ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED CONSTRUCTION OF THE KARREEBOSCH WIND FARM AND ASSOCIATED INFRASTRUCTURE

DEA REF. NO: 14/12/16/3/3/2/807

FINAL REPORT

September 2015

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PROJECT DETAILS

DEA Reference No.	:	14/12/16/3/3/2/807
Title	:	Final Environmental Impact Assessment Report: Proposed Construction of the Karreebosch Wind Farm and Associated Infrastructure in the Northern Cape and Western Cape Provinces.
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Client	:	Karreebosch Wind Farm (Pty) Ltd, a subsidiary of G7 Renewable Energies (Pty) Ltd
Report Status	:	Final Environmental Impact Assessment Report for submission to DEA

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PURPOSE OF THE EIA REPORT

Karreebosch Wind Farm (Pty) Ltd proposes to construct a wind energy facility on a site located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland. The site falls within the Karoo Hoogland Local Municipality, Northern Cape and the Laingsburg Local Municipality, Western Cape. The majority of the project infrastructure falls within the Northern Cape with only a section of the power line falling in the Western Cape province. The proposed facility will utilise wind turbines to generate electricity that will be fed into the National Power Grid.

The EIA process for the proposed Karreebosch Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN38282 of December 2014, in terms of Section 24(5) of NEMA (Act No. 107 of 1998), and includes an assessment of the above-mentioned infrastructure.

The Scoping Phase of the EIA process identified potential issues associated with the proposed project, and defined the extent of the studies required within the EIA Phase. The EIA Phase addresses those identified potential environmental impacts and benefits associated with all phases of the project including design, construction and operation, and recommends appropriate mitigation measures for potentially significant environmental impacts. The EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The release of a draft EIA Report provided stakeholders with an opportunity to verify that the issues they have raised to date have been captured and adequately considered within the study. The draft EIA Report for Karreebosch Wind Farm was made available for a 30-day public review period. The 30 day public review period ran from 14 August 2015 – 14 September 2015. The draft EIA report was also submitted to DEA. The report was available for download on http://data.g7energies.com/karreebosch or on request from Savannah Environmental. The report was also distributed to relevant Organs of State and was made available at the Sutherland and Laingsburg public libraries.

This Final EIA Report incorporates all issues and responses received during the EIA process. This final report is submitted to the National Department of Environmental Affairs (DEA), the decision-making authority for the project, for review and decision-making. Changes made from the Draft Report have been underlined for ease of reference.

TABLE OF CONTENTS

APPENDICES:

Appendix A: CVs of EIA team
Appendix B: DEA correspondence
Appendix C: Public Participation Information
Appendix D1: Ecology Report
Appendix D2: Ecologist Addendum Letter regarding compensation areas.
Appendix E: Avifaunal Report
Appendix E2: Avifaunal Monitoring and Impact Assessment Report
Appendix F: Bat Impact Report
Appendix G: Agriculture and Soils
Appendix H: Hydrological
Appendix I: Noise Report
Appendix J: Visual Impact Report
Appendix K: Heritage and PIA Report
Appendix L: Social Report
Appendix M: EMPr
Appendix N: EAP Affirmation
Appendix O: Letters from Specialists
Appendix P: Additional Information

EXECUTIVE SUMMARY

Karreebosch Wind Farm (Pty) Ltd proposes to construct a wind energy facility on a site located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland. The site falls within the Karoo Hoogland Local Municipality, Northern Cape and the Laingsburg Local Municipality, Western Cape. The majority of the project infrastructure falls within the Northern Cape with only a section of the power line falling in the Western Cape province. The proposed facility will utilise wind turbines to generate electricity that will be fed into the National Power Grid. This project was part of an initial Environmental Impact Assessment (EIA) application for the larger Roggeveld Wind Farm which has now being considered and assessed as three smaller Phases of 140MW each. This current EIA application pertains to Karreebosch Wind Farm (Phase 2 of Roggeveld Wind Farm) DEA Ref. No. 14/12/16/3/3/2/807).

Karreebosch Wind Farm (referred to as Karreebosch in this report) is the northern section of the broader Roggeveld project area. Karreebosch Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities by Independent Power Producers in South Africa. The purpose of the proposed wind energy facility is to sell the electricity generated to Eskom through a power purchase agreement under the REIPPP Programme.

In summary, the infrastructure to be constructed as part of the wind energy facility includes the following:

» Up to 71 wind turbines (2MW to 3.3MW in capacity each) with a foundation of 25m in diameter and 4m in depth.
» The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
» Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
» Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
» Internal access roads up to 12 m wide.
» Approximately 25km of 33kV overhead power lines linking the turbine strings to each other and to the on-site substations
» Approximately 25km of 132kV overhead power lines from the on-site substation to Eskom's Komsberg Substation.

- Up to two electrical substations on-site (33/132 kV substations with a footprint of 100m x 200m each)
- Underground park cabling between turbines buried along the internal access roads, where feasible.
- Extension of the existing 400kV Eskom Komsberg Substation
- An operations and maintenance building (O&M building).
- Up to 4 x 100m tall wind measuring masts.
- Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
- A borrow pit for locally sourcing aggregates required for construction (~3ha).
  - Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
  - A borrow pit for locally sourcing aggregates required for construction (~3ha).

Table 1: General Site Information

Component	***Description***
Number of turbines	Up to 71 turbines (generation capacity of up to 140MW)
Hub height	Up to 100m
Blade length	~ 70m
Rotor Diameter	Up to 140m
Area occupied by transformer stations / substation	Up to 2 x 33/132kV Substations = 40 000m^2 Extension of the existing 400kV Substation at Komsberg Transformer at each turbine: total area <1500 m^2 (2 m^2 per turbine nut up to 10m^2 at some locations)
Capacity of on-site substation	132 kV
Area occupied by construction camp	300 x 300m = 90 000m^2
Area occupied by laydown areas	Operation: (70 x 50) x 71 = 248 500 m^2
Areas occupied by buildings	~10 000 m^2
Length of (new) internal access roads	~40 km
Width of internal roads	Up to 12 m
Proximity to grid connection	~25 km from on-site substation to the existing 400kV substation at Komsberg, length of new line required will vary slightly depending on the alternative route selected
Height of fencing	Up to 3m
Type of fencing	Steal or wire mesh

In terms of sections 24 and 24D of NEMA, as read with Government Notices R982, R983, R984, R985, a Scoping and EIA process is required for the proposed Karreebosch Wind Farm project

Evaluation of the Proposed Project

The chapters contained of this report together with the specialist studies contained within **Appendices D - L** provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the Karreebosch Wind Farm. The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by Karreebosch Wind Farm (Pty) Ltd. This initial layout includes 71 wind turbines as well as all associated infrastructure. No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However, the potential for impacts of major and high significance were identified which require mitigation. Mitigation to avoid impacts are primarily associated with the relocation of certain turbine positions of concern, power line options as well as measures to be utilised during the construction phase to prevent negative impacts from occurring. These are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix M**.

The most significant impacts associated with the construction and operational phases of the development of Karreebosch wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.

Impact of the Substations and Power Line

There are up to two 132kV substations options which have no priority or preference to each other (each substation option will have 2 power line routing alternatives) and one 400kV Substation proposed at Komsberg. Due to the significant distances between the individual turbine strings, detailed technical assessments will have to evaluate which option is feasible and will ultimately be built. No substations should be located within the higher lying parts (ridges and hilltops) of the site and should be restricted to the lowlands and previously disturbed areas where possible. . The main impacts associated with the power line and substation option are impacts to ecology, avifauna and heritage impacts.

The power line routes are largely through the lower sensitivity lowlands but also traverse more sensitive hills. Although the power line traverses several drainage lines, the pylon foundations placement can be adjusted where necessary to avoid impact to drainage lines or any other sensitive features.

Power lines can also cause bird injury and/ mortality resulting from collisions with power lines and electrocution. The risk of collision where the power line cross upper valley slopes is considered greater for this group of birds than at the turbines on the ridges. This situation must be mitigated by installing markers at 3 m intervals on each wire to make the power line more visible. With the use of mitigation measures the **impact of the power line on avifauna** will be of **minor - moderate significance**.

An ecological and avifaunal pre-construction walk-through for the power line is recommended.

The developer, Karreebosch Wind Farm has chosen a preferred alternative for the grid connection of the project. The selected option for grid connection is Alternative 2 with Substation and power line alternative 2a (detailed in Chapter 4). This alternative has been chosen due to reasons of technical and environmental feasibility, it is the shortest route available and it incorporated specialist recommendations.

Cumulative Impacts

Cumulative impacts are detailed in Chapter 10. Significant cumulative impacts that could result from the development Karreebosch Wind Farm and other wind energy facilities in the area include:

» visual intrusion;
» change in sense of place and character of the area and heritage impacts;
» an increase in the significance of avifaunal impacts;
» an increase in the significance of the potential impact on bats;
» loss of vegetation and impacts on ecology; and
» temporary traffic impacts during construction.

Cumulative impacts will be of a **low – high significance** on a landscape level in this region of the Northern and Western Cape. The use of the EMPr and mitigation measures would assist in mitigating these negative impacts to an acceptable level.

Environmental Sensitivity Mapping

From the specialist investigations undertaken for the proposed Karreebosch Wind Farm, a number of sensitive areas were identified (refer to **Figure 1 and the map in Appendix R**). The following sensitive areas/environmental features have been identified on the site:

» Prominent horizontal ridges/slopes.
» Priority ridges in terms of ecology
» Drainage lines and associated riparian vegetation.
» Avifaunal sensitive areas:
  * Five saddles (the lowest areas along ridge sections). Many bird species, including the Ludwig's Bustard (vulnerable species), often use saddles when crossing ridges, especially when this requires them to fly into headwinds. The risk of collision mortalities can be mitigated by leaving a 100 m gap between successive turbines across the five saddles designated from monitoring observations.
  * Valley's between the turbine ridges – populations of bird species greater in the valleys

than elsewhere in the Karreebosch area. This is especially true for the Wilgebos Valley where species prone to collisions occur.

- Verreaux's Eagles nesting areas - to minimise the risk of disturbance to, and collision mortality risk of, no turbines should be located nearer than 1.3 km from the established nesting area.

» Areas of high bat sensitivity:
- Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line.
- Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines.
- Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
- Valleys and lower altitudes are expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats.

» Heritage sites (although outside the development footprint and of low heritage significance).

Recommendations for Micro-Siting of Turbines

The specialist studies assessed the Karreebosch layout and the following points regarding the wind turbine layout are made:

» Ecology (flora, fauna and drainage lines):
- The ecological walk-through survey of the initial layout of Karreebosch wind farm revealed that the majority of the turbines were located within physically and ecologically acceptable areas.
- Broad scale ecological sensitivity indicated that the central ridges are more sensitive than those in the west where there may be some localized areas of higher sensitivity. The power line routes are largely through the lower sensitivity lowlands but also traverse more sensitive hills. However, as their footprint is low, significant impacts on sensitive hills are considered unlikely.
- Access roads would be the primary source of impact associated with the wind farm development and specific mitigation measures to limit the ecological impact of the roads will be required. The access roads onto the ridges frequently traverse steep areas where the risks would be high.
- No highly significant impacts on the terrestrial environment are expected from the power line options, provided standard mitigation and avoidance are implemented. A preconstruction walk-through of the power line route would ensure that any species of

conservation concern within the footprint can be avoided.

- Turbine 71 was located on top of an isolated hill in a No-Go zone in terms of species of conservation concern; unique ridgeline habitats and erosion risk. Turbines 49 and 50 are also located in No-Go zones in terms of species of conservation concern; unique ridgeline habitats and erosion risk. These turbines should be removed or relocated.
- Turbine 60 was located in a 'very high sensitivity' isolated ridge which had numerous access roads traversing the narrow ridge. It was suggested that this turbine be either dropped from layout or relocated.

» Birds:

- The 100m gap between turbines occurring in saddles has been maintained in the revised layout. However, all turbines are spaced by a minimum of 3 x Rotor Diameter (i.e. up to 420m apart).
- No turbines are to be located nearer than 1.3 km from the established Verreaux's Eagles breeding cliff on Beacon Hill.
- Siting of turbines in the flatter middle part of the ridge will minimize risk of collision.
- Siting turbines closer than 50 m from the lowest point of upper valley saddles is not encouraged as with increasing ridge height, birds increase their selection of the lowest points that provide exits from the upper reaches of the valleys.
- Flight paths of the Black Harrier near Turbine 60 are not of concern as the birds were observed quartering which was often below collision risk height.
- The area around turbines 17 and 18 is both a soaring area (for raptors) and a passage route for birds commuting from one set of dams in the west to those in the east. Thus turbines nearby may have the potential for killing more birds than other placements along the ridge.

» Bats:

- No proposed turbines are located within High bat sensitive areas and their respective buffer zones.
- Turbine 57 and 52 (marginally) located in High bat sensitivity buffer.
- Areas of High sensitivity and their buffers are 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.
- ∗ Turbines within or close to Moderate Bat Sensitivity areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
- ∗ Turbine 27 located in moderate bat sensitivity area.
- ∗ Turbine 4 and 25 located in Moderate bat sensitivity buffer

» Heritage Site – archaeological sites of low heritage significance occur outside the development footprint.

» Noise – Based on the current layout - no noise mitigation procedures would need to be implemented (under the NNR) at any of the dwellings located within Karreebosch Wind Farm site boundaries.

The ecological walk-through survey of the initial layout of Karreebosch wind farm revealed that a section within the central part of the site has several turbines within a sensitive environment, and the developer was encouraged to alter the final layout of the development in response to these findings. The turbines which are proposed to be relocated, are described below:

- ∗ Turbine 18 - 26 of the initial layout are located on Low elevation ridges with vegetation indicating relative aridity compared to eastern ridges. No observed habitats of concern and abundance of species of conservation concern is also relatively low. Primary concerns are on biodiversity process rather than pattern. Major risk factor is erosion around turbines and along access roads. This is an area of Medium Sensitivity.
- ∗ Turbine 12 -17: Ridgeline at moderate elevation (1000-1100m). No observed habitats of concern and abundance of species of conservation concern is also relatively low. Primary concerns are on biodiversity process rather than pattern. Major risk factor is erosion around turbines and along access roads. This is an area of Medium Sensitivity.
- ∗ Turbine 4 – 7; 36 – 46 and 60 – 64 are located in areas with Very High sensitivity.
- ∗ Turbine 1 - 3; 8 - 11; 27 - 35; 47; 48; 51 - 59 and 65 – 70 all located in areas of high sensitivity in terms of ridge habitats, sensitive species and erosion risk. These turbines may require a final ecological walkthrough prior to construction to avoid sensitive features.
- ∗ Turbine 71 was located on top of an isolated hill in a No-Go zone in terms of species of conservation concern; unique ridgeline habitats and erosion risk. Turbines 49 and 50 are also located in No-Go zones in terms of species of conservation concern; unique ridgeline habitats and erosion risk.
- ∗ Turbine 60 was located in a 'very high sensitivity' isolated ridge

which had numerous access roads traversing the narrow ridge. It was suggested that this turbine be either dropped from layout or relocated.

As a result of the ecologically sensitive areas, the layout for Karreebosch was revised and is presented in Figure 2.

Mitigation of impacts is the next option for the rest of the environmentally sensitive areas shown in Figure 1. Mitigation measures as detailed in the specialist studies, this final EIA report and the **Draft EMPr (Appendix M**) are to be applied during the development of the wind farm. The revised layout allows for avoidance of negative impacts on sensitive areas and is considered acceptable from an environmental and social perspective and is shown in Figure 2. Specialists have been consulted with and are in support of the revised layout. Letters confirming this acceptance is available in Appendix O.

Overall Conclusion (Impact Statement)

The findings of the specialist studies undertaken within this EIA for Karreebosch Wind Farm conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The most significant impacts associated with the construction and operational phases of the development of the Karreebosch wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.
» Majority of the environmental and social impacts associated with development of the Karreebosch wind energy facility will be of moderate significance and of acceptable levels.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

Overall Recommendation

Based on the nature and extent of the proposed 140MW wind farm, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Karreebosch Wind Farm and associated infrastructure can be mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the detailed design of the project. The primary impacts relate to ecology, avifauna and bats, each having relevant mitigation.

The EAP recommends DEA needs to consider that the visual impact and impact on heritage sense of place as well as the impact on vegetation remain of moderate-major significance. This should then be weighed up against the benefits to the local economy as well as the government's commitments in terms of renewable energy targets. If promoting renewable/ alternative energy is an important consideration for the SA Government (also because of the associated benefits in terms of reduction in CO_2 emissions) it may become important that some **trade-offs and choices** would need to be made between promoting renewable energy versus the local and regional environmental and social impacts and benefits of the proposed wind farm.

The following conditions would be required to be included within an environmental authorisation for the project:

» Adherence to the final layout as indicated in Figure 2.
» Mitigation measures detailed within this report should be considered to minimise environmental impact. These are either already taken into account in the design of the final layout or are incorporated into the EMPr.
» The draft Environmental Management Programme (EMPr) as contained within Appendix M of this report should be approved and form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» The detailed engineering design of the facility must be submitted to DEA for prior to the commencement of construction.
» Should there be any changes to the location of the wind turbines and associated infrastructure (including power lines) that fall within identified sensitive areas (if any), walk - through surveys must be undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.

- An ecological and avifaunal pre-construction walk-through for the power line to be undertaken.
- Preconstruction walk-through of the development footprint for species of conservation concern that can be translocated. Before construction commences individuals of listed species within the development footprint should be marked and translocated to similar habitat outside the development footprint under the supervision of a suitably qualified person or ecologist. Permits from the relevant provincial authorities will be required to relocate listed plant species.
- Feasible mitigation measures as recommended by the Fauna and Flora Specialist report should be implemented. This includes the recommendation of releasing grazing pressure along priority ridgelines in an effort to improve habitat quality and species diversity and reduce the long term impact of the development on listed and protected plant species.
- Feasible mitigation measures as recommended by the pre-construction bird monitoring programme to be implemented. Mitigation measures, as outlined in the Avifaunal report, in terms of bird collisions with cross-valley power lines should be implemented. Electrocution risk should be prevented with use of approved types of installations.
- A heritage walk through for the proposed road alignments, especially through the valleys which are the most sensitive areas in terms of heritage.
- Feasible mitigation measures as recommended by the pre-construction bat monitoring programme to be implemented.
- Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect, quantify and remove any alien plant species that may become established.
- Implement site specific erosion and stormwater control measures to prevent excessive surface runoff from the site (turbines and roads).
- Should any heritage site, human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility. If fossil material is encountered, the palaeontologist must be given sufficient time and access to resources to recover at least a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. In the event of human bones being found on site, SAHRA must be informed immediately and the remains

removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.

» Applications for all other relevant and required permits if required to be obtained by the developer must be submitted to the relevant regulating authorities. This includes, where necessary, permits for the transporting of all components (abnormal loads) to site, water use licence for disturbance to any water courses/ drainage lines, permits for disturbance of protected vegetation and borrow pit/s.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» It is therefore put forward that the EIR provides the reviewing authority with adequate information to make an informed decision regarding the proposed project based on the factors below: The site layout is considered as environmentally acceptable as long as mitigatory measures are implemented for any sensitive features.
» A preferred grid access has been identified which is less environmentally sensitive compared to the other considered grid access alternative.
» Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the wind facility can be mitigated to acceptable levels.

The following Appendices are present in this report:

Appendix A: CVs of EIA team
Appendix B: DEA correspondence
Appendix C: Public Participation Information
Appendix D1: Ecology Report
Appendix D2: Ecologist Addendum Letter regarding compensation areas.
Appendix E: Avifaunal Report
Appendix E2: Avifaunal Monitoring and Impact Assessment Report
Appendix F: Bat Report
Appendix G: Agriculture and Soils
Appendix H: Hydrological
Appendix I: Noise Report
Appendix J: Visual Report
Appendix K: Heritage and PIA Report
Appendix L: Social Report
Appendix M: EMPr
Appendix N: EAP Affirmation
Appendix O: Letters from Specialists
Appendix P: Additional Information
Appendix P1: Title Deeds
Appendix P2: Letter regarding services on site
Appendix P3: Site Photographs
Appendix Q: Site Co-ordinates
Appendix R: Maps

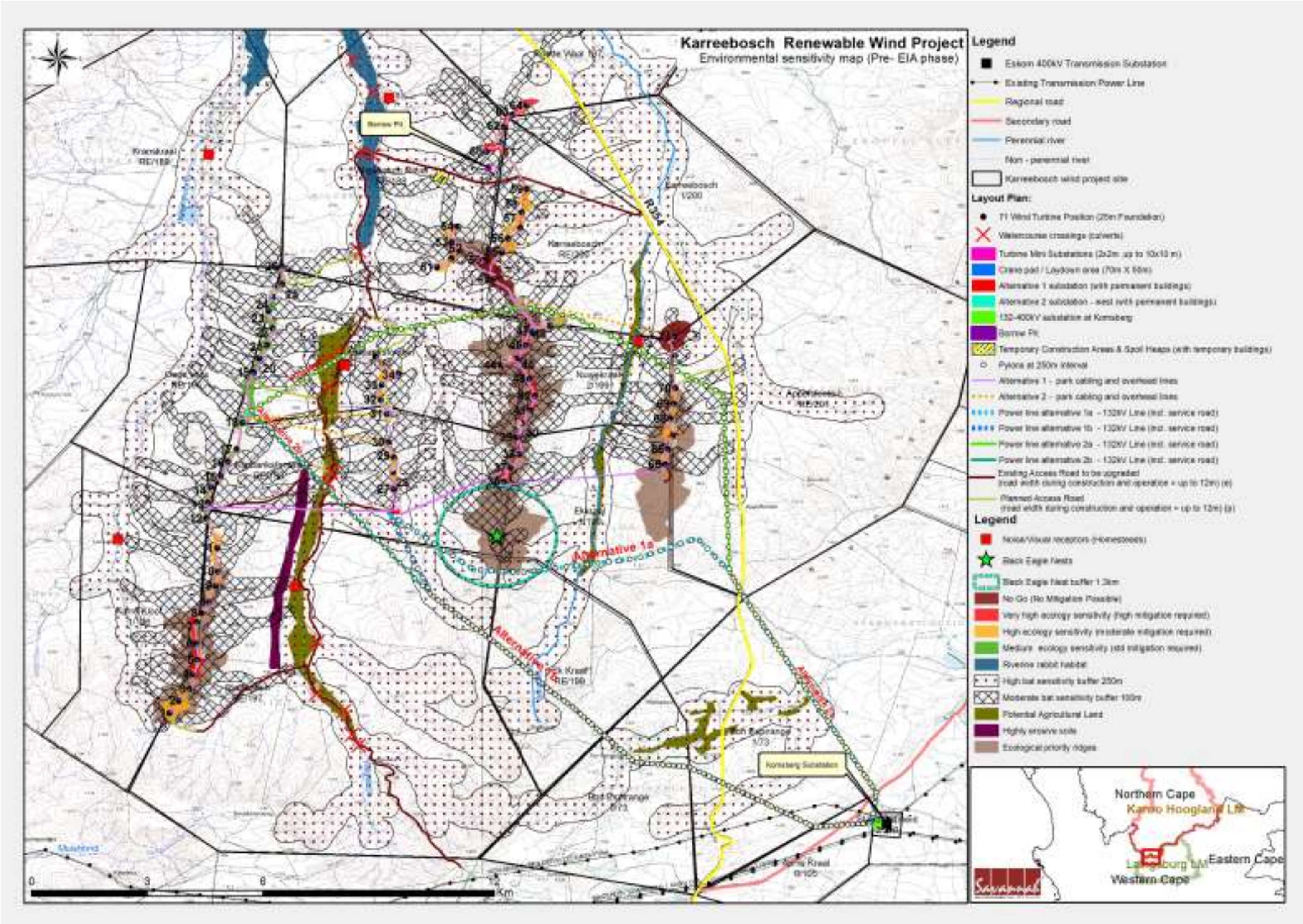

Figure 1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the original layout development footprint for Karreebosch Wind Farm **(Appendix R contains an A1 map)**

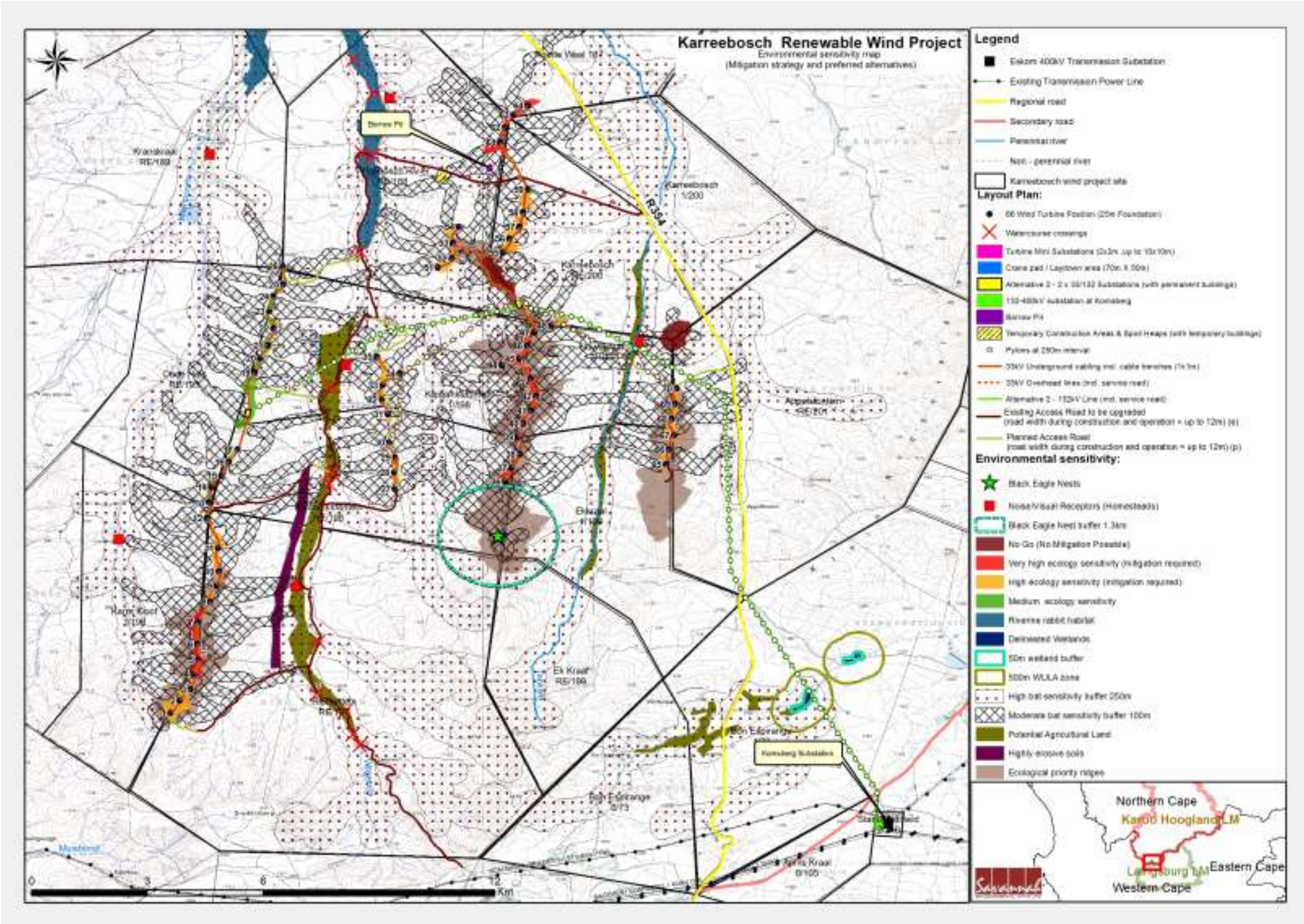

Figure 2: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the revised layout development footprint for Karreebosch Wind Farm **(Appendix R contains an A1 map)**

DEFINITIONS AND TERMINOLOGY

Alien species: A species that is not indigenous to the area or out of its natural distribution range.

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process, or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Ambient sound level: The reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Assessment: The process or collecting, organising, analysing, interpreting and communicating information which is relevant.

Biological diversity: The variables among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes they belong to.

Commence: The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

Construction: Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity as per the EIA Regulations. Construction begins with any activity which requires Environmental Authorisation.

Cumulative impacts: Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

Cut-in speed: The minimum wind speed at which the wind turbine will generate usable power.

Cut-out speed: The wind speed at which shut down occurs.

Decommissioning: To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned. This usually occurs at the end of the life of a facility.

Department/ the competent authority: Refers to the Department of Environmental Affairs.

Development footprint: in respect of land, means any evidence of its physical transformation as a result of the undertaking of any activity.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation, or maintenance of an activity and are generally obvious and quantifiable.

Disturbing noise: A noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more, in accordance with the Noise Control Regulations.

'Do nothing' alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Ecosystem: A dynamic system of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

Environment: the surroundings within which humans exist and that are made up of:

(i) The land, water and atmosphere of the earth;
(ii) Micro-organisms, plant and animal life;
(iii) Any part or combination of (i) and (ii) and the interrelationships among and between them; and
(iv) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental assessment practitioner: An individual responsible for the planning, management and coordinating of environmental management plan or any other appropriate environmental instruments introduced by legislation.

Environmental Impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management inspector: A person designated as an environmental management inspector in terms of Section 31B or 31C on the National Environmental Management Act 107 of 1998.

Environmental management programme: A plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Generator: The generator is what converts the turning motion of a wind turbine's blades into electricity.

Grazing withdrawal area: (at times referred to as 'offset' in this report). An on-site mitigation measure to reduce the ecological impact of the development, which would ultimately result in the improvement of habitat quality and ecological functioning of the area within which grazing pressure is proposed to be withdrawn, and thereby reduce the effect and significance of the habitat loss[1]. Not a biodiversity offset in terms of the official definition.

Habitat: The place in which a species or ecological community occurs naturally.

Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment (Van der Linde and Feris, 2010;pg 185).

Indirect impacts: Indirect or induced changes that may occur because of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place because of the activity.

Interested and affected party: Individuals or groups concerned with or are affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups, and the public.

Nacelle: The nacelle contains the generator, control equipment, gearbox, and anemometer for monitoring the wind speed and direction.

Pollution: A change in the environment caused by substances (radio-active or other waves, noise, odours, dust or heat emitted from any activity, including the storage or treatment or waste or substances.

Pre-construction: The period prior to the commencement of construction, which may include activities which do not require Environmental Authorisation (e.g. geotechnical surveys).

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare."

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the

[1] Refer to Appendix D for further detail in this regard

South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Rotor: The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm).

Significant impact: An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

Tower: The tower, which supports the nacelle to which the rotor is attached, is constructed from tubular steel or concrete. It is approximately 80 m to 120m tall. The nacelle and the rotor are attached to the top of the tower. The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. Larger wind turbines are usually mounted on towers ranging from 80 to 120 m tall. The tower must be strong enough to support the nacelle and blades, and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

Waste: Is defined as follows:

a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or
b) disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to the National Environmental Management: Waste Act (NEM:WA); or
c) any other substance, material or object that is not included in Schedule 3 of NEM:WA that may be defined as a waste by the Minister by notice in the Gazette, but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste.

Wind power: A measure of the energy available in the wind.

Wind speed: The rate at which air flows past a point above the earth's surface.

REGULATORY AND DEA REQUIREMENTS

Table 1: EIA report requirements checklist

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	EIA Process to proceed in accordance with the tasks contemplated in EIA Regulations 2014	The EIA process was conducted in accordance with the 2014 EIA regulations, see chapter 5 for details
	All comments and recommendations made by stakeholder and I&APs as part of the DSR and SR must be taken into account when drafting the EIR	A Comments & Response Report is included in Appendix C which includes all comments received on the project to date
	Ensure that mitigation measures and recommendations in the specialists studies must be addressed the EIAr and the EMPr	All mitigation measures in specialist studies are included in both the EMPr and the main EMP
	Please ensure that comments from all relevant stakeholders are submitted to the Department with the FEIR including: • Northern Cape of Environment and Nature Conservation • DAFF • Provincial Departments of Agriculture • CAA • Department of Transport • Karoo Hoogland Local Municipality • Laingsburg Local Municipality • Department of Water and Sanitation • Department of Communications • Sentech • Eskom Holdings • SANRAL • SAHRA • EWT • Birdlife South Africa • SABAAP • Department of Mineral Resources • South African Astronomical Observatory • DEA: Directorate Biodiversity and conservation	"Listed in Chapter 6 (Section 6.3); and Appendix C includes all comments received so far - some comments to be included with final EIR in cases where comment has not yet been received"
	Square Kilometre Array (contact person - Dr Adrian Tiplady , 011-442-2434, atiplady@ska.ac.za.	As above
	EIAr and EMPr to comply with Appendix 3 and Appendix 4 of 2014 Regulations	Both the EIAr and EMPr comply with all requirements in terms of the 2014 regulations
	Proof of correspondence with various stakeholders/ Proof that attempts were made to obtain comments.	Proof the attempts were made to obtain comments is included in Appendix C in cases where no comment could be obtained
i & ii	All listed activities applied for are specific and can be linked to development activity or infrastructure described in the project description.	All listed activities are linked to specific infrastructure in; Chapter 5 Section 5.1 & table 5.1
iii	Address / Clarify regarding activity 9 GNR984 - substations greater than 275kV in the application but SR refers to 132kV. To be clarified in the EIR and application to be amended accordingly .	An amended application is being submitted with the EIA report, This activity is no longer applicable

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
iv	Download revised application form from https://www.environment.gov.za/documents/forms	Most recent application form used - June 2015
v	EIAr must include GNR983 Item 19: Department requires the applicant to provide and indication of the preferred and alternative locations from which the material used for infiling wil be sourced and where the excavated material will be stored/disposed of. Impacts associated with this impact must be adequately assessed in the EIAr.	Chapter 4, section 4.2.7 Section 7 of the Hydrology assessment (Appendix F) covers the assessment of the project on the alteration water courses.
vi	Involvement of authorities in relation to geographically designated areas in terms of activities under GNR986. Graphical representation of the proposed development within the respective geographical areas must be provided.	We assume that the Department is referring to GNR985 as GNR986 does not exist. The geographically designated areas applicable to the project as per Table 5.1 in chapter 5 are critical biodiversity areas (CBAs) and Nationa Protected Areas Expansion Strategy (NPAES) Focus Areas. The related authorities are NC DENC, WC DEA&DP and DEA, all of which have always been on the I&AP register. CBAs and NPAES focus areas are discussed in section 7.6 and a full map representing these areas is included in Appendix R (CBA Map) as well as Figure 8. of the ecology specialist report (Appendix D)
vii	EIAr must provide an assessment of the impacts and mitigation measures for each of the listed activities applied for.	Chapter 8 details the full assessment of all impacts
viii	Specialists must consider previous studies and include cumulative impact assessment done by the same specialists.	See Chapter 9; and Chapter 6 details the specialist methodology. As far as possible the same specialists who were used during the scoping phase were also used in the EIA phase, and previous studies were considered by all specialists.
ix & x	EIAr must provide proof and mitigation measures on how the requirements of the Astronomy Advantage Act, No 21, of 2007 is complied with as per the requirements of the SALT.	Comment has been obtained from SAAO on this issue and is include in Appendix C. Refer to response in C&R report in appendix C. It is acknowledged that the visual impact assessment as it currently may have been inadequate to assess the impact of lighting impacts on SALT. Karreebosch Wind Farm undertakes to continue consultations with SAAO/SALT and the Civil Aviation Authority to ensure that the potential light pollution impacts on SALT activities are mitigated prior to construction of the wind energy facility. As a condition of approval, such consultation with SAAO/SALT and CAA must mandated to ensure that the potential light pollution impacts on SALT activities are mitigated.
xi	Layout alternative for the wind facility away from CBA's and bird and bat flight paths must be assessed and form	This is assessed in Chapter 8, section 8.2 and 8.3. A statement is also made from the bat

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	part of the EIA process	specialist in this regard in section 3.2 of Appendix F (bat assessment). CBAs are covered in the Ecology specialist report, flight paths and exclusion zones are covered by the Avifauna specialist report
xii	Provide a description of any identified alternatives for the proposed activity or alternatives will have on the environment and on commmunity. Alternatively submit written proof of an investigation and motivation if no reasonable or feasible alternatives exist.	All alternatives and their associated feasibility are described in chapter 2
xiii	Provide technical details of the proposed facility in a table format as well as their descriptions/dimensions. See annex of this letter (for minimum required information).	Table included in chapter 4, Section 4.2.2
xiv	EIAr must provide four corners coordinates for the proposed development site as well as the start, middle and endpoint of all linear activities.	Appendix Q
xv	EIAr must provide the following	
	Clear indication of area envisaged for the WEF - turbines and associated infrastructure at appropriate scale	Table included in chapter 4, Section 4.2.2
	Clear description of associated infrastructure (power lines, roads, control house, laydown areas, etc)	Maps included in Appendix R
xvi	Location of the WEF in respect of location of other energy faciliities.	Figure 9.1
xvii	Section 19 and 21 of NWA may be triggered - The EAP is advised conduct surface hydrological study as part of the EIAr. Terms of reference must include identification and sensitivity rating of all surface water courses for the impact phase; identification, assessment of all potential impacts to the watercourses and suggestion of mitigation measures; Recommendation to the preferred placement of turbines and associated infrastructure.	Hydrological study is included in Appendix H
xviii	The ElAr must provide detailed need and desirability as to why there is a need for the development and why the specific location is desirable	See Chapter 2 section 2.2.1 All infrastructure is described in details in Chapter 4
xix	This Department requires that the wind resource data be submitted as part of the ElAr. The wind resource data must be a summary of the wind resource available in the study area and motivation that the site has a good wind resource to sustain the WEF must also be provided. In addition, whilst he information may be deemed to be confidential, your attention is drawn to Regulation 10 of the ElA Regulations, 2014 which states that "An applicant must provide the competent authority with all information that it reasonably has or may have the potential ofinfluencing any decision with regard to an application."	This is discussed in chapter 2 section 2.2.1. Wind resource data is also included here.
xx	The Department of Water and Sanitation (DWS) must be consulted during the course of the process. Proof of consultation must be provided for in the ElAr.	Proof included in Appendix C
xxi	SENTECH must be consulted during the process to ensure that the WEF will not have any impact on the	Proof included in Appendix C

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	telecommunication signals in the area. Proof of consultation must be provided for in the EIAr	
xxii	The EIAr must provide an indication of the internal access roads and the impacts associated with them must be adequately assessed in the EIAr and EMPr	Impacts associated with the roads are assessed in chapter 8 as part of the impact assessment. Access roads are indicated on all layout maps.
xxiii	The EIAr must provide an indication of the preferred powerline route alternative and provide an assessment and advantages and disadvantages of the alternative power line route alternative.	Chapter 10
xxiv	The inclusion of all received comments and response thereto in the comments and response report.	Comments and response report included in Appendix C
xxv	information on services required on the site, e.g. sewage, refuse removal, water and electricity. Who will supply these services and has an agreement and confirmation of capacity been obtained? Proof of these agreements must be provided.	Letter included in Appendix P2 (other information)
xxvi	The EIAr must provide a layout which depicts the entire facility, i.e. the wind and grid connection infrastructure.	Layout maps pre and post EIA are included in Chapter 10, Figure 10.3, 10.4 as well as identical A3-size maps included in Appendix . A1 versions of these 2 maps will also be submitted to DEA.
xxvii	The assessment of impacts and the Environmental impact Assessment process; and, the requirements of the Public Participation Process (PPP) must be in accordance with Regulation 39 to 44 of the GN R982 of EIA Regulations 2014.	Main EIA report and Appendix C
xxviii	A copy of the final site layout map. All available biodiversity information must be used in the finalisation of the layout map. Existing infrastructure must be used as far as possible e.g. roads. The layout map must indicate the following: • Turbine positions and its associated infrastructure; • Permanent laydown area footprint • internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible) • Wetlands, drainage lines, rivers, stream and water crossing of roads and cables indicating the type of bridging structures that will be used; • The location of sensitive environmental features on site e.g. CBAs, heritage sites, wetlands, drainage lines etc. that will be affected by the facility and its associated infrastructure; • Substation(s) and/or transformer(s) sites including their entire footprint; • Connection routes (including pylon positions) to the distribution/transmission network • All existing infrastructure on the site, especially roads • Buffer areas;	This is included in Appendix R (A3 Maps)

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	• Buildings, including accommodation; and, • All "no-go" areas.	
xxix	An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.	Final site sensitivity map is included in Chapter 11, Figure 11.3 and Appendix R
xxx	A map combining the final layout map superimposed (overlain) on the environmental sensitivity map.	Final A1 site layout map is included in Appendix R
xxxi	A shapefile of the preferred development layout/footprint must be submitted to this Department. The shapefile must be created using the Hartebeesthoek 94 Datum and the data should be in Decimal Degree Format using the WGS 84 Spheroid. The shapefile must include at a minimum the following extensions i.e. .shp; .shx; .dbf; .prj; and, .xml (Metadata file). if specific symbology was assigned to the file, then the .avl and/or the .lyr file must also be included. Data must be mapped at a scale of 1:10 000 (please specify if an alternative scale was used). The metadata must include a description of the base data used for digitizing. The shapefile must be submitted in a zip file using the EIA application reference number as the title. The shape file must be submitted to: address	Included on CD submitted with FEIR
	EMP	
i	All recommendations and mitigation measures recorded in the EIAr and the specialist studies conducted	Main EMPr document
ii	The final site layout map.	Appendix J
iii	Measures as dictated by the final site layout map and micro-siting.	Post EIA layout map included as Figure 1.2
iv	An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.	Figure 1.2
v	A map combining the final layout map superimposed (overlain) on the environmental sensitivity map.	Figure 1.2
vi	An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.	Appendix E
vii	A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase.	Appendix A
viii	A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.	Appendix G

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
ix	An open space management plan to be implemented during the construction and operation of the facility.	Appendix F
x	A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.	Appendix H
xi	A transportation plan for the transport of components, main assembly cranes and other large pieces of equipment.	Appendix H
xii	An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.	Appendix D
xiii	A fire management plan to be implemented during the construction and operation of the facility	Objective 15, Section 7.2 Objective 7, Section 9.2
xiv	An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.	Objective 13, Section 7.1 Monitoring done by ECO
xv	Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants	Objective 8, Section 7.2
	The EAP must provide detailed motivation if any of the above requirements is not required by the proposed development and not included in the EMP	All provided
	You are required to submit an avifauna and bat pre-construction monitoring report together with the draft EIAr. Baseline monitoring must be undertaken for a period of 12 months. The avifauna and bat preconstruction monitoring must be conducted in accordance with the minimum requirements guidelines produced by Bird Life South Africa and the South African Bat Advisory Panel. The baseline monitoring programme for avifauna and bats must cover the entire site as we ell as the height of the entire facility. i.e., you may be required to install more monitoring masts at height.	Included as appendix E2 (Avifauna Monitoring) and F (Bat Report)
	The EIAr must include a cumulative assessment of the facility since there are other similar facilities proposed in the region. The specialist studies as outlined in the PoSEIA which is incorporated as part of the SR must also assess the facility in terms of potential cumulative	Cumulative impact uis assessed in chapter 9
	Please ensure that all the relevant Listing Notice activities	Refer to Chapter 5, table 5.1

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	are applied for, that the Listing Notice activities applied for are specific and that they can be linked to the development activity or infrastructure in the project description.	
	The applicant is hereby reminded to comply with the requirements of Regulation 45 with regard to the time period allowed for complying with the requirements of the Regulations, and Regulations 43 and 44 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the competent authority for decision-making.	All requirements complied with, 30 day review period on draft reports
	in addition to the above, the Department will undertake a site inspection prior to or upon receipt of the draft ElAr for comment.	Noted
	Furthermore, it must be reiterated that, should an application for Environmental Authorisation be subject to the provisions of Chapter ll, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then this Department will not be able to make nor issue a decision in terms of your application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter ll, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999. Authority as described in Chapter ll, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999.	Noted
	You are requested to submit two (2) electronic copies (CD/DVD and two (2) hard copies of the Environmental impact Report (ElAr) to the Department.	2 electronic copies and 2 hard copies to be submitted
A.	**EIA INFORMATION REQUIRED FOR WIND ENERGY FACILITIES**	
1	General site information • The following general site information is required: Descriptions of all affected farm portions • 21 digit Surveyor General codes of all affected farm portions • Copies of deeds of all affected farm portions Photos of areas that give a visual perspective of all parts of the site • Photographs from sensitive visual receptors (tourism routes, tourism facilities, etc.) • Wind plant design specifications including: ▪ Type of technology ▪ Structure height ▪ Surface area to be covered (including associated infrastructure such as roads) ▪ Structure orientation ▪ Laydown area dimensions (construction period and thereafter)	Required information is: Chapter 4 - 4.1 (farm portion) Chapter 1 - 1.1.1 (21 digit codes) Appedix P1 - for copy of deeds Photos: see various specialist reports Chapter 4 - 4.2.2 (various technical details)

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	▪ Generation capacity ▪ Generation capacity of the facility as a whole at delivery points This information must be indicated on the first page of the ElAr. it is also advised that it be double checked as there are too many mistakes in the applications that have been received that take too much time from authorities to correct.	
2	Sample of technical details: • Number of Turbines • Hub Height • Blade Length • Rotor Diameter • Area occupied by inverter I transformer stations • Substations • Capacity of on-site substation • Area occupied by both permanent and construction • laydown areas • Area occupied by buildings • Length of internal roads • Width of internal roads • Proximity to grid connection • Height of fencing • Type of fencing	Chapter 4 Table 4.2.3 Chapter 4 Table 4.2.2 and executive summary.
3	Site maps and GIS information should include at least the following: • All maps/information layers must also be provided in ESRI Shapefile format • All affected farm portions must be indicated • The exact site of the application must be indicated (the areas that will be occupied by the application)	shapefiles are included on CD submitted with FEIR. All maps included meet the minimum requirements.
	A status quo map/layer must be provided that includes the following: • Current use of land on the site including: ▪ Buildings and other structures ▪ Agricultural fields ▪ Grazing areas ▪ Natural vegetation areas (natural veld not cultivated for the preceding 10 years) ▪ with an indication of the vegetation quality as well as fine scale mapping in respect ▪ of Critical Biodiversity Areas and Ecological Support Areas ▪ Critically endangered and endangered vegetation areas that occur on the site ▪ Bare areas which may be susceptible to soil erosion ▪ Cultural historical sites and elements	Map included in Appendix R
	Rivers, streams and water courses	As above
	Ridgelines and 20m continuous contours with height	As above

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	references in the GIS database	
	Fountains, boreholes, dams (in-stream as well as off-stream) and reservoirs	As above
	High potential agricultural areas as defined by the Department of Agriculture, Forestry and Fisheries	As above
	Buffer zones (also where it is dictated by elements outside the site):	As above
	500m from any irrigated agricultural land	As above
	1km from residential areas	As above
	indicate isolated residential, tourism facilities on or within 1km of the site	As above
	A slope analysis map/layer that include the following slope ranges: • Less than 8% slope (preferred areas for turbines and infrastructure) between 8% and 12% slope (potentially sensitive to turbines and infrastructure) between 12%and 14% slope (highly sensitive to turbines and infrastructure) steeper than 18 % slope (unsuitable for turbines and infrastructure) • A map/layer that indicate locations of birds and bats including roosting	A slope analysis map is included in Chapter 7, Figure 7.2; and Section 7.7 & 7.8 (for Bird & Bats location)
3	**A site development proposal map(s)/layer(s) that indicate:**	
	Turbine positions	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Foundation footprint	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Permanent laydown area footprint	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Construction period laydown footprint	Not applicable and not planned for this development
	internal roads indicating width (construction period width and operation period width) and	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R. The construction and operation width of the roads will remain the same throughout the life span of the development
	with numbered sections between the other site elements which they serve (to make commenting on sections possible)	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R. Road number added for existing road to be upgraded (Number + "e") and for planned new roads (Number + "p") to maps in chapter 10 and Appendix R
	River, stream and water crossing of roads and cables indicating the type of bridging	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	structures that will be used	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	Substation(s) and/or transformer(s) sites including their entire footprint.	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Cable routes and trench dimensions (where they are not along internal roads)	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Connection routes to the distribution/transmission network (the connection must form part of the EIA even if the construction and maintenance thereof will be done by another entity such as ESKOM)	Information available after detailed engineering and design work is available. Final plans will be provided to the DEA prior to commencement of construction
	Cut and fill areas at turbine sites along roads and at substation/transformer sites indicating the expected volume of each cut and fill	Information available after detailed engineering and design work is available. Final plans will be provided to the DEA prior to commencement of construction
	Borrow pits	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Spoil heaps (temporary for topsoil and subsoil and permanently for excess material)	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
	Buildings including accommodation	A final layout map is included as Figure 10.4 in Chapter 10 and an A1-size map is included in Appendix R
4	**The regional map and GIS information should include at least the following:**	
	All maps/information layers must also be provided in ESRI Shapefile format	All information will be included on CD to be submitted with FEIR
	The map/layer must cover an area of 20km around the site and Indicate the following:	CBA Map is included in Appendix R. A separate A1 CBA Map and land use map included in Appendix R. The reason for separating the maps is that the areas identified as CBA areas in the CBA map would cover the entire map, as would the land use classification areas and the map areas would not be clearly visible.
	roads including their types (tarred or gravel) and category (national, provincial, local or private)	National and provincial roads are provided in The Regional Map in Appendix R. These are generally tarred roads. Regional, local and private roads are included in the Layout maps in Appendix R. These are generally gravel roads in this area, only the R354 between Matjiesfontein and Sutherland is tarred"
	Railway lines and stations	Not applicable as none are closer within 20km of the site
	industrial areas	Not applicable as none are closer within 20km of the site
	Harbours and airports	Not applicable as none are closer within 20km of the site. The road from Harbour to site is provided in Figure 4.6 of Chapter 4
	Electricity transmission and distribution lines and substations	Indicated on Locality, Layout and Land Use maps - Appendix R
	Pipelines	Not applicable as none are closer within 20km of

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
		the site
	Waters sources to be utilised during the construction and operational phases	Water will be sourced from newly drilled boreholes - Locations still to be identified. Dams may also be considered. Shown in layout maps and Regional map in Appendix R
	A visibility assessment of the areas from where the facility will be visible	A visibility assessment has been undertaken as part of Visual Impact Assessment - Map 8 (Appendix J)
	Critical Biodiversity Areas and Ecological Support Areas	CBA Map provided in Appendix R
	Critically Endangered and Endangered vegetation areas	Sensitivity Map provided in Appendix R shows ecological sensitive areas
	Agricultural fields	A Land Use map provided in Appendix R shows agricultural areas, cultivated fields and irrigated land.
	irrigated areas	A Land Use map provided in Appendix R shows agricultural areas, cultivated fields and irrigated land.
	An indication of new road or changes and upgrades that must be done to existing roads in order to get equipment onto the site including cut and fill areas and crossings of rivers and streams	Sensitivity Map provided in Appendix R shows new roads to be build and to be upgraded for the project
5	**Important Stakeholders**	
	Amongst other important stakeholders, comments from the National Department of Agriculture, Forestry and Fisheries must be obtained and submitted to the Department. Any application, documentation, notification etc. should be forwarded to the following officials: Ms Mashudu Marubini Delegate of the Minister (Act 70 of 1970) E-mail: MashuduMa@daff.gov.za Tel 012- 319 7619 Ms Thoko Buthelezi AgriLand Liaison office E-mail: ThokoB@daff.gov.za Tel 012- 319 7634	Department of Agriculture, Forestry and Fisheries is included as an Interested and Affected Party in Appendix C. Comment will be obtained during the public participation phase
	All hardcopy applications and documentation should be forwarded to the following address: Physical address: Delpen Building Cnr Annie Botha and Union Street Office 270 Attention: Delegate of the Minister Act 70 of 1970	To be sent by Savannah
	Notification in terms of Section 29 of the Electronic Communications Act (No. 36 of 2005) ("ECA") will have to be sent to all telecommunication stakeholders	Appendix C
	In addition, comments must be requested from Eskom regarding grid connectivity and capacity. Request for comment must be submitted to: Mr John Geeringh Eskom Transmission Megawatt Park D1Y38	Comment included Appendix C.

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
	PO Box 1091 JOHANNESBURG 2000 Tel: 011 516 7233 Fax: 086 661 4064 John.geeringh@eskom.co.za	
B.	**Agricultural study**	
	Detailed soil assessment of the site in question, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include the following:	All requirements in terms of the Soil Assessment - Appendix G have been met by the specialist
	identification of the soil forms present on site	Appendix G, Section 4.3
	The size of the area where a particular soil form is found	Appendix G -Section 4.3, Figure 2
	GPS readings of soil survey points	Appendix G - Section 5
	The depth of the soil at each survey point	Appendix G - Section 5
	Soil colour	Appendix G - Section 5
	Limiting factors	Appendix G - Section 3.1
	Clay content	Appendix G - Section 5
	Slope of the site	Appendix G - Section 4.4
	A detailed map indicating the locality of the soil forms within the specified area,	Appendix G -Section 4.3, Figure 2
	Size of the site	Appendix G Section 1
	Exact locality of the site	Appendix G - Section 1
	Current activities on the site, developments, buildings	Appendix G - Section 7
	Surrounding developments / land uses and activities in a radius of 500 m of the site	
	Access routes and the condition thereof	Appendix G - Section 3
	Current status of the land (including erosion, vegetation and a degradation assessment)	Appendix G - Section 4.5
	Possible land use options for the site	Appendix G - Section 8
	Water availability, source and quality (if available)	Appendix G - Section 8
	Detailed descriptions of why agriculture should or should not be the land use of choice	Appendix G - Section 8
	Impact of the change of land use on the surrounding area	As above
	A shape file containing the soil forms and relevant attribute data as depicted on the map	shapefiles included on CD with FEIR
C.	**Astronomy Geographic Advantage Act**	
	You are requested to indicate the applicability of the Astronomy Geographic Advantage Act, Act No. 21 of 2007 on the application in the BAR/EIR. You must obtain comments from the Southern African Large Telescope (SALT) if the proposed development is situated within a declared astronomy advantage area.	Impacts on SALT are assessed in Chapter 8 section 8.6.2. Chapter 5 Table 5.2 provides an indication of the applicability of the project in terms of the Geographic Advantage Act. SALT/SAAO is a stakeholder on the I&AP database and their comments are included in the final EIAr. The project developers are engaging with the CAA to ensure that requirements for night lighting of turbines make a provision for reducing/limiting impacts on the activities of the SALT. Discussions have been held between DST, SAOO,

DEA Ref. #	Items in terms of Scoping Acceptance Requirements	Report Reference
		CAA and the developer during 2015 to discuss a practical measure that will be adopted to mitigate for night lighting of turbines in the area while maintaining the safety requirements of the civil aviation industry. It is acknowledged that the visual impact assessment as it currently may have been inadequate to assess the impact of lighting impacts on SALT. Karreebosch Wind Farm undertakes to continue consultations with SAAO/SALT and the Civil Aviation Authority to ensure that the potential light pollution impacts on SALT activities are mitigated prior to construction of the wind energy facility. As a condition of approval, such consultation with SAAO/SALT and CAA must mandated to ensure that the potential light pollution impacts on SALT activities are mitigated.

