required. This too must be limited to the smallest possible area and made visible by means of demarcation.

  Where crossings are required, only vehicle tracks should be made through the surface water resources. No crossings however are to be made through the natural depression wetlands. RoW areas through surface water resources should not be completely cleared of vegetation, only the tracks should be cleared. Vegetation should otherwise be trimmed appropriately such that vehicles can move through RoW areas adequately. No structures will need to be placed in the RoW crossing areas through surface water resources since these systems are ephemeral. No bog mats or gravel running tracks would therefore be required. No surface water resources are to be crossed during or directly after a rainfall event.

  Construction workers are only allowed in the designated construction areas of the proposed development and not into the surrounding surface water resources. Highly sensitive areas are to be clearly demarcated prior to the commencement of construction and no access beyond these areas is to be allowed unless in RoW areas.

- **Preventing Soil Contamination** – No vehicles are to be allowed in the highly 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 are not to be allowed into surface water resources.

  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 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, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby surface water resources.

- **Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction and RoW areas where the environmental authorisation and the relevant water use license is obtained where and if required. The highly sensitive areas are to be clearly demarcated no access into these areas are to be allowed unless authorised.

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 therefore 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, within relative close proximity where they were found

No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from any surface water resource(s) where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills.

No water is to be abstracted unless a water use license is granted for specific quantities for a specific water resource.

No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive areas. Appropriate safety measures as stipulated above must be implemented.

No cement mixing is to take place in a 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 areas.

- **Strategic Positioning of Wind Turbines, Buildings and other Linear Infrastructure** – Preferably all wind turbines, buildings and infrastructure should be placed at least 50m from any surface water resource as far as practically possible. This will significantly reduce the potential impact on surface water resources. Where this is not possible, more intense mitigation measures will be required as stipulated below.

- **Obtaining Relevant Authorisations and Licenses** – Before any construction or removal of soils and vegetation in any delineated surface water resources is undertaken, the relevant water use license and environmental authorisation is to be obtained and conditions adhered to.

- **Limiting Damage to Surface Water Resources** – Construction must be limited to the authorized RoW areas where applicable.

- **Limiting Removal of Excavated Soils** – Should the necessary authorisations (water use license, environmental authorisation etc.) be obtained for the proposed development to be placed in surface water resources, excavated topsoils should be stockpiled separately from subsoils so that it can be replaced in the correct order for rehabilitation purposes post-construction. Soils removed from surface water resources must only be removed if absolutely required. Furthermore, any removed soils and vegetation that are not required should be taken to a registered landfill site that has sufficient capacity to assimilate the spoil. The topsoil is to be used for rehabilitation purposes and should not be removed unless there is surplus that cannot be utilised. It is important that when the soils are re-instated, the subsoils are to be backfilled first followed by the topsoil. The topsoil contains the natural seedbank from which the affected surface water resources or the associated buffer zone can naturally rehabilitate.

Where the soils are excavated from the sensitive areas, it is preferable for them to be stockpiled adjacent to the excavation pit to limit vehicle and any other movement activities around the excavation areas.

- **Preventing Pollution Impacts** – 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 of the surface water resource. Importantly, no mixing of cement directly on the surface is allowed in the construction and RoW areas in surface water resources.

- **Protection of Stockpiled Soils** – Stockpiled soils will need to be protected from wind and water erosion. Stockpiled soils are not to exceed a 3m height and are to be bunded by suitable materials. Stacked bricks surrounding the stockpiled soils can be adopted. Alternatively, wooden planks pegged around the stockpiled soils can be used.

- **Rehabilitation of RoW Areas** – Ideally, the affected RoW zones in the sensitive areas must be re-instated with the soils removed from the surface water resource(s), and 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.

- **Preventing Increased Run-off 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. Grass blocks on the perimeter of the wind turbine hard stand areas and building structure footprints can also be used to reduce run-off and onset of erosion. 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.

- **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.

  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.

  Any hardstand area or building within 50m proximity to a surface water resource 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).

  Alternatively, a suitable operational storm water management plan can 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.

6.3.5 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.
- Control dust as per standard construction site practice.
- Implement effective spillage and waste management system.

6.3.6 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 helpline where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The wind farm 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.

General mitigation measures to reduce residual risk:

- 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.
- 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 contractor's camp and storage areas at locations where minimal construction traffic will pass occupied dwellings.
- 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.

6.3.7 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.
- Ensure that dust suppression techniques are implemented on all access roads.
- All reinstated cable trenches should be re-vegetated with the same vegetation that existed prior to the cable being laid.
- 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.
- Ensure that dust suppression techniques are implemented on all access roads
- 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.

- Ensure that dust suppression techniques are implemented on all access roads.
- Light fittings for security at the on-site 132kV substation at night should reflect the light toward the ground and prevent light spill.
- The operations 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 impacts, 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.
- Ensure that dust suppression techniques are implemented on all access roads.
- Select the alternatives that will have the least impact on visual receptors.

6.3.8 Heritage

- 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
- 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. Not deemed necessary as the Allanridge Formation is unfossiliferous.
- 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.
- A walk down of the final approved layout will be required before construction commence;
- 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 management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations.

6.3.9 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.
- Contracts ensuring that on-the-job training is included and enforced as a condition for the development of this project.

- To improve the chances of skills development during the construction phase, contractors are encouraged to provide learner-ships and encourage further knowledge sharing.
- 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.
- Where possible, sub-contract to local companies.
- 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.
- 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.
- 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.
- Ensure that local labour is procured to maximise benefit to the local households.
- 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.

6.3.10 Geotechnical

- 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.

6.3.11 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.

6.4 Assessment of Cumulative Impacts

The area has seen a notable interest from developers of various renewable energy projects, which could be associated with the energy resource potential found in the region, proximity to the existing sub-station and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered as they have the potential to create numerous cumulative impacts, whether positive or negative, if implemented. The potential cumulative impact of the proposed wind facility in combination with other renewable energy facilities in the area will be identified and assessed per environmental aspect and mitigation measures will be identified to address the cumulative impact, where possible. Cumulative impacts will also be rated as part of the impact rating system and used to determine the significance of the impacts.

The proposed renewable energy developments identified in the vicinity of the Xha! Boom Wind Farm are identified in **Table 96** and shown in **Figure 41** below.

Table 96: Renewable energy developments proposed within a 55km radius of the Xha! Boom Wind Farm study site

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of the Farm Brak Pan 212
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & 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
Hantam PV Solar Energy Facility	Environmental Authorisation issued / Approved under RE IPPPP	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of the Farm Narosies 228

Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous 226
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 & 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 Springbok Pan No. 1164 & Remainder of the Farm Springbok Tand No. 215
Loeriesfontein 2 Wind Farm	Environmental Authorisation issued/Approved under RE IPPPP	Mainstream Renewable Power	140MW	Portions 1& 2 of the Farm Aan de Karree Doorn Pan No 213
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan No 213
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of the Farm Kleine Rooiberg 227
Wind farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

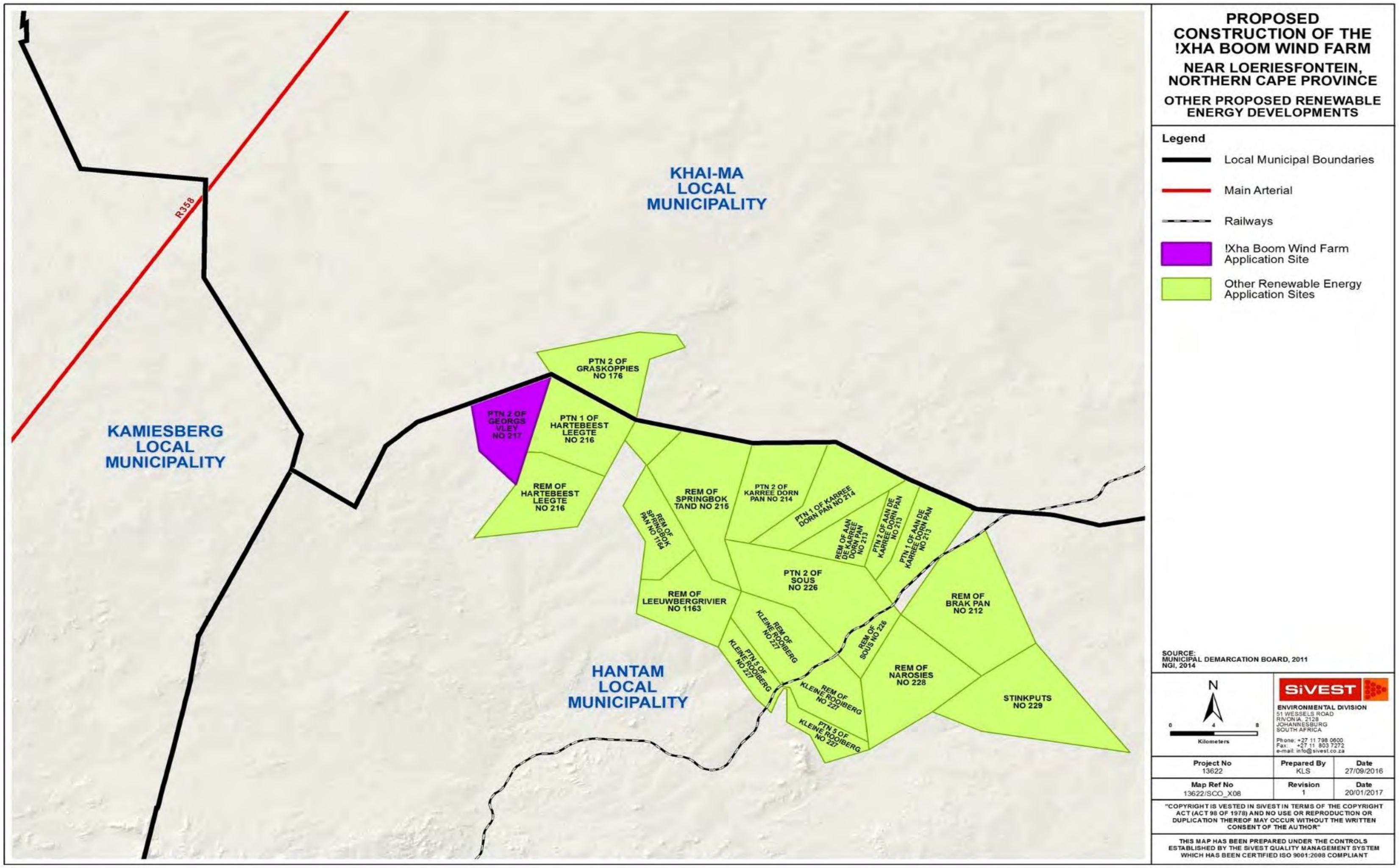


Figure 41: Renewable energy facilities proposed within a 55km radius of the Xha! Boom Wind Farm application site

6.4.1 Biodiversity

Table 97: Cumulative biodiversity impacts and loss of broad-scale connectivity

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 impacts on broad-scale ecological processes.	
Extent	The extent of the impact will be restricted the wind farm site and immediate environment as such would be largely local in nature.	
Probability	This impact is highly likely to occur due to the presence of the facility.	
Reversibility	This impact is not highly reversible as it would persist for the lifetime of the facility, but could be largely reduced thereafter.	
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 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 high, depending on where and how much vegetation was cleared.	
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	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: 1) Minimise the development footprint within the high sensitivity areas.	

CUMULATIVE IMPACTS AND LOSS OF BROAD-SCALE CONNECTIVITY	
	2) There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora. 3) Specific avoidance and mitigation may be required to reduce the impact on certain habitats of limited extent and high ecological or conservation significance

6.4.2 Avifauna

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. The combined footprint of these proposed developments is approximately 28 299 hectares[5]. 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.

- **Powerlines**

[5] 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.

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).

For a systematic exposition of the expected cumulative impacts of the existing renewable energy projects and the Xha! Boom Wind Farm on priority species within a 40km radius around Helios MTS see

Table 98 below.

Table 98: Systematic exposition of the expected cumulative impacts on avifauna.

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 Ithemba WEF (ha)	Expected combined cumulative impact of Ithemba WEF and existing renewable applications: Pre-mitigation	Expected combined cumulative impact of Ithemba WEF and existing renewable applications: Post-mitigation
Karoo Korhaan	Low: Powerlines, solar, overgrazing, climate change	Low	Karoo shrubland	510 000	34 014 (6.6%)	Minor	Not significant
Northern Black Korhaan	Low: Powerlines, solar, overgrazing, climate change	Low	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Kori Bustard	High: Powerlines,solar, overgrazing, climate change	Low	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Lanner Falcon	Low: Powerlines, poisoning, road kills, solar, WEF	Medium?	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Ludwig's Bustard	High: Powerlines, solar, overgrazing, climate change	Low	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Martial Eagle	High: Powerlines, persecution, solar, overgrazing, WEFs, climate	High	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Secretarybird	High: Powerlines, solar , overgrazing, WEFs, climate change	High	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Booted Eagle	Medium: Solar, overgrazing, WEFs, climate change	High	Karoo shrubland	510 000	34 014 (6.6%)	Minor	Not significant
Sclater's Lark	Low: Powerlines, solar, overgrazing, climate change	Low	Karoo shrubland	510 000	34 014 (6.6%)	Not significant	Not significant
Red Lark	Low: Powerlines, solar, overgrazing, climate change	Medium?	Karoo shrubland	510 000	34 014 (6.6%)	Moderate	Minor
Black-chested Snake-Eagle	Medium: Solar, overgrazing, WEFs, climate change	High	Karoo shrubland	510 000	34 014 (6.6%)	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	32 081 (6.3%)	Minor	Not significant
Greater Kestrel	Low: Solar, overgrazing, climate change	High	Karoo shrubland	510 000	32 081 (6.3%)	Minor	Not significant
Spotted Eagle-Owl	Medium: Powerlines, solar, overgrazing, WEFs, climate change, road	High	Karoo shrubland	510 000	32 081 (6.3%)	Minor	Not significant
Jackal Buzzard	Medium: Solar, overgrazing, WEFs, climate change	High	Karoo shrubland	510 000	32 081 (6.3%)	Moderate	Minor
Burchell's Courser	Medium: Solar, overgrazing, WEFs, climate change	Low?	Karoo shrubland	510 000	32 081 (6.3%)	Not significant	Not significant
Double-banded Courser	Medium: Solar, overgrazing, WEFs, climate change	Low?	Karoo shrubland	510 000	32 081 (6.3%)	Not significant	Not significant
Steppe Buzzard	Medium: Solar, overgrazing, WEFs, climate change	High	Karoo shrubland	510 000	32 081 (6.3%)	Minor	Not significant
Yellow-billed Kite	Medium: Solar, overgrazing, WEFs, climate change	High?	Karoo shrubland	510 000	32 081 (6.3%)	Minor	Not significant
Verreaux's Eagle	High: Powerlines, persecution, solar, overgrazing, WEFs, climate	High	Karoo shrubland	510 000	32 081 (6.3%)	Moderate	Minor

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.

6.4.3 Bats

The table below lists and summarises the impact assessment for Xha! Boom Wind Farm taking into account the information from available specialist reports of the neighbouring wind energy projects.

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 99: Cumulative bat mortalities due to direct blade impact or barotrauma during foraging (resident and migrating bats affected).

CUMULATIVE IMPACT – BATS	
Environmental Parameter	Impact on bat population numbers.
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. 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

CUMULATIVE IMPACT – BATS		
	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
Intensity/magnitude	4	2
Significance rating	- 84 (very high negative)	- 32 (medium negative)
Mitigation measures	The high sensitivity valley areas 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.	

6.4.4 Surface Water

Although it is important to assess the potential surface water impacts of the proposed wind farm, it is equally important to assess the cumulative surface water impacts that could materialise in the area should other renewable energy developments (both wind and solar facilities) be granted authorisation to proceed. 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.

It must be noted that for the purpose of this study, renewable energy developments within a 55km radius of the Xha! Boom Wind Farm study site were identified and mapped.
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 for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments

6.4.5 Soils and Agricultural Potential

The cumulative regional impact is a loss of agricultural land, as a result of the sum of surrounding developments, of which there are several.). Due to the extremely limited agricultural potential of all land in the area, predominantly as a result of climatic limitations, and the fact that there is no particular scarcity of such land in South Africa, the cumulative impact is assessed as being of low significance. Because of the very low agricultural potential of the site considered in this report, its contribution to any cumulative impact is also low.

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.

6.4.6 Noise

Table 100: Impact Assessment: Cumulative noise levels for the Study Area – Night-time

CUMULATIVE IMPACT – NOISE	
Environmental Parameter	Cumulative noises from operating wind turbines for the Graskoppies, Ithemba, Xha! Boom and Hartebeest Leegte Wind Farms
Issue/Impact/Environmental Effect/Nature	Increase in sound levels at the dwellings of receptors at night due to cumulative noises. Operating wind turbines from the Xha! Boom WF will generate noises of approximately 40 dBA at NSD06, with the surrounding wind turbines contributing less than 1 dBA.
Extent	Site
Probability	Possible

CUMULATIVE IMPACT – NOISE		
Reversibility	Completely	
Irreplaceable loss of resources	None	
Duration	Long	
Cumulative effect	Negligible	
Intensity/magnitude	High	
Significance Rating	low	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	3	1
Significance rating	- **27 (low negative)**	- **8 (low negative)**
Mitigation measures	Mitigation not required as the potential night-time noise impact would be insignificant.	

6.4.7 Visual

Although it is important to assess the visual impacts of the proposed wind farm itself, it is equally important to assess the cumulative visual impact that could materialise in the area should other renewable energy developments (both wind and solar facilities) be granted authorisation to proceed. 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.

These renewable energy facilities and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, if constructed. It must be noted that for the purpose of this study, renewable energy developments within a 55km radius of the Xha! Boom Wind application site were identified and mapped. The cumulative visual impact experienced by each visual receptor will however depend on the number of proposed developments within an 8km radius of the receptor location, as beyond the 8km radius the visual impact of the development would diminish to an insignificant level.

The proposed renewable energy developments identified are indicated in **Figure 42** below.

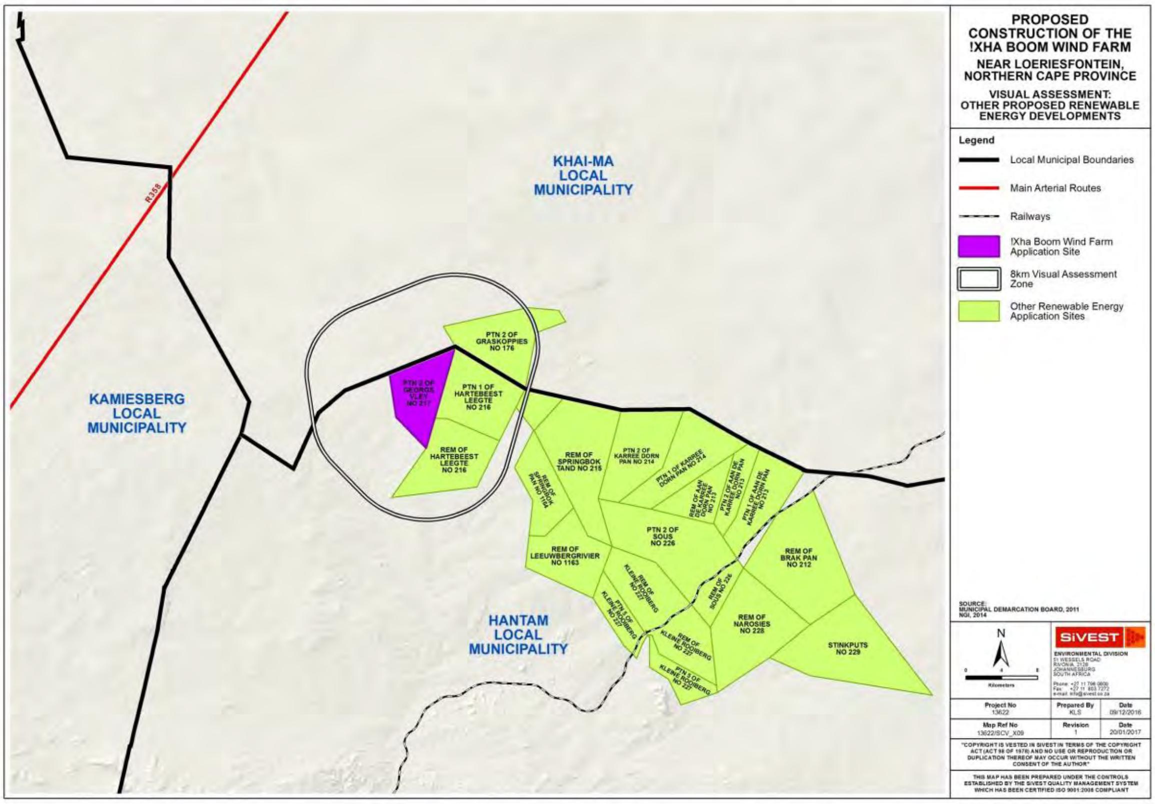


Figure 42: Renewable energy facilities proposed within a 55km radius of the Xha! Boom Wind Farm application site

Scattered farmsteads / homesteads identified in the study area are regarded as potentially sensitive visual receptor locations and it was noted that some of these dwellings are located within 8kms of certain of the additional proposed renewable energy developments, specifically the Graskoppies, Hartebeest Leegte and Ithemba Wind Farms which all form part of the greater Leeuwberg Wind Farms Project. It is therefore likely that these receptors will experience some visual impacts if these three additional wind farms are all constructed. However, it must be noted that these receptors will need to be investigated further during the EIA phase when fieldwork is undertaken and more information becomes available.

6.4.8 Heritage

Table 101: Impact rating – Cumulative

CUMULATIVE IMPACT - HERITAGE	
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	-17 (Negative low impact)	-16 (Low negative)
Mitigation measures	▪ A walk down of the final approved layout will be required before construction commence. ▪ 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 management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations.	

It is the opinion of the heritage specialist 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.

6.4.9 Socio-Economic

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 at the proposal stage as this one, need to be taken into consideration as they have a potential to create numerous positive or negative cumulative socio-economic impacts. **Table 96** lists all the various projects that will need to be considered when examining the cumulative impacts and their location relative to the project under analysis as depicted in **Figure 41**.

The Khobab and Loeriesfontein projects have both been approved and have reached financial closure. As a result of this, these two wind farms have been under construction since the beginning of 2015. Under the Renewable Energy Independent Power Producer Procurement Programme (REIPPP), only one of the other projects listed in **Table 96** has been approved whilst the rest are yet to be approved. This means that, at this stage the possible timelines of their development are uncertain.

Considering the uncertainty associated with the future project roll-out, 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 all projects which are yet to be approved will be all built at the same time. This option is considered to be the least preferred option and therefore represents the worst case scenario.

- **<u>Construction Phase Cumulative Impacts</u>**

The region, which the Xha! Boom Wind Farm is proposed to be built, is one of the examples as there are already two RE projects (i.e. Khobab and Loeriesfontein 2 Wind Farms) under construction. Several other RE projects in the area have also been proposed for the development and considering the government's continued interest in renewables as outlined in the IRP, they are likely to be implemented sometimes in the future. The development of the projects in the area, though will result in numerous cumulative effects, which will have both positive and negative outcomes.

- With respect to the positive effects, the combination of the effects of the projects already under construction as well as the ones still to be potentially approved is expected to result in increased production, temporary creation of employment both for the local labour and workers coming outside the local community, skills development, and creation of local business opportunities. Considering the small size of the local economy, the significance of these cumulative impacts in the context of the local municipality could be prominent and result in the growth and diversification of the local economy, reduced unemployment rates, and greater local government earnings.
- Construction of a number of projects in a relatively remote and rural area, which has a small economic base and limited labour, could though lead to undesired but sometimes unavoidable

socio-economic impacts. Projects of such nature would attract job seekers and bring workers from outside the local community, which could lead to various social pathologies. This could offset some of the positive impacts that would be derived from the same projects during construction and would need to be carefully managed to ensure that they are minimised and possibly eliminated altogether.

- **Operational Phase Cumulative Impacts**

Considering the existing wind farms as well as other similar projects still to be approved, cumulative socio-economic impacts arising during the operation phase are expected to be largely positive. This is due to the fact that the supposed simultaneous operational life of all these projects will provide sustainable employment opportunities, improved access to basic services as a result of increased income as well as an improved standard of living. The prescribed investment into socio-economic and enterprise development initiatives by IPPs will also lead to improvement of general standard of living in the area.

6.4.10 Path Loss and Risk Assessment

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').