Requirements in terms of Appendix 3 of 2014 EIA Regulations

DEA Ref. #	Item	Where addressed in the report by Savannah
1	(1) The environmental impact assessment process must be undertaken in line with the approved plan of study for environmental impact assessment. (2) The environmental impacts, mitigation and closure outcomes as well as the residual risks of the proposed activity must be set out in the environmental impact assessment report	Process was undertaken in line with the approved plan of study, see above detailed checklist on all scoping approval conditions for additional details. Refer to chapter 6 of the EIA report for the EIA methodology and motivation, chapter 8 and 9 for impacts and mitigation
2	**Objective of the environmental impact assessment process**	
a)	determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;	Chapter 5, table 5.2
b)	describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;	Chapter 2
c)	identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;	Chapter 10, section 10.6, Also Chapter 8 and 9
d)	determine the-- (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and (ii) degree to which these impacts- (aa) can be reversed;	EIA methodology covers all requirements, Chapter 8 and 9

DEA Ref. #	Item	Where addressed in the report by Savannah
	(bb) may cause irreplaceable loss of resources, and (cc) can be avoided, managed or mitigated;	
e)	identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;	Chapter 10
f)	identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;	Included in impact assessment (Chapter 8)
g)	identify suitable measures to avoid, manage or mitigate identified impacts; and	Included in impact assessment (Chapter 8)
h)	identify residual risks that need to be managed and monitored.	Included in impact assessment (Chapter 8)
3	**Scope of assessment and content of environmental impact assessment reports**	
	An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include-	
a)	details of- (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;	Details included in Appendix A (CVs) and Section 1.7
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; and (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Chapter 1, Section 1.1.1 (farm name and location, 21 Digit code and map) and Section 1.4
c)	a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure 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; (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Plan included in Appendix R (A3 and A1 Maps). See Appendix Q for co-ordinates
d)	a description of the scope of the proposed activity, including- (i) all listed and specified activities triggered and being applied for; and (ii) a description of the associated structures and infrastructure related to the development; and (iii) a description of the activities to be undertaken and for a linear activity, a description of the route of the activity; (iv) the sector classification of the activity as identified in the national electronic register;	"Chapter 4 includes all details relating to scope Chapter 5, Section 1 contains the listed activities triggered Sector Classification included in section 4.2.2"
e)	a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	Chapter 5, Table 5.2

DEA Ref. #	Item	Where addressed in the report by Savannah
f)	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;	Chapter 2, Section 2.1
g)	a motivation for the preferred development footprint within the approved site; (i) details of the sites considered, including maps and coordinates; (ii) details of the public participation process undertaken at each of the sites in terms of regulation 44 of these 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 into the scoping document, or the reasons for not including them; (iv) the environmental attributes associated with the sites identified focusing on the geographical, physical, biological, social, economic and cultural aspects; (v) the impacts identified including the significance, probability and duration of the impacts; (vi) the methodology used in determining the significance of potential environmental impacts and risks; (vii) description of the advantages and disadvantages that the proposed activity and alternatives will have on the environment and on the community that may be affected; (viii) the possible mitigation measure that could be applied and level of residual risk; (ix) the outcome of the site selection matrix; (x) if no alternatives sites were investigation, the motivation for not considering; alternative sites; and (xi) a statement motivating the preferred site;	Chapter 10 as well as specialist study input included as Appendices D - L, summarized in chapter 8
h)	a full description of the process followed to reach the proposed development footprint within the approved site, including:	Chapter 2 describes this process in full
i)	a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including: (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Chapter 6
j)	an assessment of each identified potentially significant impact and risk, including- (i) cumulative impacts; (ii) the nature, significance and consequences of the impact and risk;	"Chapter 8 includes the summary from the specialist reports. All reports comply with Appendix 6 of the EIA regulations, Conclusion in Chapter 10"

DEA Ref. #	Item	Where addressed in the report by Savannah
	(iii) the extent and duration of the impact and risk; (iv) the probability of the impact and risk occurring; (v) the degree to which the impact and risk can be reversed; (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) the degree to which the impact and risk can be mitigated;	
k)	where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	Chapter 8 includes the summary from the specialist reports. All reports comply with Appendix 6 of the EIA regulations, Conclusion in Chapter 10
l)	an environmental impact statement which contains-	Chapter 10 in the various sections
	(i) a summary of the key findings of the environmental impact assessment:	"A summary per impact category is provided at the end of each section of Chapter 8, a summary table is provided in Chapter 9 and Chapter 10, section 10.2"
	(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	Chapter 10, section 10.5 and section 10.6
	(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Chapter10, section 10.2 and 10.6
m)	based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	Impact management objectives and outcomes included in impact tables in chapter 8. Recommendation included in Chapter 10, section 10.8
n)	the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	Chapter 10, Section 10.6
o)	any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation	Chapter 10, Section 10.8
p)	a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed	Chapter 6, section 6.1.5 as well as the various specialist studies (appendix D-L)
q)	a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation	Chapter 10, Section 10.8
r)	where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	n/a - the activity does include operational aspects. Also covered in Chapter 10, section 10.8
s)	an undertaking under oath or affirmation by the EAP in	Included as Appendix N

DEA Ref. #	Item	Where addressed in the report by Savannah
	relation to: (i) the correctness of the information provided in the reports; (ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	
t)	where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	N/A – this is confirmed not applicable for renewable energy projects
u)	an indication of any deviation from the approved scoping report, including the plan of study, including- (i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and (ii) a motivation for the deviation;	Section 6.2.4
v)	any specific information that may be required by the competent authority; and	All specific information supplied, as per this checklist
w)	any other matters required in terms of section 24(4)(a) and (b) of the Act.	There is nothing in the Sections of the Act that has not been adequately covered within the EIA report.

DEA Ref. #	Items in terms of EIA-Phase Comment Letter from DEA	Report Reference
i	All listed activities applied for are specific and can be linked to development activity or infrastructure described in the project description.	All listed activities are linked to specific infrastructure in; Chapter 5 Section 5.1 & table 5.1
ii	If activities applied for differ from those mentioned in final EIR, an amended application form must be submitted. The department's application form template has been amended and can be downloaded from environment.gov.za/documents/forms	Amended application form was submitted previously to DEA with Draft EIR.
iii	Please ensure all issues raised and comments received during circulation of EIR from I&APs and organs of state which have jurisdiction, including this department's biodiversity section, in respect of the proposed activity are adequately addressed and included in the FEIR. Proof of correspondence with stakeholders must be included in the FEIR. Should you be unable to obtain comments, proof should be submitted to the department of attempts made to obtain comments.	Comments and response report included in Appendix C. Proof of correspondence and attempts made to obtain comment also included in Appendix C.
iii	The PP process must be conducted in terms of Regulation 39, 40, 41, 42, 43, 44 of the 2014 EIA regulations	All requirements complied with – refer to Chapter 6 and Appendix C
iv	Please ensure layout alternatives away from highly sensitive areas and bird & bat flight paths are assessed and presented. If no practical / feasible alternatives exist	"This is assessed in Chapter 8. Bird & bat flight paths are specifically addressed in section 8.2 and 8.3. A statement is also made from the bat

DEA Ref. #	Items in terms of EIA-Phase Comment Letter from DEA	Report Reference
	written proof of such an assessment and motivation as to why it is not practical / feasible must be submitted with the FEIR.	specialist in this regard in section 3.2 of Appendix F (bat assessment). CBAs are covered in the Ecology specialist report (Appendix D), flight paths and exclusion zones are covered by the Avifauna specialist report (Appendix E1&2). In addition, certain turbine positions and associated infrastructure was moved or removed from the layout as a direct result of the ecology, bat and bird recommendations, see chapter 10 for details.
v	Recommendations provided by specialist reports must be considered and used to inform layout alternatives	All recommendations have been considered. Specialist recommendations have been used to inform the layout as seen in chapter 10 section 10.6
vi	Issues surrounding the possibility of an offset area as highlighted in the DEIR must be adequately addressed and presented in the FEIR. Provincial authorities must be part of deliberations and proof of such deliberations must be submitted with the FEIR. This must also be used to inform layout alternatives.	It should be noted that the areas being referenced by the DEA are not strictly offset areas but are actually compensation areas (refer to Appendix D2 – further explanation from the ecologist regarding these areas). These areas are discussed in sections 8.1, specifically 8.1.3. Figure 8.3 shows these areas. Layout has been designed to avoid these areas.
vii	The EIR must provide technical details of the facility in table format as well as description / dimensions. Sample provided under point 2 of EIA info required for WEFs as requested in scoping acceptance letter.	Table included in chapter 4, Section 4.2.2
viii	Final EIR must comply with requirements in terms of scope of assessment and content of the EIR in accordance with Appendix 3 of the EIA regulations 2014	Refer to Appendix 3 checklist included in FEIR
ix	In terms of regulation 45 the application will lapse if the applicant fails to meet any of the timeframes prescribed in terms of these regulations, unless an extension has been granted in terms of Regulation 37	Noted.

INTRODUCTION CHAPTER 1

Karreebosch Wind Farm (Pty) Ltd proposes to construct a wind energy facility on a site located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland. The site falls within the Karoo Hoogland Local Municipality, Northern Cape and the Laingsburg Local Municipality, Western Cape. The proposed facility will utilise wind turbines to generate electricity that will be fed into the National Power Grid. This project was part of an initial Environmental Impact Assessment (EIA) application for the larger Roggeveld Wind Farm which has now being considered and assessed as three smaller Phases of 140MW each. This current EIA application pertains to Karreebosch Wind Farm (Phase 2 of Roggeveld Wind Farm) DEA Ref. No. 14/12/16/3/3/2/807).

Karreebosch Wind Farm (referred to as Karreebosch in this report) is the northern section of the broader Roggeveld project area. Karreebosch Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities by Independent Power Producers in South Africa. The purpose of the proposed wind energy facility is to sell the electricity generated to Eskom through a power purchase agreement under the REIPPP Programme.

The nature and extent of Karreebosch Wind Farm, as well as potential environmental impacts associated with the construction, operation and decommissioning of a facility of this nature are assessed in this Environmental Impact Assessment (EIA) Report. This EIA Report consists of the following sections:

» **Chapter 1** provides background to the proposed wind energy facility project and the environmental impact assessment process.
» **Chapter 2** provides information on the site selection process and consideration of alternatives within the EIA process.
» **Chapter 3** describes the operating characteristics of a wind energy facility.
» **Chapter 4** describes the project and the construction, operation and decommissioning phases of the wind energy facility.
» **Chapter 5** outlines the legislation and guidelines that are applicable to the project
» **Chapter 6** outlines the process which was followed during the EIA Process of the project, including the public consultation programme that was undertaken.
» **Chapter 7** describes the existing biophysical and socio-economic environment.

- **Chapter 8** describes the assessment of environmental impacts related to Karreebosch Wind Farm.
- **Chapter 9** assesses cumulative impacts.
- **Chapter 10** presents the conclusions of the impact assessment as well as the impact statement for the Karreebosch Wind Farm project.
- **Chapter 11** provides a list of references used in the report.

1.1. Project Description and Summary

The overarching objective for the wind energy facility planning process is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operational and maintenance costs, as well as social and environmental impacts. As local-level environmental and planning issues (except for the identification of obvious fatal flaws) were not assessed in sufficient detail through the regional-level site identification process, these issues were considered within site-specific studies and assessments through the EIA process in order to delineate areas of sensitivity within the broader site, and ultimately assess the potential impacts associated with the placement of the wind turbines and associated infrastructure on the site.

The performance of the wind turbines is also determined by disturbances to the wind resource, which requires that the turbines are appropriately spaced on the site. The wind energy facility is proposed to accommodate up to 71 turbines. The turbines and associated infrastructure are proposed to be positioned over an area of less than 320 km^2.

The scope of the proposed Kareebosch Wind Farm, including details of all elements of the project (for the construction, operation and decommissioning phases) is discussed in detail in Chapter 4.

1.1.1. Development Site location

The proposed wind energy facility site is located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland. The site falls within the Karoo Hoogland Local Municipality, Namakwa District Municipality within the Northern Cape Province and Laingsburg Local Municipality, Central Karoo District Municipality within the Western Cape Province. The site falls within Ward 4 of Laingsburg Local Municipality and Ward 1 of the Karoo Hoogland Local Municipality. The majority of the project infrastructure falls within the Northern Cape with only a section of the power line falling in the Western Cape province.

The nearest towns include Matjiesfontein and Laingsburg in the Western Cape Province and Sutherland in the Northern Cape Province. The turbine infrastructure will be positioned in the Northern Cape part of the site, while the proposed power line connection routes investigated for this phase of the project extend into the Western Cape Province. The broader study area for Karreebosch Wind Farm is ~320 km^2 in extent which includes the following eighteen farm portions (refer to Figure 1.1):

Portion Farm Name Farm No	Local Municipality	Province
The Farm Appelsfontein 201	Karoo Hoogland Municipality	Northern Cape
The Remainder of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
The Remainder of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karre Kloof 196	Karoo Hoogland Municipality	Northern Cape
The Remainder of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
The Farm Kranskraal 189	Karoo Hoogland Municipality	Northern Cape
The Farm Oude Huis 195	Karoo Hoogland Municipality	Northern Cape
The Farm Rietfontein 197	Karoo Hoogland Municipality	Northern Cape
The Farm Roode Wal 187	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Standvastigheid 210	Karoo Hoogland Municipality	Northern Cape
The Remainder of Wilgebosch Rivier 188	Karoo Hoogland Municipality	Northern Cape
The Farm Aprils Kraal 105	Laingsburg Municipality	Western Cape
The Remainder of Bon Espirange 73	Laingsburg Municipality	Western Cape
Portion 1 of Bon Espirange 73	Laingsburg Municipality	Western Cape

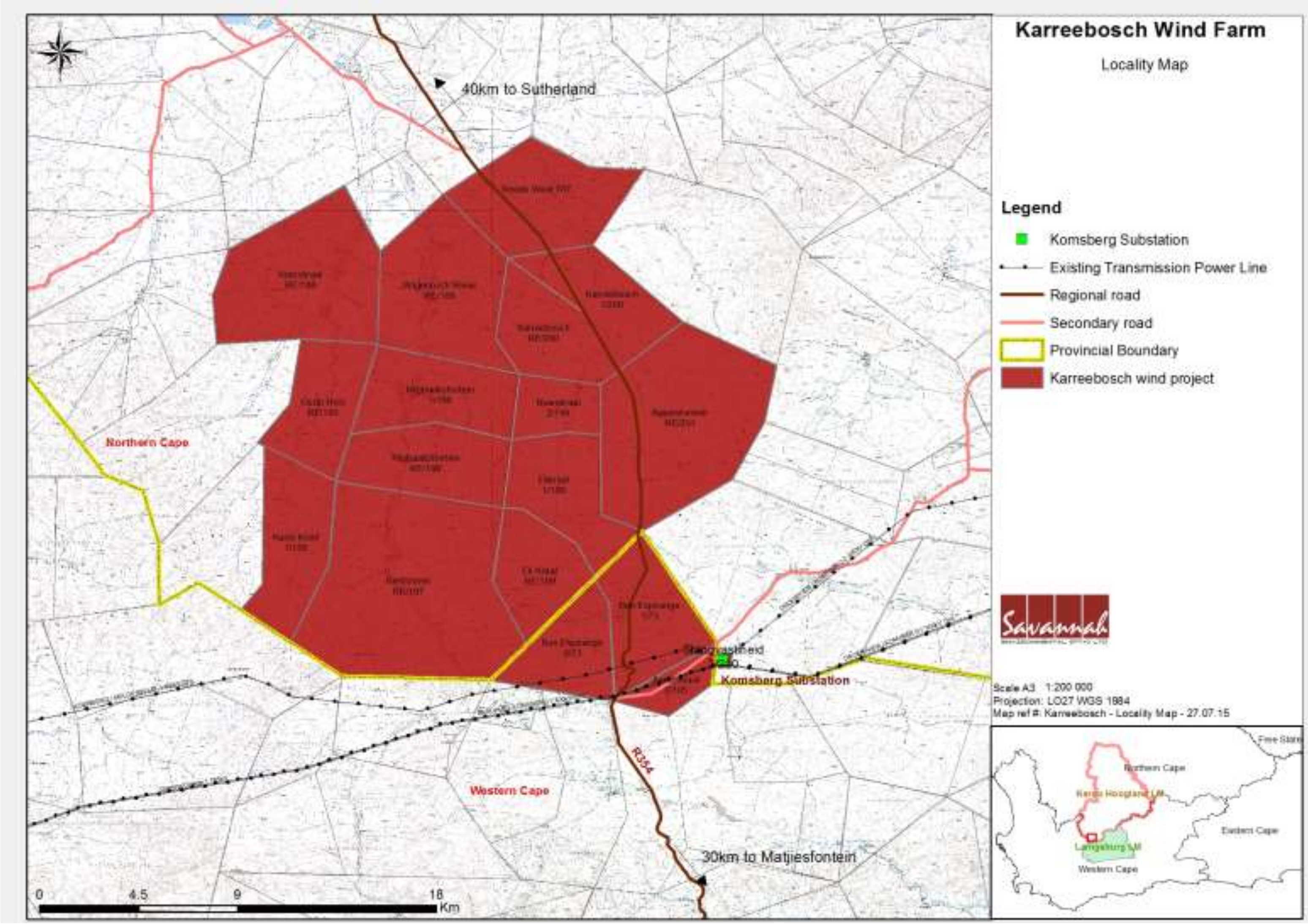

Figure 1.1: Locality map showing the farm portions and study area for the Karreebosch Wind Farm (A3 map included in Appendix P)

The 21 digit surveyor general codes for the above properties are as follows:

SG Code	Farm Name and number
C04300000000007300000	The Remainder of Bon Espirange 73
C04300000000007300001	Portion 1 of Bon Espirange 73
C04300000000010500000	The Farm Aprils Kraal 105
C04300000000018700000	The Farm Roode Wal 187
C04300000000018800000	The Remainder of Wilgebosch Rivier 188
C04300000000019500000	The Farm Oude Huis 195
C04300000000018900000	The Farm Kranskraal 189
C04300000000019600001	Portion 1 of Karre Kloof 196
C04300000000019700000	The Farm Rietfontein 197
C04300000000019800000	The Remainder of Klipbanksfontein 198
C04300000000019800001	Portion 1 of Klipbanksfontein 198
C04300000000019900000	The Remainder of Ek Kraal 199
C04300000000019900001	Portion 1 of Ek Kraal 199
C04300000000019900002	Portion 2 of Ek Kraal 199
C04300000000020000000	The Remainder of Karreebosch 200
C04300000000020000001	Portion 1 of Karreebosch 200
C04300000000020100000	The Farm Appelsfontein 201
C04300000000021000002	Portion 2 of Standvastigheid 210

1.1.2. Project infrastructure

In summary, the infrastructure to be constructed as part of the wind energy facility includes the following:

- » Up to 71 wind turbines (2MW to 3.3MW in capacity each) with a foundation of 25m in diameter and 4m in depth.
- » The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
- » Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
- » Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
- » Internal access roads up to 12 m wide.
- » Approximately 25km of 33kV overhead power lines linking the turbine strings to each other and to the on-site substations
- » Approximately 25km of 132kV overhead power lines from the on-site substation to Eskom's Komsberg Substation.
- » Up to two electrical substations on-site (33/132 kV substations with a footprint of 100m x 200m each)

» Underground park cabling between turbines buried along the internal access roads, where feasible.
» Extension of the existing 400kV Eskom Komsberg Substation
» An operations and maintenance building (O&M building).
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~3ha).

A detailed project description including the components of Karreebosch Wind Farm (including details of the construction, operation and decommissioning Phases) are discussed in Chapter 4.

1.1.3. Facility layout

Up to 71 wind turbines[2] are proposed to be constructed on the Karreebosch site, with an estimated total contracted capacity for the proposed facility of up to 140MW. The number of wind turbines will be influenced based on specialist input, technical revisions and environmental sensitivity. The electricity generation capacity of Karreebosch Wind Farm will depend on the most suitable wind turbine (in terms of the turbine efficiency; a function of rotor diameter, height, generator size, performance and cost) selected by the developer. Turbines of between 2 and 3.3 MW in capacity are being considered for the site. The worst case scenario i.e. a wind turbine up to 3.3 MW in capacity will possibly result in the reduction of number of wind turbines.

Various specialist software packages are available to assist developers in selecting the optimum position for each turbine before the project is constructed. The developer's scientific background has enabled them to create highly specialised wind measurement and analysis tools. These include a mesoscale wind atlas, which can be used to calculate wind speed and consistency across a large area at high-resolution enabling the developer to locate and validate optimum sites for wind farm development. The wind resource for the Karreebosch site has been monitored for over 4 years using equipment mounted on 60 m high wind monitoring towers. The general industry requirement is to collect at least 12 months data in order to evaluate the exact wind resources properties of a particular site. This enables the developer to reduce the market risk by ensuring that the sites they have earmarked for development are more likely to lead to commercially viable projects. This layout also informed the positioning of other infrastructure such as access roads and substation/s. The positioning or detailed

[2] The number of wind turbines will ultimately be influenced by environmental constraints, specialist input, technical revisions and planning criteria.

layout of the components of this wind energy facility has been developed and is shown in Figure 1.2. Final placement will be informed by the outcomes of the EIA.

1.2. Requirement for an Environmental Impact Assessment Process

The Karreebosch Wind Farm is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) December 2014 published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998). In terms of sections 24 and 24D of NEMA, as read with Government Notices R982, R983, R984, R985, a Scoping and EIA process is required for the proposed project.

NEMA is national legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. The National Department of Environmental Affairs (DEA) is the competent authority for this project. An application for authorisation for Karreebosch Wind Farm has been accepted by the DEA (under Application Reference number: 14/12/16/3/3/2/807). Through the decision-making process, the DEA will be supported by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) and the Northern Cape Department of Environment and Nature Conservation (DENC), as the commenting authorities.

The need to comply with the requirements of the EIA Regulations ensures that decision-makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be taken regarding the project. Karreebosch Wind Farm (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to complete the EIA Report for Karreebosch Wind Farm[3].

[3] Note that Environmental Resource Management (Pty) Ltd had undertaken full scoping and EIA process (DEA Ref. No.: 12/12/20/1988) for the 750MW Roggeveld Wind Farm between 2010 – 2013. The EAP has now changed to Savannah Environmental and a new application for authorisation for the Karreebosch Wind Farm project has been made under the December 2014 EIA Regulations.

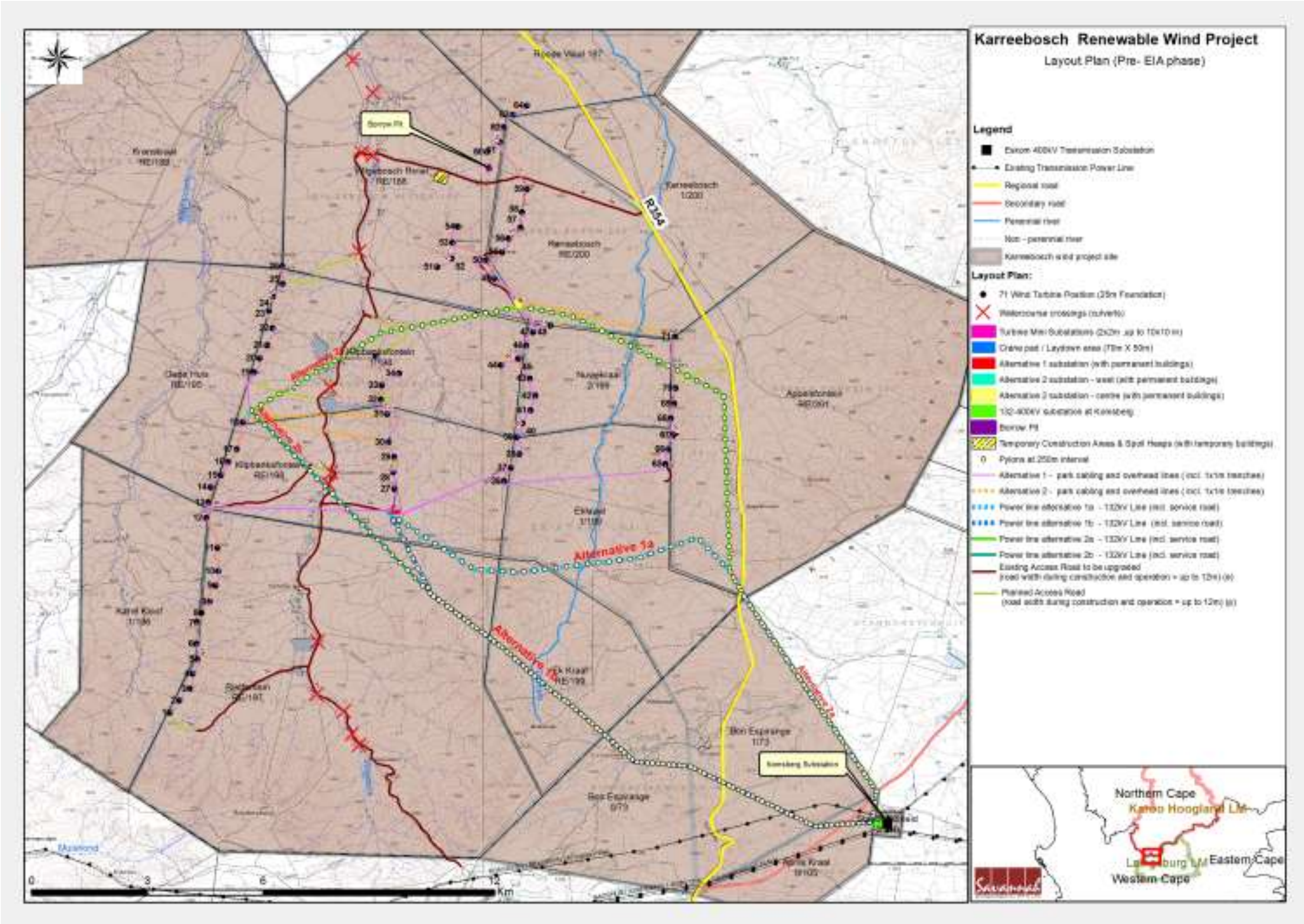

Figure 1.2: Layout map showing the technical design and layout for Karreebosch Wind Farm (A3 map included in Appendix R[4])

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[4] A1 Maps also submitted to DEA

An EIA is also an effective planning and decision-making tool for the project proponent. It allows the environmental consequences resulting from a technical facility during its establishment and its operation to be identified and appropriately managed. It provides the opportunity for the developer to be forewarned of potential environmental issues, and allows for resolution of the issue(s) reported on in the Scoping and EIA reports as well as dialogue with affected parties.

This report documents the assessment of the potential environmental impacts of the proposed construction and operation of the Karreebosch Wind Farm. This study concludes the EIA process and was conducted in accordance with the requirements of the EIA Regulations in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

1.3. EIA Process and Purpose of the EIA Report

The EIA process consists of a scoping Phase and an EIA Phase. The Scoping Phase refers to the process of identifying potential issues associated with the proposed project, and defining the extent of studies required within the EIA Phase. This was achieved through an evaluation of the proposed project in order to identify and describe potential environmental impacts.

The EIA Phase aimed to address those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with the project including design, construction, operation and decommissioning, and recommend appropriate mitigation measures for potentially significant environmental impacts. The purpose of this EIA report is to consider the impacts associated with the currently proposed layout for the Karreebosch Wind Farm. This EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The release of a draft EIA Report for a 30 day period provided stakeholders with an opportunity to consider the Karreebosch Wind Farm wind turbine layout. The final EIA Report for submission to DEA now incorporates all issues and responses raised during the public review period of the draft report.

1.4. Details of Environmental Assessment Practitioner and Expertise to conduct the Scoping and EIA

Savannah Environmental was contracted by Karreebosch Wind Farm (Pty) Ltd as the independent environmental consultant to undertaken the EIA for the proposed project. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of or are affiliated to Karreebosch Wind Farm (Pty)

Ltd. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing holistic environmental management services, including environmental impact assessments and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

The Savannah Environmental team have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation.

The EAPs from Savannah Environmental who are responsible for this EIA process are:

» John von Mayer – a registered Professional Natural Scientist and the principal author of this report. He holds a Bachelor of Science degree with Honours in Environmental Science and has 7 years of experience in environmental management and environmental impact assessment.
» Karen Jodas - a registered Professional Natural Scientist and holds a Master of Science degree. She has 18 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development. She is currently responsible for the project management of EIAs for several renewable energy projects across the country.

In order to adequately identify and assess potential environmental impacts associated with Karreebosch Wind Farm, Savannah Environmental obtained input from the following specialist sub-consultants to conduct revised/ updated specialist impact assessments for the Karreebosch project:

Specialist	**Area of Expertise**
Simon Todd of Simon Todd Consulting	Ecology (including flora and fauna)
Tony Williams of African Insights cc	Avifauna

Specialist	Area of Expertise
Rob Simmons of Birds Unlimited Environmental Consultants	Avifauna (specific focus on raptors)
Werner Marais of Animalia	Bats
Lourens du Plessis of MetroGIS	Visual impact
Tim Hart and team of ACO Associates	Heritage
Tony Barbour Environmental Consulting and Research	Social
Adrian Jongens of JKA Associates	Noise
Dr John Almond of Natura Viva cc	Palaeontology
Dr Brian Colloty of Scherman Colloty & Associates	Hydrology
Jaco Jansen of Savannah Environmental and Jasper Dreyer of the North West University	Soils and Agricultural potential
Gabriele Wood	Public Participation

The curricula vitae for EAPs from Savannah Environmental as well as the specialist consultant team are included in Appendix A.

SITE SELECTION, SITE SUITABILITY AND SITE ALTERNATIVES CHAPTER 2

In terms of the Environmental Impact Assessment (EIA) Regulations, reasonable and feasible alternatives are required to be considered within the Environmental Impact Assessment process. All identified, feasible alternatives are required to be assessed in terms of social, biophysical, economic and technical factors.

This chapter explores the following:

» The need and desirability of a project of this nature within the local, regional, and national context;
» A consideration of project alternatives, including the "do nothing" option.

The site for the proposed Karreebosch Wind Farm is located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland and falls within both the Northern Cape and Western Cape Provinces. Up to 71 wind turbines are proposed to be constructed within a broader area of approximately 320 km^2 in extent. Depending on the final turbine selection, the estimated total contracted capacity for the proposed facility is up to 140MW.

2.1. Site Selection

The proposed site was selected for the development of the Karreebosch Wind Farm based on its predicted wind resource (high wind speeds), suitable proximity in relation to the existing electricity grid, and minimum technical constraints from a construction and technical point of view. Karreebosch Wind Farm (Pty) Ltd considers the Karreebosch site as well-suited for wind energy development due to the strength of the prevailing wind resources (confirmed by more than four years of wind monitoring on the site).

During the site selection phase the developer commissioned an environmental and social pre-feasibility assessment of 14 sites, including the entire Roggeveld Wind Farm site where Karreebosch wind farm is the second phase of. This study, which was undertaken by Coastal and Environmental Services (CES)[5] in 2009 and included a high-level screening of potential environmental and socio-economic issues, as well as 'fatal flaws'. Amongst a number of other potential sites in the Karoo region identified as being potentially suitable from a wind resource perspective, the Karreebosch Wind Farm site was selected by the developer.

[5] The study is available from G7 Renewable Energies on request.

Once the land lease agreements had been entered into with the landowners, the wind measurement campaign commenced with the erection of wind monitoring masts to assess the wind resource patterns on the site.

Site selection for the proposed project considered the following aspects:

» Wind resource: Analysis of publicly available information, proprietary information and specialist on-site analysis of weather data indicated that the site has sufficient wind resource to make a wind energy facility financially viable.
» Site extent: Sufficient land was secured under long-term lease agreements to allow for a minimum number of wind turbines to make the project feasible.
» Grid access: Grid access and the distance to a viable connection point were key considerations in terms of prioritising appropriate sites. Ease of access into the Eskom electricity grid is vital to the viability of a wind facility. Projects which are in close proximity to a connection point and/or demand centre are favourable, and reduce the losses associated with power transmission. Grid access is deemed favourable for this site due to the existence of the existing Eskom Komsberg Substation.
» Land suitability: The current land use of the site is an important consideration in site selection in terms of limiting disruption to existing land use practices. Agricultural land was preferred as the majority of farming practices can continue in tandem to the operation of the wind farm once the construction and commissioning of the project is complete. Sites that facilitate easy construction conditions (relatively flat, limited watercourse crossings, lack of major rock outcrops) are also favoured during site selection.
» Proximity to aerodromes: The proximity to aerodromes and possible interactions with these facilities was considered as part of site selection. The Karreebosch site is not close to major aerodromes.
» Landowner support: The selection of sites where the landowners are supportive of the development of renewable energy is essential for ensuring the success of the project. The landowners do not view the development as a conflict with their current land use practices.

The consideration of the above criteria resulted in the selection of the preferred site by the developer. Therefore, no further site location alternatives were considered in the EIA process.

A number of the sites considered in the pre-feasibility assessment were flagged as having potentially significant environmental issues. For example two sites were considered as fatally flawed for the presence of numerous water bodies and the expected abundance of important water birds. Other sites were identified to have several technical issues such as limited access to high voltage grid connection or uncompetitive wind resources determined from the individual on-site wind measurement campaign. These sites were then excluded from developers list of priority sites while the remaining sites were prioritised in terms of those that held the best potential for success subject to an EIA being completed. The entire extent of the original Roggeveld site was selected by the developer as one of five priority sites. The pre-feasibility study concluded that what is now known as the Karreebosch site had sufficient potential for further consideration in an EIA process. Following the pre-feasibility assessment, the EIA and other permitting processes for the Karreebosch Wind Farm were commissioned.

Furthermore the National Department Environmental Affairs (DEA) initiated a process for Strategic Environmental Assessment (SEA) in 2013 for the identification of Renewable Energy Development Zones (REDZ), discussed in Section 2.2.4 of this chapter. The site selection for the Karreebosch Wind Farm was is in line with the priority areas identified in the REDZ. It has to be noted here that the neither the SEA nor the REDZ have been gazetted at this stage.

The proposed site was selected for the development of a wind energy facility based on its predicted wind climate (high wind speeds), suitable proximity in relation to the existing electricity grid, and minimum technical constraints from a construction and technical point of view. Karreebosch Wind Farm (Pty) Ltd considers this area, and specifically the demarcated site, to be highly preferred for wind energy facility development.

2.2. The Need and Desirability of the Development at the preferred site location

The Karreebosch Wind Farm is proposed to be constructed outside of the urban edge. The 18 farms where the project is proposed to be located have not been considered for an alternative land use such as urban development. The site is also located within an area which has become a node for renewable energy projects, with the following preferred bidder projects (PB) located directly adjacent to, or in close proximity to, the project development site: Roggeveld Wind Farm, Karusa Wind Farm, and Soetwater Wind Farm. Given the competitive nature of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), a high wind resource and grid connectivity suitability are some of the most important factors for success. The selection of the above-mentioned projects as PB, with Roggeveld Wind Power bidding the very lowest fully indexed price (see Figure 1 below), and the location of Karreebosch wind farm being directly adjacent to the North of the Roggeveld wind farm is a confirmed indicator that the Karreebosch wind farm possesses the required wind resources and grid connectivity characteristics to be highly competitive and suitable for the selection process by the Department of Energy for future bidding rounds of the REIPPPP.

Preferred Bidders
Onshore Wind

Project Name	Contracted Capacity	Fully Indexed Price* (ZAR/MWh)	Partially Indexed Price* (ZAR/MWh)	Portion Indexed
Golden Valley Wind	117 MW	R 583,00	R 830,00	33,1%
Oyster Bay Wind Farm	140 MW	R 612,31	R 875,93	20,0%
Roggeveld Wind Farm	140 MW	R 559,70	R 894,50	20,0%
The Karusa Wind Farm	140 MW	R 666,52	R 994,16	20,0%
The Nxuba Wind Farm	139 MW	R 671,23	R 941,67	20,0%
TOTAL	676 MW			

* April 2014 base date

Figure 1 Excerpt from the Department of Energy's REIPPPP Bid Window 4 Preferred Bidders' Announcement on 16 April 2015

2.2.1. The Desirability for the Wind Energy Facility: Receptiveness of the site to development of a wind farm

The use of wind power for electricity generation is essentially a non-consumptive use of a natural resource. Wind monitoring has been undertaken using 6 x 60m wind monitoring masts in order to confirm the wind resource on the site, and ultimately inform the layout of the facility well as the turbine selection process. The site displays characteristics which, in the opinion of the Karreebosch Wind Farm (Pty) Ltd experienced wind development team, make this development and project site desirable for Karreebosch Wind energy facility:

» The site covers an area of ~320 km^2 which will allow for a significant installed capacity on one location. The area would form part of the identified node for wind energy in the Sutherland area (the Komsberg Wind Focus Area as identified by DEA as part of the REDZ.
» The strength and direction of the prevailing wind resources i.e. the predicted wind climate was measured over the duration of more than 4 year. This determined high average wind speeds exceeding 7.5 m/s over the entire site from its preferable main wind directions (see Figure 2 and 3 below). The economic viability of a wind energy facility is directly dependent on the annual wind speeds. This area of the Northern Cape close to the Escarpment is

known to receive some of the highest average daily wind speeds in South Africa.

- » Topography of the site, i.e. hills and ridges within the project area have a significant influence on average wind speed and represent areas of greater electricity generation relative to the number of turbines and the disturbance footprint.
- » The suitable proximity in relation to the existing electricity grid:
  - The Komsberg Substation is adjacent to the Karreebosch Wind Farm site and the electricity from the project will be evacuated directly into this substation.
  - There are three 140 MW preferred bidder projects in the immediate area. The grid in the area is being strengthened to accommodate these projects. This makes the area more suitable for new energy generation projects from a technical feasibility perspective.
- » Generation of electricity on the proposed site will significantly reduce transmission losses experienced by Eskom due to decentralised generation.
- » Construction and operation of the facilities would permit the continuation of present farming activities (mainly sheep farming) and as such so it would not be considered a drastic loss of agricultural land.
- » The current land-use on the site is agriculture. The proposed site and majority of land surrounding it have minimal or no crop farming taking place. The development of the wind energy facility will allow current livestock grazing on areas of the farm portions which will not be occupied by wind turbines and associated infrastructure. Therefore the current land-use will be retained to a large degree, while also generating renewable energy from the wind. This represents a win-win situation for landowners and the developer.
- » The proximity of the site to the National and Regional roads decreases the impact on secondary roads from traffic during the construction and operation phases for the transportation of material and components. As material and components would need to be transported to the project site during the construction phase of the project, direct accessibility to the site was a key factor in determining the viability of the project, particularly taking transportation costs (direct and indirect) into consideration and the impact of this on project economics and therefore the ability to submit a competitive bid under the DoE's REIPPPP programme.

Furthermore, the developer has been measuring the wind resources at the larger Roggeveld site for more than 4 years and has determined with certainty that the site is viable for commercial electricity generation using wind turbines.

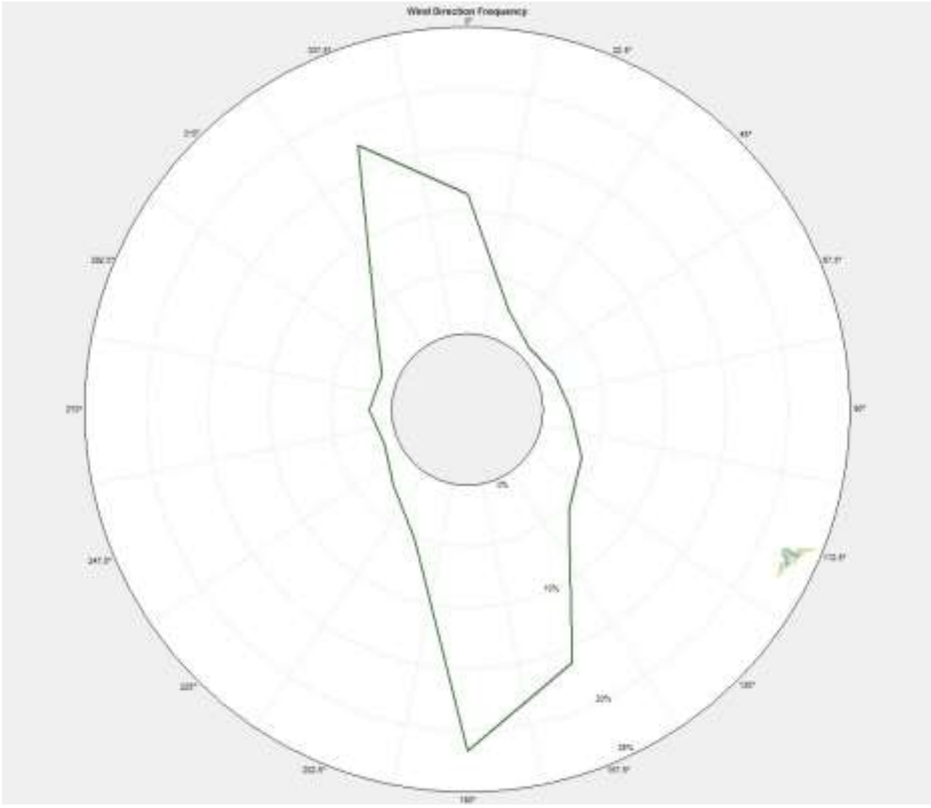

Figure 2 Wind Rose indicating the dominant wind directions

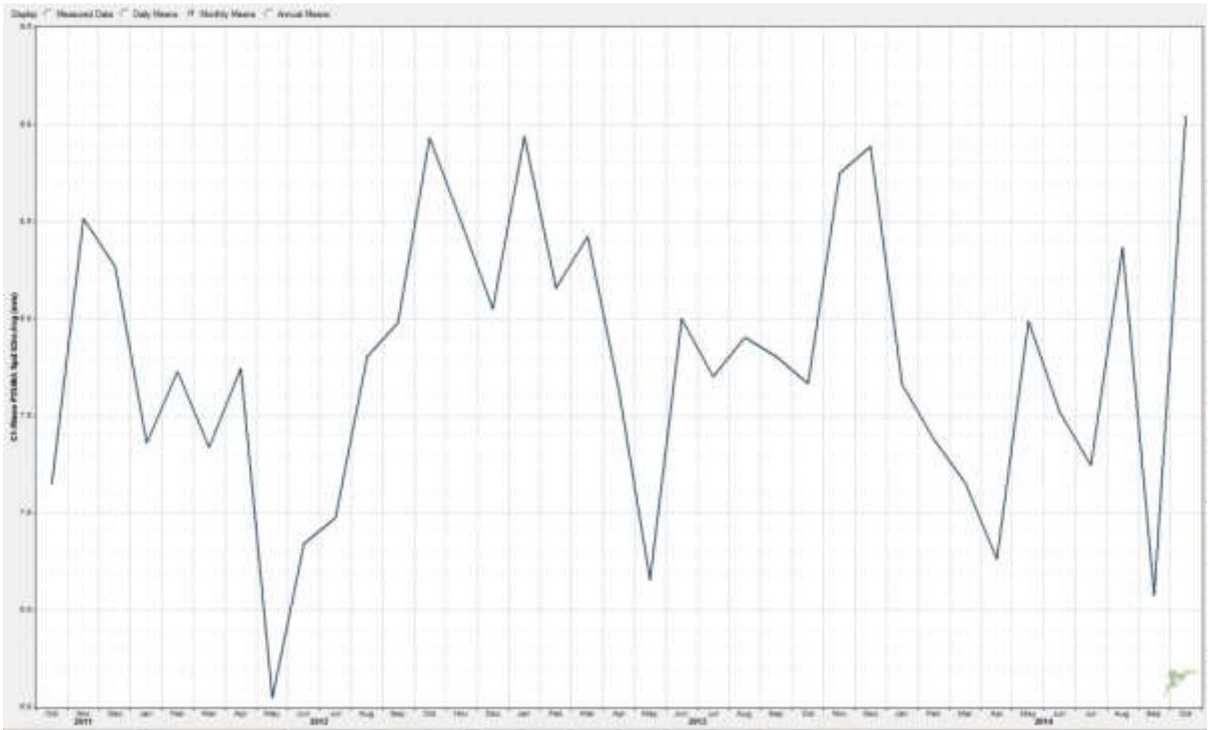

Figure 3 Average Monthly Wind Speeds measured over 4 years

The developer further motivates the development of the Karreebosch Wind Farm due to the following reasons:

» The establishment of the wind farm will reduce South Africa's dependence on fossil fuel resources;
» Improve reliability and range of electrical services;
» Meet demand for diversified energy sources;
» Ensure the future of sustainable energy use;
» Reduce CO_2 emissions and the nation's carbon footprint;
» Contribute to targets for emission reduction as outlined in IRP 2010/2030;
» Promote environmental, social and economically sustainable development;
» Create short and long-term jobs opportunities;
» Contribute to meeting the IRP goal of 30% of all new energy from IPPs.
» Aid in curbing energy shortage and avoiding load-shedding

2.2.2. The Need for the Wind Energy Facility

The need for harnessing renewable energy resources (such as wind energy for electricity generation) is linked to increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources and the rising cost of fossil fuels. In order to meet the long-term goal of a sustainable renewable energy industry, a target of 17.8 GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010 and incorporated in the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme initiated by the DoE. This programme has been designed so as to contribute towards a target of 3725 MW to be generated from renewable energy sources, required to ensure the continued uninterrupted supply of electricity, towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa. In April 2015, the Minister of Energy announced that she intended to submit to NERSA a new determination for an additional 6 300MW for the REIPPP Programme. This was to be done in accordance with the IRP 2010-2030, and to maintain the momentum of the REIPPP, especially for future Bid Submission phases.

The energy procured through this programme will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This 17,8GW of power from renewable energy amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In response to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, Karreebosch Wind Farm (Pty) Ltd proposes the establishment of the Karreebosch Wind Farm to add new capacity to the national electricity grid. The project is dependent on being selected a Preferred Bidder under the REIPPP programme in order to acquire a Power Purchase Agreement (PPA) and a generation licence. The projects submitted under the REIPPP programme need to meet certain qualification criteria including the acquisition of an environmental authorisation. Furthermore, the evaluation criteria encompass 30% Economic Development (ED) and 70 % Prices or tariff per unit of electricity, which are assessed competitively against other wind energy projects submitted. Since its inception, the prices submitted have progressively been decreasing. Effectively, in order for the Karreebosch Wind Farm to succeed, it must have a large capacity and effectively a low price. This is optimised through a very good wind resource and lower capital costs (i.e. economies of scale from a large capacity).

Moreover, the downward pressure on renewable energy tariffs means that wind energy can offer a competitive tariff in comparison to electricity generated from coal power. A wind energy facility takes approximately 2 years to come online (including development), while it takes longer than 5 years at best to realise a coal or a nuclear power station (based on recent developments with Eskom Medupi and Kusile power build). This further affirms renewable energy as being a plausible solution for the country's energy challenges, both in terms of cheaper electricity for consumers and the ability to implement quicker to meet the strained demand. That is over the above-mentioned environmental and economic development benefits mentioned above.

2.2.3. Financial Viability and Community Needs

In terms of the energy yield predicted for the facility calculated from more than 48 months monitored wind data, the developer considers the Karreebosch Wind Energy facility to be financially viable. The "need and desirability" of the local community as reflected in an IDP for the area, is also considered in this EIA. In the South African context, developmental needs (community needs) are often determined through the above planning measures (IDP, SDF and EMF). The wind projects can contribute indirectly to the two Local Municipality's Integrated Development Plans (IDPs). In terms of the needs on the local community, the IDPs identified the need for development, social services, education and employment opportunities in this area. The Karreebosch Wind Energy facility would contribute positively to these community needs. The project will create the possibility of employment and business opportunities, as well as the opportunity for skills development for the local community. The project will result in benefits to the local community, in accordance with the economic development requirements of the REIPPP Programme, including job creation, localisation and community ownership. In addition, indirect benefits and spend in the local area will benefit the local community.

The development of the project would benefit the local/regional/national community by developing a renewable energy project that would help achieve the country's targets. In addition, according to DoE bidding requirements the developer must plan for a percentage of the profit per annum from the wind energy facility to go back into the community through a social beneficiation scheme. Therefore there is a potential for creation of employment and business opportunities, and the opportunity for skills development for the local community.

2.2.4. Consideration of Wind Technology

Wind turbines generate the highest energy yield while affecting the smallest land space when compared to other renewable energy sources such as solar and bio-energy. Wind technologies convert the energy of moving air masses at the earth's surface to mechanical power that can be directly used for mechanical needs (e.g. milling or water pumping) or converted to electric power in a generator (i.e. a wind turbine).

Use of wind for electricity generation is essentially a non-consumptive use of a natural resource. A wind energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard.

2.3. Strategic Context for Energy Planning: National and Local Policy level

2.3.1. The Integrated Resource Plan (IRP)

The need for harnessing renewable energy resources (such as solar energy for electricity generation) is linked to increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources and the rising cost of fossil fuels. In order to meet the long-term goal of a sustainable renewable energy industry, a target of 17.8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010 to 2030[6] and incorporated in the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme initiated by the DoE. This programme has been designed so as to contribute towards a target of 3725 MW to be generated from renewable energy sources, required to ensure the continued uninterrupted supply of electricity, towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa. The energy procured through this programme will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This 17,8GW of power from renewable energy amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

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[6] Note that an update of the IRP has been drafted and is currently under review.

2.3.2. Renewable Energy Development Zones (REDZ)

The DEA has been mandated to undertake a Strategic Environmental Assessment (SEA) process. The wind and solar photovoltaic SEAs are being undertaken in order to identify geographical areas most suitable for the rollout of wind and solar photovoltaic energy projects and the supporting electricity grid network. The DEA and CSIR have released a map with focus areas best suited for the roll-out of wind and solar photovoltaic energy projects in South Africa.

The aim of the assessment is to designate renewable energy development zones (REDZs) within which such development will be incentivised and streamlined. Studies undertaken include identifying these areas included terrestrial and freshwater studies, socio-economic assessments, agriculture and land use studies, visual impact assessments, heritage assessments and avifauna studies. Issues outside of specialist studies were also taken into consideration, including CAA issues, the Square Kilometre Array (SKA) and mining areas. The proximity of the Eskom grid was also taken into account when identifying REDZ.

The proposed Karreebosch Wind Energy facility site falls within the Komsberg Wind Priority Area (as shown in Figure 2.1) identified as a geographical area suitable for the rollout of the development of wind energy projects within the Western Cape and Northern Cape Provinces. It is, however, important to note that the prioritised areas have not been gazetted or officially adopted for development, although this is foreseen to take place by 2016.

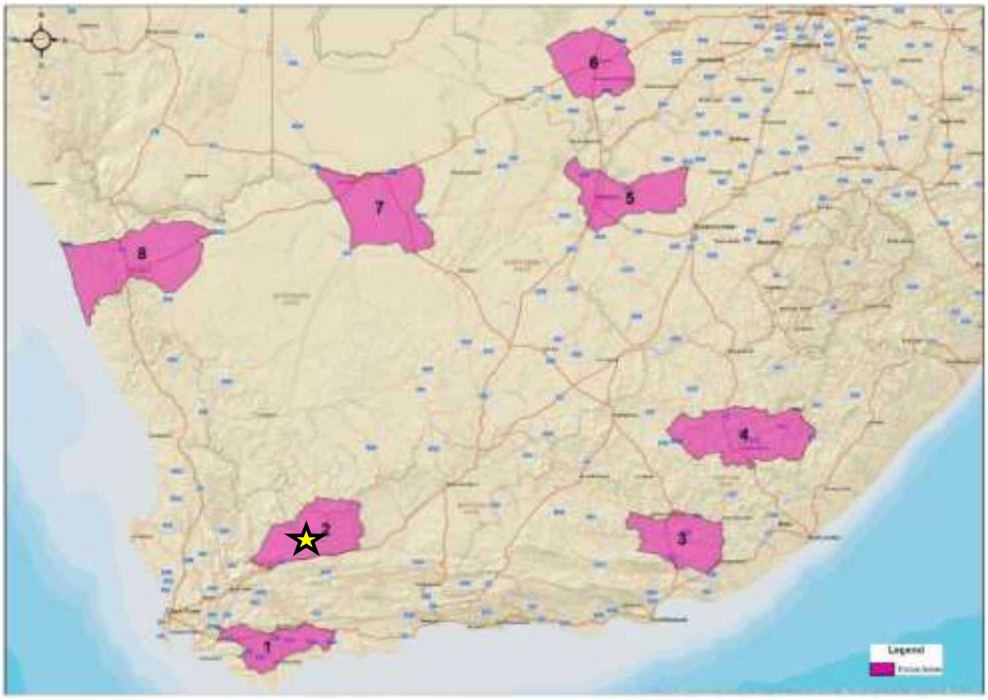


Figure 2.1: Rene

wable Energy Development Zones (REDZ) (CSIR 2014), the Karreebosch Wind Farm (shown by the yellow star) falls within REDZ.

Coupled to the Renewable Energy SEA, Eskom's Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) is also underway. The area where the Karreebosch Wind Farm is proposed is currently within the corridor planned to be strengthened by Eskom.

2.3.3. Strategic Integrated Projects (SIPs)

In 2010, a National Development Plan was drafted to address socio economic issues affecting development in South Africa. These issues were identified and placed under 18 different Strategic Integrated Projects (SIPs) to address the spatial imbalances of the past by addressing the needs of the poorer provinces and enabling socio-economic development. Amongst these is the green energy in support of South African Economy i.e. SIP 8 (*Green energy in support of the South African economy).* The SIP aims at supporting sustainable green energy initiatives on national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP, 2010). Karreebosch Wind Farm is proposing the establishment of the wind energy facility for the purpose of reducing total carbon emissions and diversifying electricity supply. In the event of the projects being developed, it will contribute to the local electricity supply and increase the security of supply to consumers. In addition, the implementation of the proposed project will both economic stimulus to the local economy through the construction process and long term employment in site management and operation and maintenance of the facility. Therefore should the proposed project become a preferred bidder project, it could potentially become a SIP 8 project.

2.3.4. Northern Cape Province Spatial Development Framework (NCPSDF)

As part of the development planning process that underlies the formulation of the NCPSDF. The NCPSDF not only gives effect to national spatial development priorities but it also sets out a series of provincial, district and local development priorities for the space economy of the Northern Cape. Of specific relevance to the proposed Karreebosch Wind Farm, the NCPSDF notes that:

"Renewable energy sources such as wind, solar thermal, biomass and domestic hydroelectricity are to constitute 25% of the province's energy generation capacity by 2020. In order to promote the development of renewable energy supply schemes, large-scale renewable energy supply schemes are strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimising detrimental environmental impacts."

The Northern Cape PSDF, is premised upon and gives effect to the following five strategic objectives of the National Strategic for Sustainable Development (NSSD 2011-2014):

» Enhancing systems for integrated planning and implementation
» Sustaining our ecosystems and using natural resources efficiently
» Towards green economy
» Building sustainable communities
» Responding effectively to climate change

The PSDF makes reference to the need to ensure the availability of energy. Under the economic development profile of the NC PSDF, the White Paper on Renewable Energy (2003) target of 10GWh of energy to be produced from renewable energy sources was discussed. It was also stated that the total area of high radiation in South Africa amounts to approximately 194 000km^2 of which the majority falls within the Northern Cape. It was also stated in the NC PSDF that the implementation of solar photovoltaic facilities has been proposed as one of the main contributors to greenhouse gas emission reductions in South Africa. The NC PSDF also discusses economic development and that it typically responds to the availability of environmental capital (e.g. water, suitable agricultural soil, mining resources); and infrastructural capital (e.g. roads, electricity, bulk engineering services etc.) over time this has resulted in the distinct development regions and corridors.

2.3.5. Accounting for the principles of environmental management as set out in section 2 of NEMA in the planning for the proposed project

The principles of NEMA have been considered in this assessment through compliance with the requirements of the relevant legislation in undertaking the assessment of potential impacts, as well as through the implementation of the principle of sustainable development where appropriate mitigation measures have been recommended for impacts which cannot be avoided. In addition, the successful implementation and appropriate management of this proposed project will aid in achieving the principles of minimisation of pollution and environmental degradation.

The EIA process has been undertaken in a transparent manner and all effort has been made to involve interested and affected parties, stakeholders and relevant Organs of State such that an informed decision regarding the project can be made by the Competent Authority.

The general objectives of Integrated Environmental Management have been taken into account for this EIA report by means of identifying, predicting and evaluating the actual and potential impacts on the environment, socio-economic conditions and cultural heritage component. The risks, consequences, alternatives as well as options for mitigation of activities have also been considered with a view to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management.

OPERATING CHARACTERISTICS OF A WIND FARM CHAPTER 3

Compared with other renewable energy sources such as solar and bio-energy, wind turbines generate the highest energy yield while affecting the smallest land space and is already to date the cheapest generation technology for new built power stations in South Africa. Wind technologies convert the energy of moving air masses at the earth's surface to mechanical power that can be directly used for mechanical needs (e.g. milling or water pumping) or converted to electric power in a generator (i.e. a wind turbine).

Use of wind for electricity generation is essentially a non-consumptive use of a natural resource. A wind energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard. The power generated from the Karreebosch Wind Farm will be at a commercial scale to up to 140MW and will feed into the Eskom national grid.

Environmental pollution and the emission of CO_2 from the combustion of fossil fuels constitute a threat to the environment. The use of fossil fuels is reportedly responsible for ~70% of greenhouse gas emissions worldwide. The climate change challenge needs to include a shift in the way that energy is generated and consumed. Worldwide, many solutions and approaches are being developed to reduce emissions. However, it is important to acknowledge that the more cost-effective solution in the short-term is not necessarily the least expensive long-term solution. This holds true not only for direct project cost, but also indirect project cost such as impacts on the environment. Renewable energy is considered a 'clean source of energy' with the potential to contribute greatly to a more ecologically, socially and economically sustainable future. The challenge now is ensuring wind energy projects are able to meet all economic, social and environmental sustainability criteria.

3.1 The Importance of the Wind Resource for Energy Generation

The importance of using the wind resource for energy generation has the attractive attribute that the fuel is free. The economics of a wind energy project crucially depend on the wind resource at the site. Detailed and reliable information about the speed, strength, direction, and frequency of the wind resource is vital when considering the installation of a wind energy facility, as the wind resource is a critical factor to the success of the installation.

» **Wind speed** is the rate at which air flows past a point above the earth's surface. Average annual wind speed is a critical siting criterion, since this determines the cost of generating electricity. The doubling of wind speed increases the wind power by a factor of 8, so even small changes in wind speed can produce large changes in the economic performance of a wind farm. Wind turbines can start generating at wind speeds of between ~3 m/s to 4 m/s, with yearly average wind speeds greater than 6 m/s currently required for a wind energy facility to be economically viable. Wind speed can be highly variable and is also affected by a number of factors, including surface roughness of the terrain. The effect of height variation/relief in the terrain is seen as a speeding-up/slowing-down of the wind due to the topography. Elevation in the topography influences the flow of air, and results in turbulence within the air stream, and this has to be considered in the placement of turbines.

» **Wind power** is a measure of the energy available in the wind.

» **Wind direction** is reported by the direction from which it originates. Wind direction at a site is important to understand, but it is not typically critical in site selection as wind turbine blades automatically turn to face into the predominant wind direction at any point in time.

A wind resource measurement and analysis programme must be conducted for the site proposed for development, as only measured data will provide a robust prediction of the facilities expected energy production over its lifetime.

The placement of the individual turbines within a wind energy facility must consider the following technical factors:

» Predominant wind direction, wind strength and frequency
» Topographical features or relief affecting the flow of the wind (e.g. causing shading effects and turbulence of air flow)
» Effect of adjacent turbines on wind flow and speed – specific spacing is required between turbines in order to reduce the effects of wake turbulence.

Wind turbines typically need to be spaced between 3 and 8 times the rotor diameter apart in order to minimise the induced wake effect the turbines might have on each other. Once a viable footprint for the establishment of the wind energy facility is determined (through the consideration of both technical and environmental criteria) the spacing requirements are considered through the process of micro-siting the turbines on the site.

3.2 What is a Wind Turbine and How Does It Work

The kinetic energy of wind is used to turn a wind turbine to generate electricity. A wind turbine typically consists of three rotor blades and a nacelle mounted at the top of a tapered tower. The mechanical power generated by the rotation of the blades is transmitted to the generator within the nacelle via a gearbox and drive train or permanent magnets.

Turbines are able to operate at varying speeds. The amount of energy a turbine can harness depends on both the wind velocity and the length of the rotor blades. It is anticipated that the turbines utilised for the proposed facility will have a hub height of up to 100 m, and rotor diameter of up to 140 m. These turbines would be capable of generating in the order of between 2 – 3.3 MW each (in optimal wind conditions) depending on the turbine ultimately selected for the site.

3.2.1. Main Components of a Wind Turbine

The turbine consists of the following major components:

» The foundation
» The tower
» The rotor
» The nacelle

The foundation
The foundation is used to secure each wind turbine to the ground. These structures are commonly made of concrete and are designed for vertical loads (weight) and lateral loads (wind).

The tower
The tower, which supports the rotor, is constructed from tubular steel or concrete. The nacelle and the rotor are attached to the top of the tower.

The tower is part of the overall wind turbine structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

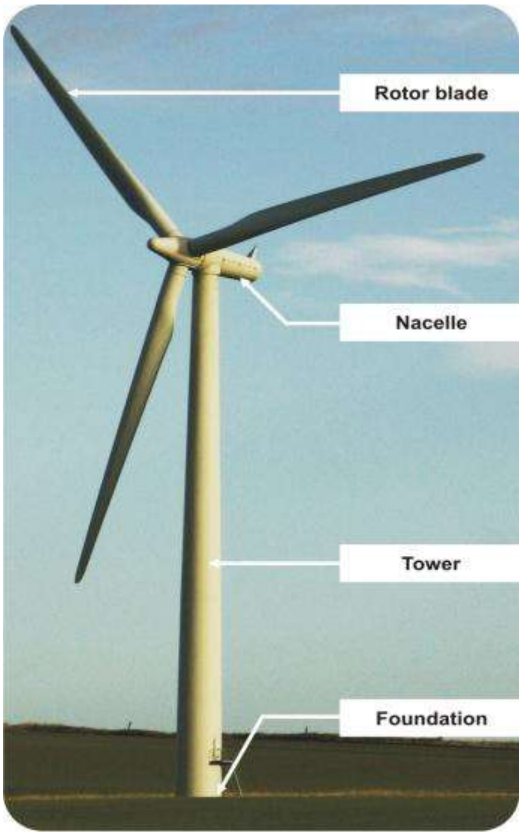


Figure 3.1: Illustration of the main components of a wind turbine

The rotor

The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades, typically made from fibreglass materials or carbon fibre reinforced plastics. When a rotor blade is in contact with wind, the airflow is deflected; airflow over the top arched edge has to take a longer path than at the relatively straight underside. This results in a low pressure at the upper side and a high pressure at the lower side. The pressure differential causes the blades to start moving. The speed of rotation of the blades is controlled by the nacelle, which can turn the blades to face into the wind ('yaw control'), and change the angle of the blades ('pitch control') to make the most use of the available wind.

The nacelle (geared)

The nacelle at the top of the tower accommodates the gears, the generator, anemometer for monitoring the wind speed and direction, cooling and electronic control devices, and yaw mechanism. Geared nacelles generally have a longer form than a gearless turbine.

3.2.2. Operating Characteristics of a Wind Turbine

A turbine is designed to operate continuously, unattended and with low maintenance for more than 20 years or >120 000 hours of operation. Once operating, a wind farm can be monitored and controlled remotely, with a mobile team for maintenance, when required.

The **cut-in speed** is the minimum wind speed at which the wind turbine will generate usable power. This wind speed is typically between 3 m/s and 4 m/s.

At very high wind speeds, typically over 25 m/s, the wind turbine will cease power generation and shut down. The wind speed at which shut down occurs is called the **cut-out speed**. Having a cut-out speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level.

It is the flow of air over the blades and through the rotor area that makes a wind turbine function. The wind turbine extracts energy by slowing the wind down. The theoretical maximum amount of energy in the wind that can be collected by a wind turbine's rotor is approximately 59%. This value is known as the Betz Limit. So, if a rotor was 100% efficient then it would extract 59% of the energy as a maximum (due to Betz law). In practice, the collection efficiency of a rotor is not 100% and further losses occur at the other components in the Nacelle, such as the generator. A more typical efficiency is 35% to 45%.

However, because the energy in the air is free, describing how efficiently the energy is converted is only useful for system improvement and monitoring purposes. A more useful measurement is the Capacity Factor which is also represented as a percentage. The Capacity Factor percentage is calculated from the actual MWh output of electricity from the entire wind farm over 1 year divided by the contracted (nameplate) maximum theoretical output for the same period. It therefore also takes wind resource, wind variability and system availability (downtime, maintenance and breakdowns) into account. This figure will be predicted more accurately when more on-site wind data has been recorded.

Wind turbines can be used as stand-alone applications, or they can be connected to a utility power grid. For utility-scale sources of wind energy, a large number of wind turbines are usually built close together to form a wind energy facility or wind farm.

PROJECT SCOPE CHAPTER 4

This chapter provides details of the infrastructure required for Karreebosch Wind Farm and the main project development activities for the construction, operation and decommissioning phases.

4.1. Project Location

The site for the proposed Karreebosch Wind Farm is located approximately 40km north of Matjiesfontein. The site falls within the Karoo Hoogland Local Municipality, Northern Cape and Laingsburg Local Municipality, Western Cape. The nearest towns also include Laingsburg (Central Karoo District in Western Cape Province) and Sutherland (Namakwa District Municipality Municipality in Northern Cape Province). The site falls within Ward 4 of Laingsburg Local Municipality and Ward 1 of the Karoo Hoogland Local Municipality. The broader study area (~320 km^2 in extent) for Karreebosch Wind Farm includes the following eighteen farm portions:

Portion Farm Name Farm No	Local Municipality	Province
The Farm Appelsfontein 201	Karoo Hoogland Municipality	Northern Cape
The Remainder of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
The Remainder of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karre Kloof 196	Karoo Hoogland Municipality	Northern Cape
The Remainder of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
The Farm Kranskraal 189	Karoo Hoogland Municipality	Northern Cape
The Farm Oude Huis 195	Karoo Hoogland Municipality	Northern Cape
The Farm Rietfontein 197	Karoo Hoogland Municipality	Northern Cape
The Farm Roode Wal 187	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Standvastigheid 210	Karoo Hoogland Municipality	Northern Cape
The Remainder of Wilgebosch Rivier 188	Karoo Hoogland Municipality	Northern Cape
The Farm Aprils Kraal 105	Laingsburg Municipality	Western Cape
The Remainder of Bon Espirange 73	Laingsburg Municipality	Western Cape
Portion 1 of Bon Espirange 73	Laingsburg Municipality	Western Cape

4.2. Site Specific Alternatives or Layout Alternatives

4.2.1. Considering layout alternatives during the EIA process

The development of the project and design of the layout for the proposed Karreebosch Wind Farm has been an iterative process since the commencement of the initial scoping and environmental impact assessment (EIA) in 2010 by Environmental Resources Management (ERM). The current layout for Karreebosch was informed by the rigorous layout revision process for Roggeveld project since it was influenced by many factors including input from the Department, and also the progression and findings of the EIA process.

The layout submitted in this report is the final alternative as a result of the initial EIA process, environmental constraints, practical mitigation measures from specialists, and input from interested and affected parties (I&APs), which had to be balanced with planning criteria, technical criteria and other permitting restrictions. The pertinent influential factors associated with the progression of the EIA process which led to the current layout are detailed briefly below.

Prior to the split of the project (November 2011), the EIA process for the Roggeveld Wind Farm (submitted under DEA reference number 12/12/20/1988) entailed an impact assessment of the site with input from various specialists who proposed mitigation measures and sensitive areas to be considered in the layout. One of the challenges during this initial assessment process was that the site was vast and did not afford the specialists sufficient time to thoroughly assess the site to a specific level of detail. However, the assessments done were deemed sufficient to compile the report. The consideration of the layout alternative was on the following backdrop:

» The initial proposal of the project was 750 MW with up 250 wind turbines;
» It was estimated that less than 1% of the overall site area would be used for the proposed development in terms of footprint.
» Initially Site Layout Alternative 1 was proposed. After field surveys, each specialist identified sensitive areas and advised which turbines require relocation or removal, and this input was used to develop a revised layout, resulting in Site Layout Alternative 2 being put forward as the preferred alternative in the Final Report.

However, the DEA rejected the initial report for Roggeveld Wind Farm on 22 June 2012 and requested that the following issues relating to layout be addressed and included:

» Removal of turbines from sensitive areas and bird exclusion areas identified by the specialists which were not clear.

- Incorporation of proposed mitigation measures to the Environmental Management Programme (EMPr).
- Illustrate how the project would be phased in its development, as the Department of Energy has set a cap of 140 MW.

The second iteration of the Final Environmental Impact Report (FEIR) was revised with a substantial improvement to address all requirements advised by the DEA from the initial rejection letter. The revised FEIR detailed how Site Layout Alternative 2 had observed environmentally sensitive areas and bird exclusion zones. Furthermore, the report considered:

- Technical criteria considered in the determination of the final layout. The revised detailed development layout had considered key parameters such as topography used as a criterion to determine turbine positions, road layout, substation location and dimensions, which informed with a level certainty, which parts of the site would likely be impacted.
- Additional environmentally sensitive constraints, which were included as a result, and the adjustment informed the siting of the revised layout.
- The proposed Layout alternative 2 was now up to 250 turbine totalling 684 MW.
- Phases of the project were shown but without detailed distinction.

After review, DEA rejected the report in May 2013 and requested the following:

- 12 month pre-construction bird and bat monitoring assessments be completed prior to the submission of the final report.
- Project Phases be clearly separated into distinct 140 MW units (submitted as separate applications).

Savannah Environmental have now submitted a new application under EIA Regulations of December 2014 and have now compiled an EIA report for the proposed Karreebosch Wind Farm project (which would have been Phase 2 of the original Roggeveld project) which considers a further refined layout. The revised layout alternative has taken into account the following:

- Revision of the project to a 140 MW project with up 71 wind turbines.
- Revisiting the site by specialists to ground-truth the revised layout.
- Detailed walk through of the site by the ecological specialist, which was not previously done due to the vastness of the site. This was requested by CapeNature to be undertaken to improve the specialist's confidence in findings.
- Input from 12-month bird/bat pre-construction monitoring reports, which have been incorporated as part of the specialists' assessments.
- The sensitive areas identified by specialists have been considered and avoided in the revision of the final layout.

» All the specialists assessed the new layout and provided additional or revised reports.
» Public participation process contributed new and additional input from I&APs.

4.2.2. Technical Details

The Table below describes various technical details of the project including the areas covered by the various types of infrastructure proposed for the site

Component	**Description**
Number of turbines	Up to 71 turbines (generation capacity of up to 140MW)
Hub height	Up to 100m
Blade length	~ 70m
Rotor Diameter	Up to 140m
Area occupied by transformer stations / substation	» Up to 2 x 33/132kV Substations = 40 000m^2 » Extension of the existing 400kV Substation at Komsberg » Transformer at each turbine: total area <1500 m^2 (2 m^2 per turbine nut up to 10m2 at some locations)
Capacity of on-site substation	132 kV
Area occupied by construction camp	300 x 300m = 90 000m^2
Area occupied by laydown areas	Operation: (70 x 50) x 71 = 248 500 m^2
Areas occupied by buildings	~10 000 m^2
Length of (new) internal access roads	~40 km
Width of internal roads	Up to 12 m
Proximity to grid connection	~25 km from on-site substation to the existing 400kV substation at Komsberg, length of new line required will vary slightly depending on the alternative route selected
Height of fencing	Up to 3m
Type of fencing	Steel or wire mesh

The project falls under the following sectors in terms of the national sector classification register:

i) Green economy + "green" and energy saving industries.
ii) Infrastructure – electricity (generation, transmission and distribution)

4.2.3. Layout of the Facility and Infrastructure Required

Karreebosch Wind Farm will have an energy generation capacity of up to 140 MW, and will include the following infrastructure:

- Up to 71 wind turbines (2MW to 3.3MW in capacity each) with a foundation of 25m in diameter and 4m in depth.
- The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
- Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
- Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
- Internal access roads up to 12 m wide.
- Approximately 25km of 33kV overhead power lines linking the wind turbines to each other and to the on-site substations
- Approximately 25km of 132kV overhead power lines from the on-site substation to Eskom's Komsberg Substation.
- Up to two electrical substations on-site (33/132 kV substations with a footprint of 100m x 200m each)
- Underground park cabling between turbines buried along the internal access roads, where feasible.
- Extension of the existing 400kV Substation at Komsberg with several electrical components to be defined by Eskom (e.g. additional feeder bay, transformer bay) on the existing substation property
- An operations and maintenance building (O&M building).
- Up to 4 x 100m tall wind measuring masts.
- Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
- A borrow pit for locally sourcing aggregates required for construction (~3ha).

Turbine infrastructure and grid connection infrastructure i.e. power lines, overlap onto 6 farms from the authorised Roggeveld Phase 1 project (12/12/20/1988/1). Although there is overlap with farm portions from the authorised Roggeveld Phase 1 (refer to Figure 1.1), this primarily relates to grid connection infrastructure and the positions of the turbines and associated infrastructure for Karreebosch will not overlap with any infrastructure from Phase 1. Effectively, new footprints are assessed on the properties to accommodate Karreebosch infrastructure. These overlapping farm portions are Portion 0 and 1 of Ekkraal 199; Portion 0 and 1 of Bon Espirange 73; Portion 0 of Rietfontein 197; Portion 0 of Appelsfontein 201; Portion 2 of Standvastigheid 210; and Portion 0 of Aprilskraal 105.

The layout for Karreebosch Wind Farm is shown in Figure 4.1.

It is important to note that the number of turbines and grid connection options detailed below has been subject to an iterative process and subsequently been changed based on the findings of the specialist reports and technical feasibility – that is, though the development of a mitigation strategy. This mitigation strategy will be detailed and discussed further in the chapters which follow. Therefore, the wind turbine layout and grid connection options discussed below are for the initial layout which was used to inform specialist surveys and studies for the Karreebosch Wind Farm.

4.2.4 Wind Turbine Infrastructure

Up to 71 wind turbines are proposed for the site. Modern wind turbine designs include a tubular tower, three blades and a nacelle which houses a generator, gear box and other operating equipment. Each of the turbines at the Karreebosch Wind Farm will have an individual capacity of between 2MW - 3.3MW. The turbines will be up to 100 m high (to the turbine hub), with a rotor diameter of up to 140m. The tip height (or the total height from the ground to the highest blade tip) would be up to 170m.

Each turbine will have a foundation of up to 25m in diameter and 4m in depth as its base, with the visible above ground part of up to 10m in diameter. A gravel hardstand and laydown area (70m x 50m in extent) adjacent to each turbine foundation is required during turbine construction for construction activities and for turbine maintenance during operation (as shown in Figure 4.2). The hard-stand area will be compacted in order to facilitate the use of a crane during construction and maintenance activities. Figure 4.3 shows general details of the crane pad / laydown area. Each turbine will be accompanied by an electrical transformer which will be located adjacent to the wind turbine. The turbines will also need to be lit to meet the Civil Aviation Authority's safety standard requirements.

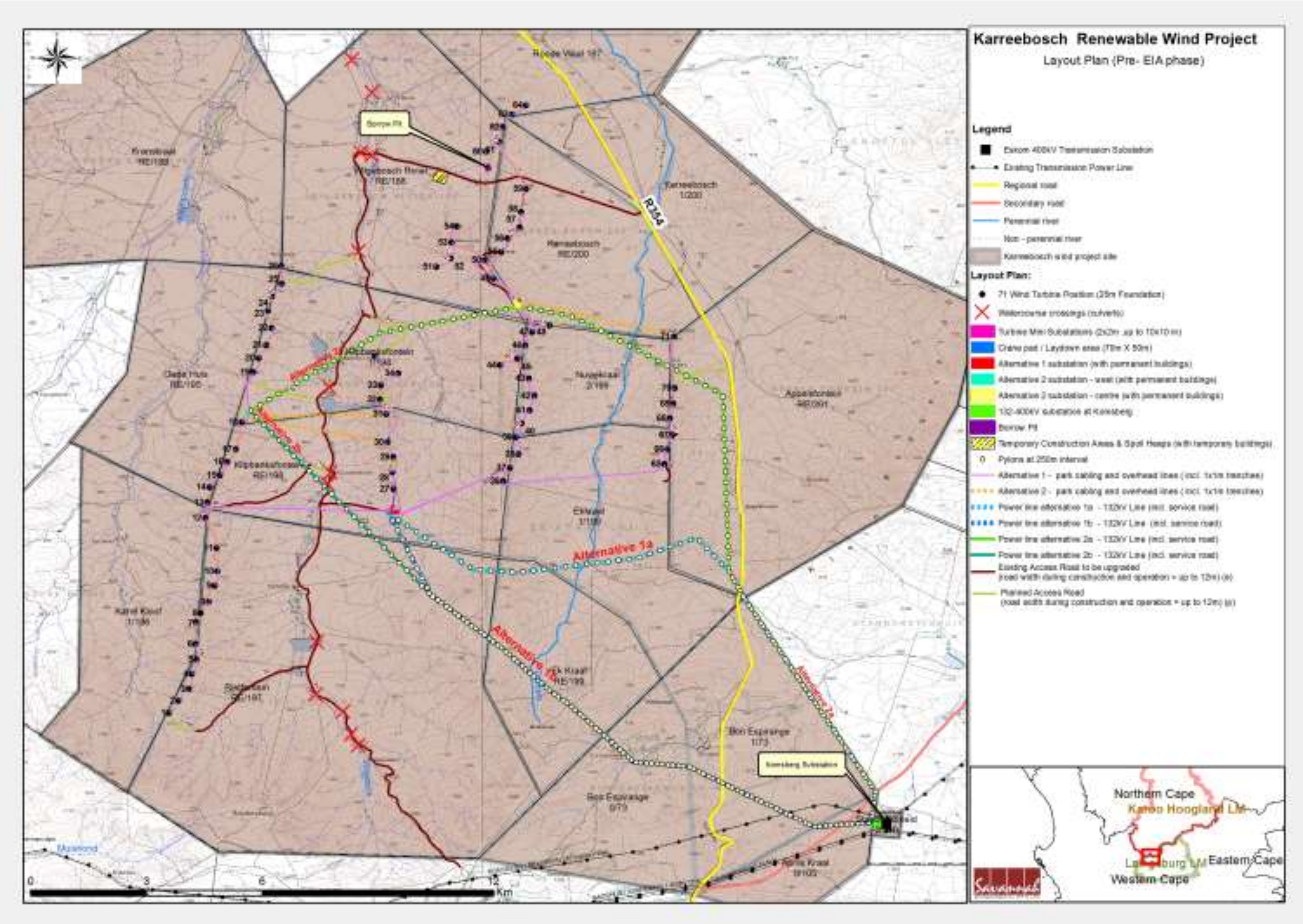


Figure 4.1: Layout map showing the technical design and layout for Karreebosch Wind Farm as assessed in this EIA report

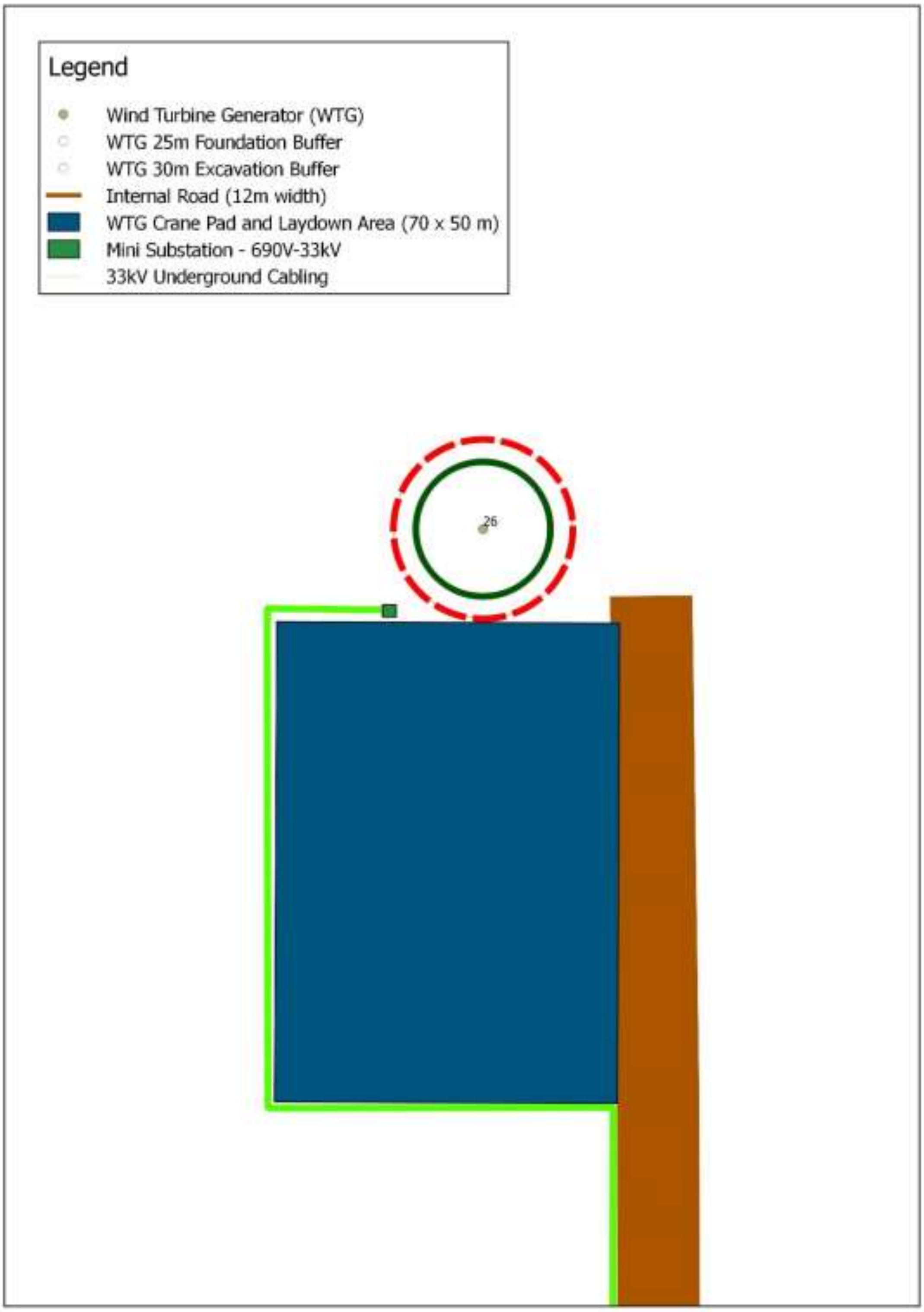


Figure 4.2 Typical drawing showing wind turbine, internal road and laydown area footprints

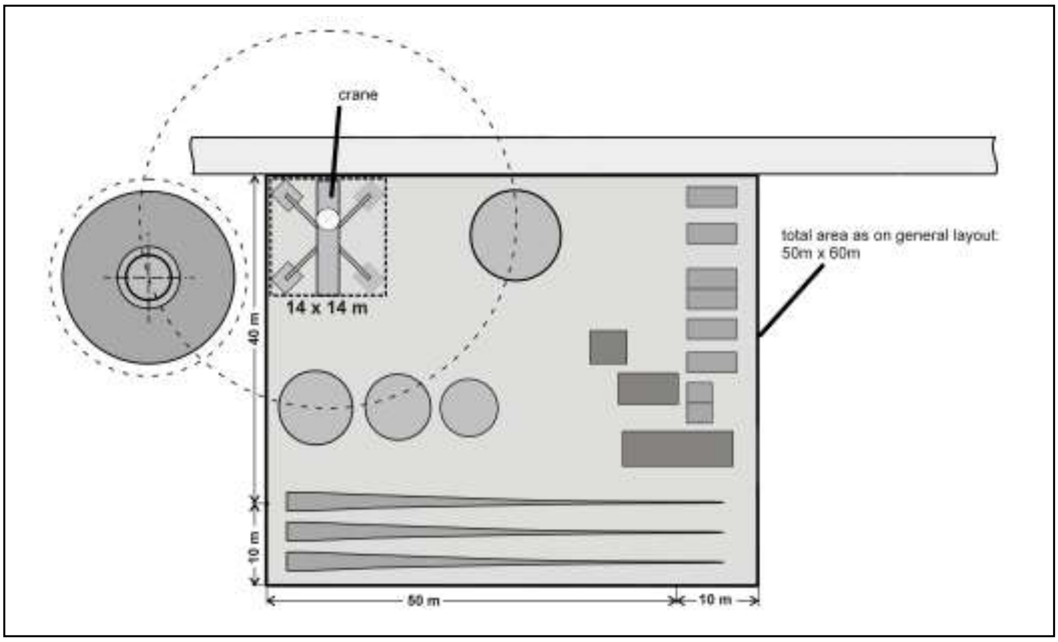


Figure 4.3: An illustration of a typical crane pad / lay-down area. The dimensions relevant to turbines on Karreebosch Wind Farm are 70mx50m.

4.2.5 Substations

There are up to two 132kV substations options which have no priority or technical preference to each other based on technical factors (each substation option will have 2 power line routing alternatives). The project will be connected to a 400kV Substation proposed adjacent to the existing Komsberg Substation. The 400kV substation will be constructed by other preferred bidder projects and therefore not part of the scope of Karreebosch Wind Farm. Due to the significant distances between the individual turbine strings, detailed technical assessments will have to evaluate which option is feasible and will ultimately be built. The following substations are proposed:

» Two alternatives for up to two on-site 33/132 kV substation (100m x 200m): The on-site substation complex would also house site offices, storage areas and ablution facilities.
  * Alternative 1: 1 x 33/132kV Substation:
    The 33/132kV substation will collect all cables at one central point to the south of Turbine 27 with 1 x 132kV line connecting to the new 400kV substation to be located adjacent to the Komsberg substation. This substation will be referred to as Alternative 1 Substation.
  * Alternative 2: 2 x 1 x 33/132kV Substations
    The two substations will be called Alternative 2 Substation West (western ridge north of Turbine 18) and Alternative 2 Substation Centre (centre ridge saddle between Turbine 47 and 49). Power line route alternative 2 (detailed below) will interconnect the two proposed

33/132kV substations with 1x132kV line and continue towards the new 400kV substation to be located adjacent to the Komsberg substation.

4.2.6 Grid Connection and Electrical Infrastructure

Ultimately, the electricity generated by the wind farm would be fed into the national grid network via a new substation that is to be built directly adjacent to the existing Eskom Komsberg 400 kV series capacitor station, which is located on the south-eastern boundary of the proposed wind farm site on the farm Standvastigheid 2/210. The substation will be built by Eskom and the preferred bidders already intending to connect to the site and Karreebosch Wind Farm will only extend the existing infrastructure to be. The electrical infrastructure required for Karreebosch Wind Farm would consist of the following:

- » Medium voltage (33kV) underground electrical cabling connecting the turbines along the ridges.
- » All internal medium voltage (33kV) park cabling leaving the ridges to connect to a substation will be overhead as it is not practical or feasible to install cabling below ground level, due to the difficulty of the terrain, the long distances and the resulting environmental damage this would cause.
- » Connection of the turbine rows to a new 33/132kV on-site substation using medium voltage (33kV) overhead electrical cabling or overhead transmission lines.
  - ∗ There are two location alternatives for the 132kV substation/s which have no priority or preference to each other.
  - ∗ Each of these two substation alternatives have two different routing alternatives. This means that there are currently four different routing alternatives investigated, two associated with each of the two substation alternatives.
- » Due to the significant distances between the individual turbine strings, detailed technical assessments and specialist studies will evaluate which single alternative is feasible and will ultimately be built. These grid connection/ power line alternatives are as follows:
  - ∗ Alternative 1[12]: This power line route will connect to the 1x 33/132kV substation (Alternative 1 Substation) option collecting all cables at a central point to the south of Turbine 27 with 1 x 132kV line connecting to the main Komsberg substation.
    - • Alternative 1a is routed east from the Alternative 1 Substation towards the R354 firstly and following the direct path to Komsberg thereafter.
    - • Alternative 1b is routed southeast from the Alternative 1 Substation and thereafter towards the R354.

[12] Referred to as Option 1 in specialist reports.

* Alternative 2[13]: This power line route will connect to the 2 x 33/132kV Substation option – referred to as Alternative 2 Substation West and Alternative 2 Substation Centre (as above).
  * Alternative 2 Substations (hereafter called Alternative 2 Substation West and Alternative 2 Substation Centre), are located on the Western Ridge, north of Turbine 18 and on the Centre Ridge, between Turbine 48 and 49 respectively.
  * Alternative 2a will connect Alternative 2 Substation West with Alternative 2 Substation Centre via a 132kV power line in a northeast direction first and will continue as one single 132kV line towards the R354 in the southeast and to Komsberg in the south.
  * Alternative 2b links Alternative 2 Substation Centre with Alternative 2 Substation West in the southwest via a 132kV power line and routes one single 132kV line to Komsberg in a southeast direction. Where possible the line will follow the line routing of the authorised Roggeveld Phase 1 project for approximately 7km.

33kV overhead power lines connecting the turbines to the on-site substations and 132kV overhead power line from the proposed on-site substations to a new proposed substation adjacent to the existing Eskom Komsberg Substation is required to be constructed. The final length of these lines will be determined once a final layout is decided upon. All internal park cabling leaving the ridge to connect to a substation will be overhead due to the distances and difficulty of terrain. The 132kV power line will have a servitude of less than 40m. The nature of the power lines being predominantly overhead infrastructure is assessed as the only feasible alternative due to the distances needed to be traversed across the project site. All the specialist reports have included the assessment of all grid infrastructure options in their respective reports. The preferred grid connection alternative is discussed in Chapter 11.

4.2.7 Access Roads and Site Access

The site would be accessed via the R354. In addition to site access roads there would be a network of access roads between each of the wind turbines. Site access roads would be up to 12m wide including stormwater control channels adjacent to the road. Within the development site area existing farm tracks would be used where feasible, some of which would be required to be upgraded, and new gravel roads will also be constructed to facilitate the transport of the turbines and other construction materials to the site and the movement of construction and maintenance vehicles. These roads will be required to be maintained for the duration of the operation of the facility to provide suitable access for maintenance. The internal service road alignment is informed by the

[13] Referred to as Option 2 in specialist reports.

final micro-siting/positioning of the wind turbines and substation position, and allow for circulation of vehicles on the site.

A number of different site access points are being considered as part of the development. Up to four site access points are viable, including two accessing the south of the site from the R354; and two accessing the north and centre of the site from the R354. Most of the planned internal site access roads are currently in form of a jeep tracks or do not exist. The overall length of the new access roads to be built is 40km, and that of existing roads to be upgraded is 40km. The final design of the access roads is based on the site development plans presented in Figure 4.1. Some minor adjustments may be effected based on a number of environmental, technical and economic considerations which will be explored further during the detailed project design phase.

The construction of the roads may need material for compacting. It is planned for the material would be sourced from cuttings on the site and if needed from the borrow pit site (already identified) in the EIR. The materials for use would be kept/stored at material heap areas within the construction camp. All materials excavated will eventually be used on the compacting of the roads and hard-standing areas. The alternatives would be sourcing the materials from outside the site, which is a less preferred alternative from an ecological perspective but may be needed to achieve a certain grade of the roads.

Most of the water crossings of access roads will involve appropriately sized culverts to be installed. This may involve earth moving of more than 5 cubic metres in order to place and secure culverts to the bed and edges of the watercourse in order to ensure durability, erosion prevention and and minimum road specifications for heavy vehicles to be met. The culverts will be designed for the 1 in 50 year flood.

Apart from the prefabricated culverts, concrete for anchoring and culvert surface material identical to adjacent road surface material sourced from the site, no foreign material will be used for infilling of the watercourses. Any material excavated from the watercourses will be reused in situ where possible.

4.2.8 Other Associated Infrastructure

Additional infrastructure that would be required for the project includes the following:

» Four wind measuring masts (lattice structure; up to 100m in height) to be positioned strategically within the wind farm development footprint are required to collect data on wind conditions during operation.
» Site fencing (as required).
» A temporary construction camp and construction laydown area for a batching plant, the storage of spoil heaps, chemicals, construction equipment and

vehicles, site offices and additional worker facilities, is envisaged to occupy approximately 9 ha (300m x 300m). The proposed location of the temporary construction camp is shown on the layout and is located along the northern access road from the R354 road on Remainder of the farm Wilgebosch Rivier 188.

» Construction laydown areas adjacent to each turbine of approximately 3500m2 (70m x 50 hardstand area for the temporary laydown of the turbine and to provide a level surface for a crane pad).
» An on-site concrete batching plant will be established for use during the construction phase. The batching plant is to be located right next to the temporary construction camp.

It is likely that a borrow pit would be required within the site area to obtain aggregate material for construction of the internal roads and possibly turbine foundations. The aggregates will be used for all roads and laydown areas, and also for infilling of near watercourses. Final road capping may, however, have to be obtained from a commercial quarry and transported to the site, to ensure the materials meet the quality requirements for the road surface layer. The borrow pit is sited and indicated on the layout about 500m north of the temporary construction camp but would still require a separate geotechnical investigation. The size of the borrow pit is approximately 3ha but also depends on suitability of the subsurface soils and the requirement for granular material for access road construction and other earthworks.

4.3 Project Construction Phase

In order to construct the proposed wind energy facility and associated infrastructure, a series of activities will need to be undertaken. The construction phase is anticipated to be approximately 24-30 months in duration. A construction workforce will be required, and it is estimated that between 266 and 310 jobs could potentially be created during the construction phase. As far as possible, local labour will be utilised. More information on construction activities is provided below.

Prior to the installation of the wind turbines, the site would be prepared as required; this would include the following activities:

» site surveys;
» vegetation clearance;
» subcontractor mobilisation;
» erection of fencing and site security;
» construction/upgrading of on-site access roads;
» construction of site office and storage facilities;
» levelling and compacting of laydown areas and hardstand areas;

- » excavation, laying and setting of turbine foundations;
- » delivery of all wind turbine components (tower sections, hub, nacelle, blades etc.)
- » turbine erection utilising specialised cranes;
- » digging of trenches and laying of underground cables;
- » delivery of electrical equipment (substation components, cabling, towers etc.)
- » substation construction; and
- » installation of towers and stringing of overhead lines.

4.3.1. Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, topographical surveys, geotechnical surveys, site survey and confirmation of the turbine micro-siting footprint and access road routes, survey of substation site, and survey of power line servitude/s to determine power line tower locations.

4.3.2. Establishment of Access Roads to provide access on the Site

The proposed site is currently accessible from the R354 road to Sutherland and each farm portion is accessible via existing gravel access roads. The individual farm portions already have a good network of "tracks" and internal roads which are considered for use by the wind energy facility. Access roads to each turbine are required to be established. As far as possible, existing access roads would be utilised, and upgraded where required. Within the site itself, access will be required between the turbines for construction purposes (and later limited access for maintenance). Special haul roads of up to 12m in width will need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation. These access roads will have to be constructed in advance of any components being delivered to site, and will remain in place after completion for future access and possibly access for replacement of parts (e.g. blades) during operation of the facility.

4.3.3. Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each turbine, the establishment of internal access roads and excavations for foundations. These activities will require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site.

Site preparation will be undertaken in a systematic manner to reduce the risk of the open ground to erosion. In addition, site preparation will include search and rescue of floral species of concern (where required), as well as identification and excavation of any sites of cultural/heritage value (where required).

4.3.4. Construction Compound

A temporary construction camp will be required during the construction phase to house construction equipment, provide amenities to the construction crew, and house construction workers as well as security guards. The construction camp will be up to 9 hectares in extent. Construction of the camp will entail vegetation clearing, site compaction, establishment of offices, amenities (including ablution facilities) and basic services such as electricity.

4.3.5. Establishment of Laydown Areas on Site

Laydown and storage areas will be established for the normal civil engineering construction equipment which will be required on site. Laydown areas will also need to be established at each turbine position for the storage and assembly of wind turbine components. The turbine laydown area will need to accommodate the cranes required in tower/turbine assembly. The extent of one turbine laydown area is up to $3500m^2$.

In addition, construction compound areas will need to be established around the site. These will be temporary structures for site offices, storage and safe refuelling areas.

Figure 4.3: Photograph illustrating laydown areas required during the erection of one of the turbines at the Klipheuwel demonstration facility (photo courtesy of Eskom)

4.3.6. Construct Foundations

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of approximately 4m, or where the bedrock is close to the surface, cleared by way of blasting or through specialised rock anchors. Concrete will have to be batched on site as there are no suitable concrete suppliers available in the vicinity. The reinforced concrete foundation will be poured and will support a mounting ring. The foundation will then be left up to a month to cure.

Figure 4.4: Photograph illustrating the construction of the foundation of one of the turbines at the Klipheuwel demonstration facility (photo courtesy of Eskom)

4.3.7. Transport of Components and Equipment to Site

The wind turbine, including the tower, will be brought to the site by the turbine supplier in sections on flatbed trucks. Turbine units which must be transported to site consist of: the tower (in segments), hub, nacelle, and three rotor blades. The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[14] by virtue of the dimensional limitations (abnormal length of the blades) and load limitations (i.e. the nacelle). In addition, components of various specialised construction and lifting equipment are required on site to erect the wind turbines and need to be transported to site. In addition to the specialised lifting equipment/cranes, the normal civil engineering

[14] A permit will be required for the transportation of these abnormal loads on public roads.

construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, site offices etc.).

Figure 4.5: Photographs illustrating the equipment required for the transportation of turbine components to site (photographs courtesy of Eskom at during the construction of the Klipheuwel demonstration facility)

The components required for the establishment of the substation/s (including transformers) as well as the power line (including towers and cabling) will also be transported to site as required. The dimensional specifications (length/height) of some loads transported during the construction phase may require alterations to the existing road infrastructure (e.g. widening on corners), accommodation of street furniture (e.g. street lighting, traffic signals, telephone lines etc.) and protection of road-related structures (i.e. bridges, culverts, portal culverts, retaining walls etc.) as a result of abnormal loading. The equipment will be transported to the site using appropriate National, Provincial and local roads, and the dedicated access/haul roads to the site itself. In terms of transporting the turbine components from the Port of Saldanha to the site, the route envisaged is shown in Figure 4.6 below. The route generally follows the R45 then onto the N7 followed by the R46. The route continues on the N1 until it reaches the R354 which intersects with the boundary of the site.

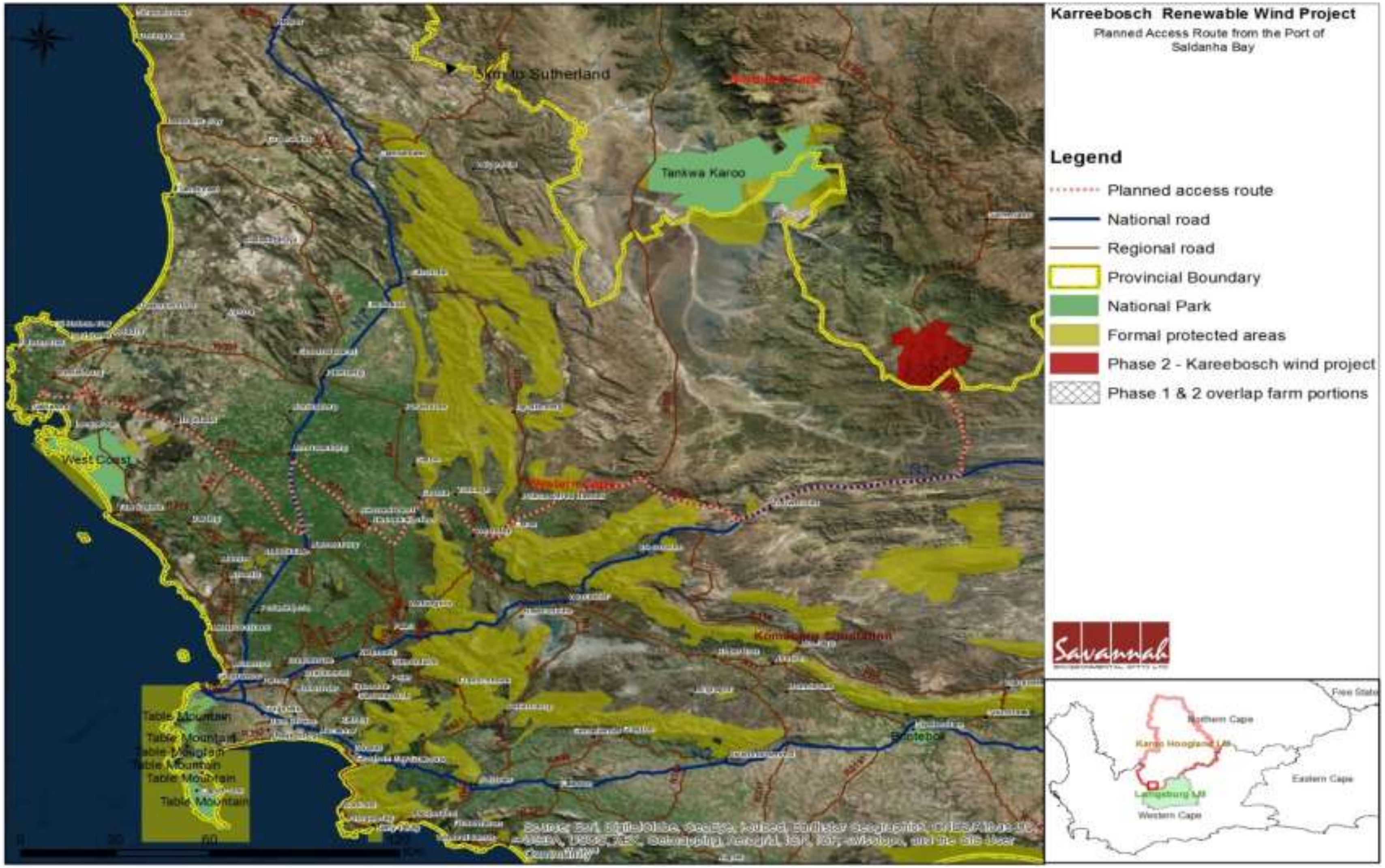


Figure 4.6: Planned transportation route from the Port of Saldanha to the Karreebosch Site

4.3.8. Construct Turbine

At least one large lifting crane will be brought on site. It will lift the tower sections into place, one at a time. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor (i.e. the blades of the turbine) on the ground to the hub. It will then be lifted to the nacelle and bolted in place. Auxiliary cranes will be needed for the assembly of the rotor while a large crane will be needed to put it in place.

Figure 4.7: Photograph illustrating the assembly of a turbine tower utilising a large lifting crane (photographs courtesy of Eskom taken during the construction of the Klipheuwel demonstration facility)

Figure 4.8: Photograph illustrating the assembly of a turbine (nacelle and blades) utilising a large lifting crane (photographs courtesy of Eskom from construction at the Klipheuwel demonstration facility)

4.3.9. Construct Substations

The position of the substation/s has been informed by the positioning of the wind turbines and Eskom's existing infrastructure. The construction of the substation would require a survey of the site; site clearing and levelling and construction of access road/s to the substation site (where required); construction of substation terrace and foundations; earthing grids, assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas.

Due to the significant distances between the individual turbine strings, detailed technical assessments will have to evaluate which grid connection alternative presents feasible and will ultimately be built.

4.3.10. Connection of Wind Turbines to the Substation

Each wind turbine will be interconnected with other turbines to a turbine string via underground cabling. The underground cables have been designed to follow the internal access roads, where possible.

All internal park cabling leaving the ridge to connect to an on-site substation will be overhead due to the distances and the difficulty of terrain. Medium voltage

(33kV) overhead electrical cabling will provide the grid connections to the new 33/132kV on-site substation/s. These are required to be overhead lines from the high ridges down to the substation in the valley, as it is not practical or feasible to install cabling below ground level, due to the difficulty of the terrain and the resulting environmental damage this would cause.

4.3.11. Connect Substation to Power Grid

Approximately 25km of 33kV overhead power lines connecting the turbines to the substation is required to be constructed. All internal park cabling leaving the ridge to connect to a substation will be overhead due to the distances and difficulty of terrain.

132kV overhead power line from the proposed substations to Eskom's Komsberg Substation is required to be constructed. The length of these lines will be recalculated once a final layout is available. The 132kV power line will have a servitude of less than 40m.

The nature of the power lines being predominantly overhead infrastructure is assessed as the only feasible alternative due to the distances needed to be traversed across the project site. All the specialist reports have included the assessment of the grid infrastructure in their respective reports. Alternative routes for the construction of the power line are assessed through this EIA. The preferred route will be surveyed, pegged, and then ground-truthed by vegetation, heritage and avifauna specialists (i.e. conduct walk-through surveys to confirm the alignment in terms of environmental sensitivities) prior to construction. The power line servitude will follow other existing linear infrastructure (including roads and or other power lines) as closely as possible to consolidate linear infrastructure in the area, and to minimise the need for additional points of access.

4.3.12. Commissioning

Prior to the start-up of a wind turbine, a series of checks and tests will be carried out. This will include both static and dynamic tests to make sure the turbine is working within appropriate limits. Grid interconnection and unit synchronisation will be undertaken to confirm the turbine and unit performance. Physical adjustments may be needed such as changing the pitch of the blades. The schedule for this activity will be subject to site and weather conditions.

4.3.13. Undertake Site Remediation

As construction is completed in an area, and as all construction equipment is removed from the site, the site will be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.

4.4 Project Operation Phase

Each turbine within the wind energy facility will be operational except under circumstances of mechanical breakdown, inclement weather conditions or maintenance activities. Technical and general maintenance staff will be required. It is anticipated that there could be security and maintenance staff required on site.

4.4.1. Maintenance and Staff

The wind turbine will be subject to periodic maintenance and inspection. Periodic oil changes will be required. Any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation. Approximately 27- 76 technical and general maintenance staff will be required. Potable water will be required for staff, and will be sourced through rainwater harvesting, local boreholes or from the local municipality.

4.5 Decommissioning

The turbine infrastructure which will be utilised for the proposed project is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Generally a power purchase agreement (PPA) of 20 years is signed with the energy buyer, typically Eskom. After the PPA comes to an end, the PPA may be renegotiated at terms that are financially viable at that point in time. The PPA may be based on a shorter term agreement using the existing turbines (if the existing turbines are still suitable) or a new longer term PPA may be negotiated based on re-powering (refurbishment) of the wind farm. It is most likely that refurbishment of the infrastructure discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time. New turbine technology may also reduce potential environmental impacts due to the increase of efficiency based on the same footprint. Where no new PPA can be negotiated it is likely that the wind farm will be decommissioned as required in the EMPr, Land Use Planning ordinance (LUPO) and other relevant regulations of that time. The following decommissioning and/or repowering activities have been considered to form part of the project scope of the proposed wind energy facility.

4.5.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment and lifting cranes, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of decommissioning equipment.

4.5.2. Disassemble and Replace Existing Turbine

A large crane will be brought on site. It will be used to disassemble the turbine and tower sections. These components will be reused, recycled or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades. The land-use will revert back to agriculture/grazing.

REGULATORY AND LEGAL CONTEXT CHAPTER 5

5.1. Requirement for an EIA

In terms of sections 24 and 24D of NEMA, as read with Government Notices R982, R983, R984, R985, a Scoping and EIA process is required for the proposed Karreebosch Wind Farm project. The key listed activity contained in GN984 which triggered a full EIA process is Listed Activity 1 of GN984: The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, as the wind farm will have a contracted capacity of up to 140MW. The table below contains the listed activities in terms of the EIA Regulations of December 2014 which apply to Karreebosch Wind Farm, and for which an Application for Authorisation has been applied. The table also includes a description of those project activities which relate to the applicable listed activities.

Table 5.1: Listed activities in terms of the EIA Regulations of December 2014 which apply to Karreebosch Wind Farm

Listed activity as described in GN 983, 984 and 985	Description of project activity that triggers listed activity
GN 983, 11(i): The development of facilities or infrastructure for the transmission and distribution of electricity- outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts;	The project will entail construction of substations and power line/s with a capacity of <275kV (outside an urban area).
GN 983, 12 (xii): The development of – (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- ~~(a) within a watercourse;~~ ~~(b) in front of a development setback; or~~ if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;	The wind energy facility will include the construction of infrastructure within 32m of a watercourse.
GN 983, 19(i): The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or	Some water crossings of access roads may require earth moving of more than 5 cubic metres in order to install culverts appropriate both size of watercourse and minimum road specifications for heavy vehicles

Listed activity as described in GN 983, 984 and 985	**Description of project activity that triggers listed activity**
rock of more than 5 cubic metres from- (i) a watercourse;	
GN 983, 24(ii): The development of- (ii) a road with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres.	The wind energy facility will require access roads with parts wider than 8m in width, and up to 12m in width, to be constructed outside urban areas.
GN 984, 1: 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 within an urban area.	The wind energy facility will have a contracted capacity of 140MW.
GN 984, 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 development footprint for the proposed wind energy facility will cover an area greater than 20 hectares.
GN 985, 4: (a) (ii) (bb), (ee) and 4(f) (i) (aa) The development of a road wider than 4 metres with a reserve less than 13,5 metres. (a) In Northern Cape province: (ii) Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (f) In Western Cape Province: (i) Areas outside urban areas (aa) Areas containing indigenous	A road wider than 4 m will be constructed. The site is located : Outside urban areas In a National Protected Area Expansion Strategy Focus area Critical Biodiversity Areas in terms of the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).

Listed activity as described in GN 983, 984 and 985	**Description of project activity that triggers listed activity**
vegetation	
R985, 12: (a)(ii), and (d) (ii) The clearance of an area of 300 square metres or more of indigenous vegetation (a) In Western Cape province: (ii) Within critical biodiversity areas identified in bioregional management plan. (d) In Northern Cape: (ii) Within critical biodiversity areas identified in bioregional plans;	» An area of 300 square metres or more of indigenous vegetation cover will be cleared. The site is located within a Critical Biodiversity Area identified in a bioregional management plan – that is in terms of the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).
GN 985, 14 (xii), (a) (ii) (bb) (ff) and 14 (f) (i) (bb) (ff); The development of- (xii) infrastructure or structures with a physical footprint of 10 square metres or more; (a) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; (a) In Northern Cape: (ii) Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (f) In Western Cape: (i) Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	Buildings such as the workshop and site office and/or infrastructure larger than $10m^2$ or $10m^2$ within 32m of a watercourse will be required to be built. The site is located: » Outside urban areas » In a National Protected Area Expansion Strategy (Focus area) Critical Biodiversity Areas in terms of the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).
R985, 18 (a) (ii) (bb) (ee) and 18 (f)	The wind energy facility will require access

Listed activity as described in GN 983, 984 and 985	**Description of project activity that triggers listed activity**
(i) (aa); The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (a) In Northern Cape provinces: (ii) Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ii) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined; (f) In Western Cape provinces: (i) All areas outside urban areas, Areas containing indigenous vegetation;	roads to be upgraded, which will include the widening of the roads as well and lengthening on roads in some areas. The site is located : Outside urban areas In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in terms of the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).
GN 985, 23 (xii) (a) (ii) (ee) and 23 (xii) (g) (j) (bb) (ff); The expansion of – (xii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more; where such development occurs – (a) if no development setback has been adopted, within 32 metres of a watercourse measured from the edge of a watercourse; (a) In Northern Cape: (ii) Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (g) In Western Cape: (i) Outside urban areas, in: (bb) National Protected Area	The project may require the expansion of roads (i.e. infrastructure) within 32m of a watercourse

Listed activity as described in GN 983, 984 and 985	Description of project activity that triggers listed activity
Expansion Strategy Focus areas; Critical biodiversity areas areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	

Activity 9 GNR984 was included at scoping but it has been determined that it is not triggered since Komsberg will be an existing 400kV substation by the time this project is connected to the grid. A revised application has been submitted excluding this activity.

5.2. Strategic Electricity Planning in South Africa

The need to expand electricity generation capacity in South Africa is based on national policy and is informed by on-going strategic planning undertaken by the Department of Energy (DoE). The hierarchy of policy and planning documentation that support the development of renewable energy projects such as wind energy facilities is illustrated in Figure 5.1. These policies are discussed in more detail in the following sections, along with the provincial and local policies or plans that have relevance to the development of the proposed wind energy facility.