6.4.10.1 Area of Interest

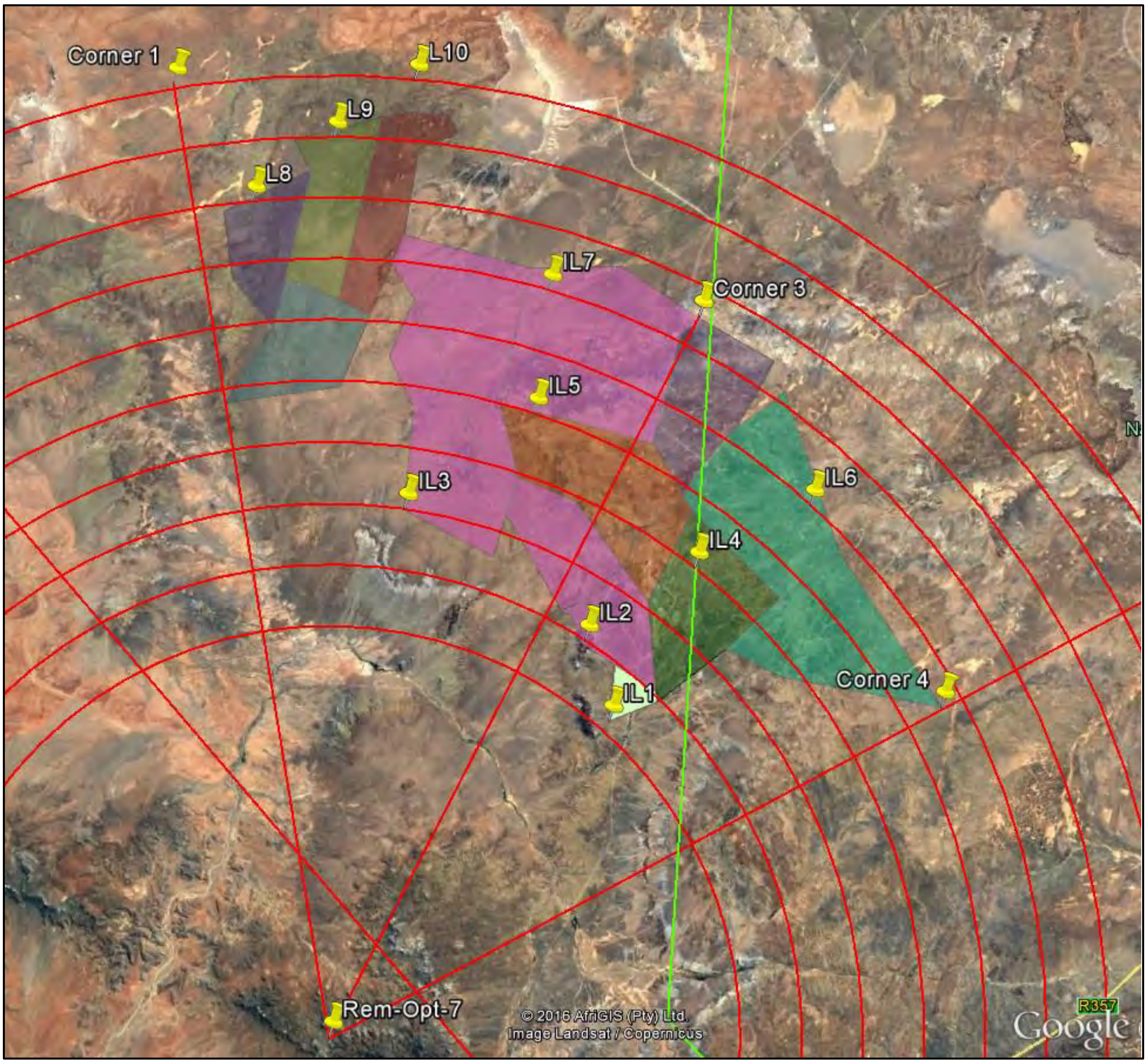


Figure 43: Wind farm areas considered for REM OPT 7 evaluation

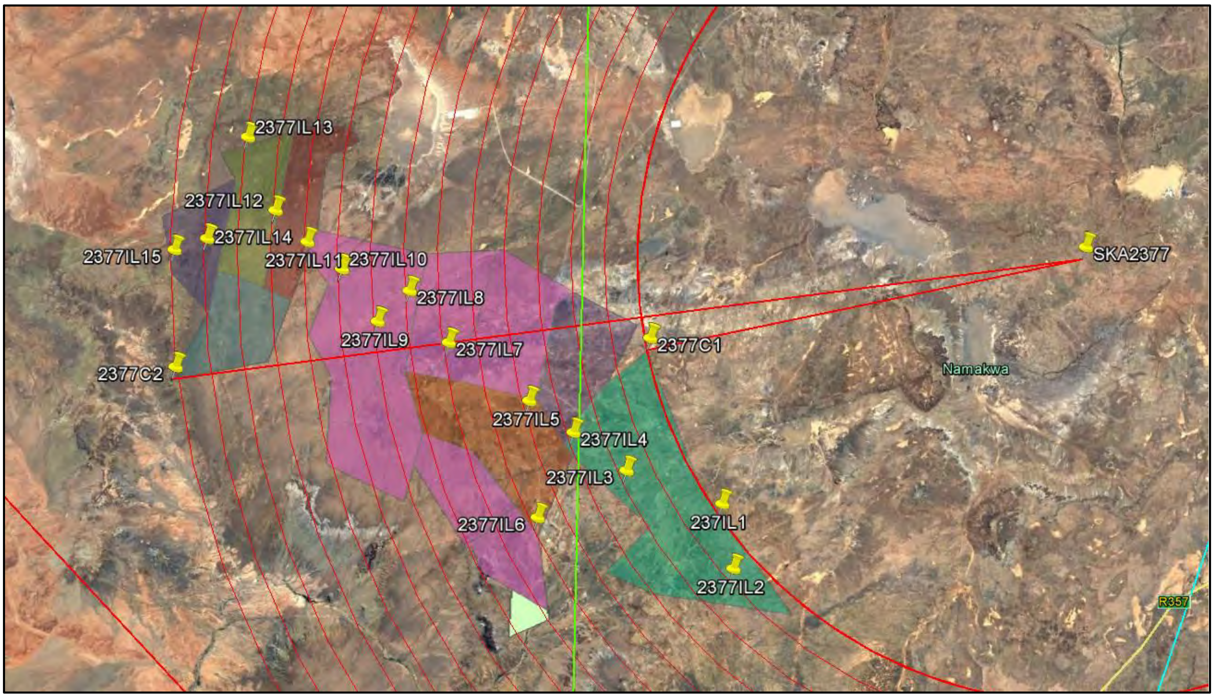


Figure 44: Wind farm areas considered for SKA ID 2377 evaluation

Table 102: Wind farm 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	235MW	70
Hartebeest Leegte	EIA ongoing	235MW	70
Ithemba Wind Farm	EIA ongoing	235MW	70
Xha! Boom Wind Farm	EIA ongoing	235MW	70

6.4.10.2 Calculation Information

A total of 500 mitigated Acciona model AW 125/3000 turbines with a 160m[6] 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.

[6] 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

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.

6.4.10.3 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 as described in ITC Services CP 1609/16: EMISSION CONTROL PLAN THE AW125 TH100A WTG. 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).

6.4.10.4 NTIA TM-89-139

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.

6.4.10.5 ITU-R P.372-13: Radio 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

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 to confirming this will be included in the Final Scoping Report (FSR).

increase for the City environment compared with the residential environment is shown in **Figure 45** below. The City median noise figure compared with the residential noise figure as measured in Japan (2009-2011) is also included. Added to **Figure 45** is the Hag *et al* model that is in line with the measured values presented.

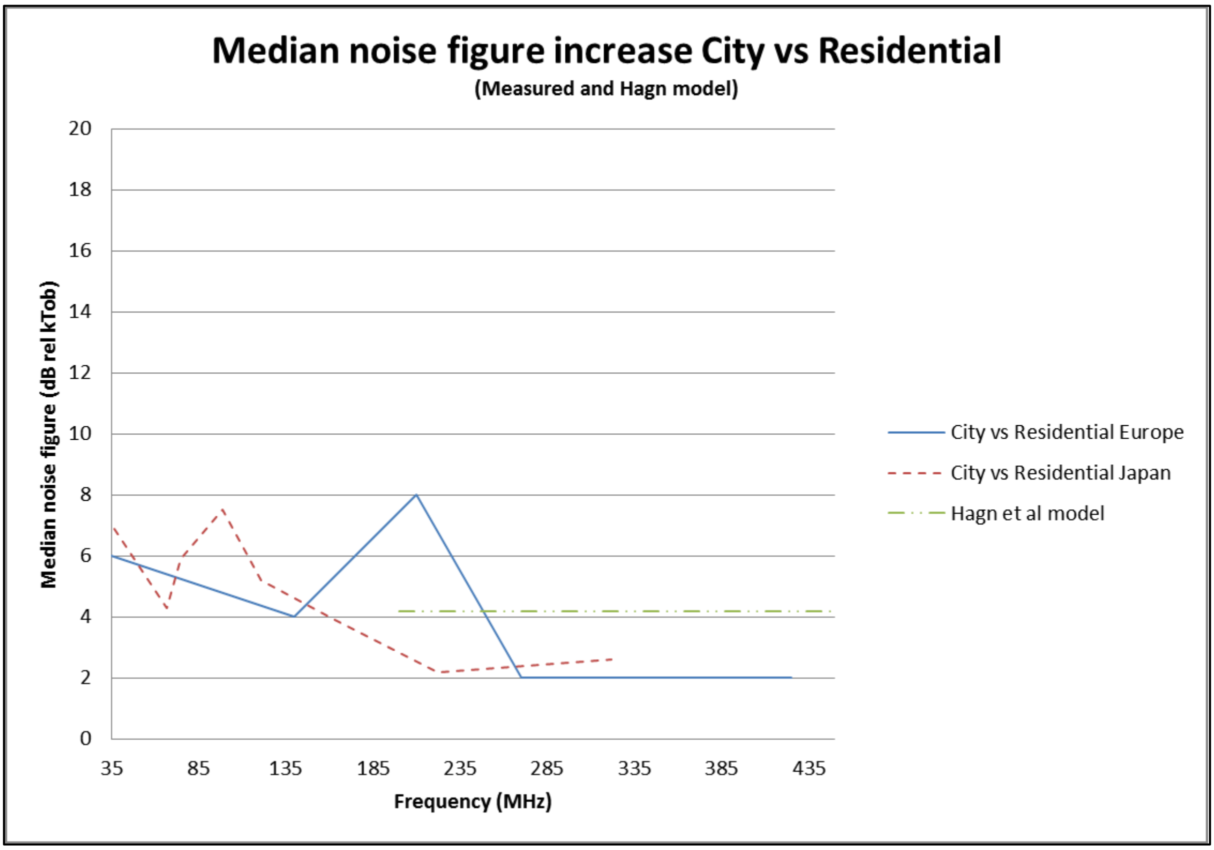


Figure 45: Man-made noise measured results (ITU-R P.372-13 Table 3 and Table 4, Hagn eq 8 and 9)

6.4.10.6 Measured Urban, Suburban, Airport and Rural Ambient Emissions

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.

6.4.10.7 Mobile Communication Radio Base Stations

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. 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.

6.4.10.8 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 border line figure when considering all the adjacent projects resulting in a relatively high emitter density.

7 LAYOUT ALTERNATIVES

One of the aims of the Scoping Report is to identify alternatives to carry through to the EIA phase of the investigation for detailed assessment (as was discussed in **Chapter 2**). The selection of alternatives during the Scoping Phase of the project usually helps to focus future investigations, both in terms of the environmental investigations required and the scope of the public participation process. 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 (**Chapter 7**). These layouts will be extensively investigated in the EIA phase of the project (see the plan of study for the EIA phase in **Chapter 11** of the DSR). At this stage, the design and layout alternatives include; alternative locations for the proposed 132kV on-site substation.

It should be noted that the layout alternatives for the EIA phase will be based on both environmental constraints and design factors. The findings of the specialist studies and sensitivity mapping will be used to inform the layout of the proposed facility within the preferred site during the EIA phase. The layout will be assessed by the specialists in their respective specialist studies which will be included in the EIA Report.

As part of the EIA, the buildable area of the proposed Wind Farm is 1897.20 hectares and will be assessed by the specialists and considered during the EIA phase. Based on the sensitivity mapping within the buildable area, the preferred location and layout for the wind farm and associated infrastructure will aim to avoid the sensitive features identified by the specialists. The area that excludes these sensitive features will be considered to be the Development Envelope for this project and no development may occur outside this envelope. Based on the boundaries of the Development Envelope, a site layout will be determined for this project (i.e. the placement of the wind turbines within the Development Envelope).

It is important to note that 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 Development Envelope 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 will assess the larger area (i.e. the buildable area) and identify sensitivities, which will be avoided in the siting of the proposed infrastructure within the Development

Envelope. The Development Envelope is considered to be a “box” in which the project components can be constructed at whichever location without requiring an additional assessment or change in impact significance. Any changes to the layout within the boundaries of the Development Envelope following the issuing of the EA (should it be granted) will therefore be considered to be non-substantive.

As mentioned above, various specialists identified preliminary site specific sensitive areas during the Scoping Phase of the EIA that may need to be precluded from the buildable area. These include the biodiversity, avifaunal, bats, visual, heritage, surface water and noise specialists. The sensitive areas identified by these specialists were used to guide the design of the wind farm where practical. The identified sensitive areas were also used to assess the impacts of each of the proposed alternatives on the environment. The sensitive areas as identified by various specialists via desktop and field verification means are shown in **Figure 46** below.

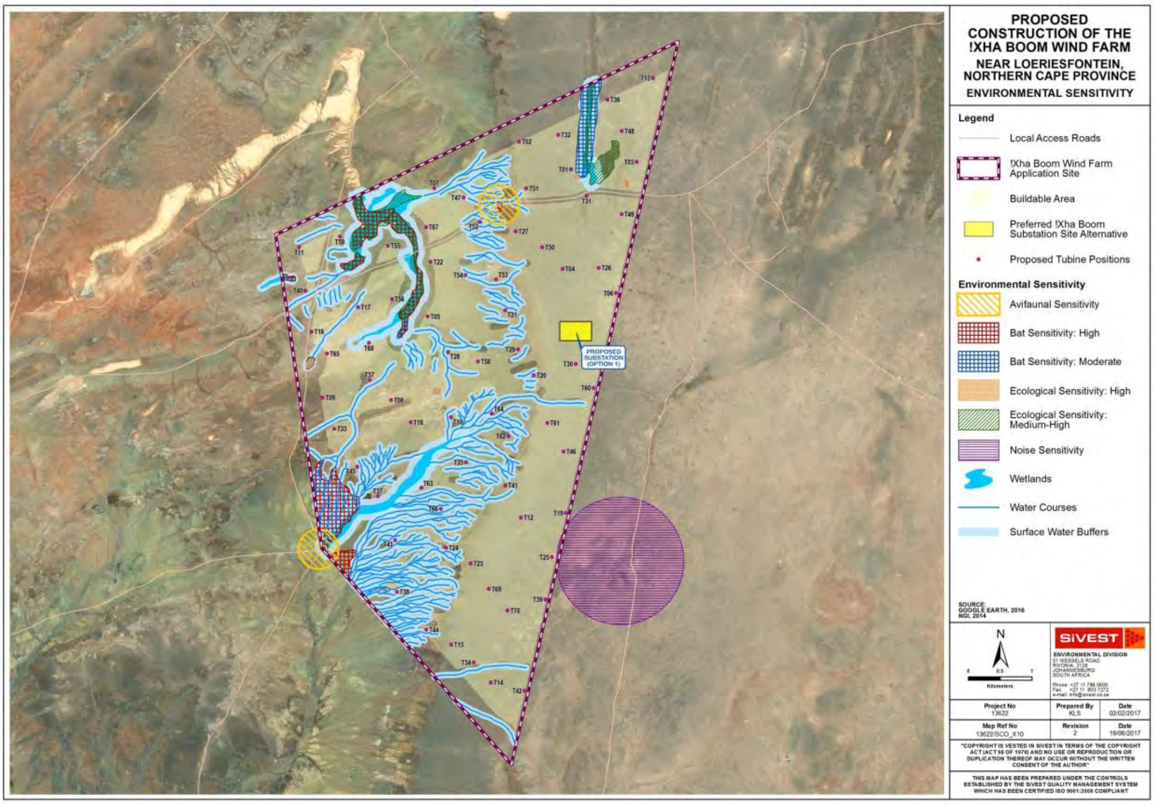


Figure 46: Sensitive areas as pertaining to biodiversity, avifaunal, bats, visual, heritage, surface water and noise

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 103: Alternatives Assessment summarising the impacts, highlighting issues/concerns and indicating the preference associated with each alternative

132kV ON-SITE XHA! BOOM SUBSTATION				
Specialist	132kV on-site Xha! Boom Substation Option 1		132kV on-site Xha! Boom Substation Option 2	
	PREFERENCE	**CONCERNS / IMPACT SUMMARY**	**PREFERENCE**	**CONCERNS / IMPACT SUMMARY**
Biodiversity	Preferred	The site is located on the typical open plains of the site, dominated by Stipagrostis. There are no sensitive features within the footprint area. No significant issues associated with the site. This is clearly the preferred option for the substation.	Not Preferred	The site is located in a transional area between the arid grasslands in the east and the Klipveld in the west. There are numerous small drainage features or washes in the site and it is not considered favourable.
Avifauna	No Preference	The habitat at the proposed turbine site is highly homogenous. The impact that the substation will have on the available habitat is therefore likely to be similar, irrespective of where the substation is located.	No Preference	The habitat at the proposed turbine site is highly homogenous. The impact that the substation will have on the available habitat is therefore likely to be similar, irrespective of where the substation is located.
Bats	Preferred	This option is located within a flatter and more homogenous area such that the only foreseen impact is habitat removal.	Not Preferred	Based on satellite imagery, this location is situated nearer to an area that is of potential interest for bat foraging activities.
Surface Water	Preferred	No surface water resources are found within this alternative site. The nearest surface water resource is a major drainage line which is located approximately 600m to the west, and separated by a low ridge acting as a watershed. The potential for indirect impacts is minimal considering the distance and barrier to the drainage line. This option is therefore preferred.	Not Preferred	There are two minor drainage lines that can be found within this substation alternative. There will therefore be direct potential impacts to these surface water resources. Additionally, there are several other minor drainage lines in close proximity (<120m). Indirect potential impacts such as increased run-off, and consequent sedimentation and erosion are therefore, likely. This option is therefore considered not preferred.
Soils and Agricultural Potential	No preference	Impact is low with no significant differences between the locations	No preference	Impact is low with no significant differences between the locations

Noise	No preference	Substations are too far from NSD to pose any noise risk.	No preference	Substations are too far from NSD to pose any noise risk.
Visual	No preference	The visual impacts associated with the proposed substation alternatives will be equal due to the close proximity of the substation locations and the flat nature of the topography.	No preference	The visual impacts associated with the proposed substation alternatives will be equal due to the close proximity of the substation locations and the flat nature of the topography.
Heritage	Preferred	No heritage resources identified in the footprint	Favourable	One (1) low significance heritage resource found in the footprint.
Socio-economic	No preference	No differentiation between this and the other option in terms of the socio-economic impacts identified will result in equal impacts.	No preference	No differentiation between this and the other option in terms of the socio-economic impacts identified will result in equal impacts.