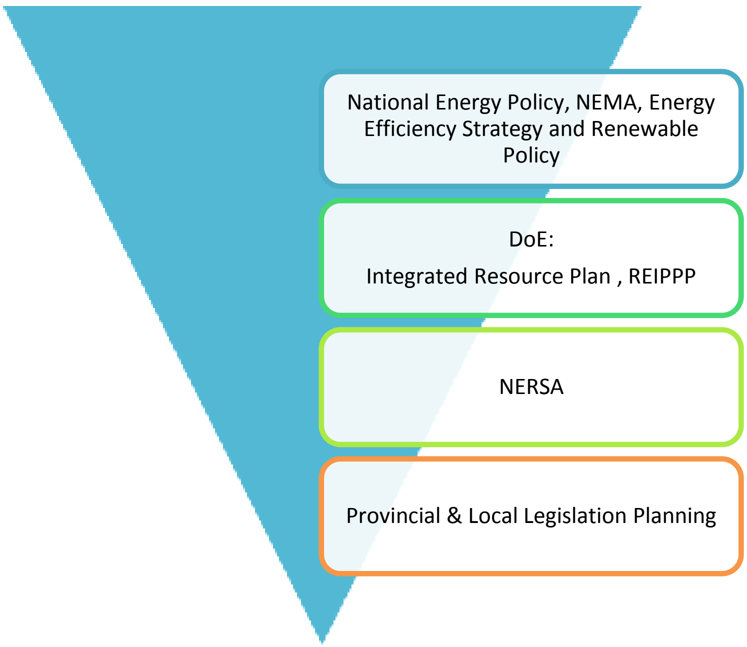


Figure 5.1: Hierarchy of electricity policy and planning documents

5.2.1. The Kyoto Protocol, 1997

South Africa's electricity is mainly generated from coal-based technologies. South Africa accounts for ~38 % of Africa's CO_2 (a greenhouse gas contributing to climate change) from burning of fossil fuels and industrial processes. The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. South Africa ratified the Kyoto Protocol in 2002. The Kyoto Protocol requires developing countries to reduce its greenhouse gas emissions through actively cutting down on using fossil fuels, or by utilising more renewable resources. Therefore certain guidelines and policies (discussed further in the sections below) were put in place for the Government's plans to reduce greenhouse gas emissions. The development of renewable energy projects (such as the proposed wind energy facility) is therefore in line with South Africa's international obligations in terms of the Kyoto Protocol. A second commitment period commenced from 1 January 2013, and extends to 31 December 2020.

5.2.2. White Paper on the Energy Policy of the Republic of South Africa, 1998

Development within the energy sector in South Africa is governed by the White Paper on a National Energy Policy (the National Energy Policy), published by DME in 1998. This White Paper identifies five key objectives for energy supply within South Africa, i.e.:

» increasing access to affordable energy services;
» improving energy sector governance;
» stimulating economic development;
» managing energy-related environmental impacts; and
» securing supply through diversity.

Furthermore, the National Energy Policy identifies the need to undertake an Integrated Energy Planning (IEP) process and the adoption of a National Integrated Resource Planning (NIRP) approach. Through these processes, the most likely future electricity demand based on long-term southern African economic scenarios can be forecasted, and provide the framework for South Africa to investigate a whole range of supply and demand side options.

5.2.3. Renewable Energy Policy in South Africa

Internationally there is increasing development of the use of renewable technologies for the generation of electricity due to concerns such as climate change and exploitation of resources. In response, the South African government ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997 and acceded to the Kyoto Protocol, the enabling mechanism for the convention, in August 2002. In addition, national response strategies have been developed for both climate change and renewable energy.

Investment in renewable energy initiatives, such as the proposed wind energy facility, is supported by the National Energy Policy (DME, 1998). This policy recognises that renewable energy applications have specific characteristics which need to be considered. The Energy Policy is "*based on the understanding that renewables are energy sources in their own right, and are not limited to small-scale and remote applications, and have significant medium- and long-term commercial potential*." In addition, the National Energy Policy states that "*Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future*".

The White Paper on Renewable Energy (DME, 2003) supplements the Energy Policy, and sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. It also informs the public and the international community of the Government's vision, and how the Government intends to achieve these objectives; and informs Government agencies and organs of their roles in achieving the objectives.

The support for the Renewable Energy Policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind, and that renewable applications are, in fact, the least cost energy service in many cases from a fuel resource perspective (i.e. the cost of fuel in generating electricity from such technology); more so when social and environmental costs are taken into account. In spite of this range of resources, the National Energy Policy acknowledges that the development and implementation of renewable energy applications has been neglected in South Africa.

Government policy on renewable energy is therefore concerned with addressing the following challenges:

» Ensuring that economically feasible technologies and applications are implemented;
» Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and
» Addressing constraints on the development of the renewable industry.

The White Paper on Renewable Energy states "*It is imperative for South Africa to supplement its existing energy supply with renewable energies to combat Global Climate Change which is having profound impacts on our planet*."

5.2.4. Integrated Resource Plan 2010 - 2030

In order to meet the long-term goal of a sustainable renewable energy industry and to diversify the energy-generation mix in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

The current iteration of the Integrated Resource Plan (IRP) for South Africa, initiated by the Department of Energy (DoE) after a first round of public participation in June 2010, led to the Revised Balanced Scenario (RBS) that was published in October 2010. A second round of public participation was conducted in November/December 2010, which led to several changes to the IRP model assumptions

The current document (IRP 2013) outlines the proposed generation new-build fleet for South Africa for the period 2010 to 2030. This scenario was derived based on the cost-optimal solution for new-build options (considering the direct costs of new build power plants), which was then "balanced" in accordance with qualitative measures such as local job creation.

The Policy-Adjusted IRP includes the same amount of coal and nuclear new builds as the RBS, while reflecting recent developments with respect to prices for renewables. In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 9,6 GW of nuclear; 6,3 GW of coal; 17,8 GW of renewables; and 8,9 GW of other generation sources. The Policy-Adjusted IRP has therefore resulted in an increase in the contribution from renewables from 11,4 GW to 17,8 GW.

The DoE has released a draft Integrated Energy Planning Report (June 2013) for public comment. The Draft Integrated Energy Planning Report gives insight on the possible implications of pursuing alternative energy policy options in South Africa. Once the implications of all the alternative options have been explored and evaluated against each of the eight (8) key objectives, final recommendations will be made in the form of the Final IEP Report.

5.2.5. Department of Energy Process for Independent Power Producers (IPPs)

In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, Karreebosch Wind Farm (Pty) Ltd proposes the establishment of Karreebosch Wind Farm to add new capacity to the national electricity grid. Karreebosch Wind Farm (Pty) Ltd will be required to apply for a generation license from the National Energy Regulator of South Africa (NERSA), as well as a power purchase agreement from Eskom (i.e. typically for a period of 20 - 25 years) in order to build and operate the proposed wind energy facility. As part of the agreement, Karreebosch Wind Farm (Pty) Ltd would be remunerated per kWh by Eskom or subsequent authority/market operator. Depending on the economic conditions following the lapse of this period, the facility can either be decommissioned, or the power purchase agreement renegotiated and extended.

The IPP will undergo a bidding process in which the Department of Energy will determine preferred bidders. A preferred bidder will be held to compliance with the price and economic development proposals in its bid, with regular reporting to demonstrate compliance during the life of the project.

5.3. Regulatory Hierarchy for Energy Generation Projects

The South African energy industry is evolving rapidly, with regular changes to legislation and industry role-players. The regulatory hierarchy for an energy generation project of this nature consists of three tiers of authority who exercise control through both statutory and non-statutory instruments – that is National, Provincial and Local levels.

At **National Level**, the main regulatory agencies are:

» *Department of Energy (DoE):* This Department is responsible for policy relating to all energy forms, including renewable energy, and are responsible for forming and approving the IRP (Integrated Resource Plan for Electricity). Wind energy is considered under the White Paper for Renewable Energy (2003) and the Department undertakes research in this regard. It is the controlling authority in terms of the Electricity Regulation Act (Act No 4 of 2006, and as amended).
» *National Energy Regulator of South Africa (NERSA):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for wind energy developments to generate electricity.
» *Department of Environmental Affairs (DEA):* This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. The DEA is the competent authority for this project, and charged with granting the relevant environmental authorisation.
» *The South African Heritage Resources Agency (SAHRA):* The National Heritage Resources Act (Act No 25 of 1999) and the associated provincial regulations provides legislative protection for listed or proclaimed sites.

- *South African Civil Aviation Authority (SACAA):* This Department is responsible for aircraft movements and radar, which are aspects that influence wind energy development location and planning.
- *South African National Roads Agency (SANRAL):* This agency of the Department of Transport is responsible for all National road routes.
- *Department of Water and Sanitation (DWS):* This Department is responsible for effective and efficient water resources management to ensure sustainable economic and social development. This Department is also responsible for evaluating and issuing licenses pertaining to water use.
- *Department of Agriculture, Forestry and Fisheries (DAFF):* This Department is the custodian of South Africa's agriculture, fisheries and forestry resources and is primarily responsible for the formulation and implementation of policies governing the Agriculture, Forestry and Fisheries Sector. This Department has published a guideline for the development of wind farms on agricultural land.
- *Department of Mineral Resources:* Approval from the Department of Mineral Resources (DMR) may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resources that might occur on site.

For the **Northern Cape Province** the main **provincial** regulatory agencies are:

- *Provincial Government of the Northern Cape – Department of Environment and Nature Conservation (Northern Cape DENC).* This department is the commenting authority for this project.
- *Department of Transport and Public Works - Northern Cape.* This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
- *Northern Cape Department of Agriculture and Rural Development* – This is the provincial authority responsible for matters affecting agricultural land.
- *Ngwao Boswa Kapa Bokoni is the Provincial Heritage Resources Authority of the Northern Cape Province*: provides legislative protection for listed or proclaimed heritage sites, such as urban conservation areas, nature reserves and proclaimed scenic routes. It is a statutory body established in terms of the National Heritage Resources Act and is responsible for the protection, conservation, management and interpretation of the heritage resources of the Northern Cape.
- *Department of Water and Sanitation:* This Department is responsible for evaluating and issuing licenses pertaining to water use.

For the **Western Cape Province** the main **provincial** regulatory agencies are:

» *Provincial Government of the Western Cape – Department of Environmental Affairs and Development Planning (DEA&DP):* This department is the commenting authority for this project for environmental assessments as well as development planning applications.
» *Department of Transport and Public Works (Western Cape):* This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *CapeNature:* This Department's involvement relates specifically to the biodiversity and ecological aspects of the proposed development activities on the receiving environment to ensure that developments do not compromise the biodiversity value of an area. The Department considers the significance of impacts specifically in threatened ecosystems as identified by the National Spatial Biodiversity Assessment or systematic biodiversity plans.
» *Department of Agriculture:* This Department's involvement relates specifically to sustainable resource management and land care.
» *Heritage Western Cape:* Heritage Western Cape (HWC) is a provincial heritage resources authority. This public entity seeks to identify, protect and conserve the rich and diverse heritage resources of the Western Cape. HWC is mandated to promote co-operative governance between national, provincial and local authorities for the identification, conservation and management of heritage resources.
» *Department of Water and Sanitation:* This Department is responsible for evaluating and issuing licenses pertaining to water use.

At a **Local Level**, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. The site is located within the Karoo Hoogland Local Municipality of the Northern Cape and within the Laingsburg Local Municipality of the Western Cape. In terms of the Municipal Systems Act (Act No 32 of 2000), it is compulsory for all municipalities to conduct an Integrated Development Planning (IDP) process to prepare a five-year strategic plan for the area under their control. Bioregional Planning involves the identification of priority areas for conservation and their placement within a planning framework of core, buffer and transition areas. By-laws and policies have been formulated by local authorities to protect visual and aesthetic resources relating to urban edge lines, scenic drives, special areas, signage, communication masts, etc.

SENTECH and other communication providers will also be consulted <u>on an ongoing basis</u> to ensure the wind energy facility will not have any impact on the telecommunication signals in the area.

There are also numerous non-statutory bodies such as Wind Energy Associations and environmental lobby groups that play a role in various aspects of planning and the environment that will influence wind energy facility development.

5.4. Legislation and Guidelines that have informed the preparation of this EIA Report

The following legislation and guidelines have informed the scope and content of this final EIA Report:

» National Environmental Management Act (Act No. 107 of 1998)
» EIA Regulations (December 2014), published under Chapter 5 of the NEMA
» Guidelines published in terms of the NEMA EIA Regulations, in particular:
  * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010)
  * Public Participation in the EIA Process (DEA, 2010)
  * Integrated Environmental Management Information Series (published by DEA)
» International guidelines – the Equator Principles and the International Finance Corporation and World Bank Environmental, Health, and Safety Guidelines for Wind Energy (2007).
» Provincial Government Western Cape, Department of Environmental Affairs and Development Planning: Guideline for Environmental Management Plans, 2005.
» Provincial Government Western Cape, Department of Environmental Affairs and Development Planning: Guideline for the Management of Development on Mountains, Hills and Ridges in the Western Cape (2002).
» Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins et al 2014).
» South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments. Wildlife & Energy Programme of the Endangered Wildlife Trust (2012).

Several other Acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the EIA Report. A review of legislative requirements applicable to the proposed project is provided in Table 5.2.

Table 5.2: Relevant legislative permitting requirements applicable to the Karreebosch Wind Farm

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
National Legislation			
National Environmental Management Act (Act No 107 of 1998 as amended)	EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations. In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. In terms of sections 24 and 24D of NEMA, as read with Government Notices R983, R984 and R985, a Scoping and EIA process is required to be undertaken for the proposed project.	National Department of Environmental Affairs – lead authority. Provincial Environmental Departments - commenting authority.	The final EIA report is submitted to the DEA and Provincial Environmental Departments in support of the application for authorisation.
National Environmental Management Act (Act No 107 of 1998)	In terms of the Duty of Care provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised. In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of	Department of Environmental Affairs (as regulator of NEMA).	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section will find application during the EIA phase and will continue to apply throughout the life cycle of the project.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	a variety of impacts.		
National Environmental Management: Waste Act (Act No 59 of 2008)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of this Act (GN 921), a Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that: » The containers in which any waste is stored, are intact and not corroded or in » any other way rendered unlit for the safe storage of waste. » Adequate measures are taken to prevent	Hazardous Waste – National DEA General Waste – DEA&DP; DENC	A waste licence could be required in the event that more than $100m^3$ of general waste or more than $35m^2$ of hazardous waste is to be stored on site at any one time. The volumes of waste generated during construction and operation of the facility are not expected to be large enough to require a waste license.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented.		
Environment Conservation Act (Act No 73 of 1989)	In terms of section 25 of the ECA, the national noise-control regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice No R55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Western Cape Province. Allows the Minister of Environmental Affairs to make regulations regarding noise, among other concerns.	National Department of Environmental Affairs Provincial Environmental Department - commenting authority. Local Municipality	There is no requirement for a noise permit in terms of the legislation; although a provision is made that exemption from any of the regulations of the NCR can be applied for from a local authority. A Noise Impact Assessment is required to be undertaken in accordance with SANS 10328 – this has been undertaken as part of the EIA process. There are noise level limits which must be adhered to.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	Sections 18, 19 and 20 of the Act allow certain areas to be declared and managed as “priority areas” in terms of air quality.	National Department of Environmental Affairs – air quality Local Municipality - Noise	No permitting or licensing requirements applicable for air quality aspects.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	Declaration of controlled emitters (Part 3 of Act) and controlled fuels (Part 4 of Act) with relevant emission standards. Section 32 makes provision for measures in respect of dust control. Section 34 makes provision for: (1) the Minister to prescribe essential national noise standards - (a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or (b) for determining – (i) a definition of noise (ii) the maximum levels of noise (2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.		The section of the Act regarding noise control is in force, but no standards have yet been promulgated. Draft regulations have however, been promulgated for adoption by Local Authorities. An atmospheric emission licence issued in terms of Section 22 may contain conditions in respect of noise. This will however, not be relevant to the facility, as no atmospheric emissions will take place. The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.
National Heritage Resources Act (Act No 25 of 1999)	Section 38 states that Heritage Impact Assessments (HIAs) are required for certain kinds of development including » the construction of a road, power line, pipeline, canal or other similar linear development or barrier exceeding 300 m in length; » any development or other activity which will change the character of a site exceeding 5 000 m^2 in extent.	» National Department of Environmental Affairs where heritage assessment is a component of the EIA » South African Heritage Resources Agency (SAHRA) – National heritage sites (grade 1	Section 4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an impact assessment report if they believe a heritage resource may be affected. A permit may be required should identified cultural/heritage sites on

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	The relevant Heritage Resources Authority must be notified of developments such as linear developments (such as roads and power lines), bridges exceeding 50 m, or any development or other activity which will change the character of a site exceeding 5 000 m^2; or the re-zoning of a site exceeding 10 000 m^2 in extent. This notification must be provided in the early stages of initiating that development, and details regarding the location, nature and extent of the proposed development must be provided. Standalone HIAs are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils the provisions of Section 38. In such cases only those components not addressed by the EIA should be covered by the heritage component.	sites) as well as all historic graves and human remains. » Heritage Western Cape – Issue of permits for removal or destruction of heritage resources in the Western Cape. » Ngwao Boswa Kapa Bokoni: Northern Cape - Issue of permits for removal or destruction of heritage resources in the Northern Cape	site be required to be disturbed or destroyed as a result of the proposed development.
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened and protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered,	National Department of Environmental Affairs	Specialist flora and fauna studies are required to be undertaken as part of the EIA process. A specialist flora, fauna and wetland assessment has been undertaken for the proposed project. A permit may be required should any listed plant species occur on site and are likely to be disturbed or

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002), 9 December 2011). » This Act also regulates alien and invader species. » Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The developer has a responsibility for: » The conservation of endangered ecosystems and restriction of activities according to the		destroyed as a result of the proposed development.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	categorisation of the area (not just by listed activity as specified in the EIA regulations). » Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity. » Limit further loss of biodiversity and conserve endangered ecosystems.		
Conservation of Agricultural Resources Act (Act No 43 of 1983)	Regulation 15 of GNR1048 provides for the declaration of weeds and invader plants, and these are set out in Table 3 of GNR1048. Declared Weeds and Invaders in South Africa are categorised according to one of the following categories: » Category 1 plants: are prohibited and must be controlled. » Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread. » Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.	Department of Agriculture, Forestry and Fisheries	While no permitting or licensing requirements arise from this legislation, this Act will find application during the EIA phase and will continue to apply throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented. The permission of agricultural authorities will be required if the Project requires the draining of vleis, marshes or water sponges on land outside urban areas. However, none of these activities are expected to be

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	These regulations provide that Category 1, 2 and 3 plants must not occur on land and that such plants must be controlled by the methods set out in Regulation 15E.		undertaken on site.
National Veld and Forest Fire Act (Act 101 of 1998)	» In terms of Section 21 the applicant would be obliged to burn firebreaks to ensure that should a veld fire occur on the property, that it does not spread to adjoining land. » In terms of section 12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material. » In terms of section 17, the applicant must have such equipment, protective clothing and trained personnel for extinguishing fires.	Department of Water and Sanitation	While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project. Due to the fire prone nature of the area, it must be ensured that the landowner and developer proactively manage risks associated with veld fires and provide cooperation to the local Fire Protection Agency.
National Forests Act (Act No 84 of 1998)	Protected trees: According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.	Department of Environmental Affairs	A permit or license is required for the destruction of protected tree species and/or indigenous tree species within a natural forest. No protected tree species were observed within or near the study area and it is highly unlikely that any protected tree species would be impacted by the development.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	Forests: Prohibits the destruction of indigenous trees in any natural forest without a licence.		
Aviation Act (Act No 74 of 1962) 13th amendment of the Civil Aviation Regulations (CARS) 1997	» Any structure exceeding 45m above ground level or structures where the top of the structure exceeds 150m above the mean ground level, the mean ground level considered to be the lowest point in a 3km radius around such structure. » Structures lower than 45m, which are considered as a danger to aviation shall be marked as such when specified. » Overhead wires, cables etc., crossing a river, valley or major roads shall be marked and in addition their supporting towers marked and lighted if an aeronautical study indicates it could constitute a hazard to aircraft. » Section 14 of Obstacle limitations and marking outside aerodrome or heliport – CAR Part 139.01.33 relates specifically to appropriate marking of wind energy facilities.	South African Civil Aviation Authority (SA CAA)	This act will find application during the permitting and operational phase of the project. Appropriate marking on the turbine structures is required to meet the specifications as detailed in the CAR Part 139.01.33. An obstacle approval for the wind energy facility is required to be obtained from the CAA prior to the start of construction.
Hazardous Substances Act (Act No 15 of 1973)	This Act regulates the control of substances that may cause injury, or ill health, or death by reason of their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the	Department of Health	It is necessary to identify and list all the Group I, II, III and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products. » Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc., nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared to be Group I or Group II hazardous substance; » Group IV: any electronic product; » Group V: any radioactive material. The use, conveyance or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.		
National Road Traffic Act (Act No 93 of 1996)	The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed	» Provincial Department of Transport (provincial roads) » South African National Roads Agency Limited (national roads)	An abnormal load/vehicle permit may be required to transport the various components to site for construction. These include: » Route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads. » Transport vehicles exceeding the dimensional limitations (length) of 22m.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges and culverts. The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.		» Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).
Development Facilitation Act (Act No 67 of 1995)	» Provides for the overall framework and administrative structures for planning throughout the Republic. » Sections 2- 4 provide general principles for land development and conflict resolution.	Provincial Department of Environmental Affairs and Development Planning (DEA&DP)	The applicant must submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the DFA.
Astronomy Geographic Advantage Act (Act 21 of 2007)	» The Astronomy Geographic Advantage Act (No. 21 of 2007) provides for the preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy;	National Department of Science and Technology. South African Astronomical Observatory (SAAO	the Northern Cape parts of the project (majority of the site) where all turbines are to be located falls within the Sutherland Central Astronomy Advantage Area gazetted in GN R140 of 28 February 2015, the 75km circular buffer centred on the

Legislation / Policy / Guideline	**Applicable Requirements**	**Relevant Authority**	**Compliance requirements**
			SALT. While no regulations (draft or final) have yet been gazetted for this area, SAAO should be consulted as a key stakeholder. It should be noted that the entire project falls outside of the Karoo Central Astronomy Advantage Areas which were gazetted for the protection of the SKA.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details the subdivision of agricultural land and provisions under which the act is triggered. It also provides for the approval of such division by the Minister of Agriculture. Applies for subdivision of all agricultural land and long-term leasing of portions of agricultural land.	National Department of Agriculture, Forestry and Fisheries (DAFF) Provincial Departments of Agriculture and Environment - commenting authority. Local Municipality – competent authority	Long-term leases on portions or subdivision of the site properties will require an approval of the Minister of Agriculture. An application to DAFF will need to be submitted detailing the areas to be subdivided or leased for the purposes of the proposed development. An application in terms of SALA will need to be undertaken and submitted following the issuing of an environmental authorization for the proposed project.
Provincial Policies / Legislation			
Western Cape Noise Control Regulations: PN 627 of 1998	The control of noise in the Western Cape Province is legislated in the form of Noise Control Regulations promulgated in terms of section 25 of the Environment Conservation Act No. 73 of 1989.	Western Cape DEA&DP	In terms of Regulation 4 of the Noise Control Regulations: "No person shall make, produce or cause a disturbing noise (greater than 5 dBA), or allow it to be made, produced or caused by any person, animal, machine, device or apparatus or any combination

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
			thereof". The NCR is not triggered by the proposed project.
Northern Cape Planning and Development Act, 1998 (Act 7 of 1998)	» The Northern Cape Planning and Development Act, 1998 (Act 7 of 1998) (NCPDA) provides for a single set of procedures and regulations to complement the accelerated development procedures as provided for in the Development Facilitation Act, 1995; » Ensures effective and co-operative planning and land development within the provincial and local spheres of the government of the Northern Cape province,	Karoo Hoogland Local Municipality Northern Cape Provincial Planning –Commenting authority Provincial and National Departments of Agriculture – Commenting Authority	The development proposal of a wind energy facility implies a non-conforming land use on land zoned as Agriculture Zone I, with The primary use of agriculture. Hence, an application is made to change the zoning of land as per provisions in the applicable Scheme regulations for the properties in the Northern Cape.
Western Cape Land Use Planning Ordinance 15 of 1985	» The Provincial Government Western Cape promulgated Scheme Regulations PN 189/2011 dated 29 July 2011 in order to make the development of commercial wind and solar energy facilities possible on land zoned Agriculture Zone I.	Laingsburg Local Municipality Western Cape Department of Environmental Affairs and Development Planning – Commenting authority Provincial and National Departments of Agriculture – Commenting Authority	An application must be submitted to obtain the land use right of consent use in order to accommodate the establishment of a wind energy facility on land zoned as Agriculture Zone 1 for the properties located in the Western Cape. The application will be submitted in terms of Section 4.6 of the Scheme regulations in terms of the Land Use Planning Ordinance, 1985 (Ord. 15 of 1985) promulgated in provincial notice, no PN 1048/1998 and as amended by provincial notice, no PN 189/2011.
The Nature and Environmental Ordinance	The Nature and Environmental Ordinance 19 of 1974, (as amended by the Western Cape Nature	CapeNature	Removal / relocation of protected plant / animal species require a

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
19 of 1974, (as amended by the Western Cape Nature Conservation Laws Amendment Act, Act 2 of 2000	Conservation Laws Amendment Act, Act 2 of 2000) defines the protection status of plants as follows: * ''endangered flora'' means flora of any species which is in danger of extinction and is specified in Schedule 3 or Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973; provided that it shall not include flora of any species specified in such Appendix and Schedule 4; (thus all Schedule 3 species) * ''protected flora'' means any species of flora specified in Schedule 4 or Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973; provided that it shall not include any species of flora specified in such Appendix and Schedule 3 * ''indigenous unprotected flora'' means any species of indigenous flora not specified in Schedule 3 or 4;		permit to be obtained from CapeNature
Northern Cape Nature Conservation Act, Act No. 9 of 2009	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations.	Provincial Department of Environmental Affairs - DENC	Permitting or licensing requirements arise from this legislation for the proposed activities to be undertaken for the proposed project as there are a succulent plants species on the proposed development site. A permit is required to remove the plants.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	Amongst other regulations, the following may apply to the current project: » Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property; » Aquatic habitats may not be destroyed or damaged; » The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. » The Act provides lists of protected species for the Province.		
Western Cape Transportation Amendment Act of 1996	The provincial MEC may grant permit to undertake works within 200m of the published route upon receipt of the report assessing the potential impacts thereof.	Western Cape Department of Public Transport and Public Works	Any application for authorisation contemplated in the ECA and NEMA in respect of a 200m area on either side of a published route determination for a provincial road must be accompanied by a report that addresses the issues listed in that section of the Act.

APPROACH TO UNDERTAKING THE EIA PHASE CHAPTER 6

An Environmental Impact Assessment (EIA) process refers to that process (dictated by the EIA Regulations) which involves the identification and assessment of direct, indirect and cumulative environmental impacts associated with a proposed project. The EIA process comprises two phases: **Scoping Phase** and **EIA Phase**. The EIA process culminates in the submission of an EIA Report (including an environmental management programme (EMPr)) to the competent authority for decision-making.

The EIA process for the proposed Karreebosch Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN38282 of December 2014, in terms of Section 24(5) of NEMA (Act No. 107 of 1998 as amended). This chapter serves to outline the EIA process that was undertaken.

6.1. Impact Assessment Methodology10

The methodology utilised for the detailed impact assessment is outlined below (a modified / slightly adapted version of the methodology used in Roggeveld EIR compiled by Environmental Resource Management, 2012). The purpose of impact assessment and mitigation is to identify and evaluate the significance of potential impacts on identified receptors and resources according to defined assessment criteria and to develop and describe measures that will be taken to avoid or minimise any potential adverse effects and to enhance potential benefits.

The EIA assessment methodology has been supplemented to include all requirements of the 2014 EIA Regulations.

6.1.1. Impact Types and Definitions

An impact is any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the bio-physical and socio-economic environment. Impacts are described as summarised in Table 6.1. Impacts are also described as *associated*, those that will occur, and *potential,* those that may occur.

[10] Taken from the Roggeveld EIR compiled by Environmental Resource Management, 2012.

Table 6.1: Impact Nature and Type

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

6.1.2. Assessing Significance

Impacts are described in terms of '*significance*'. Significance is a function of the **magnitude** of the impact and the **likelihood** of the impact occurring. Impact magnitude (sometimes termed *severity*) is a function of the **extent, duration and intensity** of the impact. The criteria used to determine significance are summarised in Table 6.2. Once an assessment is made of the magnitude and likelihood, the impact significance is rated through a matrix process as shown in Table 6.3 and Table 6.4.

Significance of an impact is qualified through a statement of the **degree of confidence**. Confidence in the prediction is a function of uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence is expressed as low, medium or high.

Table 6.2 Significance Criteria

Impact Magnitude	
Extent	**On-site** – impacts that are limited to the boundaries of the development site. **Local** – impacts that affect an area in a radius of 20km around the development site. **Regional** – impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem. **National** – impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.
Duration	**Temporary** – impacts are predicted to be of short duration and

	intermittent/occasional. **Short-term** – impacts that are predicted to last only for the duration of the construction period. **Long-term** – impacts that will continue for the life of the Project, but ceases when the project stops operating. **Permanent** – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the project lifetime.
Intensity	BIOPHYSICAL ENVIRONMENT: *Intensity can be considered in terms of the sensitivity of the biodiversity receptor (i.e. habitats, species or communities).* **Negligible** – the impact on the environment is not detectable. **Low** – the impact affects the environment in such a way that natural functions and processes are not affected. **Medium** – where the affected environment is altered but natural functions and processes continue, albeit in a modified way. **High** – where natural functions or processes are altered to the extent that it will temporarily or permanently cease. ***Where appropriate, national and/or international standards are to be used as a measure of the impact.*** *Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale used.* ____ SOCIO-ECONOMIC ENVIRONMENT: *Intensity can be considered in terms of the ability of project affected people/communities to adapt to changes brought about by the Project.* **Negligible** – there is no perceptible change to people's livelihood **Low** - People/communities are able to adapt with relative ease and maintain pre-impact livelihoods. **Medium** - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. **High** - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.
Likelihood - the likelihood that an impact will occur	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.
Reversibility - the degree to which the impact and risk can be reversed (High, Medium or Low or None)	
Irreplaceable Loss - the degree to which the impact and risk may cause irreplaceable loss of resources	

Once a rating is determined for magnitude and likelihood, the following matrix can be used to determine the impact significance.

Table 6.3: Significance Rating Matrix

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 6.4: Significance Definitions

Significance definitions	
Negligible significance	An impact of negligible significance (or an insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors such as employment, in coming to a decision on the Project.

Once the significance of the impact has been determined, it is important to qualify the **degree of confidence** in the assessment. Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence can be expressed as low, medium or high.

6.1.3. Mitigation Measures and Residual Impacts

For activities with significant impacts, the EIA process is required to identify suitable and practical mitigation measures that can be implemented. The implementation of the mitigations is ensured through compliance with the EMPr. After first assigning significance in the absence of mitigation, each impact is re-evaluated assuming the appropriate mitigation measure/s is/are effectively applied, and this results in a significance rating for the residual impact.

6.1.4. Identification of Mitigation Measures

For the identified significant impacts, the project team with the input of the client has identified suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the project design in order to avoid or reduce the negative impacts or enhance the positive impacts have been defined and require final agreement with the client as these are likely to form the basis for the conditions of authorisation by DEA.

6.1.5. Assumptions and Limitations

The Environmental Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIR deals with the future, there is inevitably some uncertainty regarding actual results. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties cannot be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided as the degree of confidence.

In line with best practice, this EIR has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists have used professional experience and available scientific research from wind farms worldwide to judge whether a significant impact is likely to occur or not. Throughout the assessment this conservative approach has been adopted to the allocation of significance.

6.2. EIA Specialist Studies

During the EIA Phase, the specialists gathered data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. They assisted the project team in assessing potential impacts according to a predefined assessment methodology which was described in the Scoping and EIA Reports. Specialists have also suggested ways in which negative impacts could be mitigated and benefits enhanced, and have assessed the potential for cumulative impacts. The independent specialists responsible for the specialist studies are listed in Table 6.5 and a brief description of the content of their reports are detailed thereafter. The specialist reports and declarations of each specialist are attached to this EIA report (Appendix D – M).

Table 6.5: Specialist studies which support this DEIR (and are appended to this report)

Specialist Study	**Specialists and Organisation**	**Appendix**
Ecological and Biodiversity study	Simon Todd (Simon Todd Consulting)	Appendix D
Avifaunal Pre-Construction Monitoring Report and Impact Assessment	Dr. A.J. Williams (African Insights cc Dr Rob Simmons & Marlei Martins (Birds Unlimited)	Appendix E
Pre-Construction Bat Monitoring Programme and Impact Assessment	Werner Marias and Monika Moir (Animalia cc)	Appendix F
Soil and Agricultural Potential	Jaco Jansen (Savannah Environmental) and Jasper Dreyer (North West University)	Appendix G
Hydrological Surface Water Study	Scherman Colloty & Associates (SC&A)	Appendix H
Visual Impact Assessment	Lourens du Plessis (MetroGIS)	Appendix I
Environmental Noise Impact Study:	Adrian Jongens (Jongens Keet Associates)	Appendix J
Heritage and Paleontological Impact Assessment	Tim Hart (ACO Associates *cc*) and John Almond (Natura Viva)	Appendix K
Socio-Economic Assessment Report	Tony Barbour (Environmental Consulting and Research)	Appendix L

Additional studies were requested by the DEA, namely Aquatic/Hydrology Study and Soils and Agricultural potential. These studies present a deviation from the approved plan of study in the scoping report.

This project was part of an initial Environmental Impact Assessment (EIA) application for the larger Roggeveld Wind Farm which has now being considered and assessed as three smaller Phases of 140MW each. Outcomes from their reports informed the current layout for Karreebosch Wind Farm.

6.2.1. Ecology and Biodiversity

A fauna and flora specialist study was conducted by Simon Todd Consulting. The turbines within the Karreebosch Wind Farm are located along for main ridges orientated in a roughly north-south direction. The eastern two ridges consist of approximately half the turbines and turbine numbers 36 through to 72 are located within this area. The western ridges contain the remaining turbines numbered from 1 to 35. This distinction was made because there is some variation in vegetation composition from east to west and also because the eastern ridges have been well sampled in the past for a variety of purposes for the greater Roggeveld Wind Farm. While the eastern half of the site was visited on a number of occasions and the ecologist was familiar with the site in this area, the western ridges were less accessible and were not investigated fully in prior visits. As a result, the focus of the current study and site assessment was the western ridges rather than the better known eastern ridges. Sensitivity maps of the study area were compiled based upon the findings of the site visit and available literature. The impact assessment phase involved the determination and evaluation of the nature of likely impacts of the development and recommendations on mitigation.

6.2.2. Avifauna

An avifaunal pre-construction monitoring report was compiled by Dr A. J Williams of African Insights. This report covered bird monitoring which took place across an 18 month period from 2013 – 2014 and focussed on the broader Roggeveld, as well as the Karreebosch site. The report followed BirdLife South Africa's pre-construction monitoring guidelines, where terrain and logistics permitted and the methodology of the previous iterations of the report. Various field techniques were employed in different seasons in order to gain a further understanding of avian diversity and activity in the area. An addendum raptor study conducted by Dr Rob Simmons forms part of the current pre-construction bird monitoring report by Dr Anthony Williams. The valley drive transects and inspection of dams provided sufficient information to appraise the potential effects on birds of the several alternative powerline routings, and to suggest mitigations

6.2.3. Bats

For the current Karreebosch Wind Farm, bat activity was monitored using active and passive bat monitoring techniques over the duration of 12 months. Active monitoring was carried out through site visits with transects made throughout the site with a vehicle-mounted bat detector. Passive detection was conducted through the mounting of passive bat monitoring systems placed on eight monitoring masts on site, specifically the five short 10m masts and three meteorological masts (met masts). One weatherproof ultrasound microphone was mounted at a height of 10 meters on each of the short masts, with two microphones being mounted at 10m and 50m heights on the meteorological masts. These microphones were then connected to the bat detectors. A similar methodology as above was used to record any bat activity. Similarly, the aim of this study was to identify any turbines/areas which required special attention with regards to bat monitoring and detail any forms of mitigation that would be possible to reduce mortality rates.

6.2.4. Surface Water (Hydrology)

A surface water study (Hydrology study) was undertaken by Brian Colloty of Sherman Colloty and Associates, who visited the site in July 2015. The potential impacts of the proposed wind farm on surface water assessed in this report.

6.2.5. Noise

The noise impact assessment was compiled by A. W. D. Jongens in order to focus on the Karreebosch area. A description was given of the noise emitted by wind energy turbines and, because of frequent misconceptions, some detail was included of various factors that influence how the noise is perceived by human receptors. The procedures used to predict and assess the impact of noise on land surrounding the turbines were presented in the report, followed by the results of predicted noise level calculations and associated noise impact.

6.2.6. Visual

The visual impact study for the Karreebosch Wind Farm was conducted by MetroGIS4. The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact. Similar to the previous visual study, viewshed analyses and photomontages were used to assist with identifying likely impacts to the development and potential mitigation measures.

6.2.7. Archaeology, Heritage and Palaeontology

Similar methodology, as in the studies carried out in 2011, for archaeology, heritage and palaeontology was applied to the heritage impact assessment in 2014 which focussed on the Karreebosch Wind Farm area only. The heritage report was compiled by Tim Hart of ACO Associates with an additional palaeontological assessment conducted by Dr John Almond. Findings of both these reports formed the content of the Heritage Impact Assessment to focus on the Karreebosch site.

6.2.8. Soils and Agricultural Potential

A soils and agricultural potential study was undertaken by Jaco Jansen of Savannah Environmental, who visited the site in July 2015. The potential impacts of the proposed wind farm on soils and agricultural potential was assessed in this report

6.2.9. Social and Land Assessment Impact

For the current Karreebosch project, a full socio-economic assessment report was compiled in July 2015 by Tony Barbour. Tony Barbour visited the site area in July 2015, collecting baseline data on the current social environment and historical social trends and identifying and collecting data on the key social issues related to the proposed development. This required consultation with affected individuals and communities. His report assesses and documents the significance of social impacts associated with the proposed project.

6.3. Public Participation Undertaken during the EIA Phase for Karreebosch Wind Farm

The public participation process was designed to satisfy the legislative requirements of the NEMA EIA Regulations, 2014. The elements relating to the public participation process that are required as per Chapter 6 Regulation 40 - 44 of GN R.982 are applicable and outlined as follows:

» The manner in which potential Interested and Affected Parties (I&APs) were notified of the application for authorisation, and that a public participation process was mandatory. This includes notice boards, giving written notice, information documents and letters to landowners and I&APs, and placing advertisements in the media (Regulation 40 - 41).
» Opening and maintaining a register, which contains the names and addresses of I&APs. These include all persons who have submitted comments, are Organs of State who have some form of jurisdiction in the assessment process, are impacted or adjacent landowners and occupiers as well as all

those who have requested that they be placed on the project database as registered I&APs (Regulation 42).

» Registered I&APs are entitled to comment, in writing, on all written submissions made to the competent authority by the applicant or the EAP managing the application, and to bring to the attention of the competent authority any issues, which that party believes may be of significance when the application is considered for authorisation (Regulation 43).
» The comments of registered I&APs must be recorded and included in the reports submitted to the competent authority (Regulation 44).

In terms of Chapter 6 (Regulation 40 – 44) of the EIA Regulations 2014, Savannah Environmental undertook to notify Interested and Affected Parties (I&APs), including affected and neighbouring landowners, of the commencement of the EIA process for the Karreebosch Wind Farm. The public participation processes undertaken are outlined in Table 6.6 below.

Table 6.6: Summary of Public Participation activities undertaken by Savannah Environmental

	Activity	**Date**
Scoping Phase	The EIA Process was advertised in the "Die Burger" newspaper and the "Noordwester" newspaper.	23 March 2015 27 March 2015
	Placement of site notices on-site & in public places.	March 2015
	Distribution of notification letters to I&APs and Organs of State via email and registered post.	20 March 2015
	30-day public review period for the Scoping Report for comment.	20 March 2015 – 21 April 2015
	Notification to registered I&APs of submission of Scoping Report to DEA	24 April 2015
EIA Phase	30-day public review period for the EIA Report for comment.	14 August 2015 – 14 September 2015
	Notification to registered I&APs of submission of EIA Report to DEA	14 August 2015
	The EIA Report availability and Public Meeting date was advertised in the "Die Burger" newspaper and the "Noordwester" newspaper.	17 August 2015
	Focus Group Meetings and public meeting	18 – 19 August 2015

Stakeholder consultation was undertaken on a one-on-one basis which included letters, emails and phone calls. All comments received on the Draft EIR are compiled into a Comments and Responses Report submitted with this Final EIR to the DEA. A public meeting and selected stakeholder focus group meetings were held during the review period of the EIA report.

A database of Interested and Affected Parties (I&APs) was created through utilising existing contacts and databases, recording responses to site notices and newspaper advertisements, recording responses on the reports as well as through the process of networking. I&APs which were identified are listed in Table 6.6 below.

Table 6.6: Interested and Affected Parties

Organs of State
National Government Departments
Department of Agriculture, Forestry and Fisheries
Department of Communications
Department of Economic Development
Department of Energy
Department of Environmental Affairs (Directorate Biodiversity and Conservation)
Department of Mineral Resources
Department of Public Works
Department of Rural Development and Land Reform
Department of Science and Technology
Department of Transport
Department of Water and Sanitation
South African Defence Force
South African National Parks (SANParks)
South African National Road Agency Limited (SANRAL)
Government Bodies and Institutions
Eskom SOC Ltd
Independent Communications Authority of South Africa (ICASA)
National Energy Regulator of South Africa (NERSA)
Sentech
South African Astronomical Observatory (SAAO)
South African Civil Aviation Authority (SACAA)
South African Heritage Resources Agency (SAHRA)
South African Large Telescope (SALT)
South African Weather Service (SAWS)
Square Kilometre Array: Southern Africa (SKA)
Telkom SA Ltd
Transnet
Provincial Government Departments: Northern Cape
Ngwao-Boswa Ya Kapa Bokone (Northern Cape Provincial Heritage Resources Authority)
Northern Cape Department of Agriculture, Land Reform and Rural Development
Northern Cape Department of Economic Affairs
Northern Cape Department of Environment and Nature Conservation (DENC)

Northern Cape Department of Roads and Public Works
Provincial Government Departments: Western Cape
CapeNature
Heritage Western Cape
Western Cape Department of Agriculture and Rural Development
Western Cape Department of Economic Development and Tourism
Western Cape Department of Local Government, Environmental Affairs and Development Planning
Western Cape Department of Transport and Public Works
Local Government Departments: Northern Cape
Karoo Hoogland Local Municipality
Namakwa District Municipality
Local Government Departments: Western Cape
Central Karoo District Municipality
Laingsburg Local Municipality
Conservation Authorities
BirdLife South Africa
Earthlife Africa
Endangered Wildlife Trust (EWT)
South African Bat Assessment Advisory Panel (SABAAP)
Wildlife and Environment Society of South Africa (WESSA)
Landowners
Affected landowners and tenants
Neighbouring landowners and tenants

The draft EIA Report for Karreebosch Wind Farm was made available for a 30-day public review period. The report is available for download on http://data.g7energies.com/karreebosch or on request from Savannah Environmental. Hard copies of the document were also made available for review at the Laingsburg Library and Sutherland Library.

DESCRIPTION OF THE AFFECTED ENVIRONMENT CHAPTER 7

This section of the final EIA Report provides a description of the environment that may be affected by the proposed Karreebosch Wind Farm. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from both existing information available for the area as well as work undertaken by specialists and aims to provide the context within which this EIA is being conducted.[11]

7.1. Location of the Proposed Wind Energy Facility Development Area

The site for the proposed wind energy facility is located in the Northern Cape Province and the Western Cape Province. The majority of the project infrastructure falls within the Northern Cape with only a section of the power line falling in the Western Cape Province. In terms of its specific location, the majority of the project site falls within the Karoo Hoogland Local Municipality within the Namakwa District of the Northern Cape, and three farm portions fall within the Laingsburg Local Municipality in the Central Karoo District of the Western Cape. The nearest town from the project site in the Northern Cape is Sutherland (40km north of the site), while the nearest town in the Western Cape from the site is Matjiesfontein (30km south of the site). Primary access to this project site is from the only arterial road (the R354), which runs in a north south direction and is the main connecting route between the N1 national road and Sutherland. A number of lower order secondary roads and local access roads traverse the study area in different directions. The following farms comprise the study/project area:

Portion Farm Name Farm No	Local Municipality	Province
The Farm Appelsfontein 201	Karoo Hoogland Municipality	Northern Cape
The Remainder of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
The Remainder of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karre Kloof 196	Karoo Hoogland Municipality	Northern Cape
The Remainder of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape

[11] Use of baseline information from the previous EIA undertaken by Environmental Resource Management (Pty) Ltd is acknowledged.

Portion Farm Name Farm No	**Local Municipality**	**Province**
Portion 1 of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
The Farm Kranskraal 189	Karoo Hoogland Municipality	Northern Cape
The Farm Oude Huis 195	Karoo Hoogland Municipality	Northern Cape
The Farm Rietfontein 197	Karoo Hoogland Municipality	Northern Cape
The Farm Roode Wal 187	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Standvastigheid 210	Karoo Hoogland Municipality	Northern Cape
The Remainder of Wilgebosch Rivier 188	Karoo Hoogland Municipality	Northern Cape
The Farm Aprils Kraal 105	Laingsburg Municipality	Western Cape
The Remainder of Bon Espirange 73	Laingsburg Municipality	Western Cape
Portion 1 of Bon Espirange 73	Laingsburg Municipality	Western Cape

The study area is approximately ~320 km^2 in extent and is located within the Moordenaars Karoo, along the foothills of the mountains that make up the great escarpment of South Africa. The study area is located on land that ranges in elevation from about 550m above sea level in the north-west of the study area, along the drainage lines, to more than 1650m above sea level on top of the escarpment in the north-east. The study area has a harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development.

The Southern African Large Telescope (SALT) observatory is located approximately 50km (at the closest) to the north east of the site.

7.2. Climatic Conditions

The climate is arid to semi-arid, but temperatures are tempered by the altitude of the region. Rainfall occurs throughout the year although the peak seasons are autumn and winter. Mean annual precipitation is approximately 290 mm, ranging from 180 – 550 mm rainfall per year. The hottest month in the summer is January and the coldest month in the winter is July. The predominant wind direction is from the north-west. High wind speeds of up to 7m/s have often been recorded in the Roggeveldberge, which makes this site ideal for placement of wind turbine technology. The incidence of frost is relatively high with between 20 to 50 frost days recorded per year. In the town of Sutherland in the Northern Cape, snow is a common feature, with Sutherland being dubbed as one of the coldest town in South Africa. The coldest temperature recorded for Sutherland was -16.4°C in 2003. Sutherland experiences an average yearly temperature of 11.3 °C and an average annual minimum temperature of 2.8 °C. The town of Laingsburg in the Western Cape is situated in a semi-desert region of South-

Africa. The town's total rainfall is about 150mm per year with the summers being extremely hot and dry, with temperatures usually exceeding 30°C and the winters being crisp to sometimes very cold, with snow occasionally occurring in the surrounding region.

7.3. Topography, Geology and Soils

The Karreebosch Wind Farm study area is situated within hilly to mountainous terrain to the south of Sutherland and the Great Escarpment (Roggeveldberge) and just west of the main Klein-Roggeveldberge range and is interspersed by valleys below the high ground. The dominant orientation of the ridges within the site is north-south. The study area occurs on land that ranges in elevation from about 550m above sea level in the north-west of the study area, along the drainage lines, to more than 1650m above sea level on top of the escarpment in the north-east. A slope analysis map is included as Figure 7.2.

An upland plateau to the south (*e.g.* Snyderberg at 1440 m above mean sea level) passes northwards into a series of north-south trending mountain ridges at 1000-1300m along which the main wind farm infrastructure will be located. The ridges are separated by the valleys of north-flowing, intermittently active tributaries of the Tanqua River drainage system, such as the Appelfontein se Rivier, Wilgebosrivier and Kareekloofrivier that are associated with fairly wide alluvial plains in their downstream sectors (refer to Figure 7.1). The gentle, distinctly stepped mountain slopes are cut by small, usually dry side streams. Levels of bedrock exposure are generally very low due to the pervasive cover by gravelly colluvium, alluvium, soils and karroid *bossieveld* vegetation. Isolated mudrock exposures occur along the stream beds and banks, in steeper gorges or *klowe*, around farm dams, in borrow pits as well as in several excellent road cuttings along the R354 Majiesfontein to Sutherland tar road that transects the study area from south to north.

Figure 7.1: View NNW into the Karreebosch Wind Farm study area from a viewpoint towards southern edge of Riet Fontein 197. Kareekloofrivier Valley in background, Wilgebosrivier Valley in foreground.

Soils are often gravelly and are mostly very shallow and contain variable amounts of clay depending on landscape position and weathering. The study area is almost entirely underlain by Middle Permian continental sediments of the Lower Beaufort Group (Adelaide Subgroup, Karoo Supergroup), and in particular the Abrahamskraal Formation (Pa) at the base of the Beaufort Group succession (Johnson *et al.* 2006 and references cited below). In the Sutherland area, situated just north of the Great Escarpment, the Lower Beaufort Group sediments have been extensively intruded and thermally metamorphosed (baked) by dolerite sills and dykes of the Karoo Dolerite Suite of Early Jurassic age (*c*. 182 Ma = million years ago; Duncan & Marsh 2006). Bedrock exposure levels in the Karreebosch Wind Farm study area are generally very poor due to the pervasive cover by superficial sediments (colluvium, alluvium, soils, calcrete) and vegetation.

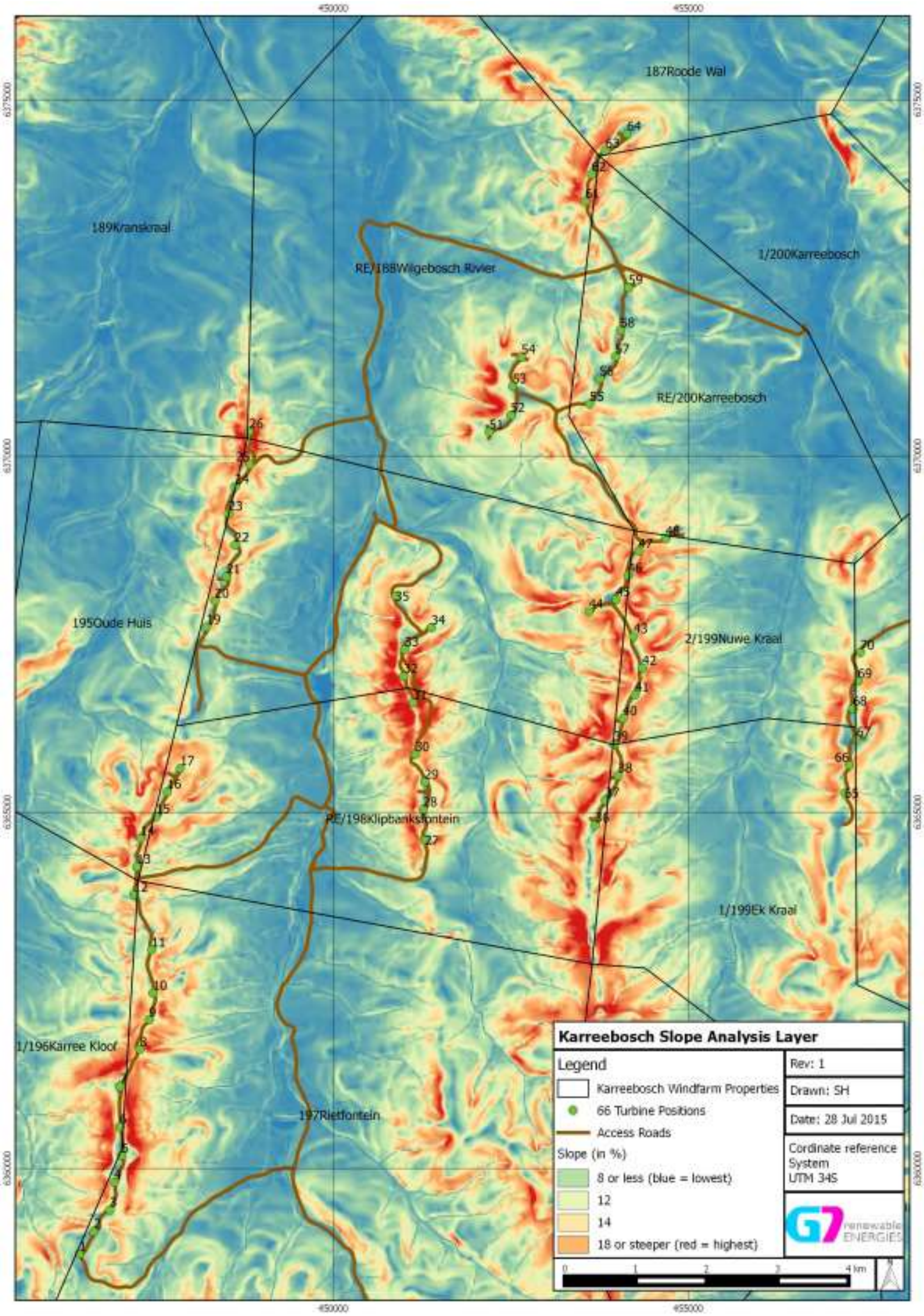


Figure 7.2: Slope analysis map

In the present study area to the south of the Great Escarpment the only major dolerite intrusions are a set of laterally persistent, NW-SE trending dykes that transect the eastern portion of the area and can be well seen in road cuttings along the R354.

Agricultural potential for the site is best suited for grazing in the Western Cape portion of the site, and the Northern Cape Province is relatively well suited for commercial agriculture but highly dependent on water availability. The majority of the current farming practices across the extent of the site is sheep farming. Large portions of the land are well suited for conservation purposes.

7.4. Water Catchments, Surface Water and Groundwater

The properties comprising the project development site are located within two water management areas (WMA) demarcated by the Department of Water and Sanitation (DWS). A WMA is an area within which catchment management agencies conduct the protection, use, development, conservation, management and control of the country's water resources. The WMAs are managed at regional or catchment level. The boundaries of WMAs are broadly based on different levels of drainage region boundaries (primary, secondary, tertiary and quaternary), but also include some administrative demarcations.

The southern part of Karreebosch Wind Farm (i.e. within the Western Cape Province) falls under the Gouritz water catchment area, while the northern section (i.e. within the Northern Cape) of the site falls under the Olifants-Doorn catchment area. Both the Gouritz and Olifants-Doorn WMAs are managed by the Western Cape region of the DWS.

The quaternary drainage regions demarcated by DWS determine the restrictions and permissible use water in terms of the National Water Act and applicable General Authorisations. The quaternary regions for the project site are (Olifants/Doorn) E23A for the most part, and J11D(Gouritz) for a minor section (as shown in Figure 7.3).

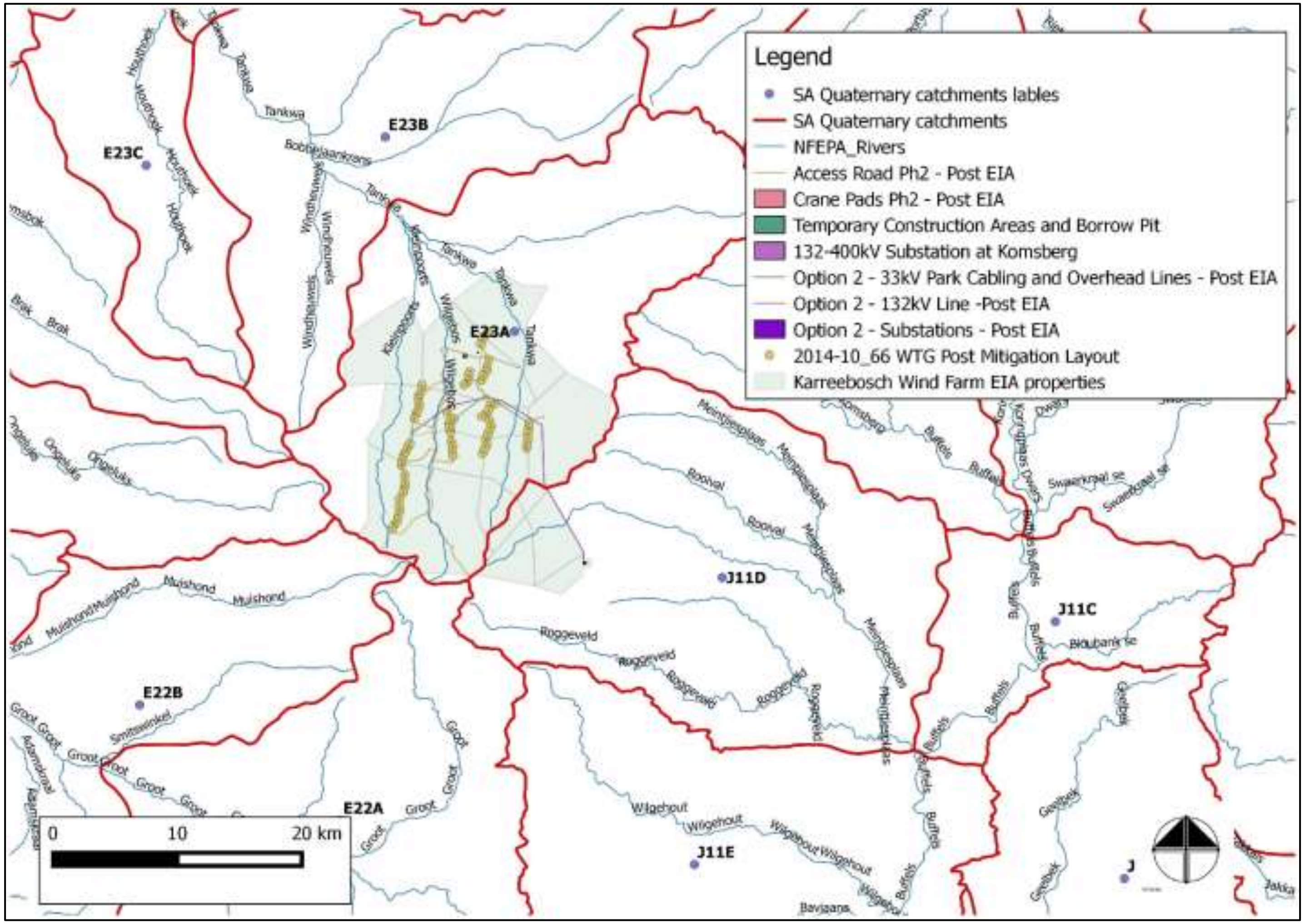


Figure 7.3: Map showing the quaternary drainage regions of the study area

Groundwater is abstracted from a fractured aquifer with a yield potential of between 0.5 to 2.0 l/s. The aquifer and groundwater is associated with joints and fractures of dolerite contact zones with country rock, decomposed dolerite and zones of semi-weathered dolerite.