Table 104: Summary of specialist Alternatives Assessment indicating the preference associated with each alternative

Specialist Assessment	132kV ON-SITE XHA! BOOM SUBSTATION OPTION 1	132kV ON-SITE XHA! BOOM SUBSTATION OPTION 2
Biodiversity	Preferred	Not Preferred
Avifuana	No Preference	No Preference
Bats	Preferred	Not Preferred
Surface Water	Preferred	Not Preferred
Soils and agricultural potential	No Preference	No Preference
Noise	No Preference	No Preference
Visual	No Preference	No Preference
Heritage	Preferred	Favourable
Socio-Economic	No Preference	No Preference

Based on the specialist scoping assessments and assessment of the proposed 132kV On-Site Xha! Boom Substation alternatives, **Substation Option 1** has been identified as the preferred alternative from biodiversity, bats, surface water and heritage perspectives respectively. As based on the biodiversity specialist studies **Substation Option 1** is located on the typical open plains of the site, dominated by *Stipagrostis*. There are no sensitive features within the footprint area and no significant issues associated with the site. From a surface water perspective, no surface water resources are found within **Substation Option 1**. The nearest surface water resource is a major drainage line which is located approximately 600m to the west, and separated by a low ridge acting as a watershed. The potential for indirect impacts is minimal considering the distance and barrier to the drainage line. With regards to bats, **Substation Option 1** is located within a flatter and more homogenous area such that the only foreseen impact is habitat removal. In addition, from a heritage perspective, no heritage resources were identified in **Substation Option 1**.

However, from a biodiversity perspective, the proposed 132kv On-Site Xha! Boom **Substation Option 2** is not preferred due to the location of the proposed substation in a transional area between the arid grasslands in the east and the Klipveld in the west. There are numerous small drainage features or washes in the site and it is not considered favourable. Additionally, from a surface water perspective the proposed 132kV On-Site Xha! Boom **Substation Option 2** is not preferred due to the presence of two (2) minor drainage lines that can be found within this substation alternative. There will therefore be direct potential impacts to these surface water resources. Additionally, there are several other minor drainage lines in close proximity (<120m). Indirect potential impacts such as increased run-off, and consequent sedimentation and erosion are therefore, likely. It should also be noted that from a heritage perspective, a site occurs at **Substation Option 2**. This site is however is of a low significance. In addition, with regards to bats, **Substation Option 2** is not preferred as based on satellite imagery, this location is situated nearer to an area that is of potential interest for bat foraging activities. Based on the above findings from the various specialist scoping reports it is recommended that only **Substation Option 1** be taken through to the EIA phase.

8 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 Scoping Report (DSR): 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 & Response Report.

8.1 Objectives of 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).

8.2 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. The DSR will be released for public review and comment on the 21st of June 2017. The stages that typically form part of the public participation process during the Scoping Phase are reflected in **Figure 47** below.

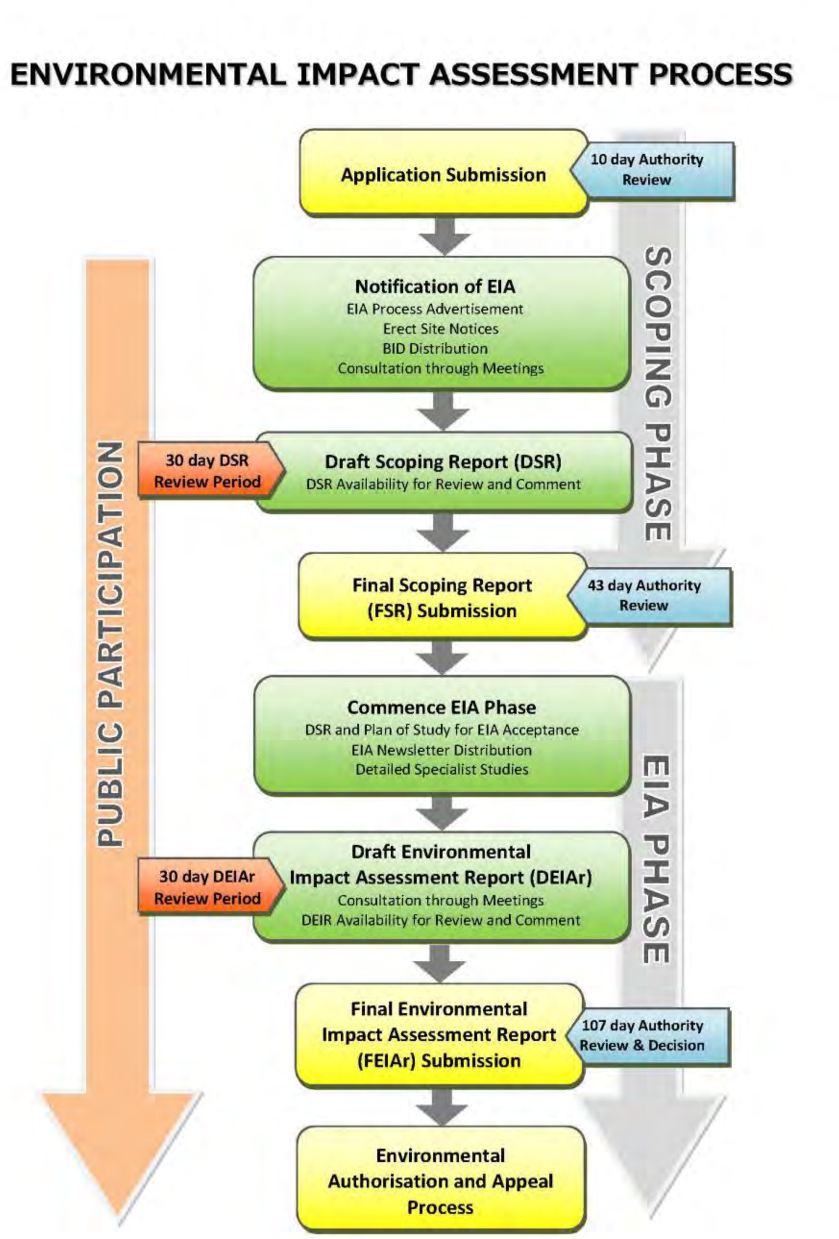


Figure 47: EIA and Public Participation Process

Members of the public who wished to be registered on the database as an I&AP were able to do so via telephone, fax, email, mail or SiVEST's website (www.sivest.co.za).

On-going consultation with key stakeholders (e.g. provincial, district and local authorities, relevant government departments, local business etc.) and identified I&APs ensured that I&APs were kept informed regarding the EIA process. Networking with I&APs will effectively continue throughout the Scoping Phase of the project until the Final Scoping Report 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).

8.3 Consultation and Public Involvement

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

8.4 Stakeholders and I&APs

In order to identify possible I&APs, use will be made of:

- print media – EIA process advertisements
    - The Noordwester (English and Afrikaans)
- site notices throughout the study area (Proofs included in **Appendix 7A**)
- referrals
- requesting databases and/or contact information from NGOs / CBOs and other organisations

A full database list of registered I&APs was compiled and is included in **Appendix 7F**.

8.5 Announcing the Opportunity to Participate

The opportunity for stakeholders to participate in the EIA were as follows:

- EIA process advert (16 June 2017).
- I&APs with e-mail addresses and fax numbers were sent copy of the BID (26th of October 2016).
- BIDs were delivered to various locations within the study area (October 2016):

The letter of invitation to participate as well as the Registration and Comment Form accompanied the BID.

8.6 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 will be placed in the Noordwester newspaper in June 2017.

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

8.6.1 Summary of comments received

I&AP	**Date received**	**Summary of comments**
Mr. Adrian Tiplady	18 November 2016	▪ Mentioned that a high level risk assessment has been conducted at the South African SKA

		Project Office to determine the potential impact of the proposed development on the Square Kilometre Array. Listed the main findings of the Risk Assessment: ▪ The location of the wind facilities was provided in the form of a Google Earth shapefiles. ▪ The nearest SKA stations has been identified as Rem-Opt-7, it is located approximately 50 km from the proposed location of wind facilities; ▪ Based on distance to the nearest SKA station, and the information currently available on the detailed design of the wind farms, a single facility electricity generation facility would pose a low to medium risk of detrimental impact on the SKA. However, multiple facilities, as is the case for this application, as well as taking into account the number of facilities already located, or to be constructed, in the area would result in an increase in the risk (to at least a medium to high risk) of detrimental impact on the SKA as a result of the integrated impact; ▪ Any transmitters that are to be established, or have been established, at the site for the purposes of voice and data communication will be required to comply with the relevant AGA regulations concerning the restriction of use of the radio frequency spectrum that applies in the area concerned; ▪ 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 impact to an acceptable level. The South African SKA Project Office would like to be kept informed of progress with this project, and reserves the right to further risk assessments at a later stage. ▪ Mentioned that the above technical advice is provided by the South African SKA Project Office on the basis of the protection requirements of the SKA in South Africa, and does not constitute legal approval of the renewable energy projects in terms of the

		Astronomy Geographic Advantage Act, the Management Authority, and its regulations or declarations.
Ms. Stephanie Knot	17 November 2016	Requested to be registered as an I&AP for the proposed development.

A detailed Comments and Response Report is included in the **Appendix 7E**.

8.7 Proof of Notification

Appendix 7 includes all proof of notification of Interested and Affected Parties. More specifically, the types of proofs are as follows:

- Site notice text (**Appendix 7A**);
- Photographs of site notices (**Appendix 7A);**
- Proof of advertisements in the newspapers (**Appendix 7C**);
- Background Information Document (**Appendix 7B**); and
- Correspondence to registered I&APs and key stakeholders (**Appendix 7D**).

8.8 Focus Group Meetings

Focus Group Meetings (FGMs) will be held with affected and surrounding landowners and with local municipality officials and councillors. FGMs are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project. This process is ongoing and will continue throughout the EIA phase.

Following all meetings, minutes will be compiled and forwarded to all attendees for their review and comment. The primary aim of these meetings is 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; and
- receive input regarding the public participation process and the proposed development.

8.9 One-on-One Consultation

Where possible, potentially directly affected landowners will be consulted on a one-on-one basis and informed about the proposed project. Any comments and/or concerns received will be noted and included in the Comments and Responses Report.

This consultation process is seen as one of the important aspects of the EIA and Public Participation process. Should the proposed project be granted an Environmental Authorisation, these particular stakeholders will be directly affected and their properties impacted upon. The consultation process will also ensure that as many uncertainties and concerns as possible are raised upfront and channelled to Mainstream to ensure that the stakeholders and the applicant are informed about these issues throughout the process.

8.10 Comments and Response Report

Issues, comments and concerns raised during the public participation process will be captured in the Comments and Response Report (C&RR) which is included in **Appendix 7E** of the DSR. This C&RR will provide 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 social impacts.

8.11 Comments on Draft Scoping Report

The Draft Scoping Report (DSR) will be made available for public review after submission to DEA, the competent authority.

The report will be out for public review and comment for a period of thirty (30) calendar days. Written notice will be given to all registered I&APs as well as all key stakeholders on the database that the DSR will be available for public review.

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

8.12 Authority Review of the Draft Scoping Report

In terms of section 40 (2) of the EIA Regulations (as amended), under Government Notices No R982, public participation must include consultation with all organs of state which have jurisdiction in respect of the activity to which the application relates.

Table 105 below includes all the organs of state who will be e-mailed the DSR and sent electronic copies (on CD) of the full report including all appendices. Telephonic follow-up with stakeholders will be done in order to provide them with ample opportunity to comment during the DSR comment period.

Table 105: Authorities follow-up consultation

DISTRIBUTION OF THE DRAFT SCOPING REPORT (DSR) TO ORGANS OF STATE FOR COMMENT					
TITLE	**SURNAME**	**NAME**	**POSITION**	**POSTAL ADDRESS**	**EMAIL ADDRESS**
HANTAM LOCAL MUNICIPALITY					
Mr.	du Plessis	Charl	Environmental Officer	Private Bag X14 CALVINIA 8190	municipalmanager@hantam.gov.za
KHAI-MA LOCAL MUNICIPALITY					
Mr.	Isaacs	Obakeng	Municipal Manager	PO Box 108 Pofadder 8890	munman@khaima.gov.za
Mr.	Josop	P	Land Use Officer	PO Box 108 Pofadder 8890	commonage@khaima.gov.za
NAMAKWA DISTRICT MUNICIPALITY					
Mr.	Loubser	Jannie	Manager: Planning	Private Bag X20 SPRINGBOK 8240	janniel@namakwa-dm.gov.za
Mr.	Madyo	Sindisile	LED Manager	Private Bag X1012 DE AAR	excellentsolutions@live.co.za
DEPARTMENT OF ENVIRONMENTAL AFFAIRS BIODIVERSITY					
Mr.	Lekota	Seoka		Private Bag X447 Pretoria 0001	slekota@environment.gov.za
Mr.	Rabothata	Mmatlala		Private Bag X447 Pretoria 0001	slekotamrabothata@environment.gov.za
AGRI SA-NORTHERN CAPE					
Mr.	Myburg	Henning	General Manager	PO Box 1094KIMBERLEY 8300	henning@agrink.co.za
DEPARTMENT OF WATER AND SANITATION					

Ms.	Makungo	Ester	Environmental Officer	Private Bag X6101 KIMBERLEY	makungoe@dws.gov.za
Mr.	Mahunonyane	Moses	Director: Institutional Establishment	Private Bag X6101 KIMBERLEY 8300	MahunonyaneM@dws.gov.za
NORTHERN CAPE DEPARTMENT OF AGRICULTURE, LAND REFORM & RURAL DEVELOPMENT					
Mr.	Steenkamp	Gert		P.O. Box 65 CALVINIA 8190	gsteenkamp@ncpg.gov.za
DEAPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES					
Northern Cape Department					
Ms.	Mans	Jacoline	Chief Forester	Koelenhof 306 Schroder Street UPINGTON, 8800	jacolinema@daff.gov.za
Provincial Department					
Mr.	Avenant	Paul	Land-use & Soil Management (Agriculture)	Private Bag X120 PRETORIA 0001	paula@daff.gov.co.za
DEPARTMENT OF MINERAL RESOURCES (DMR)					
Mr.	Ravhogoni	Ntsundeni	Regional Manager	Private Bag x6093 KIMBERLEY 8300	Ntsundeni.Ravhogoni@dmr.gov.za
NORTHERN CAPE DEPT OF ENVIRONMENT AND NATURE CONSERVATION					
Mr.	Fisher	Brian	Director Environmental Impact Management	Private Bag X86102 KIMBERLEY 8300	bfisher@ncpg.gov.za
Mr.	Mthombeni	Thulani		Private Bag X86102 KIMBERLEY 8300	tmtho@webmail.co.za
NORTHERN CAPE DEPT OF SPORT, ARTS & CULTURE: Heritage Resources Unit					
Mr.	Lenyibi	Patrick	Manager: Heritage Resources	Private Bag X5004 KIMBERLEY 8300	plenyibi@ncpg.gov.za
SANRAL - WESTERN REGION					

Ms.	De Kock	Rene	Renewable Projects	Private Bag X19 BELLVILLE 7535	Dekockr@nra.co.za
Ms.	Abrahams	Nicole	Environmental Coordinator	Private Bag X19 BELLVILLE 7535	abrahamsn@nra.co.za
NORTHERN CAPE DEPARTMENT OF ROADS AND PUBLIC WORKS					
Mr.	Roelofse	Jaco	Director: Planning & Design	PO Box 3132 Kimberley 8300	roelofse.j@vodamail.co.za
SAHRA: HEAD OFFICE					
Ms.	Higgitt	Natasha	Heritage Officer: Northern Cape	PO Box 4637 CAPE TOWN 8000	nhiggitt@sahra.org.za
ESKOM					
Mr.	Geeringh	John	Chief Planner	PO Box 1091 JOHANNESBURG 2000	GeerinJH@eskom.co.za
SQUARE KILOMETRE ARRAY					
Dr.	Tiplady	Adriaan	Manager: Site Categorisation	PO Box 522 SAXONWOLD 2132	atiplady@ska.ac.za
SA CIVIL AVIATION AUTHORITY (SA CAA)					
Ms.	Stroh	Lizell	Obstacle Specialist	Private Bag X73 HALFWAY HOUSE 1685	strohl@caa.co.za
AIR TRAFFIC AND NAVIGATION SERVICES (ATNS)					
Ms.	Morobane	Johanna	Manager: Corporate Sustainability and Environment	Private Bag X15 KEMPTON PARK 1620	JohannaM@atns.co.za
Ms.	Masilela	Simphiwe	Obstacle Evaluator	Private Bag X15 KEMPTON PARK 1620	SimphiweM@atns.co.za
SENTECH					

Mr.	Koegelenberg	Johan	Renewable Projects	Private Bag X06 Honeydew 2040	koegelenbergj@sentech.co.za
TELKOM					
Mr.	Bester	Amanda	Wayleave Officer	Private Bag X20700 BLOEMFONTEIN 9300	WayleaCR@telkom.co.za BesterAD@telkom.co.za
Ms.	van den Heever	Heleen	Ops Manager Central Region	Private Bag X20700 BLOEMFONTEIN 9300	vdheevhd@telkom.co.za
ENDANGERED WILDLIFE TRUST					
Mr.	Leeuwner	Lourens	Renewable Energy Project Manager	Private Bag X11, Modderfontein, 1609, Johannesburg	lourensl@ewt.org.za
WESSA					
Mr.	Griffiths	Morgan	Environmental Governance Programme Manager	PO Box 12444, Centrahil, Port Elizabeth, 6006, South Africa	morgan.griffiths@wessa.co.za
BIRDLIFE SOUTH AFRICA					
Mr.	Gear	Simon	Policy and Advocacy Manager	PO Box 515 RANDBURG 2125	advocacy@birdlife.org.za
Ms.	Ralston	Samantha	Manager: Renewable Energy	P O Box 515 RANDBURG 2125	energy@birdlife.org.za

9 ASSESSMENT IN TERMS OF EQUATOR PRINCIPLES

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.

9.1 Assessment Results

This section details the current compliance level with which the wind farm projects meets with the Equator Principles and the related Performance Standards which are outlined below.

Table 106: Wind farm Compliance Level in terms of Equator Principles and Related Performance Standards.

The coding key is as follows:

Compliance Level			
Clear	(red)	(yellow)	(green)
Not assessed/ determined	Not compliant	Partially compliant	Compliant

Principles	**Compliance Level**	**Reference**
General, Performance Standard 1 Environmental & Social Reporting		
1. Baseline Information	(green)	Refer to **Chapter 2** – Technical Details and **Chapter 5** – Description of the receiving environment
2. Alternatives (Assessment of alternatives)	(green)	Refer to **Chapter 7**
3. Impacts and risks	(green)	Refer to **Chapter 6**

Principles	Compliance Level	Reference
4. Global impacts		N/A
5. Legal requirements		Refer to **Chapter 3** for legal requirements and guidelines
6. Transboundary		N/A
7. Disadvantaged / vulnerable groups		Partly addressed in **5.15** as part of the Socio-economic scoping assessment. This will be addressed as part of the EMPr during the EIA phase
8. Third party		Refer to **section 1.1.**
9. Mitigation measures		Partly addressed in **section 6.3** as part of scoping assessments. These will be addressed as part of the EMPr during the EIA phase
10. Documentation process		Refer to **Chapter 1**, **Chapter 3 Sections 3.1.1** and **3.1.2** and **Chapter 7**
11. Action Plans		Partially, addresses in **Chapter 11**, To be addressed during in the FSR with the EIA Plan of study and then will be addressed further in the EIA phase
12. Organisational capacity		To be addressed as part of the EMPr during the EIA phase
13. Training		To be addressed as part of the EMPr during the EIA phase
14. Grievance mechanism		To be addressed during the EIA phase
15. Report content		To be addressed as part of the EMPr during the EIA phase
Performance Standard 2, Labour & Working Conditions		
1. Human Resource Policy		To be addressed as part of the EMPr during the EIA phase
2. Working relationship		To be addressed as part of the EMPr during the EIA phase
3. Working conditions with and terms of employment		To be addressed as part of the EMPr during the EIA phase
4. Workers organisation		To be addressed as part of the EMPr during the EIA phase
5. Non-discrimination and equal opportunities		Partly addressed in **5.15** as part of the Socio-economic scoping assessment. This issue will

Principles	Compliance Level	Reference
		also be addressed as part of the EMPr during the EIA phase
6. Grievance mechanism		To be addressed as part of the EMPr during the EIA phase
7. Occupational Health and Safety		To be addressed as part of the EMPr during the EIA phase
8. Non-employee workers		To be addressed as part of the EMPr during the EIA phase
9. Supply Chain		To be addressed as part of the EMPr during the EIA phase
10. Labour Assessment Component of a Social and Environmental Assessment		To be addressed as part of the EMPr during the EIA phase
Performance Standard 3, Pollution		
1. Pollution Prevention, Resource Conservation and Energy Efficiency		To be addressed as part of the EMPr during the EIA phase
2. Wastes		To be addressed as part of the EMPr during the EIA phase
3. Hazardous material		To be addressed as part of the EMPr during the EIA phase
4. Dangerous substances		To be addressed as part of the EMPr during the EIA phase
5. Emergence preparedness and response		To be addressed as part of the EMPr during the EIA phase
6. Technical guidance – ambient considerations		To be addressed as part of the EMPr during the EIA phase
7. Greenhouse gas emissions		N/A
Performance Standard 4, Health & Safety		
1. Hazardous materials safety		To be addressed as part of the EMPr during the EIA phase
2. Environmental and natural resource issues		Refer to **Chapter 6**
3. Emergency preparedness and response		To be addressed in the EMPr during the EIA phase
Performance Standard 5, Land Acquisition		Refer to **Chapter 4** Project needs and desirability is discussed.

Principles	Compliance Level	Reference
Performance Standard 6, Biodiversity		Refer to **Chapter 5**, **section 5.7** and **Chapter 6**, **section 6.2.1** which summarises the Biodiversity Scoping Assessment
Performance Standard 7, Indigenous People		Refer to **Chapter 8** describing public participation.
Performance Standard 8, Cultural Heritage		Refer to **Chapter 5**, **section 5.12** and **Chapter 6**, **section 6.2.6**

It is important to note that, most of the issues listed per performance standard in the table above will only be addressed during the EIA phase. Therefore at this stage (scoping phase), most of the issues are categorised as "not assessed/ to be determined". Full compliance with the EPs will only be realised following EIA assessments.

10 CONCLUSIONS AND RECOMMENDATIONS

The above report provides a broad introduction to the issues that are pertinent to the proposed Xha! Boom Wind Farm, and highlights important issues to be investigated during the EIA Phase of the project. The EIA Phase will draw on the above information and make use of the recommended specialist studies to reach an objective decision on the overall impact of the proposed development.

The EIA Phase will culminate in the compilation of detailed mitigation measures to reduce impacts, the identification of least impactful locations for the wind turbines, the identification of least impactful locations for associated infrastructure and the identification of sensitive areas within the site which may require more specific management measures. The EIA Phase will also aim to optimise and improve potential positive impacts that may result from the proposed development.

10.1 Conclusions

None of the specialist studies conducted during the Scoping Phase for the proposed development has identified any fatal flaws for the proposed Xha! Boom Wind Farm. However, a few of potentially significant (positive and negative) environmental impacts have been identified and will need to be evaluated and assessed further during the detailed EIA phase of the project. In addition, the EIA Phase will provide a more detailed comparative analysis of these potential impacts against the "no-go" alternative.

Detailed mitigation and management measures will be developed during the Environmental Management Programme (EMPr) phase of the project, in response to the detailed assessment, and will be run towards the end of EIA phase of the project. Should this project receive a positive environmental authorisation, the EMPr will guide the project proponent and appointed contractor(s) through the final design, construction and operational phases of the proposed project.

10.1.1 Summary of Findings

A summary of the findings for each identified environmental impact evaluated in the context of the proposed development (both biophysical and social) is provided in the table below.

Table 107: Summary of environmental issues identified in Specialist Studies.

Aspect	Potential impacts
Biodiversity	▪ Impacts on vegetation and protected plant species ▪ Direct Faunal Impacts during construction and operation ▪ Increased Soil Erosion Risk ▪ Alien Plant Invasion ▪ Impacts on broad-scale ecological processes ▪ Cumulative habitat loss

Aspect	Potential impacts
Avifauna	▪ Impacts associated with displacement of priority avifauna due to disturbance during construction phase ▪ Impacts associated with the displacement of priority species due to habitat destruction during construction phase ▪ Impacts associated with the Avifauna displacement of priority species due to disturbance during operational phase ▪ Impacts associated with collisions of priority species with the turbines in the operational phase ▪ Impacts associated with mortality of priority species due to electrocution on the internal MV lines in the operational phase
Bats	▪ Impacts on destruction of bats roots due to earthworks and blasting ▪ Impacts on loss of foraging habitat during the construction phase ▪ Impacts of bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration) ▪ Impacts of artificial lighting ▪ Impacts of loss of foraging habitat during the decommissioning phase
Surface Water	▪ Impacts associated with the Construction Lay-down Area directly in or in close proximity to Surface Water Resources ▪ Construction Vehicle and Machinery Degradation Impacts to Surface Water Resources ▪ Human Degradation of Flora and Fauna associated with Surface Water Resources ▪ Degradation and Removal of Vegetation and Soils associated with Surface Water Resources ▪ Increased Storm Water Run-off, Erosion and Sedimentation Impacts ▪ Vehicle Damage to Surface Water Resources ▪ Storm-water Run-off Impacts to Surface Water Resources
Soils and Agricultural Potential	▪ Loss of agricultural land use ▪ Generation of additional land use income ▪ Erosion due to alteration of the land surface run-off characteristics ▪ farm security risk ▪ Loss of topsoil caused by poor topsoil management construction phase ▪ Degradation of veld ▪ Dust generation ▪ Soil contamination impacts
Noise	▪ Increase in sound levels at the dwellings of receptors during the day as a result of the construction of the access roads and grid infrastructure during the day ▪ Increase in sound levels at the dwellings of receptors during at night due to night-time Construction (and Upgrade) of access roads and other infrastructure ▪ Increase in sound levels at the dwellings of receptors during the day due to construction traffic passing the dwellings

Aspect	Potential impacts
	▪ Increase in sound levels at the dwellings of receptors at night due to construction traffic passing the dwellings ▪ Increase in sound levels at the dwellings of receptors during the day due to daytime construction of other infrastructure (such as the sub-stations and overhead lines) ▪ Increase in sound levels at the dwellings of receptors during at night due to daytime construction of other infrastructure (such as the sub-stations and overhead lines) ▪ Increase in sound levels at the dwellings of receptors during the day due to daytime construction of Wind Turbines ▪ Increase in sound levels at the dwellings of receptors at night due to night-time construction of Wind Turbines ▪ Increase in sound levels at the dwellings of receptors during the day as a result of noise from operating wind turbines ▪ Increase in sound levels at the dwellings of receptors at night as a result of noise from operating wind turbines
Visual	▪ Visual impacts of the proposed Xha! Boom Wind Farm during construction ▪ Visual impacts of the infrastructure associated with the proposed Xha! Boom Wind Farm during construction ▪ Visual impacts of the proposed Xha! Boom Wind Farm during operation ▪ Visual impacts of the infrastructure associated with the proposed Xha! Boom Wind Farm during operation
Heritage	▪ Impact on the Palaeontology Heritage (fossils) of the development footprint ▪ Impact on Stone Age resources ▪ Impact on Unidentified heritage structures / Chance Finds
Socio-economic	▪ Increased production and temporary stimulation of GDP-R ▪ Skills development due to the creation of new employment opportunities ▪ Increased household income and improved standard of living ▪ Investment in the local community and economic development projects as part of a Social Economic Development (SED) and Enterprise Development Plan (ED) ▪ Increase in government revenue due to the capital investment ▪ Change in demographics due to migration of workers from other areas and influx of jobseekers ▪ Increase in social pathologies associated with the influx of migrant labourers and job-seekers to the area ▪ Added pressure on basic services and social and economic infrastructure ▪ Establishment of informal hospitality industry due to increased demand for accommodation ▪ Sustainable increase in GDP of the national and local economies through operation and maintenance activities ▪ Sustainable increase in government revenue stream ▪ Creation of long term employment in local and national economies through operation and maintenance activities

Aspect	Potential impacts
	▪ Skills development due to the creation of new sustainable employment opportunities ▪ Increased household income ▪ Improved standard of living of households directly or indirectly benefiting from created employment opportunities ▪ Improved access to basic services and community services
Traffic	▪ Increase in traffic generation throughout the lifetime of the project ▪ Increase in road maintenance required

Based on the specialist studies, the following conclusions can be reached for each environmental parameter assessed.