Farm dams occur also within the project development site. There are numerous non-perennial watercourses that flow from areas of high ground into and along valleys within the site including the Tankwa River, Kleinpoorts River and Wilgebos River. Perennial watercourses that are located in the broader study area (outside of the Karreebosch/Roggeveld site itself) include the following:

» Kereekloofrivier (approximately 2 km west of site);
» Matjiesfontein se Kloof (approximately 5 km west of the site); and
» Roggeveldrivier (approximately 5 km east of the site).

7.5. Flora and Fauna

The Karreebosch site occurs within an area where the Succulent Karoo Biome overlaps in areas with the Fynbos Biome. The vegetation types found on and around the site are described below and are shown in Figure 7.4.

The vast majority of the site is mapped as Koedoesberge-Moordenaars Karoo while the higher-lying parts of the study area along the southern margin of the current study area are mapped as Central Mountain Shale Renosterveld. The eastern margin contains some Tanqua Escarpment Shrubland which lies largely outside of the development footprint and there is some Tanqua Wash Riviere vegetation associated with the larger drainage features on the plains of the northern extent of the site.

Koedoesberge-Moordenaars Karoo is associated with slightly undulating to hilly landscape covered by low succulent scrub with scattered tall shrubs. This vegetation type is classified as Least Threatened and has not been significantly impacted by transformation. Conservation status is however poor and of the target of 19%, only a very small proportion is conserved within the Gamkapoort Nature Reserve. The majority of the development footprint is falls within this vegetation type and it is only in the south that a few turbines and the grid connection fall outside of this unit.

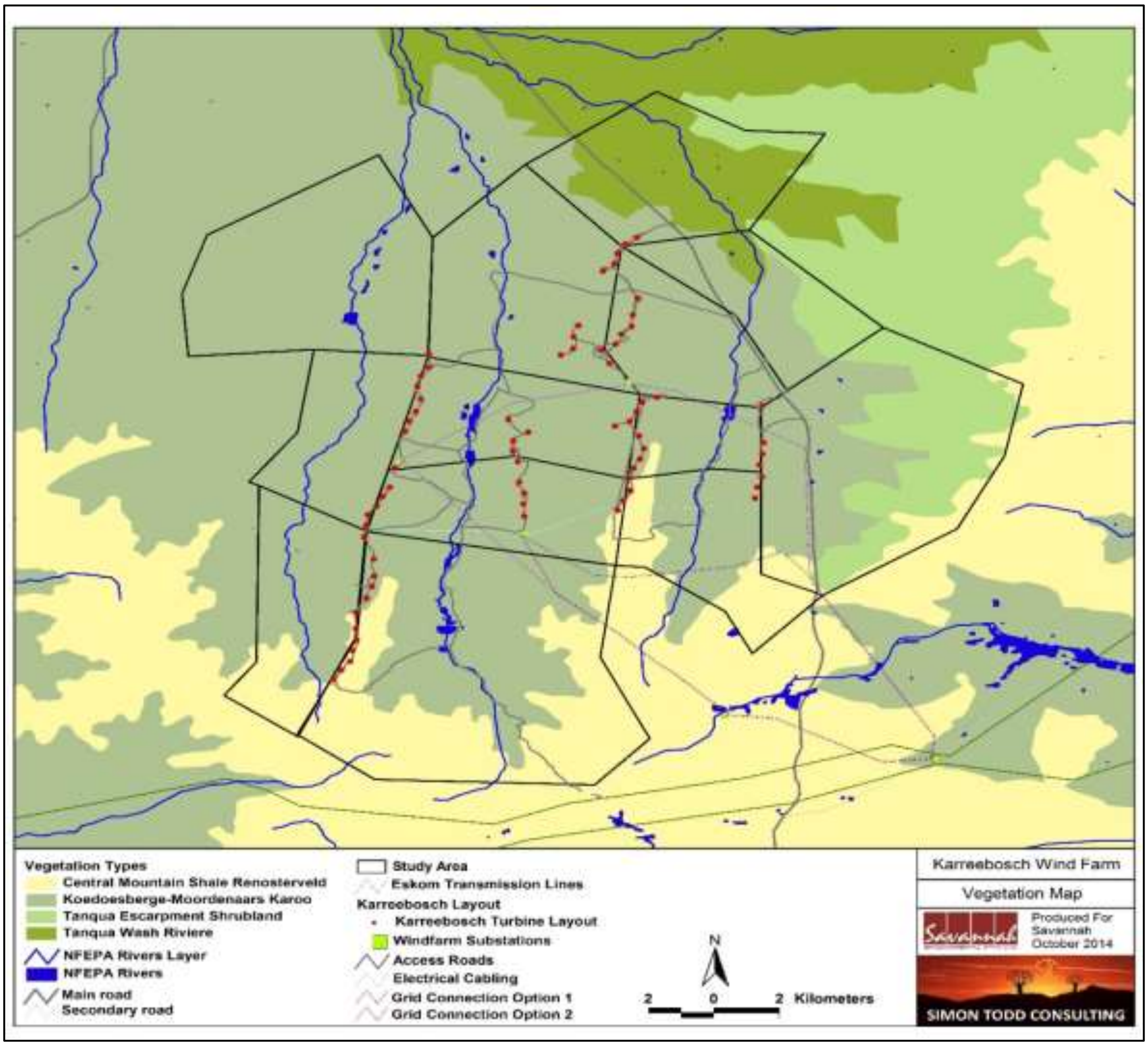


Figure 7.4: Vegetation units on the site (Mucina & Rutherford, 2006).

Central Mountain Shale Renosterveld is prominent on the southern portions of the Karreebosch site. Hill slopes and broad ridges support tall shrubland dominated by renosterbos and non-succulent Karoo shrubs. Geophytic flora occurs in more open, wetter, rocky habitats. Although this vegetation type is considered to be least threatened (Rouget et al. 2004), it has a very limited extent of 1236km^2 and is not formally conserved anywhere. Levels of transformation are however low and it is considered to be 99% intact. Although no endemic species are known to occur within this vegetation type, little is known about this Renosterveld type and it has been poorly sampled. This vegetation type should be considered as a relatively sensitive vegetation type with a relatively high abundance of species of conservation concern and in context of the site should in fact be considered to have a higher sensitivity than those areas of Koedoesberge-Moordenaars Karoo.

The Tanqua Wash Riviere vegetation type is associated with the other major drainage lines of the study area and occurs on the plains along the Wilgebos and Klienpoorts rivers to the west of the Tanqua River as well. This vegetation unit is associated with the Alluvia of the Tanqua and Doring Rivers and sheet-wash plains of their less important tributaries embedded largely within the Tanqua Karoo vegetation unit. It is classified as Least Threatened and is considered moderately-well conserved as 13% of the target 19% falls within the Tanqua National Park and other nature reserves. It has not been heavily impacted by transformation and more than 95% is still intact. At a broad level, this is considered to be sensitive vegetation type as it is vulnerable to disturbance and being associated with drainage lines is ecologically important for a variety of ecological services and processes. In addition, the Riverine Rabbit *Bunolagus monticularis* which is listed as Critically Endangered is known to occur within this vegetation unit in the broad area and may occur along the northern margin of the site associated with this vegetation unit.

According to the SANBI SIBIS database, nearly 1000 indigenous species have been recorded from the four quarter degree squares around the site. This includes 26 threatened species and an additional 44 species of lower conservation concern. This is a considerably larger area than the study area and includes a wide variety of habitats, many of which are not found within the study area, but this is a high number for a semi-arid environment.

Field surveys have confirmed that the habitats of the site and surrounds are dominated by open Karoo shrub land. Based on site investigations the site is considered to be a suitable foraging site for birds of prey which are known to use ridges and escarpments (and their associated wind conditions such as updrafts) for soaring flight activities during hunting and territorial display. The valley and lower ground within the site are likely to support breeding and foraging birds (great diversity of waterbirds near dams) and small mammals such as buck. Lower-lying areas of the site are considered to be suitable foraging habitats for bats.

The Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are not well differentiated in the field at the site and the two vegetation types usually grade into one another and also tend to form a mosaic with the Koedoesberge-Moordenaars Karoo type vegetation dominating the warmer and drier slopes while Central Mountain Shale Renosterveld species typically dominate on the higher-lying and cooler south-facing slopes. As such, the lower western ridges and the majority of the western part of the site in general is composed of Koedoesberge-Moordenaars Karoo while there is significantly more Central Mountain Shale Renosterveld along the two eastern ridges than has been captured and mapped.

In addition, the species lists and description of the Koedoesberge-Moordenaars Karoo vegetation type in Mucina and Rutherford, bears little resemblance to the vegetation type as observed in the field at the site. This suggests that the description in Mucina and Rutherford is based on the low-lying parts of the vegetation unit to the south near Matjiesfontein.

Ridges:
The ridges are the most important habitat at the site since the turbines (and majority of their footprint) will be located on and along the ridges. The ridges can be divided into two basic types for the study site, the two eastern ridges and the two western ridges. In general the eastern ridges can be considered more sensitive than the western ridges as the eastern ridges are wetter and contain a significantly higher abundance of species of conservation concern as well as sensitive plant communities. There are however some very high elevation sections along the most western ridge which are considered sensitive.

Lowlands:
The lowlands within the affected areas are fairly homogenous and contain significantly less diversity than the hills. These areas are also the most heavily grazed, which may have impacted their composition. The main driver of variation in vegetation composition of these areas is substrate type and soil depth. Species of conservation concern observed in lower-lying areas include *Drimia uranthera* (Rare) and *Drimia altissima* (Declining). Overall, the low-lying plains are not considered highly sensitive and the main feature of concern in these areas are the drainage lines, which should be avoided as much as possible.

Table 6.1: Plant species of conservation concern known to occur in the vicinity of the Karreebosch Site (list derived from SIBIS: SABIF website, those in red are confirmed present at the site, but not necessarily within the development footprint).

Family	Species	IUCN Status
AMARYLLIDACEAE	*Brunsvigia josephinae*	**VU**
APOCYNACEAE	*Duvalia parviflora*	**VU**
	Astroloba herrei	**VU**
ASPHODELACEAE	*Gasteria disticha*	**CR**
	Haworthia serrata	**CR**
ASTERACEAE	*Antithrixia flavicoma*	**VU**
	Euryops namaquensis	**VU**
COLCHICACEAE	*Wurmbea capensis*	**VU**
CRASSULACEAE	*Adromischus mammillaris*	**EN**
	Amphithalea spinosa	**VU**
	Amphithalea villosa	**EN**

Family	Species	IUCN Status
	Aspalathus candicans	**EN**
FABACEAE	*Lotononis comptonii*	**EN**
	Lotononis densa subsp. congesta	**VU**
	Lotononis gracilifolia	**EN**
	Lotononis venosa	**VU**
	Xiphotheca fruticosa	**VU**
HYACINTHACEAE	*Drimia arenicola*	**VU**
	Lachenalia martinae	**VU**
	Geissorhiza karooica	**VU**
	Moraea aspera	**VU**
IRIDACEAE	*Romulea eburnean*	**VU**
	Romulea hallii	**VU**
	Romulea multifida	**VU**
	Romulea syringodeoflora	**VU**
	Antimima hamatilis	**VU**
	Didymaotus lapidiformis	**VU**
MESEMBRYANTHEMACEAE	*Lampranthus amoenus*	**EN**
	Tanquana archeri	**VU**
	Tanquana hilmarii	**CR**
ORCHIDACEAE	*Pterygodium inversum*	**EN**
POLYGALACEAE	*Muraltia karroica*	**VU**
PROTEACEAE	*Protea convexa*	**CR**
RESTIONACEAE	*Hypodiscus sulcatus*	**EN**
RUTACEAE	*Acmadenia argillophila*	**VU**

The majority of turbines are located within the Koedoesberge-Moordenaars Karoo and some occur within Central Mountain Shale Renosterveld. Although these vegetation types are not well protected within formal conservation areas, they have not been highly impacted by intensive agriculture and both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are 99% intact.

Drainage lines:
The rugged topography of the area supports numerous drainage features. It is however only the lower reaches of the drainage lines which are well developed with woody vegetation. Although there are some significant wetlands dominated by sedges such as *Pseudoschoenus inanis* present in the wider area, there are few wetlands within the current area, which can be ascribed to the cultivation of many areas that may have historically contained wetland features. The only species of conservation concern associated with the drainage lines that was observed at the site was *Brunsvigia josephinae* (VU), which was observed south of the current

development area and would not be impacted by the current development phase. While some of the access roads will need to traverse drainage lines, the overall direct impact on these features is likely to be low. The most likely source of impact would be from erosion of the disturbed areas created during construction with resultant siltation of the drainage systems. The larger drainage features in the north of the site are significant as they contain fairly extensive floodplains dominated by *Salsola aphylla* with a variety of other woody and succulent shrubs, which correspond to the favoured habitat of the Riverine Rabbit *Bunolagus monticularis*.

The site straddles the planning domain of two different Biodiversity Assessments. Those parts of the site within the Western Cape fall within the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009). While those parts of the site which lie within the Northern Cape fall within the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).

7.6. Critical Biodiversity Areas (CBAs) and National Protected Area Expansion Strategy

Critical Biodiversity Areas (CBAs) are biodiversity assessment tools aimed at guiding sustainable development and subsequent efficient planning. In this regard, it can be used as an effective tool to enable decision makers to weigh the biodiversity value of areas over any proposed impacts to the landscape and to arrive at a justifiable decision.

There are also several technical issues regarding the delineation of CBAs in this area. The site lies along the Northern Cape – Western Cape provincial boundary and falls within two separate biodiversity assessments. The whole of the Western Cape section of the site is classified as a CBA, while only the south-facing slopes are classified as CBA in the Northern Cape. There are no differences in biodiversity between the two areas, so the difference relates to the manner in which the fine-scale conservation plans in the two areas have been implemented. The disparity across the provincial boundary raises some serious questions about the utility and validity of the respective CBAs. Neither case is considered representative of the situation on the ground, and have not been ground-truthed. Areas mapped as CBAs should have a demonstrated high biodiversity value, while areas providing connectivity between such areas or providing for broad-scale ecological processes should be mapped as Ecological Support Areas.

The NPAES focus area is a broad-scale, national-level analysis which identifies extensive areas of unfragmented habitat in situations of topographic diversity, with the assumption that such areas will be resilient to climate change impacts suitable for expansion/creation of protected areas. The NPAES does not take fine-scale biodiversity patterns into account. The distribution of biodiversity in the area is very poorly understood, and the NPAES captures the broad-scale biodiversity value of the region, but says little about the fine-scale biodiversity pattern within the area. The site intersects the Western Karoo NPAES.

Within the study area, the numerous fragments of CBA within the Northern Cape portion of the site are based on a single criterion i.e. slopes. A moderate proportion of this CBA has been identified as a priority area within the National Protected Area Expansion Strategy for South Africa (NPAES) (Government of South Africa 2008). The slopes are characterised as 'T2' CBAs and refers to all areas with steep south-facing mountain slopes larger than 25ha in extent. This area was identified as priority area on the grounds that apart from being an extensive tract of unfragmented natural vegetation, it is also an area of high climate and landscape variation which is likely to be resilient to climate change. Such areas are likely to be more climatically stable over time, providing refugia where plants and animals can persist. The Roggeveld region is also a known centre of plant endemism (van Wyk & Smith 2001) and the northern portion of the site falls within an area identified by experts as being an important area of plant diversity and endemism (SKEP Expert Map - Plants SKEP 2002). Refer to Figure 6.4.

The Central Karoo District Municipality released the Central Karoo Biodiversity Assessment Report (CKBAR) in 2009, in an effort to address biodiversity planning gaps. This assessment enabled the development of a CBA map for the district which was envisaged as being an effective biodiversity assessment tool.

Again, a moderate proportion of this CBA has been identified as a priority area within the NPAES. The CKBAR[1] identifies portions of the study falling within the Western Cape under the category of 'CBA' (refer to Figure 6.4). Areas falling under this status are characterised as such because they enable/facilitate meeting the following thresholds:

» The area may be required for meeting biodiversity pattern thresholds such as remaining areas of Critically Endangered habitat types, special habitats, listed threatened ecosystems, indigenous forest patches, high priority river reaches;
» The area may function as ecological or landscape corridors, areas for climate change adaptation and riparian corridors;
» The area might be important for hydrological processes (wetlands and priority catchment areas);
» It is considered a 'best design' site (largest, most intact, least disturbed, connected and/or adjacent) in terms of meeting pattern and process thresholds.

[1] A.L. Skowno, S.D Holness and P. Desmet (2009) Biodiversity Assessment of the Central Karoo District Municipality. DEAP Report EADP05/2008,

A large proportion of this CBA is related to the fact that is has been identified as a priority area within the National Protected Area Expansion Strategy for South Africa (NPAES). This area was identified as priority area on that grounds that apart from being an extensive tract of unfragmented natural vegetation, it is also an area of high climate and landscape variation which is likely to be resilient to climate change. Such areas are likely to be more climatically stable over time, providing refugia where plants and animals can persist. As such, it is important to recognize that the site is therefore not replaceable due to the fact that the development encompasses a large proportion of the northern extent of the mountain range, and that there are not similar areas that can perform the same function and which contain a similar set of species available elsewhere. The Roggeveld and in particular the Komsberg area is also a known centre of plant endemism (van Wyk & Smith 2001).

Within the Western Cape, the grid connection routes lie within a CBA. Within the Northern Cape, the CBAs are associated with south-facing slopes and while a few of the turbines and other infrastructure falls within these areas, this is not considered significant in its own right. There is however a large discrepancy along the Western Cape-Northern Cape boundary in terms of areas defined as CBAs, with most of the Western Cape being classified as CBA and only the south-facing slopes of the Northern Cape being classified as CBA. This is problematic because it is clear that the approach used to derive the CBA maps within each area is not harmonized and the CBA map for the Namakwa District was made at a much coarser scale than that for the CKDM. The ultimate effect of this is that the CBA map for the Northern Cape fails to adequately capture the important ecological pattern and process of the area. This shortcoming cannot be remedied here, but is accommodated through the consideration of cumulative impacts in the area. The current CBA map was used as a guiding tool for the specialists in order for them to get a broad scale understanding of the area and use the data to inform their own findings.

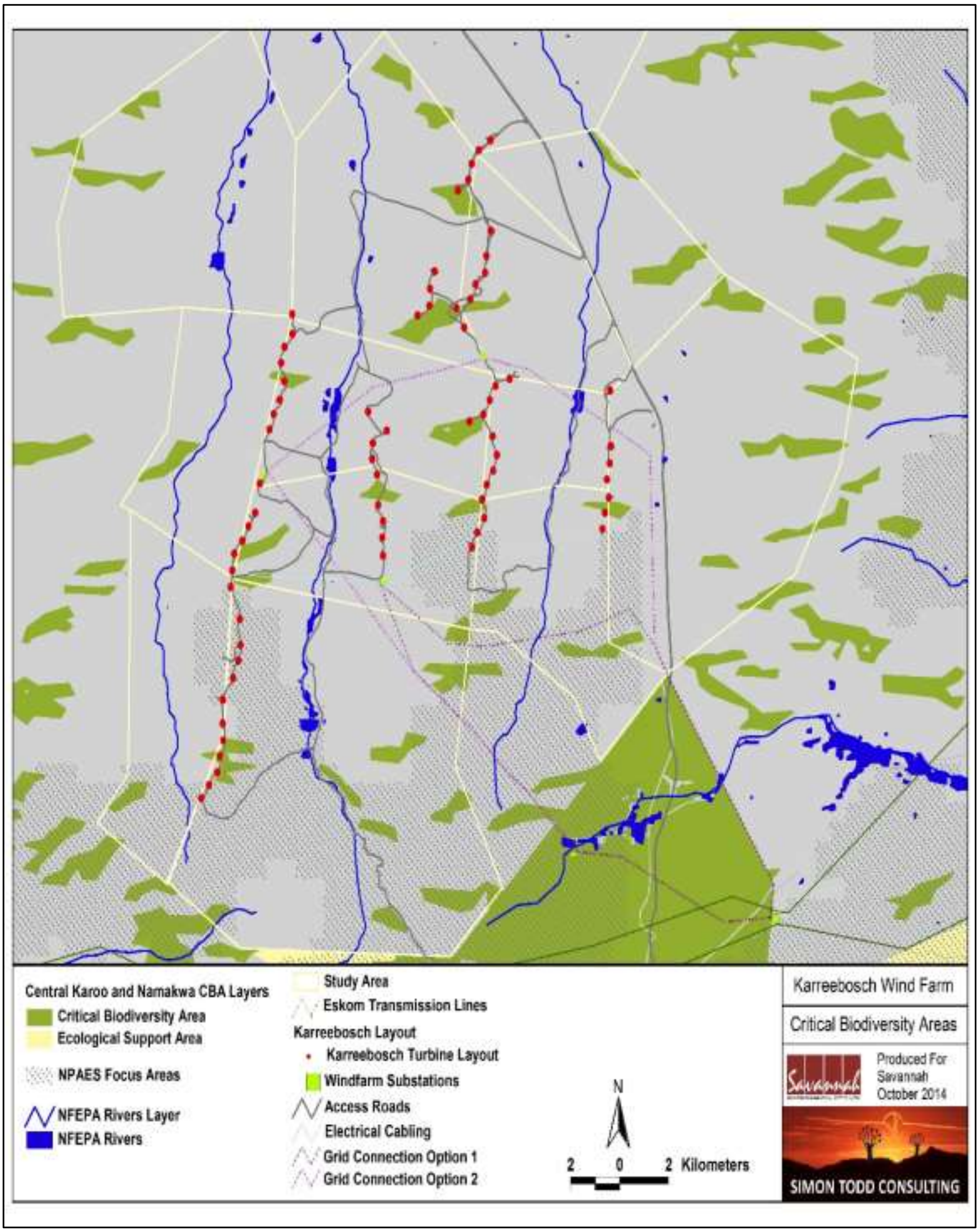


Figure 7.5: Map showing CBA areas on and around the Karreebosch Site

7.7. Avifauna

The description of the avifauna is based on information collected during the pre-construction bird monitoring. Four season bird monitoring has already been completed for the site. For ease of reference, the ridges are termed, from east to west, as the Eastern, Central, Spitzkop and Western Ridge (Figure 7.6). Both the diversity and number of birds seen along the Karreebosch ridges during the pre-construction bird monitoring programme was small. The total number of bird species seen along or passing over the ridges was 47, compared with an overall number of 115 species seen in the broader project site (most of which were seen in the lower areas despite far less time being spent there than on the ridges). These numbers are slightly lower than those observed during monitoring of the Phase 1 facility i.e. 52 and 121 respectively. In many ridge-top vantage hours, and some transect walks, no birds at all were recorded especially during strong winds. Except for some early morning periods, generally fewer than 10 individual birds from all species were seen in any hour and these often likely included individuals seen repeatedly as they moved about foraging.

A broader ecological approach has been used to consider the degree to which the proposed wind farm may impact the avifauna of the Karreebosch site. The 115 recorded bird species were first divided into 7 broad eco-groupings. These were:
1) birds of prey and scavengers;
2) other non-passerines;
3) aerial insectivores;
4) ground foraging invertivorous passerines;
5) bush foraging invertivorous passerines;
6) passerine seedeaters; and
7) waterbirds.

The 47 bird species that were seen along or over the ridges fell into two categories:

» Species that were recorded flying at turbine blade swept area heights (refer to Table 7.2).
» Species whose members seldom, if ever, fly at turbine blade heights. Of the 47 ridge-top species, 35 fell in this category. Most were passerines associated with the local scrubland habitats. When flushed, or foraging, these birds seldom flew more than 3 m above the scrubby bushes. On more purposeful cross-ridge flights they still flew at less than 10 m. Except for a few display flights, none of these 35 species were considered at risk of collision with turbine blades. Displays were only observed when winds were light i.e. at times when turbine blades would be still or slow moving, and as a result more visible and easily avoided. There were numerous flight displays in wet 2013 (due to heavier rain received) but very few in dry 2014.

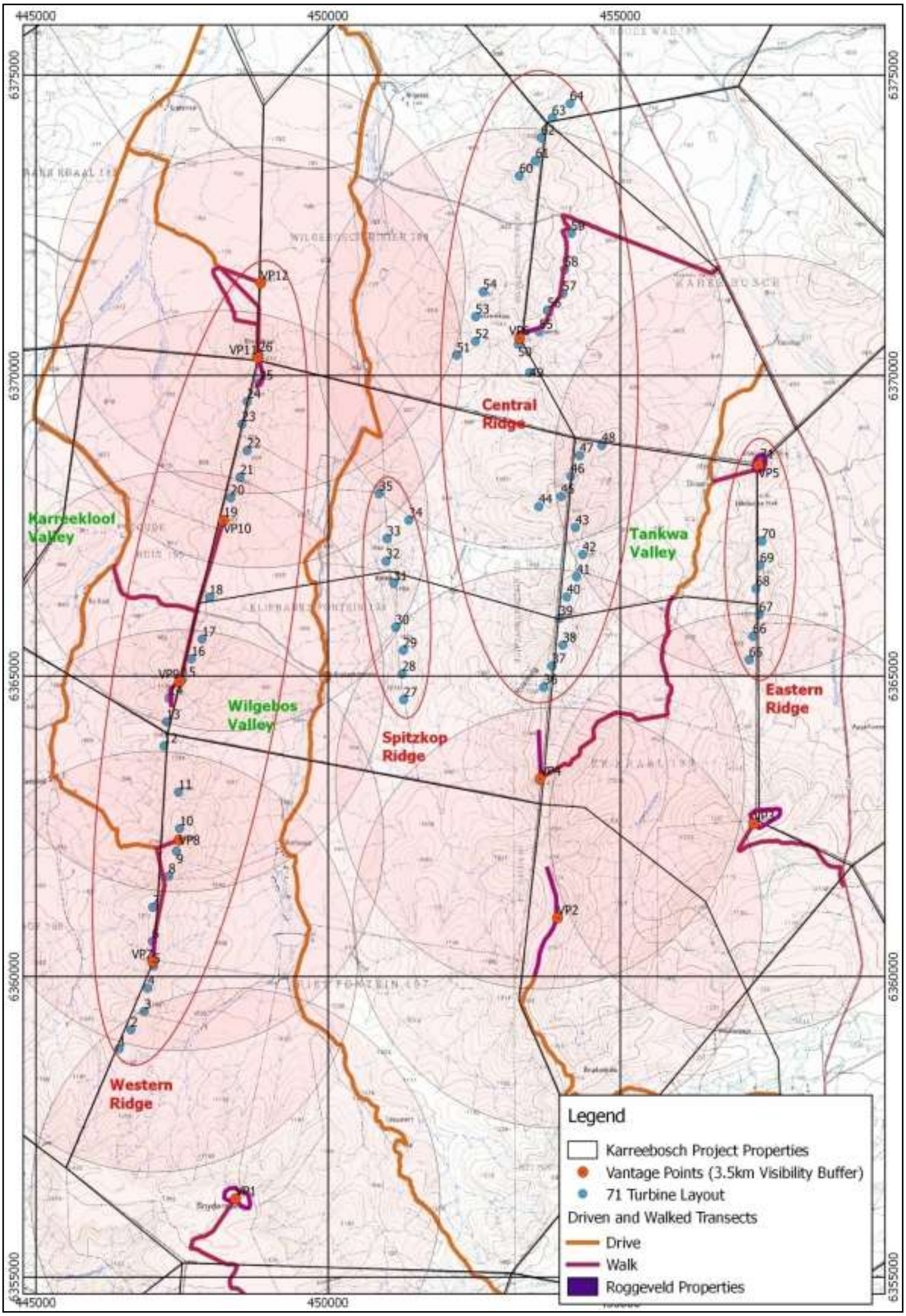


Figure 7.6: Map illustration of vantage point scan zones, transects and relevant ridges

» Displays were usually performed over the rim of the ridges i.e. off the top of the ridges and over the upper-most slopes which is where nesting is more likely to occur. Thus these display flights were generally away from the centre of the ridges where the turbines are planned to be located.

Table 7.2: Table showing flight paths along ridges and relative to turbine blade height with highlighted species (red) of special concern.

Species	Flight relative to turbine blade arc		Species	Flight relative to turbine blade arc	
	Below	**Within**		**Below**	**Within**
Ludwig's Bustard	X		Yellow Canary	X	
Verreaux's Eagle		X	Cape Bunting	X	
Rock Kestrel		X	Black-headed Canary	X	
White-necked Raven		X	White-throated Canary	X	
Pied Crow		X	Lark-like Bunting	X	
Black Harrier	X		Grey-backed Cisticola	X	
Booted Eagle	X		Bokmakierie	X	
Martial Eagle		X	Southern Banded Sunbird	X	
Jackal Buzzard	X		Layard's Tit-babbler	X	
Steppe Buzzard			Karoo Eremomela	X	
Peregrine Falcon		X	Spotted Prinia	X	
Sacred Ibis		X	Rufous-eared Warbler	X	
African Spoonbill		X	Malachite Sunbird	X	
Alpine Swift		X	Cape Penduline Tit	X	
White-rumped Swift		X	Cape Bulbul	X	
Little Swift		X	Fairy Flycatcher	X	
Namaqua Sandgrouse		X	Yellow-bellied Eremomela	X	
Grey-winged Francolin	X		Large-billed Lark	X	
Speckled Pigeon	X		Mountain Wheatear	X	
Crowned Plover	X		Long-billed Pipit	X	
Karoo Shelduck	X		Familiar Chat	X	
Pale-winged Starling	X		Karoo Long-billed Lark	X	
Rock Martin	X		Sickle-winged Chat	X	
Karoo Chat	X		Cape Clapper Lark	X	
Karoo Lark	X		Karoo Scrub Robin	X	
TOTAL	**Flights within blade swept area**			**12 species**	
	Flights seldom or never in blade arc heights			**35 species**	
	All species recorded along/over ridges			**47**	

7.7.1. Species that occasionally fly at blade height

Twelve of the ridge occurring species either often, or occasionally, flew at heights which would potentially bring them into turbine blade swept area (Table 7.2). Even in these species most observed flights along the ridges were below turbine blade heights i.e. less than 30m off the ground. In stronger winds fewer birds flew over ridges, thus when the turbine blades rotate quickly and may appear to blur, the number of individual birds at risk of flying into rotor blades will be lower.

Only three species were observed engaged in 'kiting[1]' at ridge heights during strong winds. These were Verreaux's Eagle, White-necked Raven, and a large (probably Peregrine) falcon. Updraughts are key to maintain 'kiting' behaviour and so these birds were generally positioned over the upper valley slopes and away from the centre of the ridge where the turbines are proposed.

An unanticipated flock of African Spoonbills was recorded in September 2014 flying adjacent to the Western Ridge while Sacred Ibises and Karoo Shelducks were seen using slight cols[2] to cross ridges. Namaqua Sandgrouse was also observed flying along/near ridges at heights which would bring them into the lower arc of turbine blades.

7.7.2. Bird species of concern

Eleven species are considered of potential conservation concern. Of these, two species are rated as Vulnerable [to extinction] – Black Stork and Verreaux's Eagle (Barnes 2000). Three species are listed as 'Endangered' i.e. the Ludwig's Bustard; Black Harrier and Martial Eagle.

Only a single **Ludwig's Bustard** was recorded in three regional observations crossing the ridges. Given the stony conditions and the paucity of large invertebrate prey it is probable that this species is only an occasional, generally non-breeding, visitor to the Karreebosch project development site. Though these bustards will preferentially fly over lower ground it is inevitable that they sometimes fly over the ridges. They are likely to avoid flying over the higher ridges and so if they do fly over ridges will be more at collision risk with turbines on lower ridges or near ridge saddles. **Martial Eagles** were seen on three occasions flying at heights that would coincide with turbine blade arcs. Observations were spread amongst the slopes of the Central Ridge (north-west of the Ekkraal homestead; the Wilgebos Valley and near thermal draughts close to the Western Ridge (Figure 7.7).

[1] Hanging apparently motionless in the wind for a moment in time and then swooping into another kiting position

[2] A pass or depression in a mountain range or ridge.

Black Harriers were seen twice (possibly the same individual) quartering, less than 5m off the ground, along the Central Ridge. The only other individual seen near the ridges was on the upper slope of the Central Ridge on the Wilgebos Valley side.

Neither of these two vulnerable species can be considered at particular risk of mortality through collision with the proposed turbines; however this risk is higher for the valleys where their foraging areas of these birds are as this is where the power lines will be located.

Verreaux's Eagle was observed in every monitoring season, seen to cross ridges, fly during strong winds and likely to fly at blade heights.

The aerial foraging swifts, swallows and martins were numerous, often recorded over the ridges and common species of no particular conservation concern. This leaves seven species which may be considered of particular risk to collision mortality with the Roggeveld proposed turbines. These are the Namaqua Sandgrouse, Martial Eagle, Verreaux's Eagle, Black Harriers, Jackal Buzzard, Rock Kestrel and White-necked Raven and each merits comment, provided below:

The **Namaqua Sandgrouse** is listed as a species of 'Least Concern' in the latest IUCN and BirdLife South Africa appraisals. However, this species is considered to be at the greatest risk from collision with the proposed turbines due to:

» the number of individuals seen along the ridges was greater than that of any other observed species;
» observations of the birds flying at heights that would bring them within rotor blade arcs;
» the birds flying in small tight flocks of 4-20 individuals so it would be likely that more individuals would be killed at a time;
» flight speeds of ~ 60 kmph which would result in less reaction time to an obstruction; and
» the bird choosing to fly more along, than across the ridges and so would thus approach turbine blades from the side.

This species was more common than expected in which several parties of 4-20 birds were seen. In September observations flocks flew along or near the ridge lines at heights that sometimes would have taken them into the predicted lowest blade arc. These Sandgrouse fly at speeds of 60 km/h and are known to die from collision with telephone wires so must be considered a potential collision risk on the Karreebosch ridges. However the species is currently considered of Least Concern in the latest IUCN appraisal. It is likely that numbers seen were larger than usual in response to the flush of seed-producing plants following the unusually heavy rains.

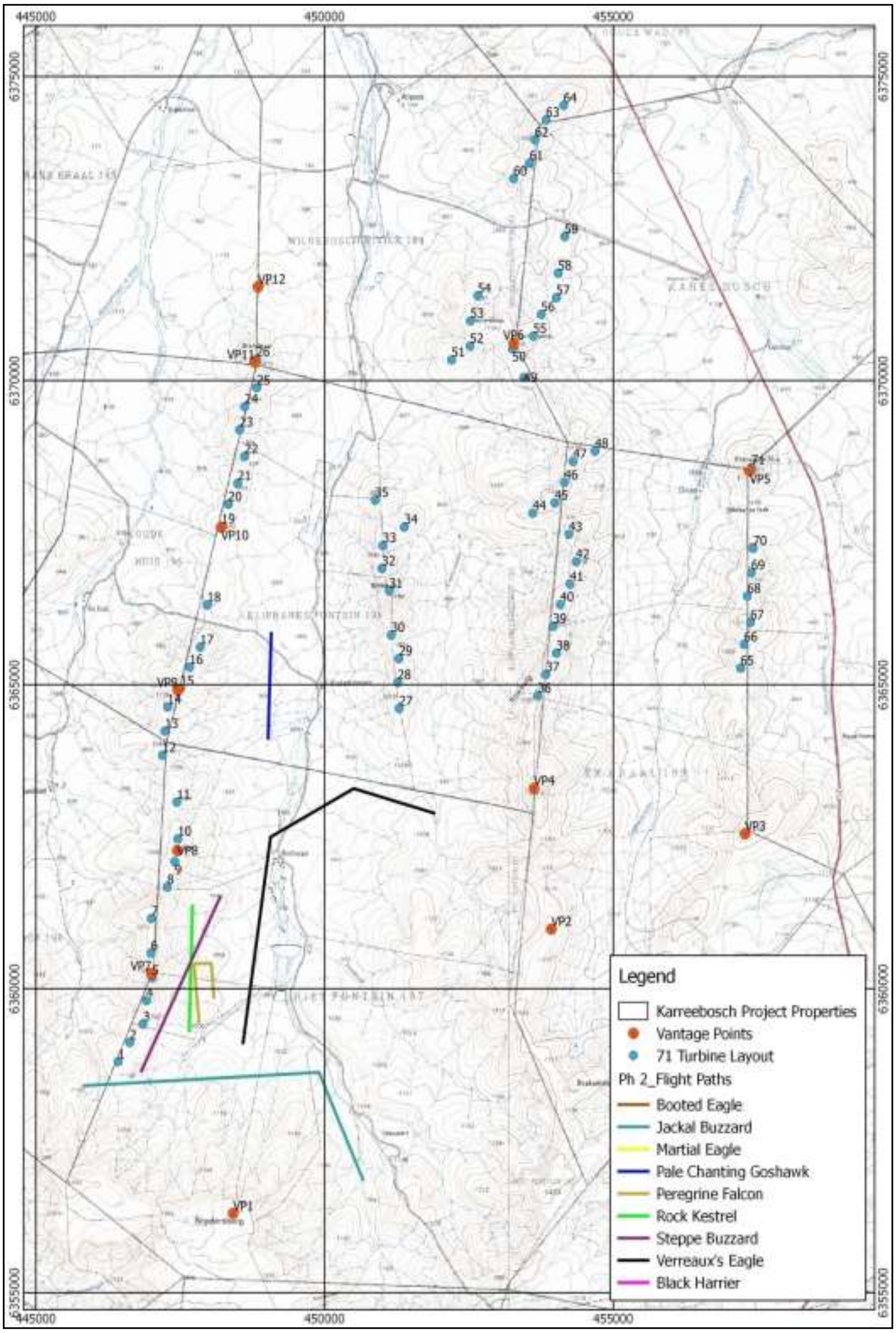


Figure 7.7: Recorded flight paths of raptors observed in September 2014

Verreaux's Eagle: It is likely that many of the observations made during monitoring were repeat sightings of the same individuals and overall probably concern a maximum of six or fewer individuals. Their distribution is presented in Figure 7.8. Verreaux's Eagle though rated as Vulnerable in South Africa, is considered as of Least Concern on a global basis by Birdlife International[1]. This eagle is for two reasons considered a keystone species relative to the proposed Karreebosch wind farm due to other species i.e. Rock Kestrel and White-necked Raven, flying up into blade-arc heights to harass the eagles and a pair bred at the southern end of the proposed turbine layout.

In July 2013, two Verreaux's Eagle nests were found close together on the north-west facing cliff of Beacon Hill on the northern end of the turbine string on Central Ridge. The nests were large, so evidently added to over a number of years, but held no fresh green material, nor was there any whitewash from recent droppings. A pair of eagles flew nearby with twigs in their claws. Their continued presence near the nests, and the carriage of potential nest material, indicates that the nests are still being maintained and the overall site must be considered active. In low resource areas, like that monitored, pairs may only breed following a year of abundant prey production. Given the considerable winter rainfall in 2013 it was anticipated that there might be a prey recovery sufficient to stimulate breeding in 2014. However, in September 2014, despite repeated observations of the nesting cliff area over 5 days from the Western Ridge, and the survey by Dr Simmons (Appendix 9 of the Raptor report) no eagle activity was recorded at or in the immediate vicinity of the cliff with the nests.

[1] www.birdlife.org/datazone/speciesfactsheet 3539

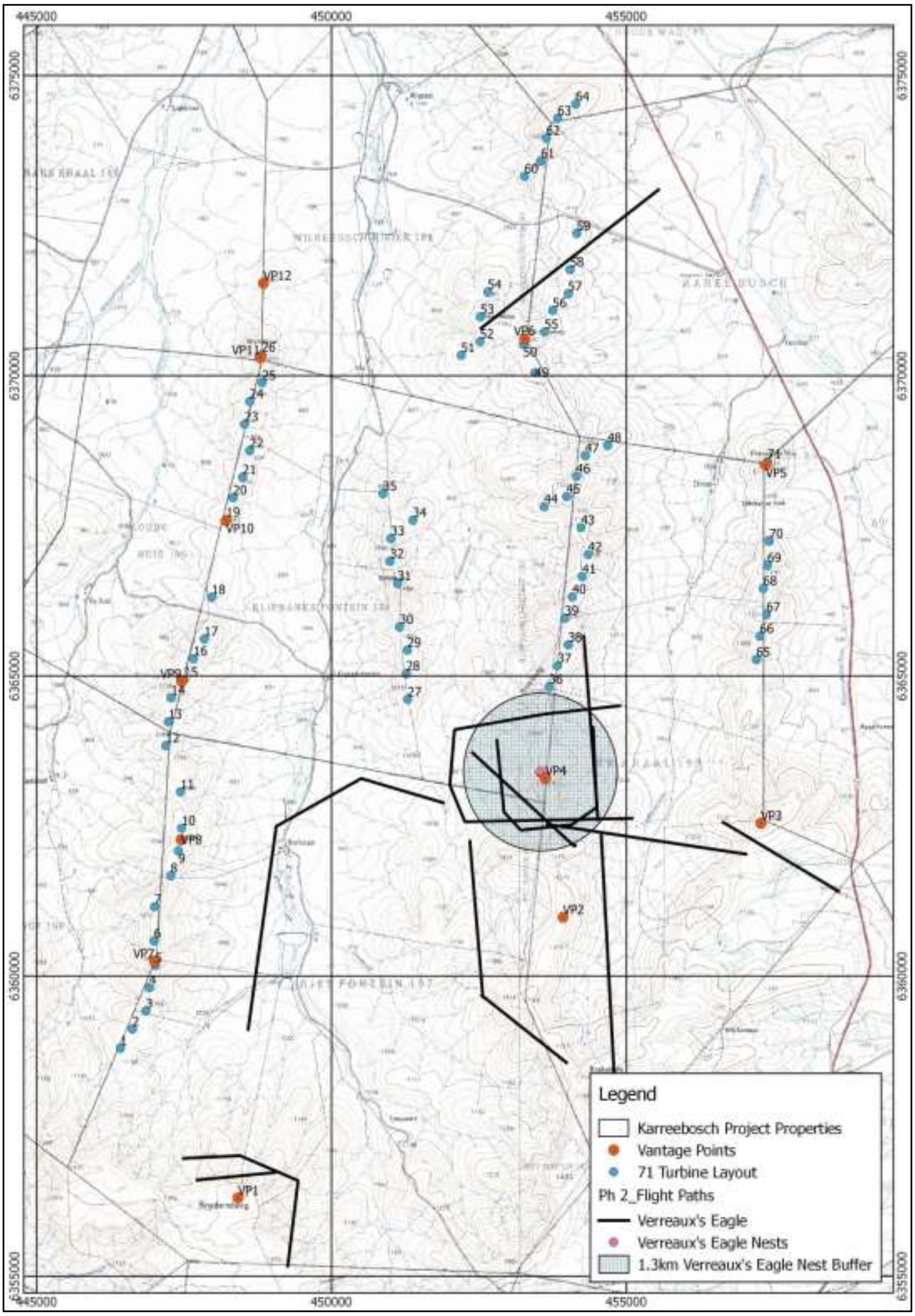


Figure 7.8: Recorded flight paths of Verreaux's Eagles during the entire monitoring period.

Martial Eagles:
Seen only three times in the Karreebosch 2 area. In July 2013 a single individual vied with a Verreaux's Eagle for dominance of a lamb carcass on the slopes of the Central Ridge north-west of the Ekkraal farmstead. An adult that flew southwards high over the Wilgebos Valley well away from the ridges. A topographic obstruction prevented tracking of this individual but it probably crossed a high saddle near Snydersberg into the next valley which was outside the Karreebosch area. In September 2014 an immature Martial Eagle was seen on two consecutive days using thermals close to the Western Ridge (Appendix 9 of the Avifauna Report).

Rock Kestrel:
Most observations were of individuals using updraughts to hover over the upper slopes i.e. off the ridge-tops. Kestrels seen over the ridges were generally flying outside/below the turbine blade swept area as they flew low to seek prey or crossed the ridge from one valley to another. Kestrels seen over the ridges were generally below turbine blade arc levels as they flew low to seek prey or crossed the ridge from one valley to another. Only when they flew up to harass eagles did these kestrels enter potential collision risk heights.

White-necked Raven:
This species was often seen flying at turbine blade heights. Ravens are highly intelligent birds adept at coping with strong and variable winds in mountainous areas. It is considered highly unlikely that they will experience significant mortality through collision with turbine blades. Many of the observations were probably repeat sightings of the same individuals and the overall number of individual ravens seen in the Karreebosch area is probably less than 10. Larger numbers may occasionally gather at large carrion as 25 were observed at a sheep carcass in the Hidden Valley wind facility area some 10 km east of the Karreebosch wind facility.

In November 2013 the number of ravens seen was considerably lower than in previous monitoring iterations. Ravens are winter breeders. In other, better studied, raven species, newly fledged juveniles birds feed on large invertebrates found whilst walking. If this applies to White-necked Ravens then in spring those that have bred successfully must move to lowland areas where, for the juvenile ravens to cope, walking is easier and suitable prey are more abundant. Since collisions are more likely among juvenile than adult birds the evident removal of recently fledged ravens from the ridges will reduce overall collision mortality risk.

Black Harriers:
Twice seen (possibly the same individual) quartering, < 5m off the ground, along the Central Ridge. The only other individual seen near the ridges was on the upper slope of the Central Ridge on the Wilgebos Valley side.

Jackal Buzzard: A single bird was recorded in July 2013 at a potential collision height.

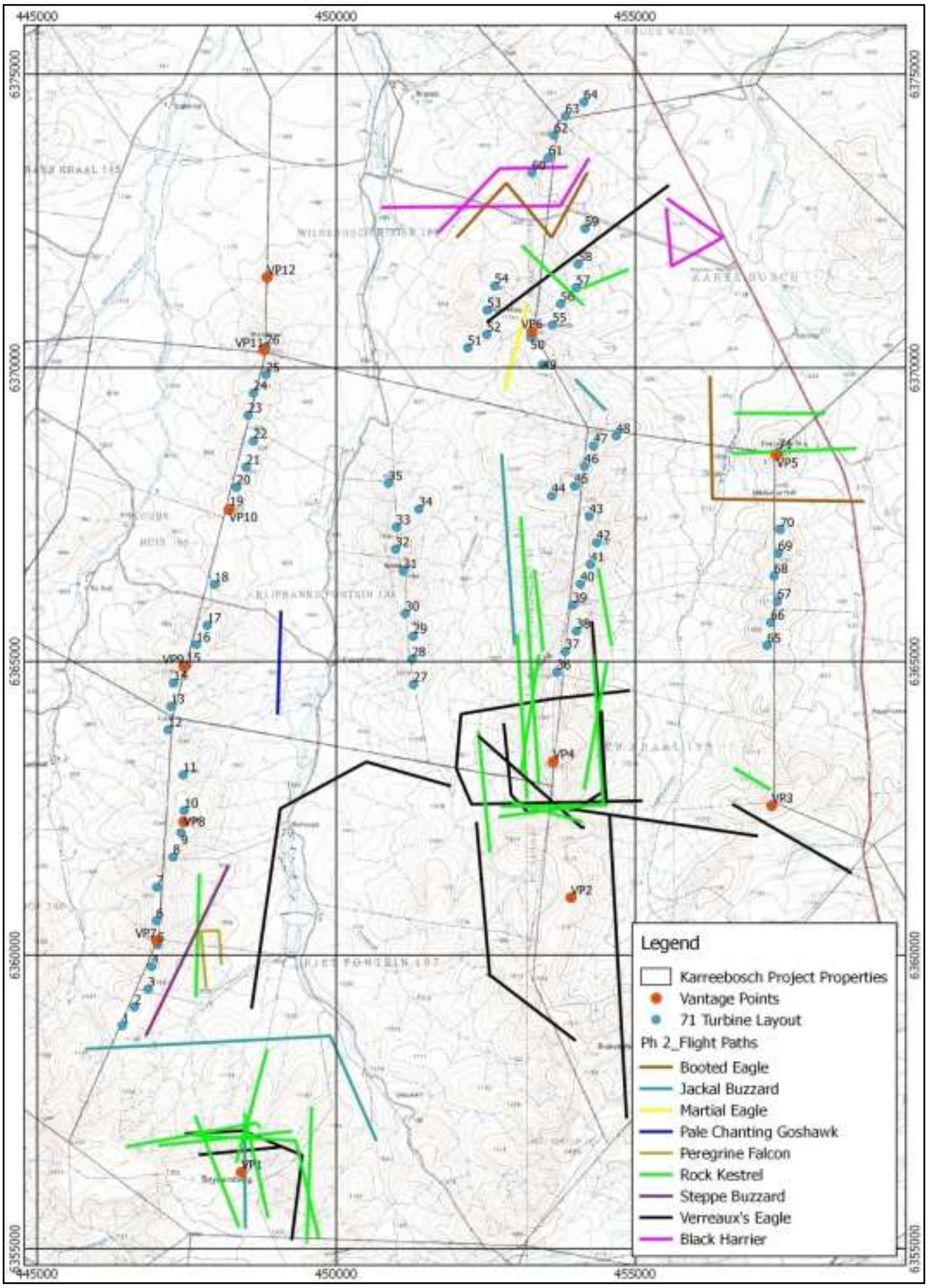


Figure 7.6: All recorded flight paths for recorded species.

7.7.3. Night active birds

Diurnal monitoring provides little or no information about the potential risk of birds colliding with turbines at night. There are two fundamental types of night activity by birds: foraging and other localized activities by locally resident species – owls, nightjars and thick-knees; and transient, cross-country, movements. There is unlikely to be any substantial nocturnal use of the ridge-top areas by locally active nocturnal bird species as the food resources are too poor to sustain them and the frequent strong winds will deter them. Owls are the most likely to occur but most will remain in the valley bottoms, or forage along the lower slopes, where prey is more abundant. Nor are there many cliff sites that potentially offer safe nesting and roosting sites for them. Furthermore, owls are unlikely to fly at turbine blade heights. The two species known or likely to occur in the region take their prey off the ground. They forage in low light conditions when detection of prey, either visually or through hearing, requires them to remain close to the ground.

Birds which are transient across turbine lines are considered at greater risk of collision mortality than birds resident in the immediate vicinity of turbines and the risk to transients is increased when their movement is at night. Long distance migrants often fly by night but most do so at heights that will keep them well above turbines even those on ridges. Nor is there any particular attraction which would lead them to descend towards this part of the Karoo.

The main area of concern is the potential for regionally resident birds dispersing at night. This particularly applies to waterbirds of which a surprisingly high number and diversity (31 species) were recorded on dams in the valleys around the ridges. Most waterbirds move between wetlands at night in order to avoid predatory eagles.

To appreciate the potential impacts of the Karreebosch wind farm on waterbirds, and the seasonally changing importance of local dams to waterbirds, it is necessary to understand some basic factors that affect the movement of waterbirds between regional dams in the area.

Focal observations of waterbirds were made at 7 dams, 4 within the Karreebosch wind facility impact area and 3 in the Tankwa Valley 8-10 km downstream. There is likely to be considerable movement of waterbirds between these dams especially in relation to seasonal rainfall. Many waterbird species prefer shallow waters that permit ready access to the wetland benthos. When small dams fill as a result of winter rains they become too deep for many of these shallow-water foragers and they move to other wetlands. In this region, these are the larger dams on the Tankwa River which flood back across adjacent flatland as seen in September-November 2013. Through the long dry summers wetlands dry down and birds move back to the smaller dams. Waterfowl are characterised by having an annual moult in which they simultaneously lose all of their flight feathers. For safety in this period when they are flightless or flight impaired for 3-6 weeks they move to large deeper water bodies where they can avoid predators.

30 of the 32 species of waterbirds were recorded at the two dams in the Wilgebos Valley. There was noticeable difference between waterbird numbers in September 2013 and the same month in 2014. In 2013 after the unusually heavy rains and with consequently deeper water levels the Wilgebos dams supported notably fewer species, and numbers, of waterbirds, than at the same dams in 2014.

In the Tankwa Valley, 8-10 km outside the immediate Karreebosch area, 25 Greater Flamingo's (Near-threatened) were seen at the larger of the two Seekoeigat dams in September 2014. In the Tuinplaas dam a small tree-covered islet supported nests of Black-headed Heron, Cattle Egret and Reed Cormorants. An immature African Fish-Eagle was seen near these dams in November 2013 and September 2014.

7.7.4. Valley birds

Of the 115 bird species recorded in the Karreebosch area, 78 species were seen only in the valleys. Almost all the species seen along the ridges were also seen in the valleys. Of the red-listed species observed six - Maccoa Duck, Black Stork, Greater Flamingo, Blue Crane, Ludwig's Bustard, Karoo Korhaan, - would only be expected in the valley bottoms. The red-listed species that sometimes were recorded along the ridges – Verreaux's Eagle, Martial Eagle, and Black Harrier - also occur in the valleys though mainly over the slopes of the ridges.

The local topography is one of high north south ridges with intervening valleys. To avoid having to fly high over the ridges most birds will fly within the valleys which in the Karreebosch area are relatively narrow. As a consequence, other than local foraging, most bird flights are likely to be along the valleys. This will place these birds at risk of collision with cross-valley power-lines installed to service the wind facility. Several groups of birds known from the area, including all the red-listed species, are considered at risk for collisions. Mitigatory measures to reduce collision risk have been taken into account and are included in the EMPr and chapters below (8-11). Their occurrence in the Karreebosch valleys is explained further below.

Bustards:

Bustards are prone to collisions (Janss & Ferrer 2000). Two species, both red-listed, were observed in the region. These were the Ludwig's Bustard and Karoo Korhaan, rated respectively as Endangered and Near Threatened**.** Neither species was seen in the specific Karreebosch project area but probably both sometimes occur.

Karoo Korhaans:

In this region, the Karoo Korhaans was either seen or heard in valley bottom fields of the immediately adjacent Roggeveld wind farm area. As there are few valley fields and, at any one time, even fewer fields with suitable plant cover, the potential number and distribution of Karoo Korhaans in the Karreebosch area is likely to be very small. If they do occur it is most likely that they will do so in the Wilgebos valley as this valley has most of the fields in the Karreebosch area.

Ludwig's Bustard:

The three regional observations of the larger Ludwig's Bustard were of single individuals in flight: one flushed from an area of low shrubland in the Hidden Valley wind farm area >10 km east of the Karreebosch area; another flying over a low ridge in the Roggeveld wind farm area; and one seen in the upper Tankwa Valley within the Karreebosch area. Given the stony conditions and the paucity of large invertebrate prey it is probable that this species is only an occasional, generally non-breeding, visitor to the Karreebosch/ Roggeveld region.

In the Karreebosch area both bustard species will preferentially occur in the valleys. There they will be at potential collision risk with the proposed cross-valley power lines. Though these bustards will preferentially fly over lower ground it is inevitable that they sometimes fly over the ridges. They are likely to avoid flying over the higher ridges and so if they do fly over ridges will be more at collision risk with turbines on lower ridges or near ridge saddles.

7.7.5. Raptors:

All the birds of prey recorded in the Karreebosch project area, including the three red-listed species - Verreaux's Eagle, Martial Eagle and Black Harrier - occur in the valleys as prey is more available below the ridges. Some species were only seen in the valleys - Jackal Buzzard, Steppe Buzzard, Booted Eagle and Pale Chanting Goshawk. Most of these birds foraged along the scrubby slopes. Only the goshawk was primarily associated with riparian areas. These birds of prey are at a greater risk of colliding with power lines in the valleys, where the birds are more often foraging and so focused more on the ground, than they are from ridge-top turbines as on ridges they are less ground focused and have a better chance of seeing the obstruction.

7.7.6. Bird Nests

Small cliffs, deemed as potentially suitable for raptor nesting, were selectively scanned from vantage points. In July 2013 two Verreaux's Eagle nests were found close together on the north-west facing cliff of Beacon Hill on the northern end of the turbine string on Central Ridge. The nests were large, so evidently added to over a number of years, but held no fresh green material, nor was there any whitewash from recent droppings. In September 2014, despite repeated observations of the nesting cliff area over 5 days from the Western Ridge, and the survey by Dr Simmons (Appendix 9 of the Ecology Report) no eagle activity was recorded at or in the immediate vicinity of the cliff with the nests.

7.8. Bats

This section on bats is based on information collected during the pre-construction bat monitoring undertaken by Animalia for Karreebosch Wind Farm.

7.8.1. Literature Based Species Probability of Occurrence

Table 7.3 provides a list of bat 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). 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 & Stoffberg (2014) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

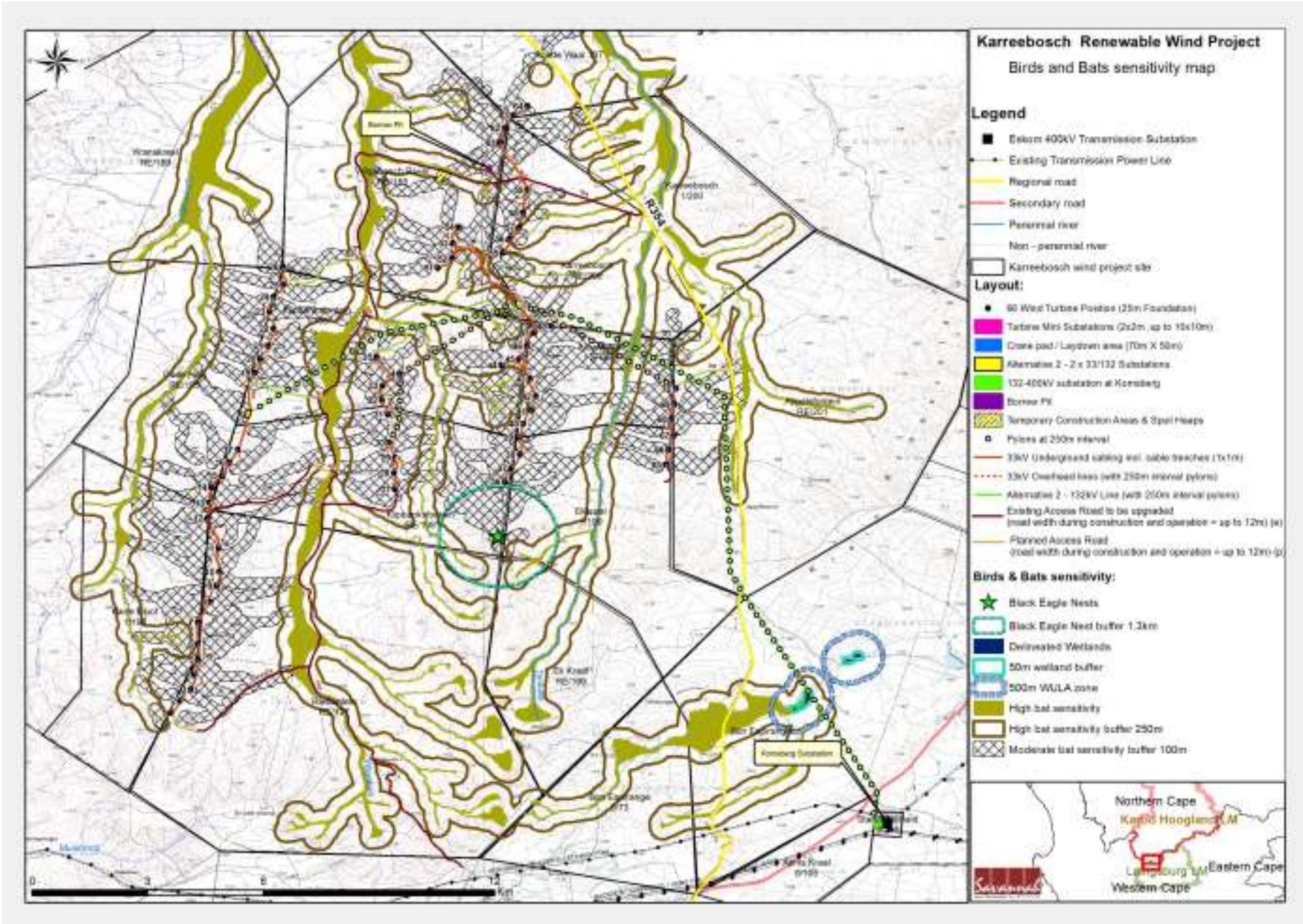


Figure 7.7: Bird and Bat sensitivity map based on findings of bird and bat monitoring

Table 7.3: List of bat 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 in Study Area	Foraging Habits (indicative of possible foraging sites in study area)	Likely Risk of Impact (Sowler and Stoffberg, 2014)
Rhinolophus clivosus	Geoffroy's horseshoe bat	20-30	Least Concern	Culverts, rock hollows and any other suitable hollow. Usually roosts in caves and mine adits, no known caves or mine adits close to site,	Clutter forager, may be found near dwellings and in denser vegetative valleys.	Low
Nycteris thebaica	Egyptian slit-faced bat	20-30	Least Concern	Hollows and culverts under roads. No known caves or mine adits close to site,	Clutter forager, may be found near dwellings and in denser vegetative valleys.	Low
Tadarida aegyptiaca	Egyptian free-tailed bat	90-100 Confirmed	Least Concern	Caves, rock crevices, under exfoliating rocks, in hollow trees, and behind the bark of dead trees	Open-air forager	High
Sauromys petrophilus	Robert's flat-headed bat	90-100 Confirmed	Least Concern	Narrow cracks and slabs of exfoliating rock. Rocky habitat in dry woodland, mountain fynbos or arid scrub.	Open-air forager	High
Miniopterus natalensis	Natal long-fingered bat	90-100 Confirmed	Near Threatened	Cave and hollow dependent, but forage abroad. Also take refuge in culverts and vertical hollows, holes.	Clutter-edge forager	Medium - High
Eptesicus hottentotus	Long-tailed serotine	90-100 Confirmed	Least Concern	Roosts in rock crevices	Clutter-edge forager	Medium - High
Myotis tricolor	Temmink'smyotis	40-50	Least Concern	Usually roosts gregariously in caves, and sometimes culverts	Clutter-edge forager	Medium - High

Species name	Common Name	Probability of occurrence (%)	Conservation status	Possible Roosting Sites Occupied in Study Area	Foraging Habits (indicative of possible foraging sites in study area)	Likely Risk of Impact (Sowler and Stoffberg, 2014)
				or other hollows. No known caves or mine adits close to site.		
Neoromicia capensis	Cape serotine	90-100 Confirmed	Least Concern	Roosts under the bark of trees and under roofs of houses. Very common bat	Clutter-edge forager	Medium - High

7.8.2. Ecology of Bat Species Most At Risk

There are five bat species recorded in the vicinity of the site that occur commonly in the area. These species are of importance due to their likelihood of being impacted by the proposed wind facility, which is a combination of abundance and behaviour. The relevant species are discussed below:

» ***Miniopterus natalensis***

Miniopterus natalensis, commonly called the Natal long-fingered bat, occurs widely across the country but mostly within the southern and eastern regions. It is listed as a Near Threatened conservation category. It is a cave-dependent species, such that the presence of suitable roosting sites in an area may be more important in predicting its presence than the vegetation. However, personal observations have proved this species to also utilise culverts as roosts, either singly or in very low numbers. This species assembles in large numbers to roost within caves. It utilises separate caves for winter hibernating activities and summer maternity behaviour. Winter hibernacula generally occur in more temperate areas of the country and at higher altitudes, while summer maternity roosts are warmer and lower altitudes (Monadjem *et al*., 2010). For this particular site, if a suitable roosting cave is located near to the site it would most likely be used as a summer maternity roost. But no locations of any caves or mine adits are known within the area of the site.

Miniopterus natalensis undertake 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. The mass movement of bats during migratory periods could result in mass casualties if wind turbines happen to be positioned over a mass migratory route, and such turbines are not effectively mitigated. The problem lies in that very little is known about bat migratory behaviour and paths in South Africa for this species, and such migrations can be up to 150 kilometres in distance. There is a pressing need for research in this direction. However, if the site is located within a migratory path the bat detecting system should detect high *Miniopterus natalensis* numbers and activity during over the 12 month monitoring survey. No signs of mass migrations have been detected on site.

Sowler & Stoffberg (2012) advise the likelihood of risk of fatality affecting *Miniopterus natalensis*, is that of Medium – High risk. Their evaluation was of the risk was based on broad ecological features, excluding migratory tendencies. A study of the habitat preference for foraging activities of *Miniopterus natalensis* showed that urban areas were by far the most used habitat category (54.0%), followed by open areas (19.8 %), woodlands

(15.5%), orchards and parks (9.1 %), and water bodies (1.5 %). On a finer scale, preferred foraging habitats were mainly urban areas (types of artificial lighting effects unmeasured) and deciduous or mixed woodlands, followed by crops and vineyards, pastures, meadows and scrublands, delimited by hedgerows or next to woodland, orchards and parks and water bodies (Vincent *et al.,* 2011). The areas of wooded and agricultural habitats were prioritised in the sensitivity maps as this species has a higher vulnerability to mortality from turbines in these areas. 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. Similar preferences for habitat use and foraging activities of M. natalensis in South Africa are expected. Therefore areas of wooded and agricultural habitats were prioritised in the sensitivity maps as *M. natalensis* has a higher vulnerability to mortality from turbines in these areas.

Mating and fertilisation generally occur in March–April, followed by a period of delayed embryo development until July–August and birth in October–December (Van der Merwe, 1979). Females congregate at maternity roosts where each one gives birth to a single pup. The results of the operational monitoring study will determine whether the same pattern of high activity for this species occurs during March-April (mating season).

» ***Neoromicia capensis***

Commonly called the Cape Serotine, *Neoromicia capensis* has a Least Concern conservation category as it is widespread over much of sub-Saharan Africa in high numbers. High mortality rates of this species due to wind turbines would be a cause of concern as *Neoromicia capensis* are abundant and widespread and therefore, have more significant roles to play within the local ecosystem than the rarer bat species. They do not undertake migrations and therefore are considered residents of the site.

It roosts individually or in small groups of two or 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 utilise most man-made structures as day roosts (Monadjem *et al*., 2010). These types of roosting sites on the farms must be considered as sensitive.

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 savannahs'; inferring that they may occupy several habitat types across the site, and are adaptable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but may occasionally forage in open spaces.

They are thought to have a Medium – High likelihood of risk of fatality due to wind turbines (Sowler & Stoffberg, 2014).

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 (van der Merwe, 1994). Although twins are common, singletons, triplets and even quadruplets have been recorded (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 caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem *et al*., 2010). Thus man-made structure and large trees on the site would be important roosts for this species.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem *et al*., 2010).

The Egyptian Free-tailed bat is considered to have a High likelihood of risk of fatality due to wind turbines (Sowler & Stoffberg, 2014). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species. The sensitivity maps are strongly informed by the areas that may be utilised by this species.

After a gestation of four months, a single young is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August (Bernard and Tsita, 1995). Maternity colonies are apparently established by females in November (Herselman, 1980).

» ***Eptesicus hottentotus***

Eptesicus hottentotus, also known as the Long-tailed serotine, has a conservation category of least concern. This species occurs widely but sparsely in Southern Africa. It has been recorded from the Northern and Western Cape, east to Lesotho and KwaZulu-Natal, and north to Zimbabwe.

Eptesicus hottentotus roosts in small groups of two to four individuals in caves and rock crevices, suggesting that it may require suitable roosting sites in rocky outcrops. It is a clutter-edge forager whose diet comprises mainly Coleoptera. The Long-tailed serotine is considered to have a Medium likelihood of risk of fatality by wind turbines (Sowler and Stoffberg 2014). Due to the widespread but sparse distribution of this species.

» ***Sauromys petrophilus***

Sauromys petrophilus, Roberts's flat-headed bat, has a conservation category of least concern. This species is widespread and abundant in the arid western parts of Namibia and South Africa, extending south to the Western Cape. There is a separate population in northern South Africa, Zimbabwe and northern Mozambique.

It roosts communally in small groups of up to 10 individuals in narrow cracks and under slabs of exfoliating rock. This species is closely associated with rocky habitats, usually in dry woodland, mountain fynbos or arid scrub.

Sauromys petrophilus has long, narrow wings with high wing loading and intermediate aspect ratio making it adapted to open-air forager strategies. Its diet consists mainly of Diptera, Hemiptera and Coleoptera.

Reproductive information of this bat is currently lacking. The only available information is that pregnant and lactating females have been found in mid-November near Mutoko in northeast Zimbabwe (Monadjem et al. 2010).

This species is considered to have a High likelihood of risk of fatality by wind turbines (Sowler and Stoffberg 2014). Due to the widespread distribution of this species and it flies high enough to come into contact with turbine blades.

7.9. Heritage Resources

7.9.1. Findings: Archaeology and heritage resources

Figure 7.7 shows the distribution of recorded heritage sites on and around the site.

Stone Age artefactual material

Within the study area the ridges are devoid of rock shelters, rock outcrops but are covered in stones and low shrubs. They are extremely in-hospitable in that they contain no foci where people could shelter from the elements. Rock shelters in this area are entirely absent, water sources are scarce. These harsh conditions were evidently experienced in the pre-colonial past as almost no evidence of any archaeological material at all was located. Even Middle Stone Age material with is normally ubiquitous throughout the Karoo was almost entirely absent. These observations are not the function of a thin search pattern over a vast area, as half of the turbine sites were easily accessible by off-road vehicle. Pre-colonial heritage tends to occur in the valley bottoms close to watercourses and springs which may explain why the high ridges of the study contains so little evidence for pre-colonial occupation.

Other pre-colonial indicators

There are very few caves or shelters within the study area that could have supported occupation (few exhibited any form of sediment trap), and those that do exist, are generally formed in soft rock strata resulting in constant exfoliation. Two small rock shelters were inspected, however these contained no habitable floors or archaeological deposits.

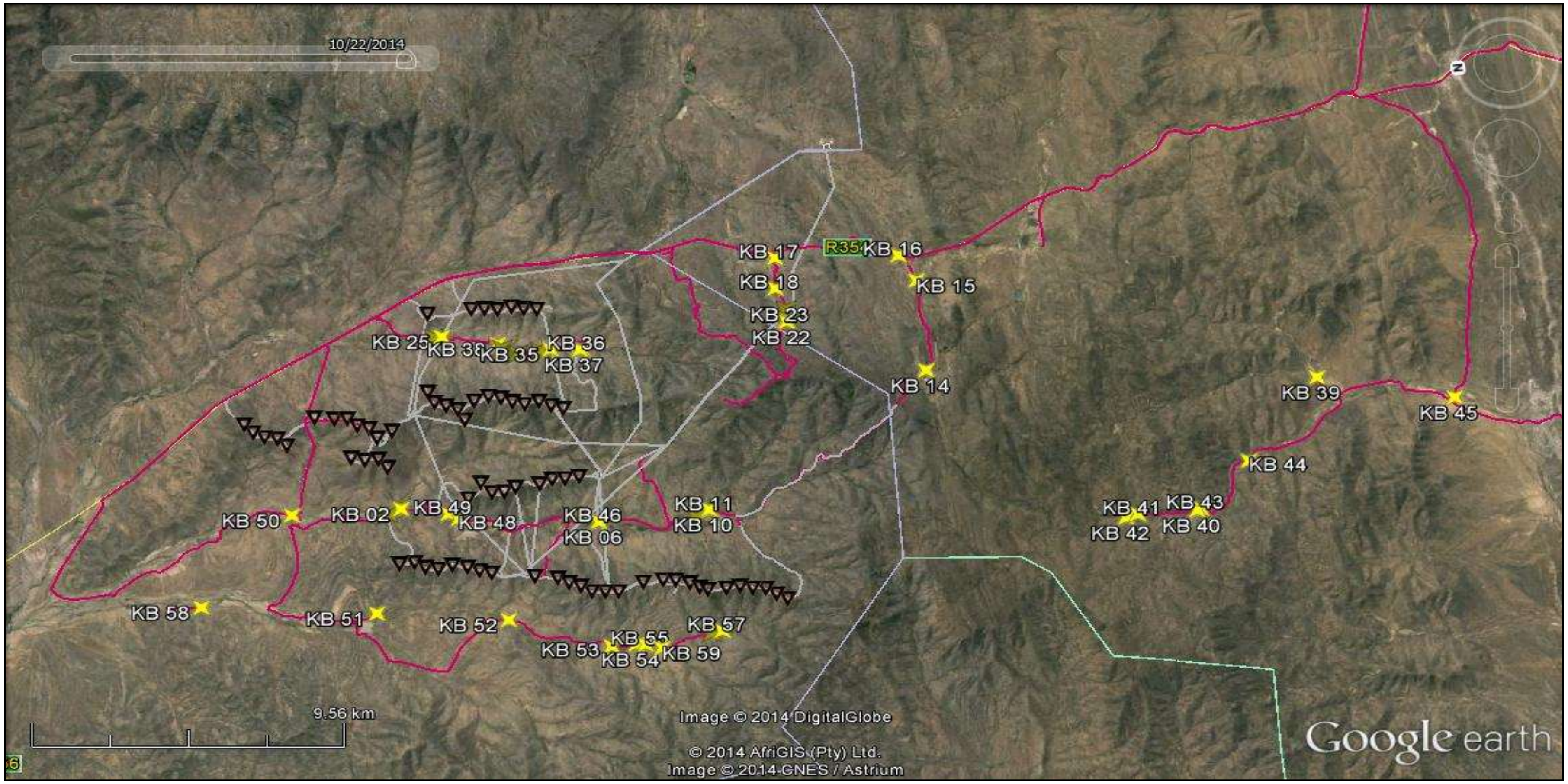


Figure 7.7: Distribution of recorded heritage sites (yellow stars) and proposed turbine layout for Karreebosch Wind Farm.. Take note of the map orientation (i.e. north)

Graves

A collection of stone piles were recorded in the Ekkraal Valley while similar and more defined examples which are almost certainly graves, have been identified in the Rietfontein and Karrekraal areas. Many of these are not far from the valley bottom roads which means they could be impacted if roads are to be widened.

Figure 6.8: Stone pile (possible grave) near Ekkraal.

Built Environment and colonial heritage

The built environment of the study area is limited to farms, farm houses, stone walls, walled kraals and secondary roads. Given the remoteness of this area, even these are sparsely distributed. Virtually all farm infrastructure is situated in the low lying areas between the ridges. Most are several kilometres from proposed turbine locations which mean that direct impacts are not expected. Characteristically, locales of colonial settlement seem to be concentrated in three areas – namely the farms known as Ekkraal Valley, Ou Mure, and the Hartjieskraal-Barendskraal valley somewhat south of the study area.

<u>Ekkraal Valley</u>

The most significant collection of heritage resources in the entire area is confined to a single remote valley at the entrance to which lies the farm Ekkraal. The valley forms a geographically delineable cultural landscape consisting of ruined 19th century farms, stone walled kraals, fragments of stone walling. The shallow Ekkraal valley lies between two of the large longitudinal ridges which form the main turbine rows. Along the gently sloping valley floor the team recorded some 16 occurrences of historical material, all evidently dating to the 19th century. The rivulet which runs down the valley bottom was evidently a wetland which attracted *trekboer* agriculture. The presence of at least two *trapvloers* (threshing floors) and remnant of disturbed landscapes and ruined stone and mud-brick homesteads indicate that the area produced some harvests of wheat. Today there is very little evidence of any fields in this essentially wilderness landscape.

The existing Ekkraal Farm (absentee owner) is a humble corrugated iron roofed building which dates from the 19th century. It is probably worthy of Grade IIIC status. The structure is not under threat and evidently well maintained. The closest turbine is well in excess of 1 km from the site, which means that no direct impacts will result from the turbines themselves. Others elements of the built environment consist of dams, kraals and two out-buildings, one of which is built from stone and has a Dutch hearth. The existing vehicle track up the valley will be upgraded and widened to allow heavy vehicles to pass. Since many of the ruined features lie very close to this track, impacts could occur.

The significance of Ekkraal valley lies in the intactness of the archaeological signature of early colonial occupation. The pattern of kraals, farm buildings, artefact scatters and walling remains highly legible. The area can be considered to be archaeologically sensitive and worthy of preserving in terms of its research potential. The heritage of the valley is not a tourism resource, and not well known to anyone other than the local populous. In these terms it does not constitute visually sensitive heritage.

<u>Rietfontein – Wilgebosch Valley:</u>
This area reflects the clear pattern of historic settlement in the valley bottoms. A number of historic ruins and graves were recorded, and highlight the need to treat the valley bottoms as conservatively as possible when designing infrastructure.

<u>Kranskraal-Karrekraal Valley:</u>
No infrastructure is planned for this valley bottom. This highly isolated area contains numerous historic ruins, and particularly to the south at Karrekraal a rare *brakdak* huis (19th century) with a traditional kookskerm, a rare heritage feature which is seldom seen these days. There are also a number of graves, both informal and with headstones. It is fortunate that infrastructure is not planned for this area as it is sensitive in terms of historical archaeology.

7.9.2. Findings: Palaeontology

The Karreebosch Wind Farm project area is located in an area that is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary, age. Table 7.4 below summarises the stratigraphy and lithology of the site.

Table 7.4: Summary of stratigraphy and lithology for the site

Age	Group	Formation	Lithology	Palaeoenvironment
Permian	Beaufort	Abrahamskraal	sandstone channel + crevasse splay	subaerial upper delta plain, aerially exposed mudflats, backswamps,

Age	Group	Formation	Lithology	Palaeoenvironment
			deposits, interbedded mudstones	
Permian	Ecca	Waterford	sandstone, greywacke, shale	shallow water, delta-front
Permian	Ecca	Fort Brown	mudstone, minor sandstone	prodelta and delta-front
Permian	Ecca	Tierberg	dark shale, mudstone	settling from suspension in deep water, shallowing towards the top

The fluvial Abrahamskraal Formation (Lower Beaufort Group, Karoo Supergroup) that underlies almost the entire wind farm study area is known for its diverse fauna of Permian fossil vertebrates - notably various small- to large-bodied therapsids and reptiles - as well as fossil plants of the *Glossopteris* Flora and low diversity trace fossil assemblages. However, desktop analysis of known fossil distribution within the Main Karoo Basin shows a marked paucity of fossil localities in the study region between Matjiesfontein and Sutherland where sediments belonging only to the lower part of the thick Abrahamskraal Formation succession are represented.

A sufficiently large outcrop area of Abrahamskraal Formation sediments, exposed in stream and riverbanks, borrow pits, erosion gullies as well as road cuttings along the R354, was examined during the palaeontological fieldwork to infer that macroscopic fossil remains of any sort are very rare indeed at this site. Exceptions include common trace fossil assemblages (invertebrate burrows) and occasional fragmentary plant remains (horsetail ferns). It was concluded that the Lower Beaufort Group bedrocks in the study area are generally of low palaeontological sensitivity and this also applies to the overlying Late Caenozoic superficial sediments (colluvium, alluvium, calcrete, soils etc.).

Figure 7.9: Trace fossils consisting of sand-filled vertical burrows in sandstone, from Ekkraal Farm (width of rock ca. 200 mm)

The Abrahamskraal Formation contains terrestrial vertebrate fossils, fish remains, non-marine molluscs and silicified wood (Johnson *et al.,* 2006). The lowest biozone of the Beaufort Group is the *Eodicynodon* Assemblage Zone, recently recognised in the southwestern part of the Karoo basin by Bruce Rubidge. This zone is characterised by fossils of *Eodicynodon*, a small primitive tetrapod reptile. Fossils of other primitive reptiles are also found in this biozone (MacRae, 1999). These are extremely important fossils documenting the rise of reptiles and evolution of mammal-like reptiles (therapsids), for which the Karoo is the pre-eminent locality.

The *Eodicynodon* Assemblage Zone is not recorded in this area and the Study Area lies within the *Tapinocephalus* Assemblage Zone. The zone is named after a therapsid (the mammal-like reptile *Tapinocephalus atherstonei*) restricted to this zone. Fossils of a wide variety of other tetrapods, both herbivores and carnivores, including early precursors to the line that gave rise to mammals, have been found in this zone (MacRae, 1999). There are very few records of vertebrate fossils in the part of the *Tapinocephalus Assemblage Zone* covered by the Study Area, and what has been found is sparse but diverse, so anything found would be of considerable significance.

7.10. Social

The proposed Karreebosch wind farm project is located within two Provinces, namely the Northern Cape and Western Cape. The Northern Cape portion of the site falls within the Namakwa District Municipality (DM) and in the Karoo Hoogland Local Municipality (LM). The Western Cape portion of the site is located within the Central Karoo DM and in the Laingsburg LM. The Namakwa DM has six local municipalities and covers a geographic area of approximately 126 747 km^2. The Central Karoo DM comprises of three local municipalities and it is the largest District in the Western Cape Province at 38 853 km^2.

7.10.1. Demographic Profile

Karoo Hoogland Local Municipality, Northern Cape:
The population of the Karoo Hoogland LM was 12,588 in 2011, showing a slight increase from the population recorded in 2001. The age profile for the LM illustrates a developing population dominated by people of working age (62.3% between 15 and 64 years). There are similar numbers of children (27.7% below 14 years) and the elderly population (above 65 years of age) comprise the remaining 10%. The racial composition is predominantly Coloured (79%), followed by Whites (14.6%), and Blacks/Africans making up the remaining population (6.4%).

Laingsburg Local Municipality, Western Cape:
This municipality is in the Central Karoo District. The population of the Laingsburg LM is highly urbanised, with 73.5% of the population living in the urban area and the remaining 26.5% percent residing in farm areas. The municipality has a population of 8289 people according to the 2011 Census. The ages of the population within the LM vary. The population aged between 15 and 64 years is higher than the other groups at 66.3 %, followed by the youth (26.5% between 0 and 14 years). The elderly comprise 7.2% of the population. The racial composition of the Laingsburg LM shows Coloured people as being the most dominant group at 79%, followed by the White population (13.3%) and then Black/African (7.7%).

Project Site:
The living arrangements of the farmers and their workers vary considerably. Most farmers have more than one farm and therefore generally do not live permanently on the site. Only three of the farmers, and their workers, live permanently on the farms that form part of the project area. The majority of the farmers stay permanently off-site and visit the farms intermittently when the livestock activities are based at the site. The workers spend more time on the farms with the livestock than the farmers do. The workers generally only live on the farm during the week and visit their family homes on weekends in Laingsburg. The number of workers living on the farms varies depending on the seasons and the farming activities. The farmers employ seasonal workers that may live on the farm for a short period. The most activity at the Karreebosch site is during winter as the site is predominantly used in the winter months.

Due to the remote location of the farms in relation to schools, many of the farmers' children (who are of school going age) attend boarding school and only visit the farm during the school holidays. Usually if the workers have young children then the wife and the children generally live on the farm, but as soon as the children start school, the wives and children generally move to Laingsburg in order to be close to schools. All the farm owners are White and the workers are Coloured.

7.10.2. Education

Illiteracy levels in the local municipalities are relate to 11.7% of the population the Laingsburg LM without any schooling. Karoo Hoogland has a higher portion of adults with no schooling (20.6%) than both the District (5.8%) and the Province (12.2%), which highlights the need for skills development and training. In Karoo Hoogland LM, illiteracy is higher than that of Laingsburg (18.4%).

7.10.3. Health

There are a lack of medical facilities in the Namakwa DM; primarily given the scattered settlement pattern in the area. The most prevalent illnesses experienced by the population of the DM are HIV/AIDS, TB and substance abuse. There used to be an asbestos mine in the DM; those who were exposed to the asbestos are likely to get ill from further exposure to asbestos. Unfortunately, the healthcare facilities do not keep any records of these incidences.

The Central Karoo DM has four provincial Hospitals, 14 mobile clinics, nine built clinics and one Community Health Care centre (CHC). Laingsburg LM has a Provincial hospital, clinic and mobile clinic which service the rural areas. The most common illnesses in both municipalities are TB, HIV/AIDS and substance abuse. There are many problems hindering the delivery of medical services to the communities including inadequate staffing and other medical resources in both local municipalities.

Social Ills Affecting the Community

Alcohol and drug abuse is causing/exacerbating many of the social problems facing the broader community. The increasing levels of substance abuse are pushing farmers to seek alternatives to local labour, and leading to increased levels of foetal alcohol syndrome, HIV, unwanted pregnancies, physical abuse and increasing school drop-out rates.

7.10.4. Economic Profile

Namakwa District Municipality Economy

The Namakwa DM's economy is characterised by an undiversified economy, with a high dependency on mining (52.7%). The relative contribution of this sector is, however, declining. The sector had an average annual growth rate of 0.3% between 2001 and 2007. Wholesale and retail trade, catering and accommodation is the next largest contributor to the GDP (13.2%), followed by finance and business services (7.8%), general government services (6.7%) and community, social and personal services (5.9%). Other sectors not mentioned contributed less than 5% including agriculture.

Central Karoo District Municipality Economy

The economy of the Central Karoo DM was one of the biggest contributors to the GDP of the Western Cape Province in 2004 with an annual growth rate of 4, 2%. The growth of the economy was largely driven by fast growing sectors such as transport and manufacturing, financial and business services, wholesale and retail, communications, and construction. The main economic sectors are as follows: agriculture (47%), finance and business services (22%), community services (19%) and construction (7%).

Laingsburg Local Municipality

The agricultural sector is the largest contributor to the Laingsburg LM's economy. The agricultural sector is, however, not optimally exploited, as natural resources are sold in their raw form and processed elsewhere. The sector accounts for 23.2% of Laingsburg's GDP and has an average annual growth rate of between 6% and 8%. The Laingsburg LM is currently investigating ways of growing this sector further through localised processing of raw materials.

The other key economic sectors of the Laingsburg LM are wholesale and retail trade; catering and accommodation; transport, construction, communication and manufacturing.

Karoo Hoogland Local Municipality

Agriculture and tourism are the largest contributors to the Karoo Hoogland LM's economy. In terms of GDP the Karoo Hoogland LM has a relative advantage within the Namakwa District Municipality in the following sectors: manufacturing; agriculture, forestry; community, social and personal services.

Social Characteristics of the Project Area

Commercial stock farming forms the economic backbone of the Laingsburg/Sutherland region, and essentially consists of extensive small stock farming, typically sheep. Carcass, wool and multi-purpose breeds are stocked. The grass component is insufficient to support meaningful numbers of large stock.

Goats are suited to the region, but are not generally favoured due to their very destructive browsing habit.

The employment opportunities associated with extensive stock farming are limited and in many instances only available seasonally (e.g. shearing). Virtually no beneficiation of primary produce (meat, wool, hides) currently takes place locally. As a result, the local primary agricultural sector supports only very limited local secondary employment and investment.

Most farming operations in the broad region produce fodder crops on a small scale, mainly for own use. The Laingsburg-Sutherland-Ceres area is a key producer of vegetable seed crops, namely onions, garlic, leeks and carrots. Olives, drying peaches, citrus and other crops are also grown on a small scale in the Laingsburg area. All cropping activities are irrigation-based. Cropping areas and potential cropping areas are therefore restricted in this region of low rainfall, ephemeral rivers and deep groundwater. With regard to the WEF study area, vegetable seed is produced on at least 3 site farms. In the case of Rietfontein and Klipbanksfontein (Conradie), workers are transported in during planting and harvesting for a few days at a time, with a skeleton staff supervising operations throughout the year.

Other land uses in the area include game farming, tourism (e.g. guesthouses) and 'lifestyle farming'. 'Lifestyle' or 'weekend farmers' refers to those people who live in the cities but own farms in the Karoo as a means of escaping the city and enjoying the peace and tranquillity. They generally reintroduce animals (including predators) as part of their plans to rehabilitate the land and conserve naturally occurring animals and habitat.

7.10.5. Employment, Unemployment and Household Income

Employment and Unemployment

The Karoo Hoogland LM has an unemployment rate of 14.6% with 20% percent of the population being the youth. The Laingsburg LM has an unemployment rate of 17.9% with 22% of the unemployed population being the youth (15-34 years). The Laingsburg Municipality has 3735 economically active people (45.5%).

Household Income

Approximately nine percent of the households in the Karoo Hoogland LM have no income and 35% live on a monthly income of up to R9600. The majority of households in the Laingsburg LM earn a medium income of between R9601 and R76 400 per month (68.1%), followed by 4.9% that earns between R1 and R9600 a month, and the remainder 21.7% earns between R76 401 and R2 457 600.

Government grants (e.g. child support, disability and pension grants) have resulted in high levels of dependency on the State. These grants are often the only source of household income, given the unemployment rate in the area.

Municipal Service Levels

Compared to other parts of the country, both local municipalities enjoy high levels of formal housing provision. According to Census 2011, only 3.4% of both LM's populations do not have access to formal housing.

Other service levels are less impressive, although both LMs have made improvements in terms of all (Karoo Hoogland) or most (Laingsburg) indicators. Access to waterborne sewage is particularly low in the Karoo Hoogland (<40%). More than 35% of Karoo Hoogland, and >20% of Laingsburg households do not have access to electricity for lighting.

Remuneration of Farm Workers

General farm workers are paid minimum wage and supervisors/farm managers are paid more. The monthly pay varies between R1 200 and R2 000 per month. The farmers raised concern that the majority of workers spend all their money immediately after payday (Friday) on alcohol and drugs and therefore do not have any money left to meet their basic needs.

Permanent farm workers also receive benefits from the farmers. The benefits vary but the standard benefits include free accommodation, electricity (where infrastructure is available), water and sanitation (where water is available), and wood for cooking purposes. Some of the farmers provide additional benefits, such as transportation to town/ school, work clothes, a bonus at the end of the year, additional income for killing predators such as jackal and Rooikat (approximately R300-R400 per animal), other foodstuff including milk and vegetables from the farm, substantially discounted/ free meat, skin and wool of slaughtered sheep, and some workers are allowed to keep their own sheep and/or goats as well as to grow their own vegetable gardens on the property.

Farm Workers

Sheep farming is not labour intensive and the intensity of farming activities increases for about four months every year for seasonal tasks (e.g. sheep shearing, harvesting); during this time the farmers employ casual labour from Laingsburg and surrounding areas. The wives of permanent workers are also employed for this seasonal work. Some farmers will not use local labour because of the labour challenges; as an alternative, they contract the services of Cape Mohair and Wool (CMW) for sheep shearing services; farmers noted that they prefer to use the services of CMW because they are reliable and professional.

The employment tenure of workers varies considerably. For the majority of the farmers, the employment time range from a few months to several years. Some farmers have long-term employees. For example, one farmer in the neighbouring area has two workers that have been employed on the farm for 20 years and 30 years respectively. There is no clear trend regarding the length of employment. Employment depends on the individual circumstances of the worker and the farmer as the pay and worker benefits are relatively similar.

7.10.6. Tourism and Heritage

Tourist flows into the study area municipalities are currently modest, and mainly associated with the town of Sutherland (observatory) and the small Victorian rail siding of Matjiesfontein along the N1 west of Laingsburg.

The construction and commissioning of the South African Large Telescope (SALT), the largest telescope in the Southern Hemisphere, is credited as the most important contributing factor to the growth of the tourism sector in Sutherland. Prior to the construction of SALT in 2005 the accommodation in the town was limited to a single guesthouse and one hotel. At present, the town has over 30 B&B/guest house facilities and one hotel (providing a total of approximately 300 beds), as well as a number of restaurants and coffee shops/ bistros. In addition, fourteen guest farms have become established around the town. An estimated 15 000 visitors visit the town annually. The majority of tourist are from the Western Cape and visit the town during the winter months when atmospheric conditions for viewing are optimal. Peak visitor numbers are over the June school holidays. Snow tourism is also becoming a major attraction. As major attractions are limited to a few winter months, accommodation facilities and restaurants battle with significant under-subscription during most of the year.

Matjiesfontein is a quaintly preserved/ restored scattering of Victorian houses and the Lord Milner Hotel around a rail siding. Thanks to its location near the N1, Matjiesfontein is arguably one of South Africa’s best-known bastions of Victoriana and nostalgia tourism. Matjiesfontein is largely dedicated to residential and tourism uses. Its location along the N1, between Laingsburg and Touwsrivier, makes it ideal as a stop or stop-over for tourists. Travellers are less well catered for, as general shops and services (e.g. fuel station) are not represented.

Information provided by the Karoo Hoogland Tourism Bureau as well as the Laingsburg Tourism Bureau indicates that no significant tourism attractions or destinations are located in the WEF study area. Guest accommodation is available on two farms to the south of the WEF site, but mainly caters for contractors and consultants working in the area. In this regard, the WEF is located more or less in between two major accommodation destinations, namely Matjiesfontein and Sutherland.

7.10.7. General Infrastructure and Services

Existing Site Infrastructure

The infrastructure on the farms is directly related to the land use (i.e. livestock and crop farming). The basic infrastructure found on the farms varies between farms but includes *inter alia* the following:

- perimeter and camp fencing;
- farm roads;
- sheds and storage;
- boreholes;
- wind pumps;
- solar powered water pumps;
- worker accommodation;
- main farm house;
- farm dams;
- pivot and other irrigation systems; and
- various types of pumps to pump water from boreholes.

General Municipal Infrastructure and Services

It is important to note that these statistics are relevant to towns in district and local municipalities and may not necessarily apply to rural farms. Whilst some services may be supplied by the municipality e.g. electricity, others are independently sourced e.g. boreholes for water use.

Water

Bulk water supply is limited in both the District Municipalities and is not adequate to meet the demands of proposed large-scale economic developments that require large quantities of water. Water shortages have an impact on local economic activities as it costs farmers more to transport livestock for processing. Continued demand, lack of proper planning and sustainable water supplies also limit the addition of new economic sectors. The source of water for the project would be boreholes and, to a limited extent, surface water (i.e. dams) located on the project properties.

Service delivery in the Karoo Hoogland Municipality does not face any serious challenges as most households receive basic services. In the Karoo Hoogland LM 97.3% of the population within the LM have access to piped water (either in their dwellings or in their yard), while the remaining 3% of the population access their water from boreholes and/or rain, rivers and water tanks. Laingsburg LM has a relatively similar number of households with access to tap water (97.2%) compared to Karoo Hoogland. Another 0.6% of the households in Laingsburg

Municipality have no access to piped water and receive water from rain, boreholes and dams.

Sanitation

Access to sanitation facilities in the Laingsburg LM is relatively high, with 82.8% of households having access to flush toilets. A further 10.5% use dry, chemical and ventilated (VIP) toilets, 1.4% use the bucket system and 0.5% have no toilets. The Laingsburg LM has delivered toilets to 82.8% of the communities; this is significantly high compared to Karoo Hoogland's provision of sanitation facilities (56.9%). In both the Karoo Hoogland and Laingsburg local municipalities there are still households without sanitation facilities (1.6% and 0.5%, respectively) and those who are using the buckets system (1.1% and 1.4%, respectively).

Housing

In the Karoo Hoogland LM 76 percent of households live in formal houses and approximately 23% live in hostels or live in informal housing. The Laingsburg LM has a higher percentage of the population living in formal housing compared to Karoo Hoogland at 96.9%. Approximately 3.1% of the population in Laingsburg LM are living in informal housing such as shacks and backyard rooms.

Energy

In Karoo Hoogland LM 82.4% of households have electricity. Another 11.3% use candles, 3.3% use solar and 2.9% use other sources of energy. In the Laingsburg LM approximately 79.4% of the population have access to electricity. Approximately 10.2% of the population use candles, with the remainder using solar energy and other sources of energy such as firewood and coal.

Roads

In the Namakwa DM, the current backlog on re-graveling was estimated to be R70 million for the District. Many complaints were received by the department regarding the worsening condition of the road network. The information from the gravel road management system report indicated that about 1072 km of the roads in the district are without any gravel (that is, dirt/earth roads). The condition of the gravel road network was rated as fair, with 22% of the roads considered to be in poor to very poor condition.

The roads in the Central Karoo DM are critical to the transport sector; the largest GDP contributor. There are a total of 96km of trunk roads, 726km of Main Roads, 1 725km of Divisional roads and 4 256km of access roads. The National and provincial roads are well financed and maintained, whereas those that are the responsibility of the District and Local Municipalities are not as well maintained.

Policing

Some landowners reported that there is a sense of lawlessness in the area because people are aware that the police are not very strong in the area. The police officers are Black/African and do not speak the local language therefore there seems to be a breakdown in communication between the police and community making enforcement and assistance/support more difficult.

7.10.8. South African Large Telescope

The Karreebosch site lies approximately 50km from South African Large Telescope (SALT). SALT is the largest single optical telescope in the Southern Hemisphere, is credited as the most important contributing factor to the growth of the tourism sector in Sutherland. Regulations promulgated in terms of AGA in 2009 require all developments in the Sutherland area that impact on the operations of the SALT and other astronomy operations be limited. Mitigations measures in such environment include minimisation of external night lighting, to be fully cut-off, or with no light emitted in the upward direction. This is aimed at protecting the observational integrity of SALT.

ASSESSMENT OF IMPACTS: CHAPTER 8

KARREEBOSCH WIND FARM & ASSOCIATED INFRASTRUCTURE

Environmental impacts associated with the proposed Karreebosch Wind Farm are expected to be directly or indirectly due to the construction, operation and decommissioning of the facility. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts can be expected to vary significantly from site to site.

The construction of a wind energy facility project includes land clearing for site preparation and access/haul roads; transportation of supply materials and fuels; construction of foundations involving excavations and cement pouring; compaction of laydown areas and roadways; manoeuvring and operating cranes for unloading and installation of equipment; laying cabling and overhead lines; and commissioning of new equipment. Decommissioning activities may include removal of the temporary project infrastructure and site rehabilitation. Environmental issues associated with construction and decommissioning activities may include, among others, threats to biodiversity and ecological processes, including habitat alteration and impacts to wildlife through mortality, injury and disturbance; impacts to sites of heritage value; soil erosion; and nuisance noise from the movement of vehicles transporting equipment and materials during construction.

Environmental issues specific to the operation of a wind energy facility may include visual impacts; noise produced by the generator and spinning of rotor blades; avian/bat mortality resulting from collisions with blades and barotrauma; avian mortality resulting from collisions with overhead power lines and light/illumination issues.

These and other potential environmental issues were identified through the scoping evaluation and assessment phase. Potentially significant impacts identified for Karreebosch Wind Farm have now been assessed within this EIA Report. The EIA process has involved input from specialist consultants, the project proponent, as well as input from key stakeholders, relevant authorities and interested and affected parties engaged through the public consultation process.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed wind energy facility and associated infrastructure (substation, power line, access road/s to the site, internal access roads between turbines, underground electrical cabling between turbines, turbine foundations and associated footprint), and to make recommendations regarding preferred alternatives for consideration by the competent authority, the Department of Environmental Affairs (DEA), as well as for the management of the impacts for inclusion in the draft Environmental Management Programme (EMPr) (refer to **Appendix M**). The impacts being discussed in the chapter are based on the initial (pre-EIA) layout. A revised layout presented in Chapter 10 has been developed based on the proposed mitigation measures from the specialists below.

In order to assess the impacts associated with the proposed Karreebosch Wind Energy Facility, it is necessary to understand the extent of the affected area. The affected area primarily includes the location for the turbines, substation and associated access roads. A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. Karreebosch Wind Farm will include the following infrastructure:

» Up to 71 wind turbines (2MW to 3.3MW in capacity each) with a foundation of 25m in diameter and 4m in depth.
» The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
» Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
» Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
» Internal access roads up to 12 m wide.
» Approximately 25km of 33kV overhead power lines linking the turbine strings to each other and to the on-site substations
» Approximately 25km of 132kV overhead power lines from the on-site substation to Eskom's Komsberg Substation.
» Up to two electrical substations on-site (33/132 kV substations with a footprint of 100m x 200m each)
» Extension of the existing 400kV Substation at Komsberg with several electrical components to be defined by Eskom (e.g. additional feeder bay, transformer bay) on the existing substation property
» Underground park cabling between turbines buried along the internal access roads, where feasible.
» An operations and maintenance building (O&M building).
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~3ha).

Two alternatives for up to two on-site 33/132 kV substation (100m x 200m): The on-site substation complex would also house site offices, storage areas and ablution facilities.

* Alternative 1: 1 x 33/132kV Substation:
  The 33/132kV substation will collect all cables at one central point to the south of Turbine 27 with 1 x 132kV line connecting to the existing 400kV substation located adjacent to the Komsberg substation. This substation will be referred to as Alternative 1 Substation.
* Alternative 2: 2 x 1 x 33/132kV Substations
  The two substations will be called Alternative 2 Substation West (western ridge north of Turbine 18) and Alternative 2 Substation Centre (centre ridge saddle between Turbine 47 and 49). Power line route alternative 2 (detailed below) will connect the two proposed 33/132kV substations with 1x132kV line and continue towards the existing 400kV substation located adjacent to the Komsberg substation.

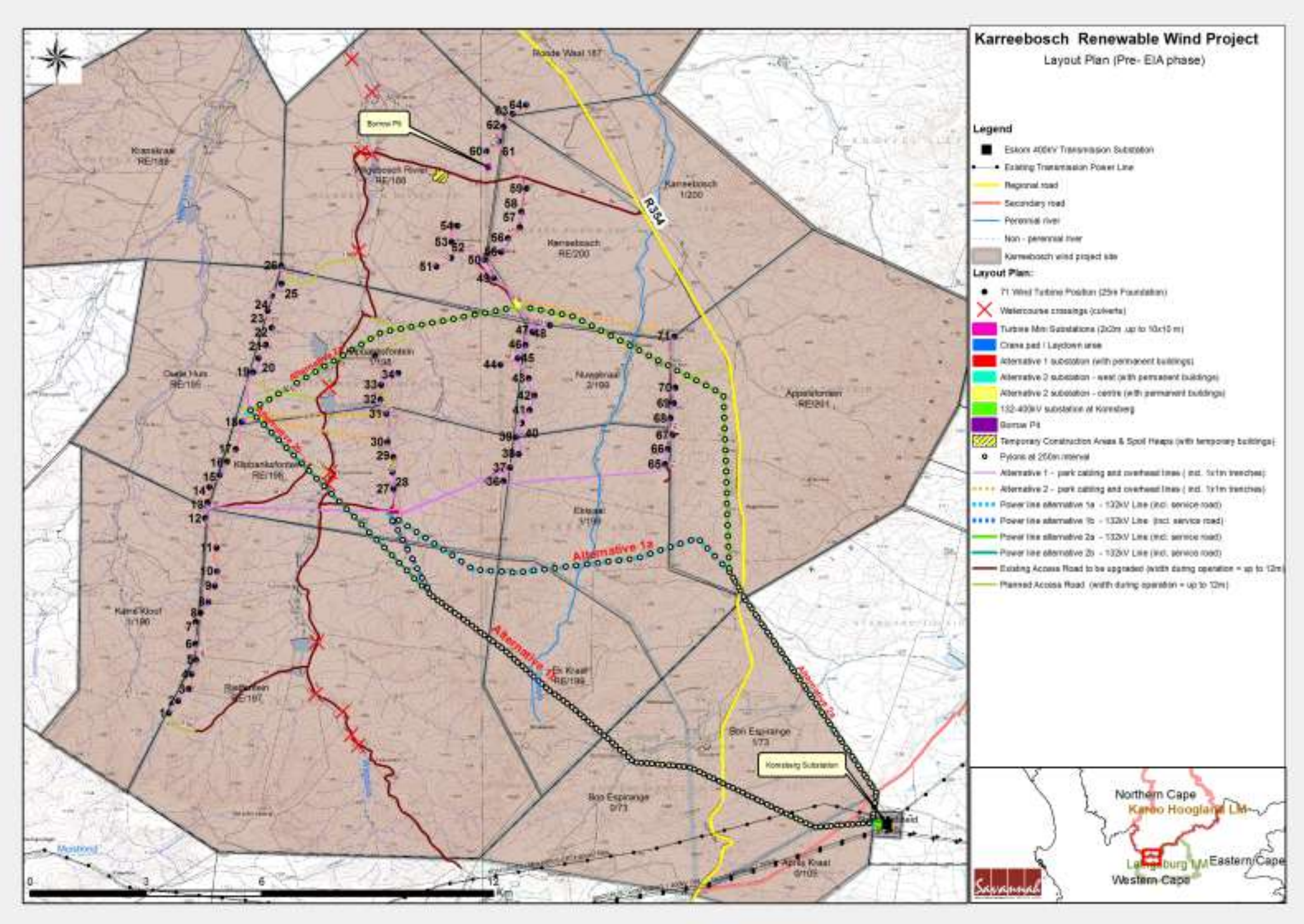


Figure 8.1: Layout map showing the technical design and layout for Karreebosch Wind Farm

The assessment presented within this chapter of the report is on the basis of a layout provided by the developer. This layout indicates 71 wind turbines as well as associated infrastructure which includes several grid connection options. The assessment of issues presented within this chapter (and within the specialist studies attached within **Appendices D – L**) considers the worst-case scenario in terms of potential impacts. The wind turbines and associated infrastructure is assessed in this chapter. Chapter 9 assesses cumulative impacts for each impact.

8.1. Assessment of Potential Impacts on Ecology

Ecological Sensitivity of the Site

The fine-scale ecological sensitivity map of the site is depicted in Figure 8.2. The wind turbines are proposed to be located along elevated ridgelines traversing the site. While this map is not intended for interpreting the sensitivity of individual turbine locations, it indicates that at a broad scale, the central ridges are more sensitive than those in the western portion of the site, which typically have localised areas of higher sensitivity. The power line routes are proposed largely through the lower sensitivity lowlands. Where these traverse more sensitive hills, significant impacts on these areas are unlikely as their disturbance footprint is small.

At least 50 mammal species potentially occur at the site (refer to Appendix 2 of the ecology report). Due to the diversity of habitats available, which includes rocky uplands, densely vegetated kloofs and riparian areas, as well as open plains and low shrublands, the majority of species with a distribution that includes the site are likely to be present in at least part of the broader site. The mammalian community is therefore relatively rich and due to the remote and inaccessible nature of large parts of the area probably has not been highly impacted by human activities aside from livestock grazing. A number of antelope are relatively common at the site and would potentially be impacted by the development. Springbuck are confined by fences and occur only where farmers have introduced them or allowed them to persist and should be considered as part of the farming system rather than as wildlife per se. Klipspringer are associated with steep slopes, cliffs and rocky outcrops and of the antelope present may be most vulnerable to impact from the development due to greater overlap between their habitat and the distribution of the wind turbines.

The Riverine Rabbit, which is listed as Critically Endangered and is regarded as the most threatened mammal in South Africa is known to occur within the broader area. Populations of this species occur between Sutherland and Fraserburg to the northeast as well as around Touwsriver to the southwest. Suitable alluvial plains habitat for this species was observed along the Wilgebos and Kleinpoorts Rivers in the valleys towards the north of the site. With the majority of the Karreebosch facility's infrastructure layout located on the high elevated ridges, there is only a single access road which passes through the Wilgebos River while the nearest turbines are 1.7km away from the margin of the area deemed to have suitable habitat. As a result, a significant impact on the Riverine Rabbit is highly unlikely under the current layout.

There is a wide range of habitats for reptiles present at the site, including rocky uplands and cliffs, open flat and lowlands and densely vegetated riparian areas. As a result the site is likely to have a rich reptile fauna which is potentially composed of 7 tortoise species, 20 snakes, 17 lizards and skinks, two chameleons and 10 geckos. Impacts associated with the development would be habitat loss and fragmentation for reptiles, with the potential for increased levels of predation being a secondary impact which may occur as a result of vegetation clearing for roads and laydown areas. There do not appear to be any reptiles which are specifically restricted to the higher-lying ridges of the site and which would be particularly vulnerable to impact as a result.

The most important areas for amphibians at the site are the riparian areas, seeps and wetlands and the man-made earth dams which occur in the area. As these are widely recognised as sensitive habitats, impacts to these areas have been largely avoided at the design phase of the development and a minimum amount of infrastructure has been located in the vicinity of these features. Consequently, direct impacts on amphibians at the site are likely to be fairly low. Amphibians are however highly sensitive to pollutants and the large amount of construction machinery and materials present at the site during the construction phase would pose a risk to amphibians should any spills occur.

As the ridges where the turbines would be located are mostly fairly flat, the risk of erosion and similar impact from turbine construction activities is relatively low. However, the access roads onto the ridges frequently traverse steep areas where the risks would be high. In addition, the footprint of the turbines with the associated service areas would be about 25 ha, which is considerably less than the approximately 160 ha disturbed by the access roads. Consequently, the access roads would be the primary source of impact associated with the wind farm development and specific mitigation measures to limit the ecological impact of the roads will be required.