Table 108: Conclusions of Specialist Studies.

Biodiversity	The Xha! Boom Wind Farm consists largely of arid grassland or low open shrubland on flat plains and gently sloping hills that are low sensitivity, with few species of conservation concern. Development in these areas would generate low impacts of local significance only. The only sensitive feature present at the site are some minor drainage lines in the south and some rocky outcrops along the transitional area between the grasslands of the east and the arid shrubland of the west. These however occupy a small proportion of the site and these can easily be avoided by the final layout of the development. Cumulative impacts as a result of the development are likely to be relatively low as the footprint of the development is quite low and the intensity of development in the wider area is still low despite the fact that a node of renewable energy is developing around the Helios substation. In addition, there are no specific features of the Xha! Boom development area which would indicate that it is more important than the surrounding area for faunal movement or landscape connectivity. The contribution of the Xha! Boom development to cumulative impact is thus likely to be relatively low and would operate at a local scale only. With the application of relatively simple 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 apparent reasons that it should not proceed to the EIA phase.
Avifauna	Information on the micro habitat level was obtained through a pre-construction monitoring programme which was conducted over four seasons between November 2015 and September 2016. The proposed Mainstream Xha! Boom Wind Farm will have a variety of impacts on avifauna which range from low to high. 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. 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. 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. 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. 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. 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 Wind Farm 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. 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. *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 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. Met Mast monitoring system indicates the highest amount of bat passes, followed by Short Mast 3. 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. Short Mast 1 had no data for the months of April, June, and July 2016 due to system failures. 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. A sensitivity map was drawn up indicating potential roosting and foraging habitat. The Moderate bat sensitivity areas and associated buffer zones must be prioritised during operational monitoring and preferably be avoided during turbine placement, if another feasible option is available. 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. Turbines located within high sensitivity areas and their buffers must be moved out of high sensitivity areas and buffers or removed from the layout. There were no turbines located within moderate sensitivity areas. 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. Mitigations are expected to be implemented once the turbines become operational. The proposed mitigation schedule follows the precautionary approach strongly and therefore the mitigations will be adjusted and refined during a post-construction bat monitoring study.
Surface water	Findings from the database assessment showed that there is only one (1) natural depression wetland. This wetland is not considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). Aside from the wetland, two (2) non-perennial watercourses were identified in the Northern Cape ENPAT (2000) database. No other watercourses were identified from the NFEPA (2011) database. No other surface water resources were identified from the available databases. In terms of the desktop delineation exercise, the following surface water resources were identified: ▪ Two (2) Depression Wetlands; ▪ Three (3) Major Drainage Line (drainage lines with channel width >5m); ▪ Two hundred and thirty, six (236) Drainage Lines (drainage lines with a channel width <5m). Between the database findings and the desktop delineation information, the identified features identified are to be earmarked for groundtruthing in the fieldwork phase. A refinement of the surface water resources will be undertaken in the impact phase pending the fieldwork findings. A provisional buffer zone of 50m has been implemented at this stage for all surface water resources. Pending the results of the in-field groundtruthing and verification exercise, the buffer zone may be increased or decreased depending on the assessment findings.

	A comparative assessment was undertaken to determine the environmentally preferred alternative (from a surface water perspective) for the proposed substation. Based on the comparative assessment, the preferred alternative site for the proposed substation was Substation Option 1. In terms of NEMA (1998) and the EIA Regulations (2014), as no specific layout is available at this time, it is provisionally identified that Activities 12 and 19 of Government Notice 983 Listing Notice 1 are identified that may be triggered 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 and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. The applicability of these environmental activities and water uses can ultimately only be confirmed once a more detailed layout is available. 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. The considerable distance (9km) and separation by two watersheds between the proposed development and the Kokerboom 2 Wind Farm mean that it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm. 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. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.
Soils and Agricultural Potential	The key findings of the Soils and Agricultural Potential scoping study are: ▪ Soils across the site are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms. ▪ The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils. ▪ As a result of these limitations, the site is unsuitable for cultivation and agricultural land use is limited to low intensity grazing. ▪ The land capability is classified as Class 7 - non-arable, low potential grazing land. The site has a very low grazing capacity of 45 hectares per large stock unit.

	▪ There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development. ▪ The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance 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. ▪ Six potential negative impacts of the development on agricultural resources and productivity were identified as: o Loss of agricultural land use caused by direct occupation of land by the energy facilities' footprint. o Soil Erosion caused by alteration of the surface characteristics. o Generation of dust caused by alteration of the surface characteristics. o Loss of topsoil in disturbed areas, causing a decline in soil fertility. o Degradation of surrounding grazing land due to vehicle trampling. o Soil contamination from hydrocarbon spills during construction. ▪ Two potential positive impacts of the development on agricultural resources and productivity were identified as: o 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. o Increased security against stock theft due to the presence of the energy facility. ▪ All impacts were assessed as having low significance. ▪ 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. ▪ Despite any cumulative regional impact that may occur, 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. ▪ There are no conditions resulting from this assessment that need to be included in the environmental authorisation. ▪ There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts.
Noise	The Noise scoping 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 and operating wind turbines. The construction of access roads as well as construction traffic may increase the noise levels sufficiently to result in noise impacts of medium significance. Mitigation measures are available and easy to implement to reduce the potential significance of the noise impact to low.

	The potential noise impact of operational activities is of a low significance, similarly the potential cumulative noise effect when all the surrounding wind turbines are operating is of low significance. There is a high confidence in the finding of this report, and with the implementation of the mitigation measures there exists a low potential for a noise impact. An additional noise impact assessment is not required for the EIA phase, as it will not provide additional information. During the Environmental Impact Assessment (EIA) phase the noise models will be redone based on the revised turbine layout that takes the sensitive areas into account. Based on the layout assessed in the Scoping Phase it was concluded that the project can be authorised (subject to the implementation of the mitigation measures agreeable with the identified receptors) from a noise perspective.
Visual	A scoping-level study has been conducted to identify the potential visual impact and issues related to the development of the Xha! Boom Wind Farm near Loeriesfontein, in the Northern Cape Province. The study area has a largely natural, untransformed visual character although there are several renewable energy developments (solar and wind) proposed within relatively close proximity to the proposed wind farm. These facilities and their associated infrastructure, will significantly alter the visual character and baseline in the study area once constructed and make it appear to have a more industrial-type visual character. The proposed wind farm development is likely to visually influence only one (1) farmstead / homestead identified within the visual assessment zone, therefore this is regarded as a potentially sensitive visual receptor location. The sensitivity of the receptor locations will need to be confirmed through further assessment in the next phase of the study. The nature of the visual impacts associated with a development of this size on the receptors in the study area could be significant. An overall impact rating was also conducted as part of the Scoping Phase in order to allow the visual impact to be assessed alongside other environmental parameters. The assessment revealed that overall the proposed Xha! Boom Wind Farm is expected to have a low visual impact during construction and a medium visual impact during operation, with relatively few mitigation measures available. In addition, the infrastructure associated with the proposed Xha! Boom Wind Farm would have a low visual impact during construction and a low visual impact during operation. Further assessment will however be required in the EIA-phase to investigate the sensitivity of the receptor locations to visual impacts associated with the proposed development and to quantify the impacts that would result.
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.

	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. The design process and methodology followed by the developer for this project will enable the heritage assessment to provide input into the proposed layouts before the impact assessment. This resulted in cognisance being taken of the positions of the heritage resources and thus the reduction of impacts at an early design phase. **Palaeontology** The proposed Xha! Boom Wind Farm development is 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. 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. **Comparative Assessment of Alternatives** A comparative assessment of the preferred substation position has shown that from a heritage perspective both area considered as good options. Substation Option 1 is however preferred as Substation Option 2 will impact on a low significance heritage find. **Cumulative Impact** 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.
Socio-economic	Relevant national, provincial and local government policies reveal that the development of RE technologies is strongly supported both: ▪ At the national level, developing an RE sector is supported with respect to the need to diversify and expand energy supply

	▪ At the provincial and local level, RE sector development support is premised on the prioritisation of regional economic stimulation as well as the creation of employment opportunities for the benefit of local people. The overall consideration of the favourable alignment of local, regional and national policy with the proposed project as well as the complementary nature of wind farms and the current land use of the project site is evidence that no fatal flaws are present from the socio-economic perspective. Considering all the potential socio-economic impacts for both the construction and operational phase, with respect to the substation, there is no differentiation that can be made regarding the potentially ensued socio-economic effects as they will remain the same regardless of the sub-station site alternative chosen.
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. 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.
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 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. 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. 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 legal vehicles as well as abnormal vehicles carrying the wind turbine components.
Radiation Emissions (SKA)	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. 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 Acciona Control Plan. 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 TH100A Acciona turbines are installed. This shown by the 10dB to 20dB higher path loss for Xha! Boom compared to Garob. 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. 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.

10.2 Recommendations

Table 109: Outcomes and Recommendations of Specialist Studies

Aspect	Fatal flaws	Site refinement / Recommendations	Further Investigations
Biodiversity	None	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. No layout has been provided for the current assessment and an important activity for the EIA will be assessing the layout in relation to the sensitive features of the site	Yes
Avifauna	None	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 Wind Farm on priority avifauna, if appropriate mitigation is implemented, will range from minor to insignificant.	Yes
Bats	None	▪ A sensitivity map was drawn up indicating potential roosting and foraging habitat. The Moderate bat sensitivity areas and associated buffer zones must be prioritised during operational monitoring and preferably be avoided during turbine placement, if another feasible option is available. ▪ High Bat Sensitivity areas are 'no – go' areas due to expected elevated rates of bat fatalities due to wind turbines. ▪ Turbines located within high sensitivity areas and their buffers must be moved out of high sensitivity areas and buffers or removed from the layout. ▪ Mitigation schedule should be monitored during the operational phase bat study, and the recommended mitigation measures and	Yes

Aspect	Fatal flaws	Site refinement / Recommendations	Further Investigations
		levels of curtailment be adjusted according to the results of the operational monitoring. ▪ The proposed mitigation schedule follows the precautionary approach strongly and therefore the mitigations will be adjusted and refined during a post-construction bat monitoring study.	
Surface water	None	Specialist recommendations in terms of the proposed development are as follows: • An impact phase assessment with in-field groundtruthing and verification of surface water resources on the Wind Farm site must be undertaken to inform the layouts proposed in the impact phase; • All surface water resources and buffer zones must be avoided as far as practically possible in the layouts to be designed in order to minimise and potentially avoid potential impacts as far as possible; • The following are to be revised (if required) based on in-field findings in the impact phase surface water assessment: o Surface water buffer zones; o Legislative requirements; o Impact assessment (including mitigation measures); and o Cumulative Impact Assessment. • The impact phase surface water assessment must include the following: o Surface water environmental baseline findings obtained from the in-field assessment; and o Alternatives comparative assessment.	Yes
Agricultural potential	None	▪ There are no agriculturally sensitive areas that need to be avoided by the development. There are no conditions resulting from this assessment that need to	Yes.

Aspect	Fatal flaws	Site refinement / Recommendations	Further Investigations
		be included in the environmental authorisation. ▪ Because of the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development. ▪ No additional investigation of agricultural issues is required for the Environmental Impact Assessment of the proposed development, however the turbine layout put forward in the plan of study will need to be reassessed and the cumulative impacts will need to be further investigated.	
Noise	None	▪ The potential noise impact of operational activities is of low significance, similarly the potential cumulative effects when all the surrounding wind turbines are operating. ▪ There is a high confidence in the finding of this report, and with the implementation of the mitigation measures there exist a low potential for a noise impact. An additional noise impact assessment is not required for the EIA phase, as it will not provide additional information, however the turbine layout put forward in the plan of study will need to be reassessed and remodelled. The cumulative impacts will also need to be further investigated.	Yes
Visual	None	Further assessment will be required in the EIA phase to investigate the sensitivity of the receptor locations to visual impacts associated with the proposed development and to quantify the impacts that would result.	Yes
Heritage	None	These findings provide the basis for the recommendation of further field truthing through an archaeological walk covering the site. The aim of this will be to compile a comprehensive database of heritage sites in the study areas, with the aim of developing a heritage management plan for inclusion in the Environmental Management Plan as derived from the EIA. In Palaeontological terms the	Yes

Aspect	Fatal flaws	Site refinement / Recommendations	Further Investigations
		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.	
Socio-economic	None	The previously listed potential impacts will need to be investigated in the EIA phase in greater detail.	Yes
Geotechnical	None	▪ A detailed Traffic Management Plan should be completed once the project details are finalised and before construction can commence. ▪ Material for construction purposes must be sourced from site to reduce costs; ▪ Groundwater from the site can be used for human consumption and construction considered that it will be treated. A water purification plant to be constructed on site in order to treat this water before use. ▪ 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.	No
Traffic	None	▪ 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 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	No

Aspect	Fatal flaws	Site refinement / Recommendations	Further Investigations
		speed cameras or Average Speed Over Distance.	
Path Loss and Risk Assessment (ITC)	None	▪ 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 10dB to 20dB higher path loss for Xha! Boom compared to Garob. ▪ 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.	No – the impact would need to be remodelled at a later stage, once the final turbine has been selected and the layout finalised. This would not be required in the EIA phase but would be required prior to construction.

It is therefore recommended that the following studies be taken through to the EIA Phase:

- Biodiversity (flora and fauna) Assessment (Simon Todd – Simon Todd Consulting)
- Avifauna Assessment (Chris van Rooyen - Chris van Rooyen Consulting)
- Bat Assessment (Werner Marais, Dalene Burger and Monika Moir – Animalia)
- Surface Water Impact Assessment (Shaun Taylor– SiVEST) – including external peer review by Michiel Jonker – Ecotone Freshwater Consultants
- Agricultural Potential Assessment (Johann Lanz)
- Noise Assessment (Morné De Jager – Enviro Acoustic Research (EAR)
- Visual Impact Assessment (Andrea Gibb and Stephan Jacobs – SiVEST) – including external peer review by Keagan Allan – SRK Consulting
- Heritage Assessment (Wouter Fourie – PGS Heritage)
- Socio-economic Impact Assessment (Zimkita Nkata and Elena Broughton – Urban-Econ Development Economists)

The proposed scope of work and methodology to assess each of the above impacts has been detailed in the plan of study to undertake an EIA, as per the EIA Regulations. The Plan of Study is included below.

11 PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Issues identified during the Scoping Phase will be investigated further during the EIA phase of the project. Various specialist studies will be conducted during the EIA phase to assess these issues. Mitigation measures will be formulated and these will be included in the Environmental Management Programme (EMPr).

This information will assist DEA in making an informed decision with regards to the proposed development.

11.1 Aim of the EIA Phase

The aim of the impact assessment phase is to:

- Conduct a detailed impact assessment of the issues identified
- Identify potential mitigation measures to reduce impacts
- Ensure information is disseminated to Interested and / or Affected parties and there is a constant flow of communication

The following tasks will form part of the Environmental Impact Assessment Phase:

- A comprehensive Public Participation Process (as above)
- Conduct specialist studies
- Conduct alternatives assessment on the alternative layouts identified in this DSR
- Compilation of an Environmental Impact Assessment Report (EIAr)
- Compilation of an Environmental Management Programme (EMPr)
- Make Draft EIAr available for public comment
- Submit Final EIAr to DEA
- Await decision

The following specialist studies will form part of the EIAr:

- Biodiversity (flora and fauna) Assessment (Simon Todd – Simon Todd Consulting)
- Avifauna Assessment (Chris van Rooyen - Chris van Rooyen Consulting)
- Bat Assessment (Werner Marais, Dalene Burger and Monika Moir – Animalia)
- Surface Water Impact Assessment (Shaun Taylor– SiVEST) – including external peer review by Michiel Jonker – Ecotone Freshwater Consultants
- Agricultural Potential Assessment (Johann Lanz)
- Noise Assessment (Morné De Jager – Enviro Acoustic Research (EAR)
- Visual Impact Assessment (Andrea Gibb and Stephan Jacobs – SiVEST) – including external peer review by Keagan Allan – SRK Consulting
- Heritage Assessment (Wouter Fourie – PGS Heritage)

- Socio-economic Impact Assessment (Zimkita Nkata and Elena Broughton – Urban-Econ Development Economists)

The terms of reference for these studies involve assessing the potential impacts that have been identified in the Scoping Report in addition to any new issues that are identified during the detailed assessments. The qualifications of these specialists are included in their CV's which are included in **Appendix 2**.

11.2 Decision-Making Authority Consultation

The stages at which the competent authority will be consulted are as follows:

- Submission of the draft Scoping Report (DSR) for comment;
- Submission of the final Scoping Report (FSR) for comment;
- Submission of draft Environmental Impact Assessment Report (DEIAr) for comment;
- Submission of final Environmental Impact Assessment Report (FEIAr) with comments; and
- Response from competent authority regarding acceptance of final Environmental Impact Assessment Report (FEIAr).

Additional consultation may occur with the DEA during the EIA process should the need arise.

11.3 Proposed Method of Assessing Environmental Issues

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.

A brief Terms of Reference for each specialist study is included below:

11.3.1 Biodiversity Assessment

The current study is based on a desktop study as well as a site visit, which reduces the uncertainty associated with the scoping-level assessment. In addition, since a field assessment has been conducted for the current assessment, the characteristics of the affected environment have been well defined and there is little uncertainty as to the sensitivity of the site and the presence of sensitive features has been verified in the field. No layout has been provided for the current assessment and an important activity for the EIA will be assessing the layout in relation to the sensitive features of the site. Additional activities and outputs for the EIA will include the following studies and activities:

- Evaluate the impact of the final layout of the development in relation to the sensitive features and attributes of the site.
- Evaluate, based on the site attributes, what the most applicable mitigation measures to reduce the impact of the development on the site would be and if there are any areas where specific precautions or mitigation measures should be implemented.
- Assess cumulative impacts in the area based on the current as well as the other proposed and existing developments in the area.
- Assess the impacts identified above in light of the site-specific findings and the final layout for assessment to be provided by the developer.

11.3.2 Avifauna Assessment

The EIA phase avifaunal report will contain the results of preconstruction monitoring. The monitoring protocol for the site is designed according to the latest version (2012) of Jenkins A R; Van Rooyen C S; Smallie 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 objective of the pre-construction monitoring at the proposed wind project was to gather baseline data over a period of 12-months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the broader study area and a suitable control area to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the broader study area to measure the potential collision risk with the turbines.

Methods

The monitoring protocol for the site is designed according to the latest version (2014) 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.

Monitoring surveys were conducted at the broader study area and a control area by four field monitors during the following periods:

10 – 23 November 2015
23 February – 03 March 2016
18 May - 30 May 2016
22 August – 1 September 2016

Monitoring was conducted in the following manner:

- Four drive transects were identified on the study area totaling 52.1km and one drive transect in the control site with a total length of 13.7km.
- Two observers travelling slowly (± 10km/h) in a vehicle records all species on both sides of the drive transect. The observers stop at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects are counted three times per sampling session.
- In addition, eleven walk transects of 1km each were identified at the study area, and four at the control site, and counted 8 times per sampling season. All birds are recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1 - 7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
    - Co-ordinates (priority species only).

- Eleven vantage points (VPs) were identified to record the flight altitude and patterns of priority species at the development areas. Two VPs were also identified on the control area. The following variables were recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m);
    - Flight mode (soar; flap; glide; kite; hover); and
    - Flight time (in 15 second-intervals).

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

Four potential focal points of bird activity, two boreholes and two salt pans, one known as Die Soutkomme and the other as Konnes se Pan, were identified in the greater study area and monitored.

11.3.3 Bat Assessment

Bat activity was monitored using active and passive bat monitoring techniques. Active monitoring was done through site visits with transects made throughout the site with a vehicle-mounted bat detector. Passive detection was carried out with the mounting of passive bat monitoring systems placed on six monitoring masts on site. Specifically, five short 10m masts (**Figure 48**) and one meteorological mast. The monitoring systems consisted of SM2BAT+ time expansion bat detectors that were powered by 12V, 18Ah, sealed lead acid batteries and 20W solar panels that provided recharging power to the batteries (**Figure 49**). Each system also had an 8-amp low voltage protection regulator and SM3PWR step down transformer. Four SD memory cards, class 10 speed, with a capacity of 32GB each were utilized within each SM2BAT+ detector; this was to ensure substantial memory space with high quality recordings even under conditions of multiple false wind triggers.

One weatherproof ultrasound microphone was mounted at a height of 10 meters on the short masts, while two microphones were mounted at 10m and 80m on the meteorological mast. These microphones were then connected to the SM2BAT+ bat detectors.

Each detector was set to operate in continuous trigger mode from dusk each evening until dawn (times were correlated with latitude and longitude). Trigger mode is the setting for a bat detector in which any frequency which exceeds 16 kHz and -18dB will trigger the detector to record for the duration of the sound and 500 ms after the sound has ceased, this latter period is known as a trigger window. All signals are recorded in WAC0 lossless compression format. The table below summarizes the above-mentioned equipment setup.

Figure 48: Short mast monitoring system

Figure 49: SM2BAT+ detector and supporting hardware

Table 110: Site Visits Information

Site visit dates		First Visit	30 November – 5 December 2015
		Second Visit	14 – 18 February 2016
		Third Visit	25 April – 4 May 2016
		Fourth Visit	29 August – 3 September 2016
		Fifth Visit	28 November – 02 December 2016
Met mast passive bat detection systems	Quantity on site	1	
	Microphone heights	10m; 80m	
	Coordinates	Met Mast 1: 30°18'49.56"S 19°19'0.01"E	
Short mast passive bat detection systems	Quantity on site	5	
	Microphone height	10m	
	Coordinates	SM1: 30°13'9.21"S 19°23'18.12"E SM2: 30°16'56.03"S 19°15'20.45"E SM3: 30°18'16.16"S 19°21'34.84"E SM4: 30°21'7.55"S 19°16'29.17"E SM5: 30°21'34.44"S 19°18'55.03"E	

Replacements/ Repairs/ Comments	
First Visit	The microphones were mounted such that they pointed approximately 30 degrees downward to avoid excessive water damage. Crows have been found to peck at microphones and subsequently destroying them. Hence, measures were taken for protection against birds, without noticeably compromising effectiveness. The bat detectors were installed within their weatherproof containers and all peripherals attached. Monitoring at 80m height will provide an assessment of the bat activity occurring within rotor-sweep height.
Second Visit	All the systems were functioning correctly apart from Short Mast 2 which had a software malfunction causing the detector to freeze resulting in the low bat activity recorded. A software update was loaded and the system is functional again.
Third Visit	Short Mast 1 bat detector had frozen and a firmware update was applied. Short Mast 2 bat detector had no power and after inspection it was found that the wire connection on the regulator was faulty and was reconnected. Short Mast 3 solar panel had turned slightly towards north east and was turned to north west. All the other systems were functional.
Fourth Visit	Short Mast 1 bat detector was not powered, due to a discharged battery. The battery was charged, and solar panel was re-aligned. Short Mast 2 had collapsed, after which it was erected again and solar panel re-aligned. Firmware update was applied to Short Masts 3 - 5 and the Met Mast. Short Mast 1 and 3 decibel settings were updated to 12db.
Fifth Visit	All the systems were functioning correctly.
Type of passive bat detector	SM2BAT+, Real Time Expansion (RTE) type
Recording schedule	Each detector was set to operate in continuous trigger mode from dusk each evening until dawn (times were automatically adjusted in relation to latitude, longitude and season).
Trigger threshold	>16KHz, -18dB
Trigger window (time of recording after trigger ceased)	500 ms
Microphone gain setting	36dB
Compression	WAC0
Single memory card size (each system uses 4 cards)	32GB
Battery size	18Ah; 12V
Solar panel output	20 Watts
Solar charge regulator	6 - 8 Amp with low voltage/deep discharge protection

Other methods	Terrain was investigated during the day for signs of roosting and foraging habitat.

All site visits were conducted following the same methodology as mentioned above, over the course of the 12-month preconstruction monitoring period.

After each site visit, the passive data of the bat activity was downloaded from each monitoring system. The data was analysed by classifying (as near to species level as possible) and counting positive bat passes detected by the passive systems. A bat pass is defined as a sequence of ≥1 echolocation calls where the duration of each pulse is ≥2 ms (one echolocation call can consist of numerous pulses). A new bat pass will be identified by a >500 ms period between pulses. These bat passes will be summed into 10 minute intervals which will be used to calculate nocturnal distribution patterns over time. Bat activity was grouped into 10 minute periods. Only nocturnal, dusk and dawn values of environmental parameters from the wind data will be used, as this is the only time insectivorous bats are active. Times of sunset and sunrise was adjusted with the time of year.

The bat activity was correlated with the environmental parameters; wind speed and air temperature, to identify optimal foraging conditions and periods of high bat activity.

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.

The above information will be incorporated into the Bat Impact Assessment Report during the EIA phase as well as further investigation of the identified impacts associated with the proposed development.

11.3.4 Surface Water Impact Assessment

The surface water assessment during the EIA phase would primarily entail more detailed field investigation of surface water bodies (identified during the scoping phase) within the project site.

The fieldwork would be focused on:
- Larger wetland and drainage systems;
- Those wetland systems identified as sensitive or as having a high functionality; and
- Riparian zones of larger river systems.

The primary aim of the EIA-level assessment would be to determine the boundaries of the relevant wetland / riparian systems so that the wind farm can be placed outside of the wetlands / riparian areas. The wetland / riparian area boundary delineation would be undertaken using the DWAF guideline 'A practical field procedure for the identification and delineation of wetlands and riparian areas'.

The surface water analysis would propose measures to mitigate any identified potential negative impacts associated with the wind farm, and these would inform the EMPr phase. Mitigation measures would possibly entail slight changes to the proposed locations and extent of the wind farm to avoid impacts on surface water bodies, where significant or likely impacts have been predicted.

Input will be given to the proposed layout and buffers recommended.

The study will culminate in the compilation of a Surface Water Impact Assessment as well as mitigation measures which will feed into the Environmental Management Programme (EMPr).

The Surface Water Impact Assessment Report will be peer reviewed by an external surface water specialist and the report will be updated based on the peer reviewers' comments prior to finalisation.

11.3.5 Agricultural Potential Impact Assessment

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

The AGIS data was supplemented by a field investigation. This was aimed at ground-proofing the Agricultural Geo-Referenced Information System (AGIS) data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the site. The field investigation involved a drive and walk over of the site using assessment of surface conditions and existing excavations and burrows. The field assessment was done on 2 November 2016.

Soils were classified according to the South African soil classification system (Soil Classification Working Group, 1991).

It is the specialist's opinion that the level of soil mapping detail in the Department of Agriculture, Forestry and Fisheries (DAFF) requirements (see Section 2 of the Agricultural Potential Specialist Report) is appropriate for arable land only. It is not appropriate for this site. Detailed soil mapping has little relevance to an assessment of agricultural potential in this environment, where the agricultural limitations are overwhelmingly climatic, soil conditions are generally poor, and cultivation potential is non-existent. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. Conducting a soil assessment at the stipulated level of detail would be very time consuming and be a waste of that time, as it would add no value to the assessment. The level of soil assessment that was conducted for this report (reconnaissance ground proofing of land type data) is considered more than adequate for a thorough assessment of all agricultural impacts.

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

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

Telephonic consultation was done with the land owners, Mr. Albie Louw and Mr. Nico Louw to get details of farming activities on the site.

It should be noted that the impact ratings associated with agricultural potential in the Scoping Phase Report will be updated based on the new layout. In addition, the cumulative impact section will also be updated based on the new layout.

11.3.6 Visual Impact Assessment

The focus of the EIA phase VIA will be to undertake a more detailed GIS-based assessment, to quantify the magnitude and significance of the visual impacts of the proposed development in both a day-time and night-time context.

This assessment will focus on areas where potential sensitive receptors are located. Should data be available, digital terrain models and viewsheds will be generated for the areas of focus. This analysis will be conducted using ArcGIS software in conjunction with the Spatial Analyst and 3D Analyst extensions where necessary. The assessment will rely on site visits to each potentially sensitive receptor location (where possible) to identify the extent of visual impact of the proposed wind farm from these locations. A further assessment of the intensity of potential visual impact, expressed in terms of bands of differing visual significance will be undertaken. The fieldwork will also allow for the correction and refinement of the baseline information.

The overall significance of visual impacts associated with the proposed wind farm will be assessed through a rating matrix. Once this has been undertaken, measures to mitigate potential visual impacts will be identified, and if practical, layout alternatives within the application site will be considered and suggested to minimise visual impact of the proposed development.

A separate rating matrix will be used to assess the visual impact of the proposed development on the sensitive receptor locations, as identified. This matrix is based on the distance of a receptor from the proposed development, the primary focus / orientation of the receptor, the presence of screening factors, the visual character and sensitivity of the area and the visual contrast of the development with the typical elements and forms in the landscape.

Thereafter, the alternatives will be comparatively assessed, in order to ascertain the preferred alternative from a visual perspective.