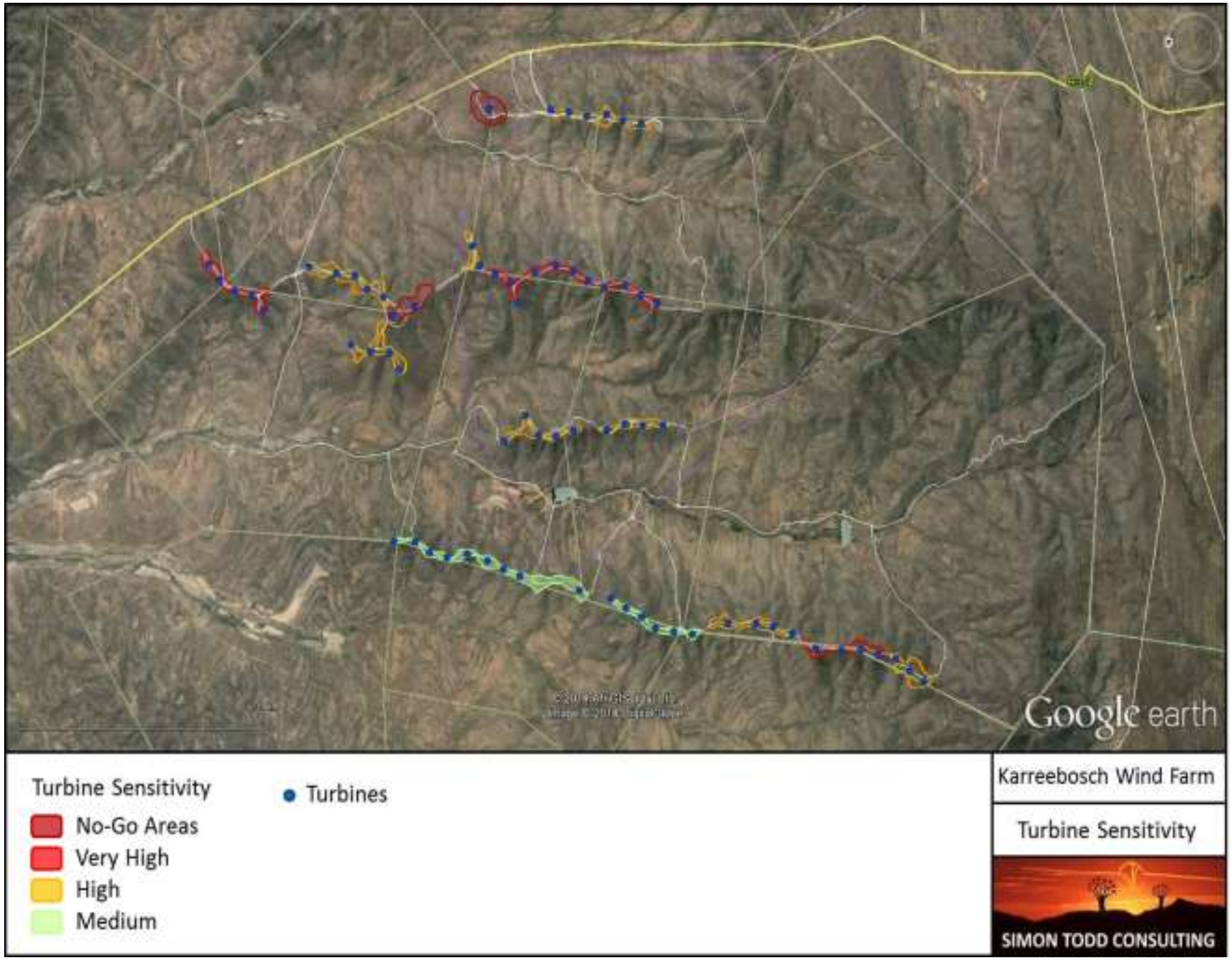


Figure 8.2: Fine-scale ecological sensitivity map of Karreebosch Wind Farm

Fine-Scale Ecological Sensitivity

The ecological walk-through survey of the layout supplied for Karreebosch Wind Farm undertaken by Simon Todd (ecological specialist) revealed that the majority of the turbines were located within physically and ecologically acceptable areas. The following findings and recommendations are relevant:

» The majority of the ridges within the development footprint are relatively wide flat-topped ridges with sufficient space to accommodate the turbines and service areas without impacting the adjacent more sensitive slopes.
» There are few rocky outcrops or other sensitive edaphic features along the tops of the ridges that might be impacted by the development.
» Three turbines (49 and 50 and 71) were found to be located in areas that are considered as very high sensitivity areas where there is no possibility of adequate mitigation due to the presence of species of conservation concern or disproportionate levels of impact. These turbines and associated infrastructure are deemed likely to generate unacceptably high impacts. This information was used to develop a mitigation strategy and inform a revised layout.
» An additional 20 turbines are located within areas which are considered to be of high to very high sensitivity. Impacts associated with these turbines would be high and it is unlikely that there is any standard mitigation and avoidance that can be implemented to reduce impacts to these areas to a low level. Methods to mitigate or counter this impact are proposed through the release from grazing pressure in other areas of the site, which is detailed further below and in the Ecological report (Appendix D).
» The proposed road network for the grid and turbine infrastructure should be realigned and, preferably, minimized.

8.1.1. Impact Assessment

Potential ecological impacts resulting from the development of Karreebosch Wind Farm would stem from a variety of different activities and risk factors associated with the preconstruction, construction and operational phases of the project including the following:

» <u>Pre-construction Phase</u>
    * Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purpose.
    * Site clearing and exploration activities for site establishment would have a negative impact on biodiversity if this is not conducted in a sensitive manner.

» Construction Phase
* Vegetation clearing for access roads, turbine pads, electrical trenches, etc. is likely to impact listed plant species as well as high-biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.
* Increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. Parts of the site are steep and risk of erosion would be high. This may impact downstream riparian and wetland habitats if a large amount of silt enters the drainage systems.
* Presence and operation of construction machinery on site. This will create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
* Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

» Operational Phase
* The operation of the facility will generate noise and disturbance which may deter some fauna from the area.
* The presence of the facility will disrupt the connectivity of the landscape for some species which may impact their ability to disperse or maintain gene flow between subpopulations.
* The facility will require management and if this is not done appropriately, it could impact adjacent intact areas through impacts such as erosion, alien plant invasion and contamination from pollutants, herbicides or pesticides.

» Cumulative Impacts
* The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
* Transformation of intact habitat associated with CBAs could compromise the ecological functioning of the CBAs and would contribute to the fragmentation of the landscape and potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

The assessment of likely ecological impacts associated with the Karreebosch Wind Farm follows. The facility and associated infrastructure is assessed as a whole. The different elements such as roads, turbines or grid connection are not considered separately in the assessment as the development requires all elements and the facility is restricted to a reasonably homogenous environment and assessing the different components separately would have little functionality.

Construction Phase

Construction Impact: Impacts on vegetation and listed or protected plant species

Impact: Destruction and Loss of Vegetation and Listed Plant Species

Nature: The density of listed and protected plant species within some parts of the development area is high and some impact on these species is therefore inevitable. Alien plant species may also impact on natural vegetation in areas disturbed by construction.

Impact Magnitude – High

- Extent: Local; the extent of the impact will be limited to the development footprint and near surroundings. The footprint of the development in terms of direct habitat transformation and destruction will be around 200 ha. Impacts on listed plant species may however have broader implications for the wider area as the effect on biodiversity will be more significant.
- Duration: The duration of the impact will be long-term as the majority of impact will remain until the project is decommissioned.
- Intensity: Since this results in the total loss of vegetation within affected areas, the intensity is seen to be **Moderate-Major**.

Likelihood: As this infrastructure is required for the operation and construction of the facility, this impact will **definitely** occur.

Impact Significance: Pre-Mitigation Major (-ve), Post-Mitigation (-ve)

Degree of Confidence: High. Based on the project description, this impact will definitely occur.

Reversibility: Low, listed and protected species cannot be replaced.

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» There should be minimal infrastructure placed within the areas classified as no-go areas, including the upgrading of existing infrastructure such as roads.

» A large proportion of the impact of the development stems from the access roads and therefore the number of roads should be reduced to the minimum possible and routes should also be adjusted to avoid areas of high sensitivity.

» No substations should be located within the higher-lying parts (ridges and hilltops) of the site and should be restricted to the lowlands and previously disturbed areas where possible.

» The location of the borrow pits should be reviewed and potential sites should be surveyed for plants of conservation concern in the field prior to construction.

» A preconstruction walk-through of the entire development footprint should be undertaken to inform adjustment to road and power line routes and infrastructure locations where appropriate and make recommendations regarding the translocation of listed species which cannot be avoided.

» Preconstruction environmental induction must be undertaken for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas etc.

» All areas to be cleared must be demarcated with construction tape or similar material. Caution should be exercised to avoid using material that might entangle fauna.
» Develop and implement an appropriate alien plant management plan.

Construction Impact: Direct faunal impacts during construction

Impact: Direct Faunal Impacts Due To Construction Disturbance

Nature: The construction phase will result in a large amount of noise as well as physical disturbance and habitat destruction for resident faunal species. This may result in direct mortality for smaller fauna unable to move away from the construction activities and a loss of faunal habitat in general. The human activity and noise generated by the construction also is likely to frighten most medium and larger fauna away from the construction area.

Impact Magnitude - Moderate

- Extent: **Local**; the extent of the impact will be limited to the site and near surroundings.
- Duration: The duration of the impact will be short term or as along as construction is underway. The impact with regards to habitat loss is considered part of the operational phase.
- Intensity: The large amount of activity at the site and the associated disturbance resulting from clearing and construction will constitute a **Moderate to High** disturbance intensity.

Likelihood: There is a very high likelihood that this impact will occur in and around construction areas.

Impact Significance: Pre-Mitigation Moderate (-ve), Post-Mitigation Moderate (-ve)

Degree of Confidence: Medium. Based on the project description, this impact will occur to a greater or lesser extent.

Reversibility: Not reversible.

Irreplaceable Loss of Resources: Yes, high.

Mitigation:

» A preconstruction walk-through of the facility must be undertaken to identify areas of faunal sensitivity which must be avoided.
» Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.
» The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander outside of the demarcated construction area.
» No fires should be allowed within the site as there is a risk of runaway veld fires.
» No fuelwood collection should be allowed on-site.
» No dogs should be allowed on site.
» If any parts of the site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs), which do not attract insects and which should be directed downwards.
» All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
» No unauthorized persons should be allowed onto the site. Site access should be strictly controlled.

» All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises.
» All personnel should undergo environmental induction, including information with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition.
» Regular dust suppression must be implemented during construction, especially along gravel access roads which are used frequently.
» Any dangerous fauna (snakes, scorpions etc.) that are encountered during construction should not be handled or mistreated by the construction staff, and the ECO or other suitably qualified persons should be contacted to remove the animals to safety.
» Excavations and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days should have places where the loose material has been returned to the trench to form an escape ramp present at regular intervals to allow any fauna that fall in to escape.

Construction Impact: Increased erosion risk during construction

Impact 3: Increased Erosion Risk during Construction

Nature: During construction, there will be a large amount of disturbed and loose soil at the site which will render the area vulnerable to erosion. As some of the roads and other infrastructure will traverse steep areas, the potential for erosion is very high. Furthermore, roads even on low slopes may capture overland flow, concentrating the water from a large area onto the road which would then be vulnerable to severe erosion. The turbine service areas may also cause or be vulnerable to erosion if they are compacted resulting in large amounts of runoff. Erosion is potentially one of the greatest risk factors associated with the development and it is therefore critically important that appropriate erosion control structures are built and maintained over the lifespan of the project.

Impact Magnitude – Moderate

- Extent: **Local**; the extent of the impact will be largely limited to the site, but downstream and adjacent areas may also be affected.
- Duration: Should severe erosion occur then the duration of the impact will be **long-term** as such erosion is not easily remedied.
- Intensity: The intensity of the impact is potentially **high** as there is a large number of steep slopes within the footprint that would be vulnerable to extensive and severe erosion.

Likelihood: Based on the distribution of roads and the steep sides of the ridges there is a very high likelihood that erosion would occur if mitigation measures are not implemented.

Impact Significance: Pre-Mitigation Major (-ve); Post –Mitigation Minor (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Reversibility: Highly reversible

Irreplaceable Loss of Resources: Yes.

Mitigation:

» A rehabilitation and revegetation plan should be developed as part of the EMPr.
» Roads should be constructed and routed in a manner which minimizes erosion potential. Roads should therefore follow the contour as far as possible and roads parallel to the slope direction should be avoided as much as possible.

» All access roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.
» Regular monitoring for erosion must be undertaken during and after construction to ensure that no erosion problems have developed as result of the disturbance.
» All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
» Reduced activity should be undertaken at the site after large rainfall events when the soils are wet. No driving off of designated roads should occur.
» Any topsoil, waste rock or other material stockpiles should be protected from erosion with silt fences and other suitable prevention measures.
» All bare areas resulting from construction activities should be revegetated with an appropriate mix of locally occurring species to bind the soil and limit erosion potential.
» Topsoil should be removed and stored separately and should be reapplied where appropriate as soon as possible after construction is completed in an area in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
» Phased development and vegetation clearing should be undertaken so that cleared areas are not left unvegetated and vulnerable to erosion for extended periods of time.
» Construction of gabions and other stabilization features on steep slopes to prevent erosion should occur.

Operational Phase

Operational Impact: Impacts on fauna due to operation

Impact: Impacts on fauna due to presence and daily operational activities of the facility

Nature: Noise from the turbines and disturbance from operational activities are likely to impact some fauna. The roads and turbine service areas will also fragment the landscape for some species which may avoid traversing the cleared areas.

Impact Magnitude - Moderate

- Extent: **Local**; the extent of the impact will be limited to the site.
- Duration: The duration of the impact will be **long-term** as this will be present for the duration of the operational lifespan of the facility.
- Intensity: As this impact will be concentrated on a few targeted species, the impact on these species could be of high intensity.

Likelihood: There is a high probability that this would occur if appropriate mitigation measures are not taken.

Impact Significance: Pre-Mitigation Moderate (-ve); Post Mitigation Minor (-ve)

Degree of Confidence: Moderate. This impact can be assessed with a moderate degree of certainty.

Reversibility: Medium. Some animals will not return to the site following disturbance

Irreplaceable Loss of Resources: No

Mitigation:

» The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. (Except by landowners or scientists with the appropriate permits)
» No fires should be allowed within the site.
» No fuelwood collection should be allowed on-site.

» If any parts of site such as maintenance and operations buildings must be lit at night, this should be done with low-UV type lights (such as most LEDs), which do not attract insects.
» All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
» No unauthorized persons should be allowed onto the site. Site access should be strictly controlled.
» All maintenance vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises.
» If any parts of the facility need to be fenced off then no electrical fencing should be placed within 40cm of the ground as tortoises retreat into their shells and are killed when they encounter electrical fencing.

Operational Impact: Increased erosion risk during operation

Impact: Increased erosion risk as a result of soil disturbance and loss of vegetation cover.

Nature: Disturbance created during construction will take several years to fully stabilize. The presence of an extensive area of hardened surface from roads, turbine crane pads etc. will generate a lot of runoff which will pose a significant erosion risk on the steep slopes of the ridges. Particular areas of concern would be roads traversing steep slopes as well as any infrastructure on steep or gentle slopes with erodible soils. Erosion is potentially one of the greatest risk factors associated with the development and it is therefore critically important that appropriate erosion control structures are built and maintained over the lifespan of the project.

Impact Magnitude – High

- Extent: **Local**; the extent of the impact will be largely limited to the site, but downstream and adjacent areas may also be affected.
- Duration: Should severe erosion occur then the duration of the impact will be **long-term** as such erosion is not easily remedied.
- Intensity: The intensity of the impact is potentially **high** as there are a large number of steep slopes at the site which would be vulnerable to extensive and severe erosion.

Likelihood: There is a moderate likelihood that erosion would occur if mitigation measures are not taken.

Impact Significance: Pre-Mitigation Major (-ve), Post-Mitigation Minor (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Reversibility: Highly reversible

Irreplaceable Loss of Resources: Yes

Mitigation:

» Regular erosion monitoring and control programme must be implemented as part of the EMPr for the development. There are many steep slopes within the development and the risk of erosion will be high, on the roads themselves as well as the areas receiving the runoff. Monitoring and repair should be implemented at least every 6 months.

Operational Impact: Increased alien plant invasion during operation

Impact: Alien Plant Invasion

Nature: The large amount of disturbed and bare ground that is likely to be present at the site after construction will leave the site vulnerable to alien plant invasion for some time. The presence of alien plants may prevent the natural recovery of the natural vegetation, reduce plant and animal diversity at the site as well as impact a variety of ecosystem services.

Impact Magnitude - Moderate

- Extent: **Local**; the extent of the impact will be largely limited to disturbed areas of the site, but adjacent areas may also become affected if invasion is severe.
- Duration: Should alien plants become established this would be considered to have a **long-term** impact as these plants would probably persist at the site for years or decades and once a seed bank has established, alien plants may be difficult to eradicate.
- Intensity: The intensity of the impact is likely to be of moderate intensity as the soils at the site are generally quite nutrient poor which would reduce the potential for alien plant invasion.

Likelihood: Since the development of the site will result in a fairly extensive disturbance, it is highly likely that some alien plant invasion will occur.

Impact Significance: Pre-Mitigation Moderate (-ve); Post Mitigation Minor (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Reversibility: Highly reversible

Irreplaceable Loss of Resources: N/A

Mitigation:

» Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.

» When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur.

» Clearing methods should themselves aim to keep disturbance to a minimum.

» No planting or importing of any alien species to the site for landscaping, rehabilitation or any other purpose should be permitted.

Decommissioning

During the decommissioning phase the project is likely to face similar issues to those associated with the construction phase; that is negative impacts related to disturbance and human presence at the site. The decommissioning phase should attempt to rehabilitate the site with as little disturbance as possible. The major risk associated with the decommissioning phase would be that the site is not adequately restored to its previous potential and a degraded and disturbed ecosystem is left behind.

Decommissioning Impact: Inadequate rehabilitation of the site

Impact: Inadequate rehabilitation of the site.

Nature: Decommissioning will involve a large amount of disturbance at the site as the majority of infrastructure will need to be removed and some roads will need to be rehabilitated. This will leave the site vulnerable to erosion and alien plant invasion. If the site is not adequately restored at decommissioning, a degraded ecosystem would persist at the site possibly for decades.

Impact Magnitude - Moderate

- Extent: Local; the extent of the impact will be largely limited to disturbed areas of the site, but adjacent and downstream areas could also be affected in the case of erosion problems.
- Duration: Should erosion occur and alien plants become established this would be considered to have a long-term impact as the problems would probably persist at the site for years or decades.
- Intensity: The intensity of the impact is likely to be of low to moderate intensity as it is likely that the weedy species present at the site will colonise the disturbed areas and reduce the potential extent and severity of erosion and alien plant invasion.

Likelihood: Since the decommissioning of the site will result in a fairly extensive disturbance, it is highly likely that some erosion and alien plant invasion will occur if mitigation measures are not implemented.

Impact Significance: Pre-Mitigation Moderate (-ve), Post-Mitigation Minor (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Reversibility: N/A

Irreplaceable Loss of Resources: No

Mitigation:

» All infrastructure should be decommissioned and removed from the site.

» Roads not required for use by the landowner should be decommissioned and rehabilitated.

» All disturbed areas should be rehabilitated with locally-sourced seed of indigenous species.

» The site should be monitored for erosion and alien plant invasion for a period of at least five years after the infrastructure has been removed to ensure that rehabilitation is successful and that areas that do not recover adequately can be identified and remedied.

8.1.2. Power Line and Substations

The impact of the two proposed on-site substation alternatives on ecology will be of a low significance. The two substation positions are located in ecologically acceptable areas.

The overhead power line which is proposed to connect the facility to the Komsberg Substation is not likely to generate significant impacts on the ecological environment. Although the power line traverses several drainage lines, it is only the pylon foundations and service road that generate significant impact and the placement of these can be adjusted where necessary to avoid impact to drainage lines or any other sensitive features. The alternative power line routes all cross the lower sensitivity lowlands but also traverse more sensitive hills. However, as the power line footprint and access road required are limited in extent, significant impacts on these areas are unlikely.

In terms of the two power line options, **Alternative 1 is identified as the preferred option from an ecological perspective**, as the distance from the on-site substation to the Eskom substation is shorter and it would also utilise a similar alignment to the grid connection for the authorised Roggeveld Phase I Wind Farm[16]. No highly significant impacts on the terrestrial environment are expected from the power line, provided standard mitigation are implemented. A preconstruction walk-though of the power line route would ensure that any species of conservation concern within the footprint can be avoided.

8.1.3. Conclusions & Recommendations

A summary of the pre- and post-mitigation significance ratings for the various impacts as identified is provided in Table 8.1.

Table 8.1: Summary of pre- and post-mitigation impact significance ratings for the ecological impacts and risk factors identified for Karreebosch Wind Farm.

Phase	Impact	Significance Pre Mitigation	Significance Post Mitigation
Construction	Impacts on vegetation and listed or protected plant species	Major(-ve)	Moderate (-ve)
	Direct faunal impacts during construction	Moderate (-ve)	Moderate (-ve)
	Increased erosion risk during construction	Moderate – Major	Minor (-ve)
Operation	Impacts on fauna due to operation	Moderate (-ve)	Minor (-ve)
	Increased erosion risk during operation	Major (-ve)	Minor (-ve)
	Increased alien plant invasion during operation	Moderate (-ve)	Minor (-ve)
Decommissioning	Inadequate rehabilitation of the site leading to ecosystem degradation.	Moderate (-ve)	Minor (-ve)

The impact of the development of the Karreebosch Wind Farm is largely determined by the characteristics of the site. The affected ridges are narrow and

[16] An environmental authorisation has been issued for this project. The project has been selected as a preferred bidder under the Department of Energy REIPPP Programme.

contain distinctive plant communities and vegetation types compared to the adjacent slopes and intervening plains. As the majority of the footprint of the development is focused on these ridges and in particular the high elevation sections, the actual extent of habitat loss and associated impact is high within this habitat type. This is of particular concern as it is these same areas which have the highest diversity and abundance of species of conservation concern. The impacts on these areas cannot be easily mitigated as the extent of ridgeline is limited and the options for avoidance are limited. Due to the limited extent of the ridgelines and the high potential impact of the development on these areas, this is considered a significant impact that requires specific mitigation and consideration:

» The three turbines (49 and 50 and 71) located within areas that are considered very high sensitivity where there is no possibility of adequate mitigation due to the presence of species of conservation concern or disproportionate levels of impact are recommended to be excluded from the layout or relocated outside of the sensitive areas.
» There are an additional 20 turbines located within areas of ridgeline that are considered to be of high to very high sensitivity (Figure 8.2). The options for avoidance for these turbines are limited as there are no alternative available locations outside of the sensitive areas, however these are not considered no go areas. The significance of the impacts on these areas can be reduced to acceptable levels if all mitigation measures recommended are applied.

Development of the areas of very high sensitivity would generate a high cumulative impact on the ridgeline habitat that cannot easily be mitigated through traditional avoidance measures. Although mitigating this impact represents a challenge for the development, a viable option for reducing the overall impact of the development on these areas is detailed below.

» On-site mitigation is viewed as the most practical and appropriate option for the current situation[17].
» From a technical perspective, there is little scope for avoidance due to the limited extent of the ridges. Improving the quality of the remaining habitat is however a potential mitigation mechanism.
» The priority high-elevation sections of the ridges are identified below in Figure 8.3.
» Three different ridge sections have been identified as potential priority areas but it is the larger central ridge that is considered the most important. The

[17] Although off-site mitigation or offsets can be considered to offset the impact of development in situations where mitigation is difficult or not possible, offsets are difficult to implement and manage. Furthermore, offsets are not appropriate in situations where the receiving environment is still largely intact and there are still extensive tracts of non-threatened habitat available.

extent of the demarcated area on the central ridge is approximately 3000 ha and the protection of this area from grazing would significantly improve the quality of the remaining habitat and is deemed to be the most suitable mitigation measure to address the likely impacts of the development on the ridgeline habitats. As this requires the co-operation of the landowners, it may not be possible to secure the entire area and a minimum of 1300 ha is identified as a minimum area required to counter the impact of the development. As these areas currently fall within much larger livestock paddocks, it may be necessary to fence some of these areas off in order to retain the use of the lower-lying areas for livestock grazing. As it would not be possible to fence off the areas as demarcated, the actual area set aside would need to be larger than required as it would include areas outside of the demarcated area.

The rationale for setting these areas aside from grazing is that the ridgelines are currently grazed by livestock and this has a visible impact on the vegetation condition of these areas and also introduces alien species from sheep wool and dung. Setting these areas aside from grazing would release the vegetation from grazing pressure and improve the quality of the habitat for fauna as well as grazing-sensitive plant species. Although grazing is an important disturbance that serves to maintain the diversity of plant communities, there are more than enough indigenous grazing animals in these areas to perform this function and the overall impact of livestock is negative.

There are no formal conservation areas in the Komsberg area and the current proposal to have more than 1000ha of potentially sensitive habitat removed from livestock grazing would result in a unique conservation outcome for the area, which is highly likely to outweigh the potential negative effects of the access roads and wind turbines within this area. Therefore, with the implementation of the above grazing protection mitigation area, the impacts on listed flora and the cumulative impact on the ridgeline habitat would be reduced to an acceptable level. The implementation of such an area should be included as part of the required mitigation measures to be implemented by the wind farm development as this represents the most viable mitigation mechanism available. It is important to note that it is not the intention of the grazing withdrawal area to form an offset, but this should more appropriately be viewed as an on-site mitigation measure to reduce the ecological impact of the development. Although it is clear that it does not directly address the impact of the habitat loss resulting from roads and turbine footprint, this measure would ultimately result in the improvement of habitat quality and ecological functioning of the withdrawn area and thereby reduce the effect and significance of the habitat loss.

Figure 8.3: High elevation ridges identified as priority areas for protection from grazing as mechanism mitigation strategy. The proposed wind turbine positions are indicated by blue dots.

It is important to note that the developer has taken the mitigation measures recommended within this section of the report into consideration in order to produce the final layout which is discussed further in Chapter 10.

8.2. Assessment of Potential Impacts on Avifauna

The avifaunal impact assessment considers the information collected during the 12 months pre-construction bird monitoring undertaken by African Insight cc, led by Dr A. Williams, for Karreebosch Wind Farm. Additional observations of raptor occurrence to support the monitoring programme were made by Dr A. Williams and Dr R. Simmons in the following season. For details on the monitoring methodology refer to Chapter 6 and Appendix 9 of the Avifaunal Report (attached to this document as Appendix E).

Avifaunal sensitivity: Results of the Pre-Construction Bird Monitoring Programme

A total of 115 bird species were recorded in, or immediately adjacent, to the Karreebosch project site area during the six visits in wet and dry seasons for the period of March 2013 – September 2014. A further two species were recorded by Dr Simmons' team in September 2014. Conditions on the elevated ridges within the site were generally of strong breezes to light gales. As most birds prefer not to fly at wind speeds greater than 7 m/second there were often periods of one to several hours when few, if any, birds were observed on the site. However, raptors, such as eagles use high wind speeds to soar and would prefer such conditions than avoid to them. The combination of poor food resources and strong winds reduced bird use of the ridges and bird activity was especially reduced as winds increased in strength during the latter part of most mornings. During avian observations on the ridges, the total number of species recorded was considerably lower than the number of species recorded in the valleys between the ridges. It was clear that birds occurred in considerably greater numbers in the valleys than on the ridges, where in many hours no birds of any species were recorded or often only 1-3 individual passerines.

Table 8.2: Occurrence of bird groups - along the ridges by month and overall in adjacent valleys

Bird group	March ridges	May ridges	July ridges	September ridges	November ridges	Valleys
Birds of prey & carrion	4	4	6	9	6	14
Other non-passerines	1	1	3	3	5	9
Aerial insectivores	3	1	1	3	3	7
Ground invertivores	4	3	8	8	8	19

Bird group	March ridges	May ridges	July ridges	September ridges	November ridges	Valleys
Bush foraging insectivores	3	4	7	8	10	21
Seed-eaters	2	2	5	5	5	10
Waterbirds	0	0	1	3	1	33
Totals	**17**	**15**	**31**	**36**	**38**	**113**

The total number of species recorded along or passing over the ridges during the five monitoring iterations was 48, compared with the overall number of 113 species recorded in the Karreebosch project area (Table 8.2), most of which were recorded in the lower valley areas. This was despite far less time being spent in the lower areas than on the ridges. In many ridge-top vantage hours, and some transect walks, no birds were recorded at all, especially in strong wind conditions or in higher temperatures. Except for some early morning periods, generally fewer than 20 individual birds from all species were recorded in any hour and these were likely to have included repeated sightings of the same individuals as they moved about foraging.

Observations of avifauna were put into two categories, i.e. birds recorded along the ridge-tops; and those below the ridge-tops (on the ridge slopes below turbine positions and, especially, in the valley bottoms). This categorisation was important as the diversity and number of birds differed between the two sections, as do the potential impacts of the wind farm. Along the ridges, the diversity and number of birds is low and the main impacts to avifauna are the collision risk with wind turbines and displacement as a result of habitat loss and disturbance. Below the ridges however, the diversity and number of birds, especially conservation priority species, is greater and impacts associated with collision with power lines, biotic impacts, and electrocution are expected.

The 47 bird species that were recorded along or over the ridges fell into two categories according to whether they were recorded flying at turbine blade arc heights or not. These are described below.

Ridge Species whose members seldom, if ever, fly at turbine blade heights.

Of the 47 ridge-top species, 35 fell in this category. Most were passerines associated with the local scrubland habitats. When flushed, or foraging, these birds seldom flew more than 3 m above the scrubby bushes. On more purposeful cross-ridge flights they still flew at less than 10 m in height.

Most birds breed during the spring season. In many ground-breeding bird species males perform display flights prior to mating. Displays were usually performed over the rim of the ridges, i.e. off the top of the ridges and over the upper-most slopes which is where nesting is more likely to occur. Therefore, these display flights were generally away from the centre of the ridges where it is recommended that the turbines be relocated (refer to mitigation measures below). Except for a few display flights, none of these 35 species were considered at risk of collision with turbine blades.

Table 8.3: Bird species recorded along the ridges and their flight relative to turbine blade height (birds of particular conservation concern are shown in bold)

Species	Flight relative to turbine blade arc		Species	Flight relative to turbine blade arc	
	Below	Within		Below	Within
Ludwig's Bustard	X		Yellow Canary	X	
Verreaux's Eagle		X	Cape Bunting	X	
Rock Kestrel		X	Black-headed Canary	X	
White-necked Raven		X	White-throated Canary	X	
Pied Crow		X	Lark-like Bunting	X	
Black Harrier	X		Grey-backed Cisticola	X	
Booted Eagle	X		Bokmakierie	X	
Martial Eagle		X	Southern Banded Sunbird	X	
Jackal Buzzard	X		Layard's Tit-babbler	X	
Steppe Buzzard			Karoo Eremomela	X	
Peregrine Falcon		X	Spotted Prinia	X	
Sacred Ibis		X	Rufous-eared Warbler	X	
African Spoonbill		X	Malachite Sunbird	X	
Alpine Swift		X	Cape Penduline Tit	X	
White-rumped Swift		X	Cape Bulbul	X	
Little Swift		X	Fairy Flycatcher	X	
Namaqua Sandgrouse		X	Yellow-bellied Eremomela	X	
Grey-winged Francolin	X		Large-billed Lark	X	
Speckled Pigeon	X		Mountain Wheatear	X	
Crowned Plover	X		Long-billed Pipit	X	
Karoo Shelduck	X		Familiar Chat	X	
Pale-winged Starling	X		Karoo Long-billed Lark	X	
Rock Martin	X		Sickle-winged Chat	X	
Karoo Chat	X		Cape Clapper Lark	X	
Karoo Lark	X		Karoo Scrub Robin	X	
TOTAL	Flights within blade arc heights			12 species	

Species	Flight relative to turbine blade arc		Species	Flight relative to turbine blade arc	
	Below	Within		Below	Within
	Flights seldom or never in blade arc heights			35 species	
	All species recorded along/over ridges			47	

Species that occasionally fly at blade heights

Twelve of the ridge occurring species were recorded as either often, or occasionally, flying at heights which would potentially bring them into the turbine blade swept area (refer to Table 8.3). Even in these species, however, most of the observed flights along the ridges were below turbine blade heights, i.e. less than 30m off the ground. In stronger wind conditions fewer of these birds were recorded in flight over the ridges and most that did so flew lower than during light winds. Therefore in strong winds, when turbine blades rotate faster and may appear to blur, the number of individual birds at risk of flying into rotor blades will be lower.

Bird species of particular concern

» **Namaqua Sandgrouse**: This species is considered to be at the greatest risk from collision with the proposed turbines. This is due to: the number of individuals seen along the ridges being greater than that of any other species. The species does fly at heights that would bring them within rotor swept area. They often fly in small tight flocks of 4-20 individuals which could increase the mortality rate in a potential single occurrence. They have flight speeds of 60 km/h which would result in less reaction time to an obstruction; and birds were observed flying more along, than across, the ridges and so would thus approach turbine blades from the side which could result in a lower likelihood of the bird perceiving the turbine blades.

» **Martial Eagle (Endangered):** These were recorded only on three occasions in the Karreebosch project area. In July 2013 a single individual vied with a Verreaux's Eagle for dominance of a lamb carcass on the slopes of the Central Ridge north-west of the Ekkraal farmstead. An adult was observed flying southwards high over the Wilgebos Valley well away from the ridges. A topographic obstruction prevented tracking of this individual but it probably crossed a high saddle near Snydersberg into the next valley which was outside the Karreebosch project area. In September 2014 an immature Martial Eagle was seen on two consecutive days using thermals close to the Western Ridge (refer to Appendix 9 of the Avifaunal report).

» **Black Harrier** (Endangered): These were recorded on two occasions (possibly the same individual) quartering, less than 5m off the ground, along the Central Ridge. The only other individual recorded near the ridges was on the upper slope of the Central Ridge on the Wilgebos Valley side.

» **Blue Crane** (Near Threatened): A single transient individual was recorded at a farm dam in November 2013.

» **Ludwig's Bustard** (Endangered): The three regional observations of the larger Ludwig's Bustard were of single individuals in flight: one flushed from an area of low shrubland in the Hidden Valley wind facility area, more than 10 km east of the Karreebosch area; another flying over a low ridge in the Roggeveld Wind Farm area; and one seen in the upper Tankwa Valley within the Karreebosch Wind Farm area. Given the stony conditions and the paucity of large invertebrate prey it is probable that this species is only an occasional, generally non-breeding, visitor to the Karreebosch/ Roggeveld project region.

In the Karreebosch Wind Farm area both bustard species will preferentially occur in the valleys. There they will be at potential collision risk with the proposed cross-valley power line. Though these bustards will preferentially fly over lower ground it is inevitable that they sometimes fly over the ridges. They are likely to avoid flying over the higher ridges and therefore if they do fly over ridges will be more at collision risk with turbines on lower ridges or near ridge saddles.

» **Jackal Buzzard**: A single bird was recorded in July 2013 at a potential collision risk height.

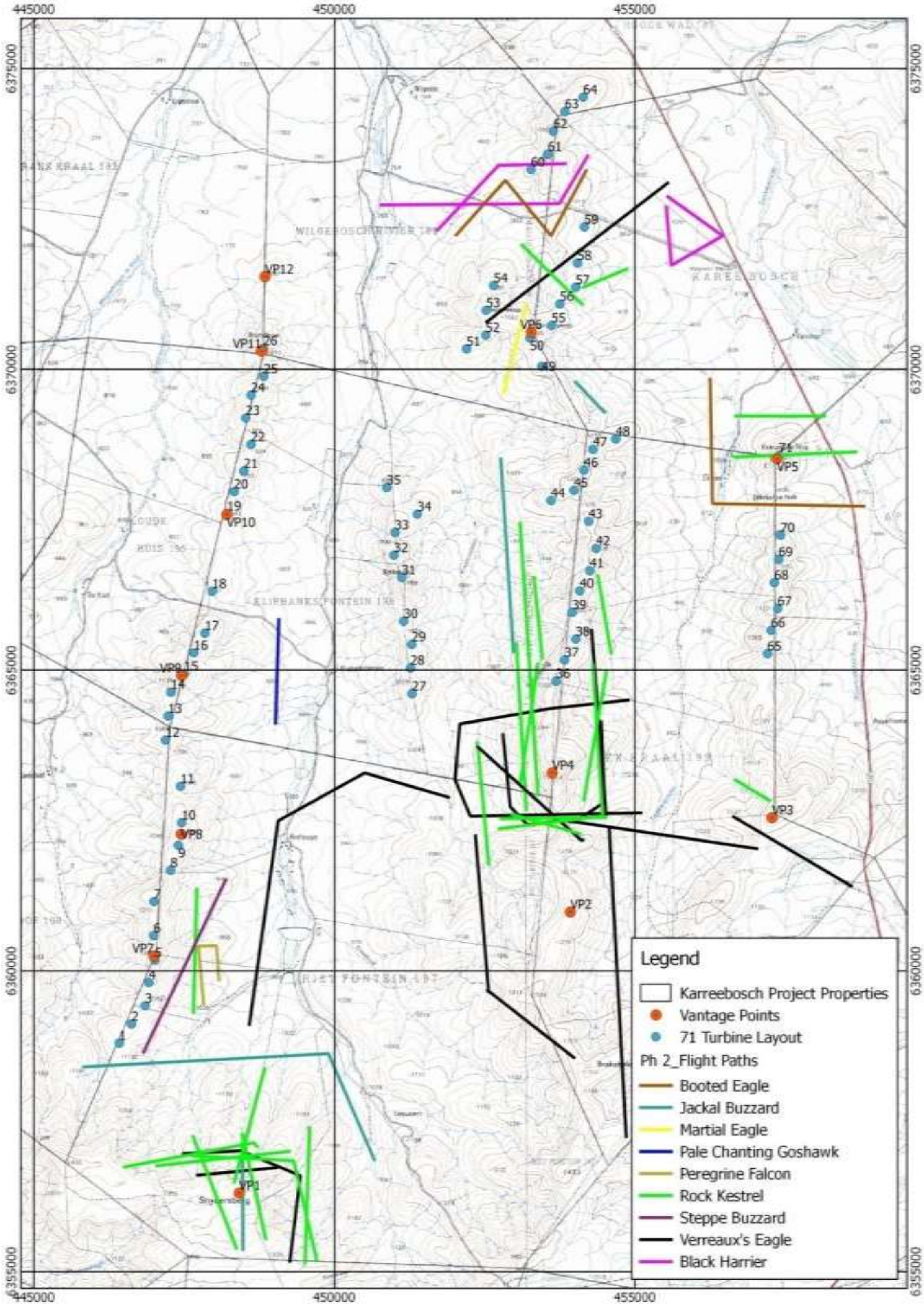


Figure 8.5: Recorded flight paths of all raptors

This leaves four species which may be considered of particular potential risk to collision mortality with the proposed Karreebosch Wind Farm turbines. These are the Namaqua Sandgrouse (discussed above), Verreaux's Eagle, Rock Kestrel and White-necked Raven and each merits comment.

» **Verreaux's Eagle** (Vulnerable in South Africa): The most frequently observed raptor recorded along the ridges was Verreaux's Eagle. Observations for this species and relevant flight paths are presented Figure 8.6. Many of the observations were of a pair, probably that connected with the nests on Beacon Hill. Most of the other sightings were probably repeated views of individuals from this pair. The total number of individual Verreaux's Eagles recorded over the Karreebosch project area was considered to be less than 5.

  Verreaux's Eagle, although rated as Vulnerable in South Africa, is considered as of Least Concern on a global basis by Birdlife International[18] (www.birdlife.org/datazone/speciesfactsheet 3539). This eagle is considered a priority species relative to the proposed Karreebosch Wind Farm for the following two reasons. These reasons are: 1) that flights by these eagles led to other species – Rock Kestrel and White-necked Raven - flying up into blade swept area heights to harass the eagles; and 2) a pair bred[19] at the southern end of the proposed turbine layout.

  In July 2013 two Verreaux's Eagle nests were found close together on the north-west facing cliff of Beacon Hill on the northern end of the turbine string on Central Ridge. The nests were large, so evidently added to over a number of years, but held no fresh green material, nor was there any whitewash from recent droppings. A pair of eagles flew nearby with twigs in their claws. Their continued presence near the nests, and the carriage of potential nest material, indicates that the nests are still being maintained and the overall site must be considered active. No evidence of breeding was seen when the nests were examined from above the cliff in July, September and November 2013. However, in September 2014, despite repeated observations of the nesting cliff area over 5 days from the Western Ridge, and the survey by Dr Simmons (Appendix 9 of the avifauna report) no eagle activity was recorded at or in the immediate vicinity of the cliff with the nests.

[18] www.birdlife.org/datazone/speciesfactsheet 3539

[19] There has been evidence of past breeding with regards to nest material and maintenance of nests; however no evidence of breeding was recorded in the monitoring period.

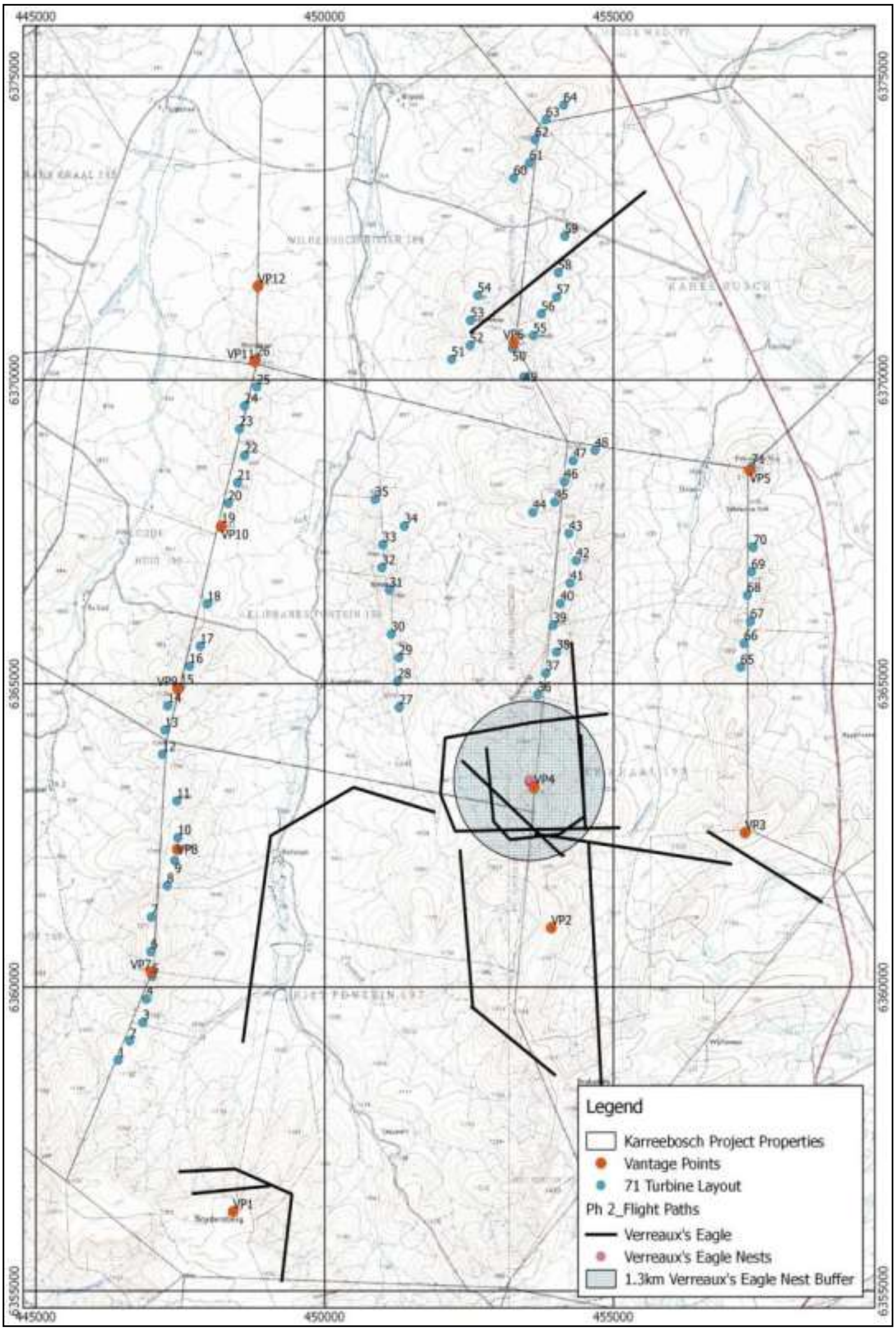


Figure 8.6: Recorded flight paths of Verreaux's Eagles

- **Rock Kestrel**: Most observations were of individuals using updraughts to hover over the upper slopes, i.e. off the ridge-tops. Kestrels recorded over the ridges were generally below turbine blade swept area levels as they flew low to seek prey or crossed the ridge from one valley to another. Only when they flew up to harass eagles did these kestrels enter potential collision risk heights.

- **White-necked Raven**: This species was often recorded flying at turbine blade heights. Ravens are highly intelligent birds adept at coping with strong and variable winds in mountainous areas. It is considered highly unlikely that they will experience significant mortality through collision with turbine blades. Many of the observations were probably repeat sightings of the same individuals and the overall number of individual ravens recorded in the Karreebosch area is probably less than 10. Larger numbers may occasionally gather at large carrion as 25 were observed at a sheep carcass in the Hidden Valley Wind Facility area some 10 km east of the Karreebosch Wind Farm.

  In November 2013 the number of ravens recorded was considerably lower than in previous monitoring iterations. Ravens are winter breeders. In other, better studied raven species, newly fledged juveniles feed on large invertebrates found while walking. If this applies to the White-necked Ravens, then in spring those that have bred successfully must move to lowland areas where, for the juvenile ravens to cope, walking is easier and suitable prey are more abundant.

Nocturnal birds

- **Night active birds:** Diurnal monitoring provides little or no information about the potential risk of birds colliding with turbines at night. There are two fundamental types of night activity by birds: foraging and other localised activities by locally resident species – owls, nightjars and thick-knees; and transient, cross-country, movements. There is unlikely to be any substantial nocturnal use of the ridge-top areas by locally active nocturnal bird species as the food resources are too poor to sustain them and the frequent strong winds will deter them. Owls are the most likely to occur but most will remain in the valley bottoms, or forage along the lower slopes, where prey is more abundant. Nor are there many cliff sites that potentially offer safe nesting and roosting sites for them. Furthermore, owls are unlikely to fly at turbine blade heights. The two species known or likely to occur in the region tend to forage in low light conditions when detection of prey, either visually or through hearing, requires them to remain close to the ground.

- **Nocturnal Transients:** Birds which are transient across turbine lines are considered at greater risk of collision mortality than birds resident in the immediate vicinity of turbines and the risk to transients is increased when their movement is at night. Long distance migrants often fly at night but most do so at heights that will keep them well above turbines even those on ridges. Nor is there any particular attraction in the region which would lead them to descend towards the area proposed for the wind farm.

The main area of concern is the potential for regionally resident birds dispersing at night. This particularly applies to waterbirds of which 32 species were recorded on dams in the valleys around the ridges. Most waterbirds move between wetlands at night in order to avoid predatory eagles. There is the possibility that, in moving between dams, they would fly across ridges. It is likely that they fly high at night to be able to survey for wetland areas reflecting moonlight. They would thus potentially fly at blade heights. However, in this area the dams lie in relatively deep valleys.

The greatest risk to any red-listed waterbird species in the Karreebosch project area is that of collision with power-lines across the Wilgebos Valley by Maccoa Ducks as they move between dams in the valley and the larger dams in the lower Tankwa valley. The risk is considered great as these ducks are nocturnal dispersers; in local movements probably fly at less than 100 m; fly in flocks; and are stocky birds having low in-flight agility, i.e. with little ability to adjust flight when a power-line is perceived. Overall, the risk of nocturnal collisions is considered to be low and within acceptable levels.

Water Birds

To appreciate the potential impacts of the Karreebosch Wind Farm on waterbirds, and the seasonally changing importance of local dams to waterbirds, it is necessary to understand some basic factors that affect the movement of waterbirds between regional dams in the area.

Focal observations of waterbirds were made at 7 dams, 4 within the Karreebosch Wind Farm impact area and 3 in the Tankwa Valley 8-10 km downstream to the North of the project site. There is likely to be considerable movement of waterbirds between these dams especially in relation to seasonal rainfall. 30 of the 32 species of waterbirds were recorded at the two dams in the Wilgebos Valley. There was a noticeable difference between waterbird numbers in September 2013 and the same month in 2014. In 2013 after the unusually heavy rains and with consequently deeper water levels the Wilgebos dams notably fewer species, and numbers, of waterbirds were supported, than at the same dams in 2014.

In the Tankwa Valley, 8-10 km outside the immediate Karreebosch project area, 25 Greater Flamingoes (Near-threatened) were recorded at the larger of the two Seekoeigat dams in September 2014. In the Tuinplaas dam a small tree-covered islet supported nests of Black-headed Heron, Cattle Egret and Reed Cormorants.

An immature African Fish-Eagle was recorded near these dams in November 2013 and September 2014.

8.2.1. Impact Assessment

The proposed Karreebosch Wind Farm development will potentially have four key negative impacts on birds. These potential impacts are (in descending order of predicted importance):

» mortality through collision with the power lines necessary to link the turbines ultimately to the proposed substations (via a 33 kV line) and from the substations (via a 132 kV lines) to the Eskom grid via the existing 400 kV substation at Komsberg Station;
» mortality through collision with wind turbines;
» displacement from habitat; and
» electrocution on 132kV power lines.

Impact of the Power Line on Avifauna

Power lines can cause bird injury and/or mortality resulting from collisions and electrocution. In the Karreebosch project site area, the risk of collision with power lines is considered to be greater than that with wind turbines. This is because a number of cross-valley power lines are proposed. The position of the final power line is dependent on which power line alternative is selected for this development. The greatest threat to the widest range of priority species, and of bird diversity, comes from proposed cross-valley power lines, both 33 kV and 132 kV, which will obstruct long-valley bird movements. The risk of collision is greatest at night and especially so to nocturnally dispersing water birds moving between the two dams in the valley. The water birds also move to or from the several larger dams on the downstream sector of the Tankwa Valley. The risk of birds of prey colliding with cross-valley power lines is also greater than their risk of collision with turbines. There are several reasons why risk is considered greater for these cross-valley power lines than for the wind turbines:

» The number and diversity of birds is considerably greater in the valleys than along the ridges.
» The ridge and valley topography constrains most bird movement to the valleys.
» The larger birds of greatest risk of collision with power lines - raptors, bustards, and especially water birds - will all generally move along the valleys and so cannot avoid traversing cross-valley power lines.
» Most of the precocial water birds (refer to Appendix 7 of avifaunal report within Appendix E), which often fly in groups, are nocturnal dispersers and in this terrain will usually follow watercourses between dams. They are considered the group most at risk as a bird's ability to detect power lines is greatly reduced at night.

» A greater number of red-listed species are at greater collision risk in the valleys than along the ridges. These are the two bustards, the Maccoa Duck and, if and when they occur, the Greater Flamingo and Blue Crane. In addition most of the birds of prey, including the red-listed Black Harrier, Martial Eagle and Verreaux's Eagle forage more in the valleys and over slopes than along the adjacent ridges. Food resources are richer in valleys than they are along the resource poor ridges and therefore raptors will spend a greater proportion of their time foraging for prey and, when so occupied, are less likely to perceive power lines.

Further, since more species and more movements occur in the lower or downstream parts of the valleys (i.e. farthest from the source of potential impact i.e. the wind turbines) necessary power lines should, where feasible, be located as far upstream as possible. Specifically in the Wilgebos Valley, power line crossings should be away from the two dams and ideally upstream of the Rietfontein dam. It is therefore critically important that mitigation measures are considered in order to minimise the risk of collision with cross-valley power lines.

Collision with turbines
In the Karreebosch area the risk of bird collision with wind turbines is considered lower than the risk of power line collisions. The risk of collision mortality varies in several general ways and these affect the manner in which collision mortality can be mitigated. Review of these generalities provides a context for appreciation of the differences in collision risk between that associated with power lines and that associated with turbines in the Karreebosch project area. These differences affect the manner in which collision mortality can be mitigated.

There are a number of generic factors which influence the risk of birds colliding with infrastructure. These include: whether flight is in daylight or at night; the agility and manoeuvrability of birds in flight; their age and experience; the sex of the birds; the degree to which birds fly by day or night; whether they fly in flocks; and especially the frequency with which their flights take them near infrastructure. Birds differ in their ability to manoeuvre while in flight. Aerial manoeuvrability depends on the overall size of the bird, its wing span and wing-loading such that larger birds with wider wingspans are less manoeuvrable than smaller lighter individuals (Brown 1993, Janss 2000).

Young birds take time to fully develop their flight abilities (Nelson & Nelson 1976, APLIC 1994), more often fly in flocks, and form a high proportion of migrant populations (Bevanger 1998). As a result young birds more frequently than adults fall victim of collisions (Rubolini et al. 2001).

Differences may occur in the level of collision risk to male and female birds during the breeding season. Males may be more distracted than females during courtship (Brown 1993). In some birds, including ravens and some raptors, the female undertakes most incubation and brooding of chicks. During these periods the male feeds both the female and the brood and so undertakes most of the foraging which increases his risk of collision with moving rotor blades and power lines (Steinen *et al*. 2008).

Particular ecological groupings of birds differ in the way their lifestyles expose them to the risk of collision. At the species level there are also differences in the degree to which such mortality is acceptable from a conservation perspective.

Daylight fliers may have an increased risk of collision in periods of fog or mist when visibility is severely reduced. In the Karreebosch project area low clouds often cover the ridges in fog. It is unclear to what extent birds fly over the ridges in such conditions.

Habitat destruction and displacement

Development of the project development footprint inevitably causes the loss of foraging and nesting habitat for most locally resident species of birds. Birds displaced by this loss of habitat must find alternative suitable habitat, which may be less favourable. The displaced birds must compete for resources with the established population of birds of the same or other species potentially to the detriment of both. The result is a reduction in the local population of most small birds. Disturbance during installation and maintenance, noise generated, and physical obstruction of the environment can all lead to birds avoiding habitat in a wider area around the footprint. Electric magnetic forces may also have undesirable effects on birds.

Habitat destruction is scarcely an issue for the proposed Karreebosch Wind Farm as a high proportion of the ground along the ridges is bare and/or rock covered and so of limited attraction to birds in terms of resources. For birds with more extensive foraging areas, and usually of larger size, the loss of use of the precise footprint area is less important than for small birds. However, these birds are more affected by disturbances (perceived as a potential mortality risk) during installation and maintenance. Large physical structures on the footprint – turbines, power lines and their supports - may also be deter larger birds from using adjacent habitat (Larsen & Madsen 2000, Exo et al. 2003).

Habitat destruction in the valley bottoms will be limited to widening (by about 2 m) of existing roads and clearance of small areas for the installation of trans-valley power lines. In neither case is this considered likely to have a significant effect on local bird populations in terms of habitat loss or disturbance. Construction period disturbance, and subsequent operational maintenance, along the ridges and power line servitudes is unlikely to have substantial negative effects on resident bird populations since the species will temporarily avoid the area largely by moving into the ample adjacent areas of similar habitat. In 2013, a new Eskom 400 kV power line was being constructed within 1-5 km of the southern part of the Karreebosch project site. Observations from a control site overlooking the power line construction area showed that, despite considerable vehicle and human activity, birds of prey still traversed the area, and indeed were seen as commonly there as during observations in more distant undisturbed areas within the Karreebosch project area.

Noise

A potentially negative issue is the effect turbine noise may have on birds accustomed to generally quiet habitats. Studies of birds along roads have shown that due to traffic noise some bird species are less common, or even absent, within 2-5 km of major roads (Forman & Deblinger 2000, Rheindt 2003).

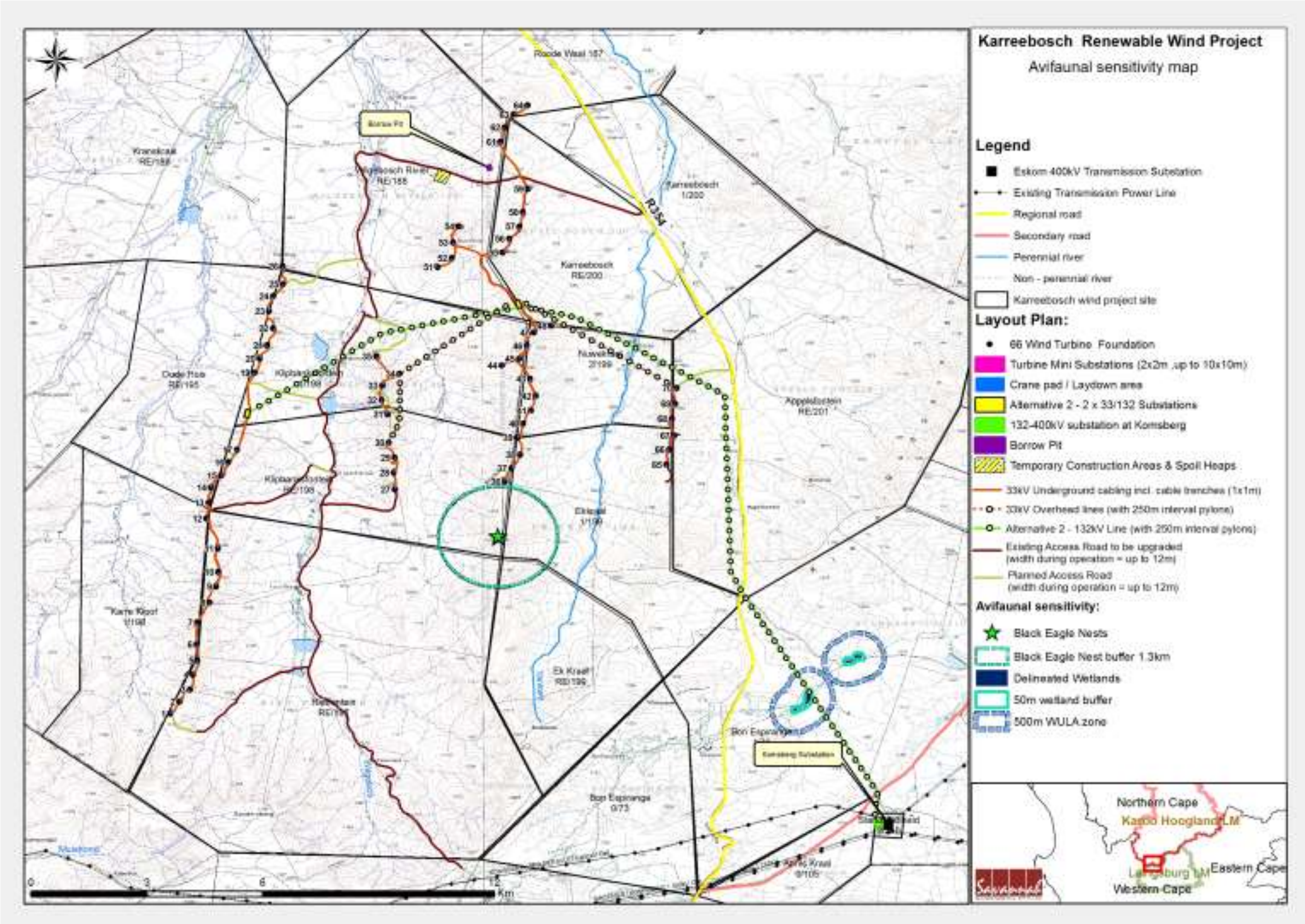


Figure 8.7: Avifaunal sensitivity map

Construction Phase:

Construction Impact: Habitat Loss for birds

Impact: Habitat Loss for birds due to construction activities

Nature: Construction activities will result in a negative direct impact on the avifauna as a result of habitat loss.