Interested and Affected Parties will be consulted through the public participation process being undertaken as part of the EIA process, in order to establish how the proposed wind farm will be perceived from the various receptor locations and the degree to which this impact will be regarded as negative.

It is envisaged that the main deliverable of the study would be the generation of a spatial databases / maps indicating the zones of visual impact, as well as a detailed report indicating the findings of the study.

The Visual Impact Assessment Report will be peer reviewed by an external surface water specialist and the report will be updated based on the peer reviewers' comments prior to finalisation.

11.3.7 Heritage Assessment

The Heritage Impact Assessment (HIA) report to be compiled by PGS Heritage (PGS) for the proposed Xha! Boom project will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999) and the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey will be conducted on foot through the proposed project area by qualified archaeologists, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involves the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites is based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
    - Density of scatter (dispersed scatter)
        - Low - <10/50m^2
        - Medium - 10-50/50m^2
        - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 111: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction

Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

11.3.8 Noise Assessment

The noise emissions into the environment from the various sources as defined by the project developer will be calculated during the EIA phase using the sound propagation models described by ISO 9613-2 (operational phase) and SANS 10357[13] (construction phase). The following will be taken into account:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The layout details of the proposed project;
- The height of the noise source under investigation;
- Topographical layout; and
- Acoustical characteristics of the ground.

The potential impact from traffic will be considered during the EIA phase using the sound propagation model described in SANS 10210:2004[14]. Corrections such as the following will be considered:

- Distance of a noise-sensitive development from roads;
- Road construction material;
- Average speeds of travel; and
- Types of vehicles used.

The layout as presented will be assessed in detail and used to assess the magnitude, the extent of potential noises as well as the potential significance of the noise impact. As the details of the preferred wind turbine are unknown, the sound power emission levels of a relatively noisy wind turbine will be used. The assessment will therefore lean towards a worst-case approach.

11.3.9 Socio-economic Impact Assessment

A socio-economic impact assessment will be conducted during the EIA phase in order to:

- Delineate the zone of influence that stretches beyond the directly affected sites following the discussions with other specialists on the team
- Collect primary socio-economic data (through personal or telephonic interviews) of the communities and economic activities that will be directly or indirectly affected (positively or negatively) by the proposed developments (per project and its components)
- Quantify the potential positive and negative effects of the proposed project and its alternatives (if applicable) on the socio-economic environment in the delineated study area;
- Evaluate the change in the size and composition of the local and regional economies that will be stimulated by the proposed development, as well as the state of local communities
- Evaluate the potential positive and negative impacts following the environmental specialist's methodology
- Assess cumulative impacts

- Develop a management and mitigation plan by proposing mitigation measures for negative effects and enhancement measures for positive impacts, supported by methods for the implementation, timeframes, costs and responsibilities information

The following methods will be employed in undertaking the study.

- Surveys and interviews

  Surveying is one of the fastest ways to obtain primary information. Surveys can be conducted over the telephone, internet, e-mail, or personal interviews. The latter is relatively expensive but since it involves one person interviewing another, it is a way to get in-depth and comprehensive information. The use of surveys and interviews is particular applicable for collecting primary data of the community that could potentially be affected by the project or collecting specific data from an identified official or stakeholder.

  The following data will be sourced using surveys and interviews:
    - Land use information and type of economic activity on properties within the affected environment
    - Economic profiles of the activities within the affected environment
    - Demographic and social characteristics of the local environment (population, income levels, crime levels, etc.)

- Mapping

  Land use mapping technique would be used to illustrate and analyse the land uses in the affected area. The map will be created based on the information collected during the surveys and include the following data:
    - Types and location of tourism facilities in the area
    - Land uses in the area surrounding the facility (defined by the visual impact)

- Economic modelling and impact assessment

  Assessment of economic impacts will be done using economic models developed for the South African economy and the North West Province. The former will be used to assess the impacts on the country's economy, whilst the latter will be used to estimate the impact on the provincial and local economies.

  Economic models are compiled on the basis of Social Accounting Matrices that illustrate the linkages between various economic agents. The use of economic models allows identifying the industry-specific multipliers on production, capital formation, Gross Domestic Product (GDP), employment, and income. Such multipliers can also be broken in terms of various effects that can be observed as a result of an exogenous change introduced into the economy, be it capital investment or operating expenditure. Three types of effects are distinguished, inter alia:
    - Direct – these represent the original purchases for the project's establishment or operations

- Indirect – these are effects that spill over the industries that supply goods and services required for the implementation of the project or for its operation, whether directly to the contractor or operator, or through their suppliers
- Induced – these are the effects that are stimulated by the change in income levels of households that would directly or indirectly be affected by the project and businesses.

11.4 Cumulative Impact Assessment

The potential cumulative impact of the proposed wind farm in combination with other renewable energy facilities in the area will be identified and assessed per environmental aspect in **section 6.4** of this DSR. In addition, mitigation measures were identified to address the cumulative impact, where possible. The Scoping Phase specialist reports included a detailed cumulative impact assessment, including a review of other specialist studies conducted for renewable energy projects in the area. The recommendations contained in the specialist reports will be reflected in the mitigation measures to be provided in the DEIAr and EMPr. Cumulative impacts were also rated as part of the impact rating system and used to determine the significance of the impacts. It should be noted that cumulative impacts will be further assessed during the EIA phase of the project.

11.5 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 113**.

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.

11.6 Impact Rating System

Impact assessment will 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 will also be assessed according to the project stages:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact will be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance is also been included.

11.6.1 Rating System Used to Classify Impacts

The rating system will be applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts will be consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 112: Description of terms.

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	International and National	Will affect the entire country
2	Province/region	Will affect the entire province or region
3	Local/district	Will affect the local area or district
4	Site	The impact will only affect the site
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	Irreversible	The impact is irreversible and no mitigation measures exist.
2	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
3	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
4	Completely reversible	The impact is reversible with implementation of minor mitigation measures
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.

The table below is to be represented in the Impact Assessment section of the report.

Table 113: Rating of impacts.

IMPACT TABLE	
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*

IMPACT TABLE		
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
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low 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.*	

11.7 Environmental Management Programme (EMPr)

In accordance with the EIA Regulations, 2014 a draft Environmental Management Programme (EMPr) will be included within the Environmental Impact Assessment Report. The EMPr will include the mitigation measures formulated by the various specialists.

11.8 Alternative Assessment

In accordance with the EIA Regulations, 2014 and as discussed in **Chapter 7** of this report, the layout alternatives identified within this DSR will be described and comparatively assessed in the EIA phase. The size and layout of the proposed 70 wind turbines will depend on the development area and the total generation capacity that can be produced as a result, and will be informed by the findings of the Scoping Phase specialist studies. Additionally, the substation, O&M buildings and turbine layout will be adjusted based on more detailed specialist studies conducted during the EIA phase of the proposed development.

Table 114: Summary of specialist Alternatives Assessment indicating the preference associated with each alternative

Specialist Assessment	132kV ON-SITE XHA! BOOM SUBSTATION OPTION 1	132kV ON-SITE XHA! BOOM SUBSTATION OPTION 2
Biodiversity	Preferred	Not Preferred
Avifauna	No Preference	No Preference
Bats	Preferred	Not Preferred
Surface Water	Preferred	Not Preferred
Soils and agricultural potential	No Preference	No Preference
Noise	No Preference	No Preference
Visual	No Preference	No Preference
Heritage	Preferred	Favourable
Socio-Economic	No Preference	No Preference

Based on the specialist scoping assessments and assessment of the proposed 132kV On-Site Xha! Boom Substation alternatives, **Substation Option 1** has been identified as the preferred alternative from biodiversity, bats, surface water and heritage perspectives respectively. As based on the biodiversity specialist studies **Substation Option 1** is located on the typical open plains of the site, dominated by *Stipagrostis*. There are no sensitive features within the footprint area and no significant issues associated with the site. From a surface water perspective, no surface water resources are found within **Substation Option 1**. The nearest surface water resource is a major drainage line which is located approximately 600m to the west, and separated by a low ridge acting as a watershed. The potential for indirect impacts is minimal considering the distance and barrier to the drainage line. With regards to bats, **Substation Option 1** is located within a flatter and more homogenous area such that the only foreseen impact is habitat removal. In addition, from a heritage perspective, no heritage resources were identified in **Substation Option 1**.

However, from a biodiversity perspective, the proposed 132kv On-Site Xha! Boom **Substation Option 2** is not preferred due to the location of the proposed substation in a transitional area between the arid grasslands in the east and the Klipveld in the west. There are numerous small drainage features or washes in the site and it is not considered favourable. Additionally, from a surface water perspective the proposed 132kV On-Site Xha! Boom **Substation Option 2** is not preferred due to the presence of two (2) minor drainage lines that can be found within this substation alternative. There will therefore be direct potential impacts to these surface water resources. Additionally, there are several other minor drainage lines in close proximity (<120m). Indirect potential impacts such as increased run-off, and consequent sedimentation and erosion are therefore, likely. It should also be noted that from a heritage perspective, a site occurs at **Substation Option 2**. This site is however is of a low significance. In addition, with regards to bats, **Substation Option 2** is not preferred as based on satellite imagery, this location is situated nearer to an area that is of potential interest for bat foraging activities. Based on the above findings from the various specialist scoping reports it is recommended that only **Substation Option 1** be taken through to the EIA phase.

As previously stated, the sensitive areas used to determine the layouts were based on specialist scoping studies, it is recommended that further studies be done on the proposed site alternatives during the EIA phase, including specialist fieldwork. The specialist studies in the EIA phase will provide a more detailed assessment of sensitive areas. If necessary, the proposed locations for the 132kV on-site substation may be amended at this stage to more accurately avoid highly sensitive or no-go areas.

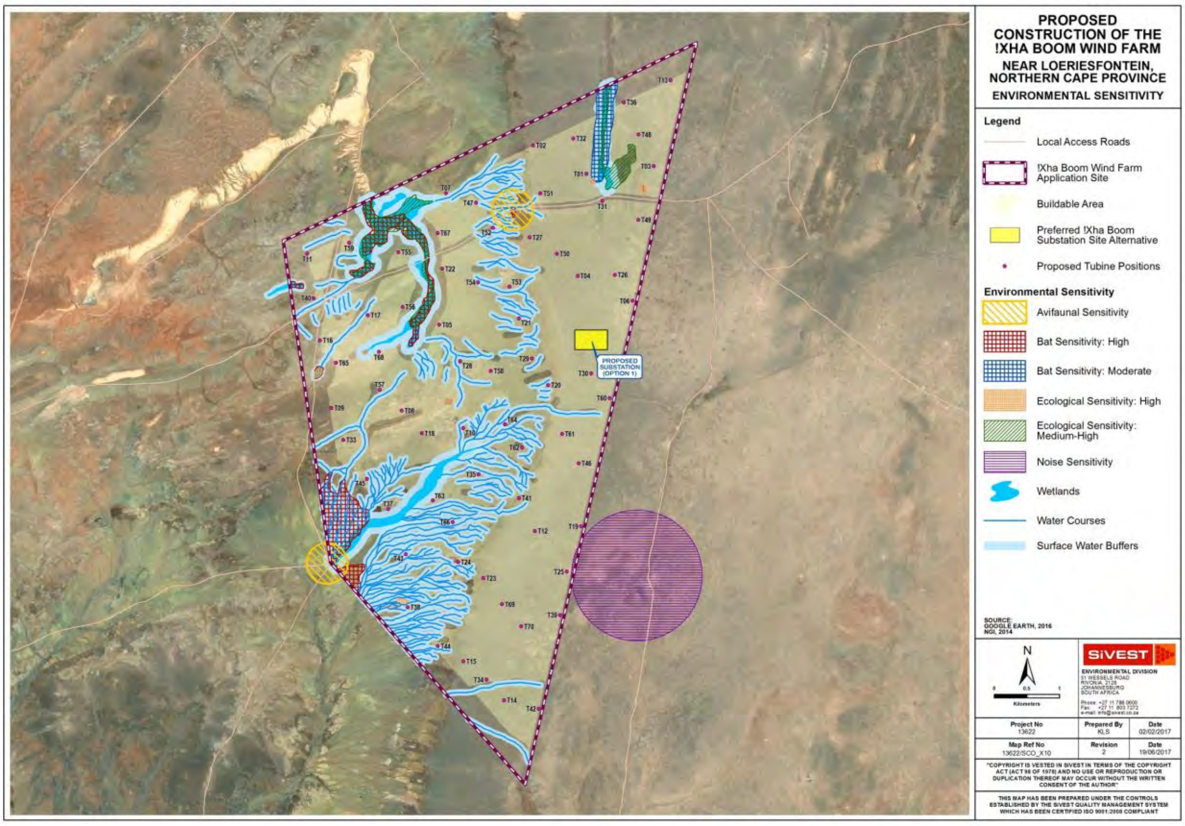


Figure 50: Proposed Layout Alternatives to be assessed in the EIA phase in relation to the Sensitive Areas

11.9 Recommendations

It is recommended that the specialist studies pertaining to certain aspects be carried forward into the EIA Phase, namely, those studies mentioned above. Various issues and concerns have been identified which require detailed assessment and thus it is recommended that the EIA phase be allowed to continue in order to assess these and the impacts associated.

11.10 Public Participation

The Public Participation during the EIA Phase will involve the following:

Table 115: Public Participation activities still to take place.

ACTIVITY	FUNCTION
Prepare and distribute EIA newsletter	Notify registered I&APs of outcome of the Scoping Phase (including timeframes and when their input is required).
Focus Group Meeting	Meeting to provide feedback on the findings of the detailed specialist studies to key stakeholders (specifically the Local and District Municipalities and Landowners)
Public Meetings	Provide feedback on the findings of the detailed specialist studies to the general public.
Public comment period	Notification of I&APs of the availability of the EIAr reports for public comment.
Notification of granting or refusal of Environmental Authorisation	Informing of all registered I&APs of the EA
Environmental Authorisation appeal period	Receive any appeals and forward to DEA

11.11 Proposed Project Schedule going forward

The table below represents the proposed schedule of events for the project till closure upon DEA's decision.

Table 116: Proposed Project Schedule

	June 2017	July 2017	August 2017	September 2017	October 2017	November 2017	December 2017	January 2018	February 2018	March 2018
Start of DSR Comment period	21st June 2017 to 21st of July 2017									
Submission of FSR to DEA			August 2017							
DEA Decision on FSR				September 2017						
Distribution of EIA Newsletter			August 2017							
DEIAr Comment period				September 2017 to October 2017						
Hold Meetings (FGMs and PM)					October 2017					
Submission of FEIAr to DEA						November 2017				
DEA Decision										March 2018

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