Impact Magnitude - Low

- Extent: Local (ridge-wide).
- Duration: Medium term – the ecology is unlikely to recover within the 20 year operational phase
- Intensity: Minimal loss of habitat for any bird species.

Likelihood: There is a high likelihood that areas of habitat will be lost.

Impact Significance: Minor (-) Pre-mitigation and Minor (-) post mitigation

Degree of Confidence: High

Reversibility: Low

Irreplaceable Loss of Resources: No

Mitigation:

» Minimize the destruction of riparian habitat in the valley bottoms when upgrading existing tracks to allow heavy vehicle access

Construction Impact: Disturbance

Impact: *Disturbance to birds*

Nature: Construction activities will result in a negative direct impact on the wind farm site avifauna as a result of disturbance

Impact Magnitude - Low

- Extent: Local
- Duration: Short term
- Intensity: No threatened species will be particularly impacted. The magnitude will be low
- Likelihood: There is a medium likelihood that birds will be disturbed

Impact Significance: Minor (-) Pre-mitigation, Minor (-) post mitigation

Degree of Confidence: High

Reversibility: High, impact will only exist for duration of construction

Irreplaceable Loss of Resources: No

Mitigation:

» Minimize the destruction of riparian habitat in the valley bottoms when upgrading existing tracks to allow heavy vehicle access.
» Power line support structures should be designed to minimize positions which scavenger/predator birds can perch upon to monitor prey.
» Construction must be limited to the development area.

Operational Phase

Operational Impact: Disturbance

Impact: *Disturbance to birds*

Nature: Negative direct impact on birds as a result of disturbance and displacement

Impact Magnitude - Low

- Extent: Local
- Duration: Long-term
- Intensity: low

Likelihood: There is a low likelihood that birds will be disturbed

Impact Significance: Minor (-) Pre-mitigation; Minor (-) Post Mitigation

Degree of Confidence: Medium

Reversibility: Low

Irreplaceable Loss of Resources: No

Mitigation:

» Minimize the number of cross-valley power lines, especially in the Wilgebos Valley.

» Day-visible bird diverters should be installed on all cross-valley power lines to make the lines, and especially the earth-wires, more conspicuous.

Operational Impact: Collision with power lines

Impact: *Collision*

Nature: Collision Mortality with Power Lines during the Operational Phase

Impact Magnitude – Low - medium

- Extent: Local
- Duration: Long-term (operational lifespan of facility)
- Intensity: low

Likelihood: It is likely that some individuals in key species will be killed

Impact Significance: Minor to moderate (-) Pre-mitigation, Minor (-) Post-mitigation

Degree of Confidence: Medium – High (due to uncertainty about nocturnal bird activities)

Reversibility: No

Irreplaceable Loss of Resources: Yes, in the case that endangered species are lost they may not be able to be replaced

Mitigation:

» Day-visible bird diverters should be installed on all cross-valley power lines to make the lines, and especially the earth-wires, more conspicuous.

» The risk of collision can be substantially mitigated by minimizing the number of cross-valley power lines, especially in the Wilgebos Valley, and the placing of bird diverters on those power lines that are installed.

Operational Impact: Collision with turbines

Impact: *Collision*

Nature: Impact of the Turbines on Birds during the Operational Phase

Impact Magnitude – Low - medium

- Extent: Local
- Duration: Long-term (operational lifespan of facility)
- Intensity: low

Likelihood: There is a low likelihood that key species will be killed

Impact Significance: Minor (-) Pre-mitigation; Minor (-) Post-mitigation

Degree of Confidence: Medium (due to uncertainty about nocturnal bird activities)

Reversibility: No

Irreplaceable Loss of Resources: Yes, in the case that endangered species are lost they may not be able to be replaced

Mitigation:

» The best means to mitigate bird collisions in wind farms is to make structures – towers and rotor blades - more visible both by day and by night and to site turbines away from areas used by birds.

» In the context of the site, the risk of collision mortalities in these situations can be mitigated in three ways:
   * By not siting any turbines closer than 1.3 km from the established Verreaux's Eagle breeding cliff on Beacon Hill.
   * By siting turbines in the middle of the ridges to minimise the risk of collisions by birds using wind updraughts on the upper slopes; and
   * By not locating turbines closer than 50m from the lowest point of upper valley saddles as with increasing ridge height, birds increase their selection of the lowest points that provide exits from the upper reaches of the valleys.
   * Turbine positions 17 and 18 should be moved as these were good slope-soaring conditions for the juvenile Martial Eagle recorded and future eagles are likely to be attracted for the same reasons. The adjacent saddle (where turbine 18 is sited) is likely to be a commuting route for wetland birds heading for the largest dam on site to the east. These turbine placements may therefore negatively impact the survival of eagles and waterbirds alike.

Pre- and post- mitigation significance: Roggeveld WEF – Birds

Phase	Impact	Pre-mitigation significance	Residual Impact Significance
Construction	Habitat Loss	Minor	Minor
	Disturbance	Minor	Minor
Operation	Displacement	Minor	Minor
	Mortality due to turbines	Minor	Minor
	Mortality due to power lines	Minor - Moderate	Minor

8.2.2. Power Line and Substations

Alternative 1

Alternative 1 is based on a single substation located on the southern end of the Spitzkop Ridge. Alternatives 1a and 1b concern routing of 132 kV line from this substation to deliver power to the Eskom grid at the Komsberg grid connection.

Alternative 2

Alternative 2 is based on having two substations, one on the Western Ridge and another on the northern section of the Central Ridge. Alternatives 2a and 2b concern routing of 132 kV lines from these substations to deliver power to the Eskom grid at the Komsberg substation. Alternative 2a involves a 132 kV line running northeast from the Western Ridge substation across the Wilgebos Valley close to the Klipbanksfontein Dam to the Central Ridge substation, then southeast across the lower Tankwa Valley as well as the northern end of the Eastern Ridge, before turning south beside the R354 road and finally to the Eskom grid at the Komsberg substation. In alternative 2b, a 132 kV line is routed southeast from the Western Ridge substation across the Wilgebos Valley between the Klipbanksfontein and Rietfontein Dams and then along the same route as alternative 1b to the Komsberg grid connection.

In addition to these effectively four alternatives for 132 kV power lines there will be lower voltage 33 KV power lines that link turbine strings to the substations. Currently six of these proposed power lines will be cross-valley lines: 3 traversing the Wilgebos Valley, two crossing the Tankwa Valley, and one linking the Central Ridge to the proposed substation on the Spitzkop Ridge.

Alternative 1 is not supported from an avifaunal perspective as it requires more lines across the Wilgebos Valley. The 1a routing crosses the Central Ridge in the deep saddle less than 1km of the Verreaux's Eagle breeding locality. This route is undesirable as it poses considerable risk to the pair of eagles which are still resident even though they did not breed at their local nest sites in either of the two years of monitoring. Route 1b takes the line down the Bonne Esperance Valley.

Alternative 2a is the preferred option from an avifaunal perspective and will be more so if it is feasible to locate the substation on the Western Ridge 10km farther to the north than currently planned. With a more northerly location the 132 kV line link to the Central Ridge substation will have a more direct, and so shorter, crossing of the Wilgebos Valley than the currently planned diagonal. Day-visible bird diverters should be installed on all cross-valley power lines to make the lines, and especially the earth-wires, more conspicuous.

8.2.3. Conclusions & Recommendations

The impacts of the proposed Karreebosch Wind Farm will have a negligible effect on the majority of bird species that occur on the Karreebosch property. The turbines will be established on ridge tops and far from sensitive habitats. The only feature of concern is potential mortality through collisions with power lines and to a far lesser extent, rotor blades. The means of mitigating the impacts on birds of the proposed wind farm development are simple but limited.

Turbine positions 17 and 18 should be moved as these were good slope-soaring conditions for the juvenile Martial Eagle recorded and future eagles are likely to be attracted for the same reasons. The adjacent saddle (where turbine 18 is sited) is likely to be a commuting route for wetland birds heading for the largest dam on site to the east . These turbine placements may therefore negatively impact the survival of eagles and waterbirds alike.

Based on the bird-depauperate habitat, the low overall number of birds, and the small number of species that, at least by day, fly over the ridges at potential collision height, there is minimum probable impact on the local avifauna whether in terms of habitat loss, disturbance, or collision risk. This site is likely to cause substantially less impact on birds than a wind farm of equivalent size in a lowland situation. There is no particular reason from an avifaunal perspective to object to this wind farm development and authorisation is recommended.

8.3. Assessment of Impacts on Bats

This impact assessment considers the information collected during the 12 months pre-construction bat monitoring undertaken by Animalia for Karreebosch Wind Farm.

Results of the Pre-Construction Bat Monitoring Programme

Five different species were detected by the eight monitoring systems installed on the site during the 12-month monitoring programme, with only *Miniopterus natalensis* having a Near Threatened conservation status. *Neoromicia capensis* and *Tadarida aegyptiaca* are the most common and abundant insectivorous bat species found across South Africa. They dominated the bat assemblage detected by all of the monitoring systems. The common and more abundant species are of large value to the local ecosystems as they provide greater ecological services than the more rare species, due to their greater abundance. These two species have a conservation category of Least Concern.

Although *M. natalensis, E. hottentotus and S. petrophilus* were not detected nearly as frequently as *N. capensis and T. aegyptiaca,* they were detected in sufficient numbers to suggest healthy populations of these species on site. Therefore, their value in terms of biodiversity cannot be ignored. Moreover, *M. natalensis* is a migratory species and occurs in large numbers when nearby cave-roosts are available. As no such nearby cave-roosts or migration events were found in this study, the proposed initial mitigation measures are considered applicable to all five bat species found on site.

The 50m microphone on Met mast 1 recorded 50% fewer *T. aegyptiaca* than the 10m microphone on the same Met mast and no occurrences of *N. capensis* were recorded at 50m, indicating a negative correlation between bat activity and height above ground. In general the airspace around 50m were dominated by *T. aegyptiaca*.

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.

The proposed mitigation schedule (once the wind farm is operational) follows the precautionary approach strongly and therefore the mitigation measures will be adjusted and refined during a post-construction bat monitoring study (operational bat monitoring), in order to account for mitigation measures being either too lenient or too strict. An adaptive mitigation strategy must therefore be implemented at the site.

Bat Sensitive Areas

A sensitivity map was drawn up indicating potential roosting and foraging areas (refer to Figure 8.8). The sensitivity map shows that currently no turbines are located within High Sensitivity areas and only turbine 57 is positioned within a High Bat Sensitivity buffer area. Additionally, turbine 27 is located within a Moderate Bat Sensitivity area and turbines 4 and 28 are located in Moderate Bat Sensitivity Buffers.

Turbine 57 within the High Sensitivity buffer will either be required to be relocated or removed from the layout as these are 'no-go' areas. These areas 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. The High sensitivity valley areas can also serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several wind farms in an area. The turbines within Moderate Sensitivity areas and buffers can either be relocated or must receive special attention during operational monitoring, not excluding all other turbines from operational monitoring.

Figure 8.8 a-c depicts the bat 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. Therefore, 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.

Table 8.4: 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, with an expected relative higher risk of impacting on local bats. 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 and their buffers	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.

Table 8.5: Sensitive bat areas used to develop sensitivity map

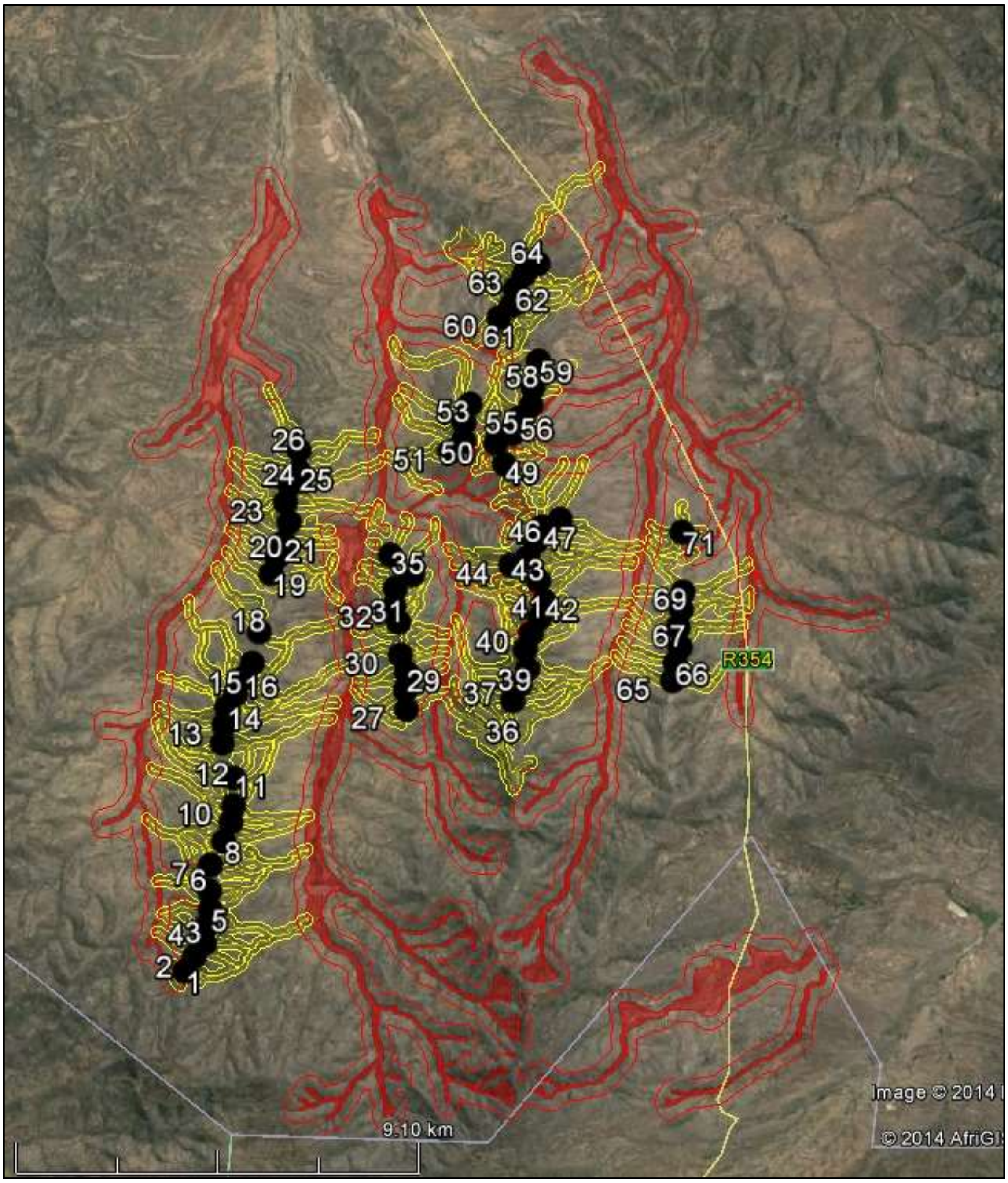
Last iteration	**July 2015**
High sensitivity buffer	200m from blade tip to nearest feature of High sensitivity (based on 140m rotor diameter and 100m hub height). On a flat surface the distance from the base of a turbine must be 250m from a sensitivity to maintain 200m from the blade tip (if the sensitivity feature is on ground level), thus a 250m buffer in relation to turbine bases have been applied to all High sensitive features. However, in cases where 250m overlapped with a proposed turbine position, the difference in elevation between the turbine position and sensitivity (at a lower elevation in this case) has been incorporated in the formula which effectively increases that specific turbines hub height (in relation to the sensitivity). Formula used: b= $\sqrt{(200+bl)^2-(hh+ed)^2}$, derived from Mitchell-Jones & Carlin(2009) Where: *b*= horizontal buffer distance to turbine base *bl* = blade length *hh*= hub height *ed*= elevation difference between turbine base and sensitivity
Moderate sensitivity buffer	100m radial buffer
Features used to develop the sensitivity map	Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line
	Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines
	Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
	Valleys and lower altitudes is expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats.

There are no South African guidelines for the consideration of specific buffer zone distances for bats in relation to wind farms. Guidance can be taken from other guidelines:

» Gauteng Department of Agriculture and Rural Development recommend a 500m buffer for natural bat caves and a 200m buffer on conservation important vegetation and habitat features.
» The Eurobats Guidance (Rodrigues *et al.,* 2008) proposes a minimum buffer distance of 200m from forest edges.

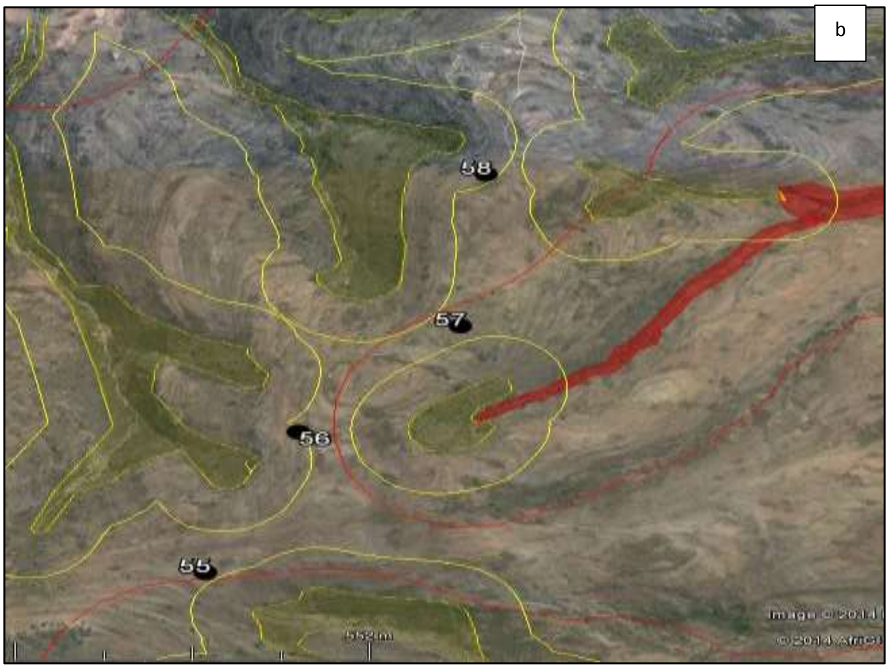
According to current proposed turbine layout, the following turbines are located in potentially sensitive areas as in the table below. These specific locations can be seen in Figures 8.8a, b and c below. Bat sensitivity is also included in the maps attached in Appendix R.

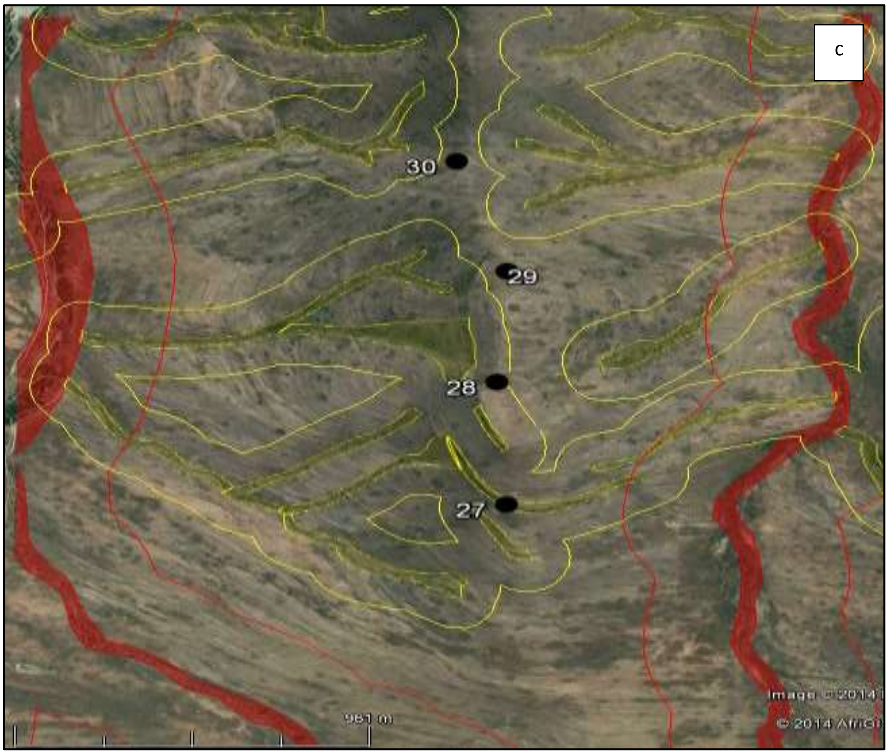
Turbines in high bat sensitivity	**None**
Turbines in high bat sensitivity buffer	57, 52 (marginally)
Turbines in Moderate bat sensitivity area	27
Turbines in Moderate bat sensitivity buffer	4, 28



High sensitivity
High sensitivity buffer
Moderate sensitivity
Moderate sensitivity buffer
Proposed turbines

Figure 8.8a: Bat sensitivity of the Karreebosch site





High sensitivity | High sensitivity buffer | Moderate sensitivity | Moderate sensitivity buffer | Proposed turbines

Figure 8.8b and c. Bat sensitivity of the northern central part of site indicating (a) turbine 57 located within High bat sensitivity buffer and (b) turbines located in Moderate sensitivity area and buffer

8.3.1. Impact Assessment

Construction Phase

Construction Phase Impact: Destruction of roosts

Impact: Destruction of bat roosts due to earthworks and blasting

Nature: During construction, the earthworks and especially blasting can damage bat roosts in rock crevices. Intense blasting close to a rock crevice roost can cause mortality to the inhabitants of the roost.

Impact Magnitude – Moderate

- Extent: On Site
- Duration: Long term
- Intensity: Medium

Likelihood: Based on the distribution of roads and the steep sides of the ridges there is a very high likelihood that erosion would occur if mitigation measures are not implemented.

Impact Significance: (Pre-Mitigation): Moderate (-ve), (Post-Mitigation) Negligible

Degree of Confidence: Medium

Reversibility: No

Irreplaceable Loss of Resources: Yes.

Mitigation:

» Avoid placing turbines within areas of high to moderate sensitivity as detailed within the sensitivity map in Figure 8.8. Blasting should be minimised and used only when necessary

Construction Phase Impact: Artificial Lighting

Impact: Effect on bat diversity due to artificial lights

Nature: During construction 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.

Impact Magnitude – Moderate

- Extent: On Site
- Duration: short term
- Intensity: Medium

Likelihood: Moderate

Impact Significance: (Pre-Mitigation): Minor (Post-Mitigation) Negligible

Degree of Confidence: Medium

Reversibility: High, impact during construction only

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» Utilise lights with wavelengths that attract less insects (low thermal/infrared signature). Such lights generally have a colour temperature of 5000k (Kelvin) or more. If not required for safety or security purposes, lights should be switched off when not in use.

Construction Phase Impact: Loss of bat foraging habitat

Impact: *Loss of bat foraging habitat during construction*

Nature: Some 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

Impact Magnitude – Moderate

- Extent: On Site
- Duration: short-term
- Intensity: Medium

Likelihood: Moderate

Impact Significance: (Pre-Mitigation): Moderate (Post-Mitigation) Minor

Degree of Confidence: Medium

Reversibility: High, impact during construction only

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» Avoid placing turbines within areas of high to moderate sensitivity as detailed within 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.

» Disturbed areas not required after construction should be rehabilitated in consultation with an experienced rehabilitation specialist.

Operation Phase

Operation Phase Impact: Bat Mortality

Impact: Bat mortalities due to direct blade impact or barotrauma during foraging activities

Nature: Bat mortalities due to turbines have been attributed to be caused by direct impact with the blades and by barotrauma (Baerwald et al. 2008). Barotrauma is a condition where low air pressure found around the moving blades of wind turbines, causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz et al. 2007). If the impact is too severe (e.g. in the case of no mitigation) local bat populations will not recover from mortalities.

Impact Magnitude – Moderate

- Extent: Local (On Site)
- Duration: long term
- Intensity: High

Likelihood: Moderate

Impact Significance: (Pre-Mitigation): Major (Post-Mitigation) Moderate

Degree of Confidence: Medium

Reversibility: Impact will exist for operation lifespan of facility

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» The proposed development footprint for all associated infrastructure should adhere to the sensitivity map as far as it is practical.

Decommissioning Phase

Decommissioning Phase Impact: Artificial Lighting

Impact: Effect on bat diversity due to artificial lights

Nature: During decommission 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.

Impact Magnitude – Moderate

- Extent: On Site
- Duration: short term, termporary
- Intensity: Medium

Likelihood: Moderate

Impact Significance: (Pre-Mitigation): Minor (Post-Mitigation) Negligible

Degree of Confidence: Medium

Reversibility: High, impact during decommissioning only

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» Utilise lights with wavelengths that attract less insects (low thermal/infrared signature). Such lights generally have a colour temperature of 5000k (Kelvin) or more.

» If not required for safety or security purposes, lights should be switched off when not in use.

Decommissioning Phase Impact: Loss of bat foraging habitat

Impact: *Loss of bat foraging habitat during decommissioning*

Nature: Some foraging habitat could be disturbed during decommissioning of the wind farm. Temporary foraging habitat loss may occur due to storage areas and movement of heavy vehicles.

Impact Magnitude – Moderate

- Extent: On Site
- Duration: short-term (temporary)
- Intensity: Medium

Likelihood: Moderate

Impact Significance: (Pre-Mitigation): Minor (Post-Mitigation) Negligible

Degree of Confidence: Medium

Reversibility: High, impact during construction only

Irreplaceable Loss of Resources: Yes, high

Mitigation:

» Keep to designated areas when storing building materials, resources, turbine components and/or vehicles and keep to designated roads with all vehicles.

» Disturbed areas not required after decommissioning should be rehabilitated in consultation with an experienced rehabilitation specialist

8.3.2. Proposed Mitigation Measures

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area, and should be considered as the preferred option for mitigation. The tables below are based on the passive data collected. They infer mitigation be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are prevailing (considering conditions in which 80% of bat activity occurred). A maximum curtailment cut in speed of 10 m/s is applied to scenarios where the data implies more than >10 m/s as a mitigation cut in speed.

Bat activity at 10m height is used, since bats are expected to move in an upwards fashion towards turbine blades (bat activity negatively correlated with height above ground). Additionally, the higher bat activity levels at 10m provides more robust and accurate relations between climate and bat activity, and is therefore considered as the precautionary approach in determining the initial parameters with which mitigation should commence.

The following turbines are linked to the passive systems below and are thus affected by the below mitigation schedule:
Short mast 1: Turbines 56 – 64
Short mast 2: Turbines 1 – 4, 12, 18 – 20, 25, 27, 29, 30, 33 – 35
Met mast 3: Turbines 44, 45, 47 – 55, 65, 66, 68, 70, 71

The times of implementation of mitigation measures is preliminarily recommended (considering more than 80% bat activity, normalized data) as follows:

Table 8.6: Bat mitigation implementation timing

	Terms of mitigation implementation
Winter peak activity (times to implement curtailment/ mitigation)	None
Spring peak activity (times to implement curtailment/ mitigation)	Short Mast 1 • 15 September – 15 October • Sunset – 22.00
Environmental conditions in which to implement curtailment/mitigation	Below 11m/s – measured at nacelle height • Above 13.5°C
Summer peak activity (times to implement curtailment/ mitigation)	**Short Mast 2** 1 December – 28 February Sunset – 00.00

Environmental conditions in which to implement curtailment/mitigation	Below 9 m/s measured at nacelle height , above 16.5°C		
Autumn peak activity (times to implement curtailment/ mitigation)	**Short mast 1** Full month of March 23.00 - sunrise	**Short mast 2** 15 March - 15 April 00:00 – sunrise	**Met mast 3** 1 – 15 March 20: 30 - 00:00
Environmental conditions in which to implement curtailment/ mitigation	Below 10m/s measured at nacelle height Above 13.5°C	Below 9m/s measured at nacelle height Above 12.5°C	Below 8.5m/s measured at nacelle height Above 10°C

Where mitigation by location is not possible, other options that may be utilised include curtailment, blade feathering, blade lock, acoustic deterrents or light lures. The following terminology applies:

» **Curtailment:** Curtailment is defined as the act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by locking or feathering the turbine blades.
» **Cut-in speed:** The cut-in speed is the wind speed at which the generator is connected to the grid and producing electricity. For some turbines, their blades will spin at full or partial RPMs below cut-in speed when no electricity is being produced.
» **Feathering or Feathered:** Adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation. Normally operating turbine blades are angled almost perpendicular to the wind at all times.
» **Free-wheeling:** Free-wheeling occurs when the blades are allowed to rotate below the cut-in speed or even when fully feathered and parallel to the wind. In contrast, blades can be "locked" and cannot rotate, which is a mandatory situation when turbines are being accessed by operations personnel.
» **Increasing cut-in speed:** The turbine's computer system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) is programmed to a cut-in speed higher than the manufacturer's set speed, and turbines are programmed to stay locked or feathered at 90° until the increased cut-in speed is reached over some average number of minutes (usually 5 – 10 min), thus triggering the turbine blades to pitch back "into the wind" and begin to spin normally and producing power.

Blade stalling or feathering that render blades motionless below the manufacturers cut in speed, and not allow free rotation without the gearbox engaged, is more desirable for the conservation of bats than allowing free rotation below the manufacturers cut in speed.

Acoustic deterrents are a developing technology and will need investigation closer to time of wind farm operation.

Light lures refer to the concept where strong lights are placed on the periphery (or only a few sides) of the wind farm to lure insects and therefore bats away from the turbines. The long term effects on bat populations and local ecology of this method is unknown.

Habitat modification, with the aim of augmenting bat habitat around the wind farm in an effort to lure bats away from turbines, is not recommended. Such a method can be adversely intrusive on other fauna and flora and the ecology of the areas being modified. Additionally it is unknown whether such a method may actually increase the bat numbers of the broader area, causing them to move into the wind farm site due to resource pressure.

Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds and cut-in speeds under environmental conditions favorable to bats.

A basic "6 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation:

1. No curtailment (free-wheeling is unhindered below **manufacturers** cut in speed so all momentum is retained, thus normal operation).
2. Partial feathering (45 degree angle) of blades below **manufacturers** cut-in speed in order to allow the free-wheeling blades half the speed it would have had without feathering (some momentum is retained below the cut in speed).
3. 90 Degree feathering of blades below **manufacturers** cut-in speed so it is exactly parallel to the wind direction as to minimize free-wheeling blade rotation as much as possible without locking the blades.
4. 90 Degree feathering of blades below **manufacturers** cut-in speed, with partial feathering (45 degree angle) between the **manufacturers'** cut-in speed and **mitigation** cut-in conditions.
5. 90 Degree feathering of blades below **mitigation** cut in conditions.
6. 90 Degree feathering throughout the entire night.

Preliminarily it is recommended that curtailment mitigation initiates at Level 3 for the months, times and weather conditions outlined in the table above (table 8.6), then depending on the results of the post construction mortality monitoring the mitigation can be either relaxed or intensified up to a maximum intensity of Level 5. This is an adaptive mitigation management approach that will require changes in the mitigation plan to be implemented immediately and in real time during the post construction monitoring. Information gathered during the preconstruction assessment of Karreebosch Wind Farm will also inform proposed mitigation measures, affected turbines, and times of implementation and the initial level of curtailment to be used.

8.3.3. Conclusions & Recommendations

Five different bat species were confirmed as occurring on the proposed Karreebosch Wind Farm site through the 12-month pre-construction monitoring programme. No migration events were found in this study, and the proposed initial mitigation measures are considered applicable to all five bat species found on site. A sensitivity map was drawn up indicating potential roosting and foraging areas. The sensitivity map shows that currently no turbines are located within High Sensitivity areas and only turbine 57 is positioned within a High Bat Sensitivity buffers. Additionally, turbine 27 is located within a Moderate Bat Sensitivity area and turbines 4 and 28 are located in the Moderate Bat Sensitivity Buffers. Turbines within the High Sensitivity Buffers will either require relocation or to be removed from the layout as these are 'no-go' areas. The turbines within Moderate Sensitivity areas and buffers can either be relocated or must receive special attention during operational monitoring, not excluding all other turbines from operational monitoring.

8.4. Impacts on Soils and Agricultural Potential

<u>Construction Phase</u>
Preparation of the site for the establishment of turbines, underground cables, access roads, lay-down areas, substation site and operation and maintenance building and power line during the construction phase will result in vegetation clearance, removal of topsoil and subsoil to varying depths, and soil compaction.

A total of 71[20] wind turbines is proposed. The deepest excavations will be for turbine foundations which will extend up to 6m in depth. Areas cleared of vegetation in preparation for the establishment of the wind farm and associated grid connection are prone to erosion by wind or rain. The vegetation cover is the most important physical factor influencing soil erosion. An intact cover reduces impact from rain-drops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. However, the intensity of potential erosion is also influenced by precipitation which is generally low in this arid region with an annual rainfall of 250mm.

[20] The number of turbines has since been refined to 66 following the findings of the EIA. See Chapter 10.

In addition, although the area directly affected may be small, the effects of potential soil erosion and increased sediment load in surface runoff may extend to other areas onsite and downstream if appropriate controls are not in place.

Compaction of soils results in lower permeability resulting in decreased infiltration and increased runoff. Permanent removal of the topsoil horizon changes the soil profile which may inhibit rehabilitation which may, in turn, increase the erosion potential of the soil.

Soils may be impacted as a result of spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks. These impacts are dependent on the size of the spill and the speed with which it is addressed and cleaned up. The likelihood of a spill is also associated with the volume of product that may be stored on-site. Usually, above ground storage tanks for diesel and varying amounts of hydraulic oils, transformer oil and used oils will be required on-site during the construction phase. The volume stored on site will be within permissible levels and not trigger any further listed activities.

Agricultural Potential

The unfavourable climate of the Karoo environment greatly decreases agricultural potential. The area is known to be an agricultural-hub in terms of sheep farming but the footprint of all the turbines would fall under Land Class VIII. The turbines are proposed on rocky tops where little soil development is encountered and livestock seldom graze.

The overall impacts of the proposed facility on agriculture and soil conditions will be fairly low, principally because of the climatic conditions and the low agricultural and grazing potential of the site. There has never been any substantial industrial scale farming practices (agriculture or grazing) on the property because of the dominant climatic conditions and prevailing soil conditions. Low rainfall, along with other soil-related factors lead to low agricultural potential. The soil and rock type properties tend to be very homogenous in the area and the rocky tops of the site would be better utilised for power generation than any other current land use practise. The rather small footprint area of the development is in comparison with the vast area of the broader site and significantly reduces impacts. The positioning of the crane pads and turbines on the rocky tops will occupy land with a grazing capacity of between 30-40 hectares per animal unit or 40-80 hectares per large animal unit. Local sources indicated that even in a good season with ample rainfall they need to substitute grazing with extra feed during summer months. It may be concluded that this is not regarded as viable commercial farming site and would be suited to house the proposed Karreebosch Wind Farm.

8.4.1. Impact Assessment

Construction Impact: Soil Erosion

Nature: Soil erosion on impacted sites of turbine foundations construction during and after the construction phase due to decreased vegetation cover and increased water run-off.

Impact Magnitude –Medium

- **Extent:** local (on-site).
- **Duration:** The duration would be permanent since although removal of topsoil and compaction will occur largely during the construction phase, the effect may continue through the project lifecycle.
- **Intensity:** medium

Likelihood – There is a **medium** likelihood that this impact will occur.

Impact Significance (Pre-mitigation) – Moderate (-ve), (Post Mitigation) Minor (-ve)

Degree of Confidence: The degree of confidence is **medium**.

Reversibility: No

Irreplaceable Loss of Resources: Yes, high

Irreplaceable Loss of Resources: Yes.

Mitigation:

» Care must be taken with the ground cover during and after construction on the site.

» If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e. straw, mulch, erosion control mats, etc., until a healthy plant cover is again established. Care should also be taken to control and contain storm water run-off.

» Rehabilitate construction sites by using indigenous grasses.

» Minimise activity on steep slopes / the side of slopes.

» Implement effective erosion control measures and Erosion Management Plan.

» Keep to existing roads, where practical, to minimise impact on undisturbed ground.

» Ensure stable slopes of stockpiles/excavations to minimise slumping.

» Stockpiles should not exceed 2m in height unless otherwise permitted.

» Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion, only if natural seeding does not occur.

Construction Impact: Dust Generation

Nature: The movement of vehicles and the effects of construction activities will increase the amount of dust generated in the area.

- **Extent:** on-site.
- **Duration:** The duration would be **long-term** as the soils may be affected at least until the project is decommissioned.
- **Intensity:** The intensity is **high** since the impact will be limited to areas that are already disturbed or to areas in close proximity thereof.
- **Likelihood –** The impact will definitely occur

Impact Significance (Pre-mitigation) – Moderate(-ve), (Post-mitigation) – Minor (-ve)

Degree of Confidence: The degree of confidence is **medium**.

Reversibility: No

Irreplaceable Loss of Resources: No
Irreplaceable Loss of Resources: Yes.

Mitigation:
- » Use dust suppression methods/material/chemicals
- » Care should also be taken to control and contain storm water run-off.
- » Minimise activity on steep slopes / the side of slopes.
- » Implement effective erosion control measures and Erosion Management Plan.
- » Keep to existing roads, where practical, to minimise impact on undisturbed ground.
- » Ensure stable slopes of stockpiles/excavations to minimise slumping.
- » Stockpiles should not exceed 2m in height and must be handled with dust suppressants.
- » Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion, only if natural seeding does not occur.

Construction Phase Impact: Erosion and land degredation due to construction of power lines

Construction Impact: Erosion due to power line construction

Nature: The construction of power lines on the site and the risk of erosion and land degradation.
- **Extent:** limited to the site boundaries.
- **Duration: permanent**
- **Intensity:** The intensity is **high** since the impact will be limited to areas that are already disturbed or to areas in close proximity thereof.
- **Likelihood –** The impact will definitely occur

Impact Significance (Pre-mitigation) – Moderate(-ve), (Post-mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **medium**.
Reversibility: No
Irreplaceable Loss of Resources: Yes.

Mitigation:
- » Limit the footprint of the power line to the area and choose stable foundations to construct.
- » Rehabilitate construction sites by using indigenous grasses.
- » Minimise activity on steep slopes / the side of slopes.
- » Implement effective erosion control measures and Erosion Management Plan.
- » Keep to existing roads, where practical, to minimise impact on undisturbed ground.
- » Ensure stable slopes of stockpiles/excavations to minimise slumping.

Operational Phase

Operational Impact: Impact on Agricultural Potential

Nature: Loss of land with high agricultural potential and land capability due to the direct occupation of the facility.
- **Extent:** The extent of the impact is **local,** the impacts are predominantly limited to the site boundaries.
- **Duration:** long term
- **Intensity:** The intensity is

- **Likelihood –** There is a **medium** likelihood that these impacts will occur.

Impact Significance (Pre-mitigation) – Minor (-ve) (Post mitigation) Negligible (-ve)
Degree of Confidence: The degree of confidence is **medium**.
Reversibility: Moderate.
Irreplaceable Loss of Resources: Yes, high
Irreplaceable Loss of Resources: Yes.

Mitigation:

» Rehabilitate construction sites by using indigenous grasses or prior vegetative cover.
» Implement effective erosion control measures and Erosion Management Plan.
» Keep to existing roads, where practical, to minimise impact on undisturbed ground, virgin soils or agricultural land.
» Stockpiles should not exceed 2m in height unless otherwise permitted.
» Assist land owners in recommissioning farm land.

Decommissioning

Once the facility has reached the end of its life the wind turbines may be refurbished or replaced to continue operating as a power generating facility, or the facility can be closed and decommissioned. If decommissioned, all the components of the wind farm would be removed and the site would be rehabilitated.

Removal of site equipment including turbines, buildings, underground cables and access roads, will induce more disturbance to the site and have a potential for soil contamination as a result of spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks if managed inappropriately

Power Line and Substation Alternatives:

There is preference in terms of power line alternatives from a soils and agricultural perspective, as impacts will be similar for all identified alternatives.

8.4.2. Conclusions and Recommendations

With correct and adequate soil management practices during all phases of development of the project, the impacts on soil will be of an acceptable level. Mitigation measures as contained in this section of the EIA report and the EMPr are to be implemented.

8.5. Hydrological Impacts (Surface Water)

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

- Impact 1: Loss of riparian systems and water courses

- Impact 2: Impact on riparian systems through the possible increase in surface water runoff on riparian form and function
- Impact 3: Increase in sedimentation and erosion
- Impact 4: Potential impact on localised surface water quality

No aquatic protected or species of special concern (flora) were observed during the site visit.

Construction Phase

Impact: Loss of riparian systems and water courses

Nature: The physical removal of the narrow strips of riparian zones and disturbance of any alluvial watercourses by road crossings, being replaced by hard engineered surfaces. This biological impact would be localised, as a large portion of the remaining catchment would remain intact.

- **Extent:** Local
- **Duration:** Pre-mitigation: Long-term, post-mitigation: short term
- **Intensity:** Pre-mitigation: Moderate, post-mitigation: Minor
- **Likelihood:** Likely

Impact Significance (Pre-mitigation) – Moderate (-ve),
(Post-mitigation) – Minor (-ve)

Degree of Confidence: High
Reversibility: High
Irreplaceable Loss of Resources: No
Mitigation:

» Where water course crossings are required, the engineering team must provide an effective means to minimise the potential upstream and downstream effects of sedimentation and erosion (erosion protection) as well minimise the loss of riparian vegetation (small footprint).
» Where possible culvert bases must be placed as close as possible with natural levels in mind so that these do not form additional steps / barriers.
» No vehicles are to be permitted to refuel within drainage lines/ riparian vegetation.
» During the operational phase, monitor culverts to see if erosion issues arise and if any erosion control is required.

Impact: Impact on riparian systems

Nature: Impact on riparian systems through the possible increase in surface water runoff from hard surfaces and/or roads on riparian form and function

- **Extent:** Local
- **Duration:** Pre-mitigation: Long-term, post-mitigation: short term
- **Intensity:** Pre-mitigation: Moderate, post-mitigation: Minor
- **Likelihood:** Likely

Impact Significance (Pre-mitigation) – Moderate (-ve),
(Post-mitigation) – Minor (-ve)

Degree of Confidence: High
Reversibility: High

Irreplaceable Loss of Resources: No

Mitigation:

- » Any stormwater within the site must be handled in a suitable manner, i.e. trap sediments and reduce flow velocities.
- » An appropriate stormwater management plan must be developed and implemented for the site.
- » Appropriate erosion control measures must be implemented and maintained on the site

Impact: Impact on localized surface water quality

Nature: During both preconstruction, construction and to a limited degree the operational activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, concrete, shutter-oil, etc.) associated with site-clearing machinery and construction activities could be washed downslope via the ephemeral systems.

- **Extent:** Local
- **Duration:** Pre-mitigation: Long-term, post-mitigation: short term
- **Intensity:** Pre-mitigation: Moderate, post-mitigation: Minor
- **Likelihood:** There is a medium likelihood that this impact will occur**.**

Impact Significance (Pre-mitigation) – Moderate (-ve),
(Post-mitigation) – Minor (-ve)

Degree of Confidence: High

Reversibility: High(with or without mitigation)

Irreplaceable Loss of Resources: Pre-mitigation: Moderate, post-mitigation: Low

Mitigation:

- » Strict use and management of all hazardous materials used on site must be implemented.
- » Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.) must be implemented.
- » Containment of all contaminated water must be ensured by means of careful run-off management on the development site.
- » Strict control over the behaviour of construction workers must be implemented by the contractor.
- » Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.

<u>Operation Phase</u>

Impact: Increase in sedimentation and erosion within the development footprint

Nature: Increase in sedimentation and erosion within the development footprint

- **Extent:** Local
- **Duration:** Pre-mitigation: Long-term, post-mitigation: short term
- **Intensity:** Pre-mitigation: Moderate, post-mitigation: Minor
- **Likelihood:** Likely

Impact Significance (Pre-mitigation) – Moderate (-ve),
(Post-mitigation) – Minor (-ve)

Degree of Confidence: High

Reversibility: High

Irreplaceable Loss of Resources: No
Mitigation:

- Any stormwater within the site must be handled in a suitable manner, i.e. trap sediments and reduce flow velocities.
- An appropriate stormwater management plan must be developed and implemented for the site.
- Appropriate erosion control measures must be implemented and maintained on the site

8.5.1. Conclusions and Recommendations

The proposed layout for the facility is expected to have limited impact on the aquatic environment as most of the proposed structures will avoid the delineated watercourses (Figure 8.9) with the exception of a number of watercourse crossings. This is also largely dependent on the layout making use of any existing roads and tracks. It is however recommended that the hard stand / platform area for Tower 47 be moved outside of the drainage line and its buffer.

Based on the site visit and the assessment presented in the section above, the significance of the impacts assessed for the aquatic systems after mitigation would be low.

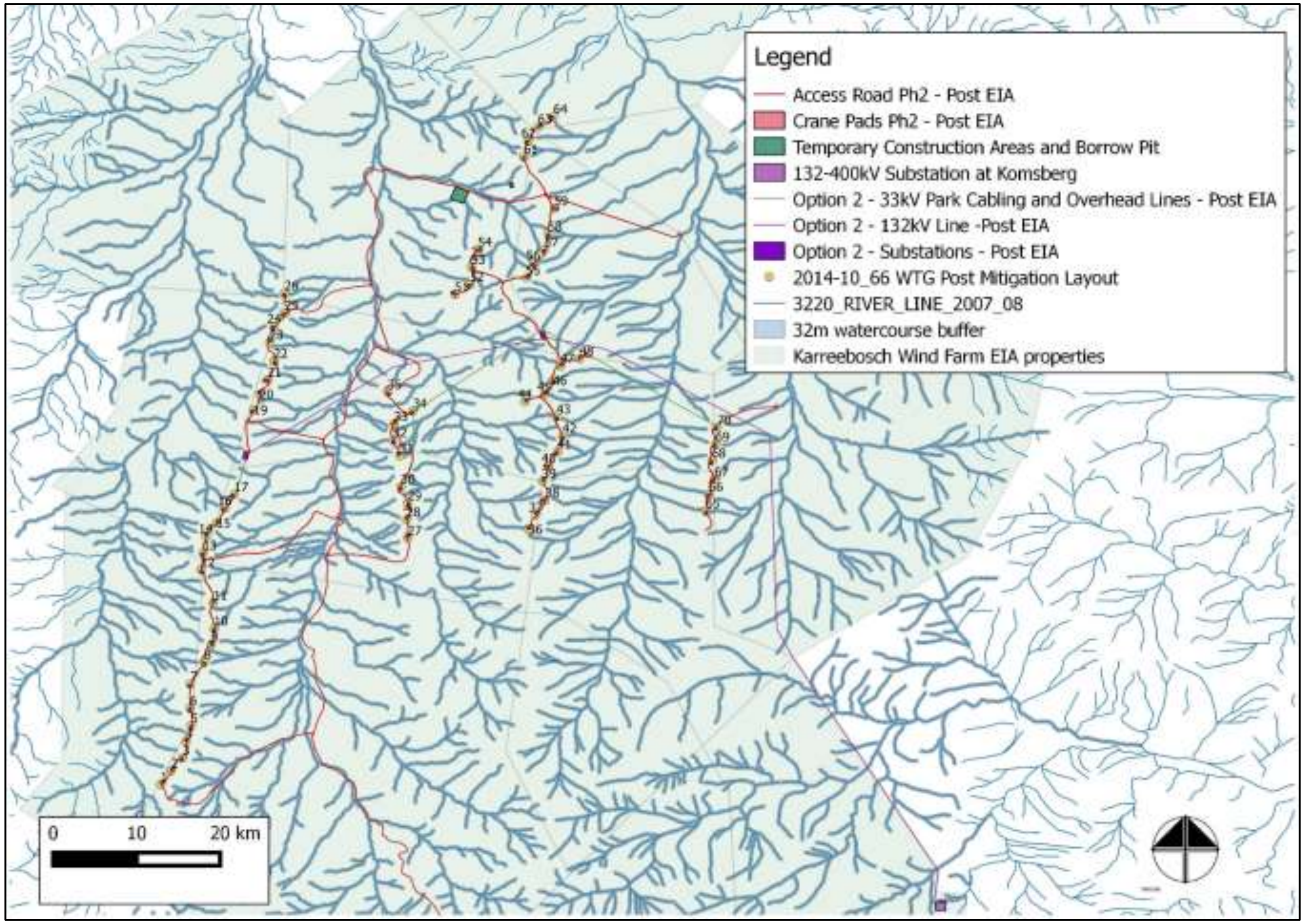


Figure 8.9: The 1:50000 water course within the study area that will either be spanned or crossed

8.6. Assessment of Potential Visual Impacts

This impact assessment section on visual impacts considers the information collected during the assessment undertaken by MetroGIS.

The combined results of the visual exposure, viewer incidence / perception and visual distance of the proposed WEF are displayed on Figure 8.10. Here the weighted impact and the likely areas of impact have been indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.
The visual impact index for the WEF is further described as follows.

» The visual impact index indicates a core area of potentially high visual impact within a 5km radius of the proposed WEF. This area falls mostly within the farms earmarked for the development. It is anticipated that the residents of these farms endorse the WEF and that the visual impact would be negligible from these receptors. At residences and homesteads of receptors not associated with the WEF (e.g. Langhuis, Brakwater and the Matjiesfontein homesteads), the potential visual impact may be very high, due to the relative close proximity to the WEF infrastructure.
» Observers travelling along the R354 arterial road, especially in a southerly direction, are expected to have a very high level of visual exposure to the wind turbine structures, potentially resulting in a very high visual impact.
» At distances between 5km to 10km from the WEF, the potential visual impact may be moderate, where observers are generally absent. Where observers are present (i.e. at residences and along roads within this zone) the potential visual impact may be high. This impact is further aggravated due to the potential additional exposure to the Phase 1 and Hidden Valley turbines (i.e. the observer's field of view widens with distance). Homesteads within this zone include: Windheuwel, Brakwater, Langhuis, Wadrif and Ou Tuin.
» The WEF infrastructure will become less prominent at distances exceeding 10km (up to 20km), but may still be visible and distinguishable within the natural landscape. Observers residing at homesteads and travelling along roads may experience moderate (in the event of a single WEF) to high (in terms of cumulative exposure) visual impacts. Residences within this zone include: Rooiheuwel, Seekoeigat, Klein Ashoek, Kraairivier, Brandhoek, Oliviersberg, etc.
» At distances exceeding 20km the visual impact is anticipated to be low to very low and even negligible for the individual WEFs (i.e. not considering the cumulative visual exposure).

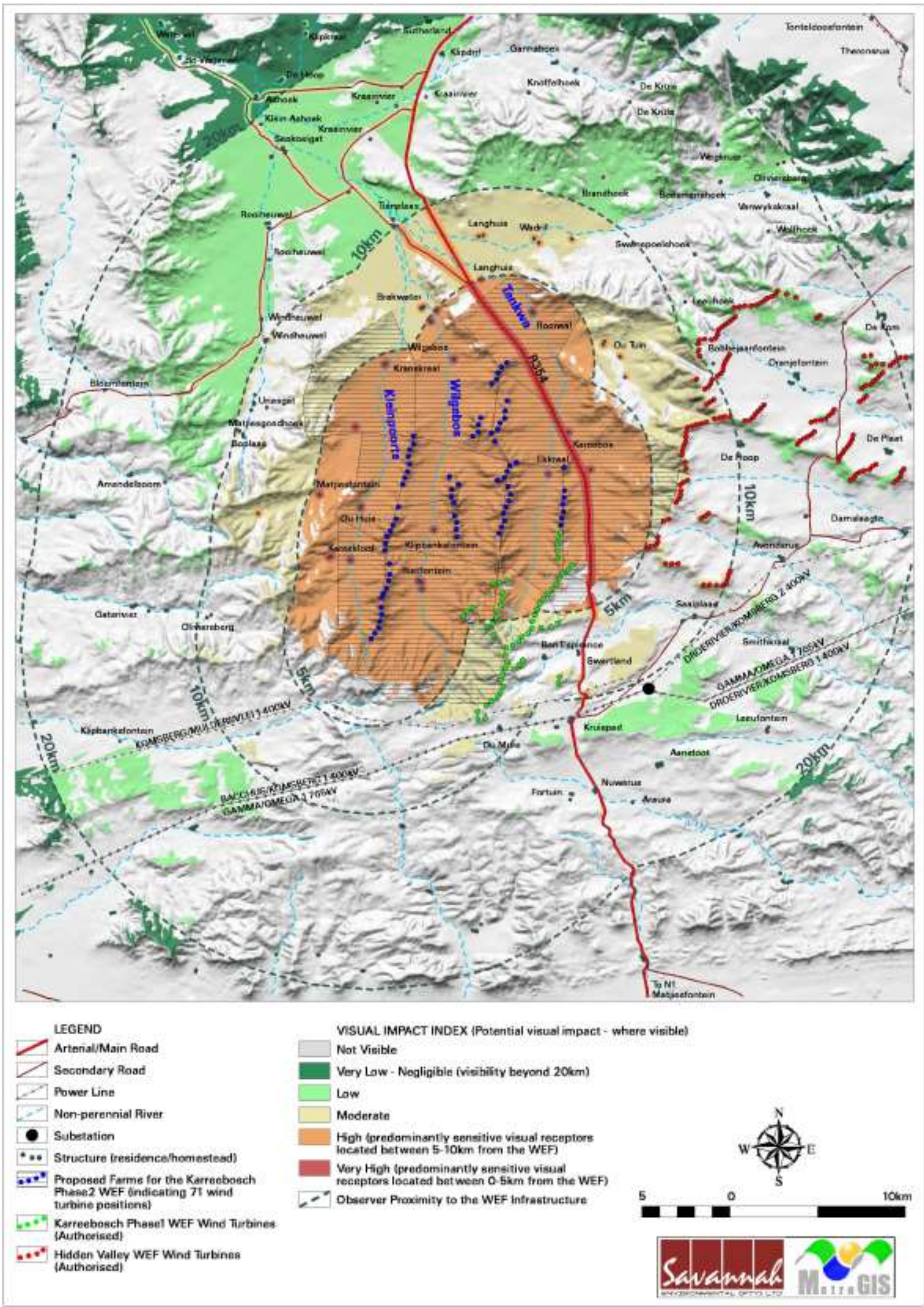


Figure 8.10: Visual impact index for Karreebosch Wind Farm

8.6.1. Photo Simulations

Photo simulations were undertaken (in addition to the spatial analyses) in order to illustrate the potential visual impact of the proposed Karreebosch wind facility within the receiving environment. The photo simulations include the authorised Roggeveld Phase 1 Wind Farm and the Hidden Valley Wind Farm, as these authorised facilities are expected to contribute to the increased or cumulative visual impact of wind farms within the study area.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout. The photograph positions are indicated on **Figure 8.11** below and should be referenced with the photo simulation being viewed in order to place the observer in spatial context.

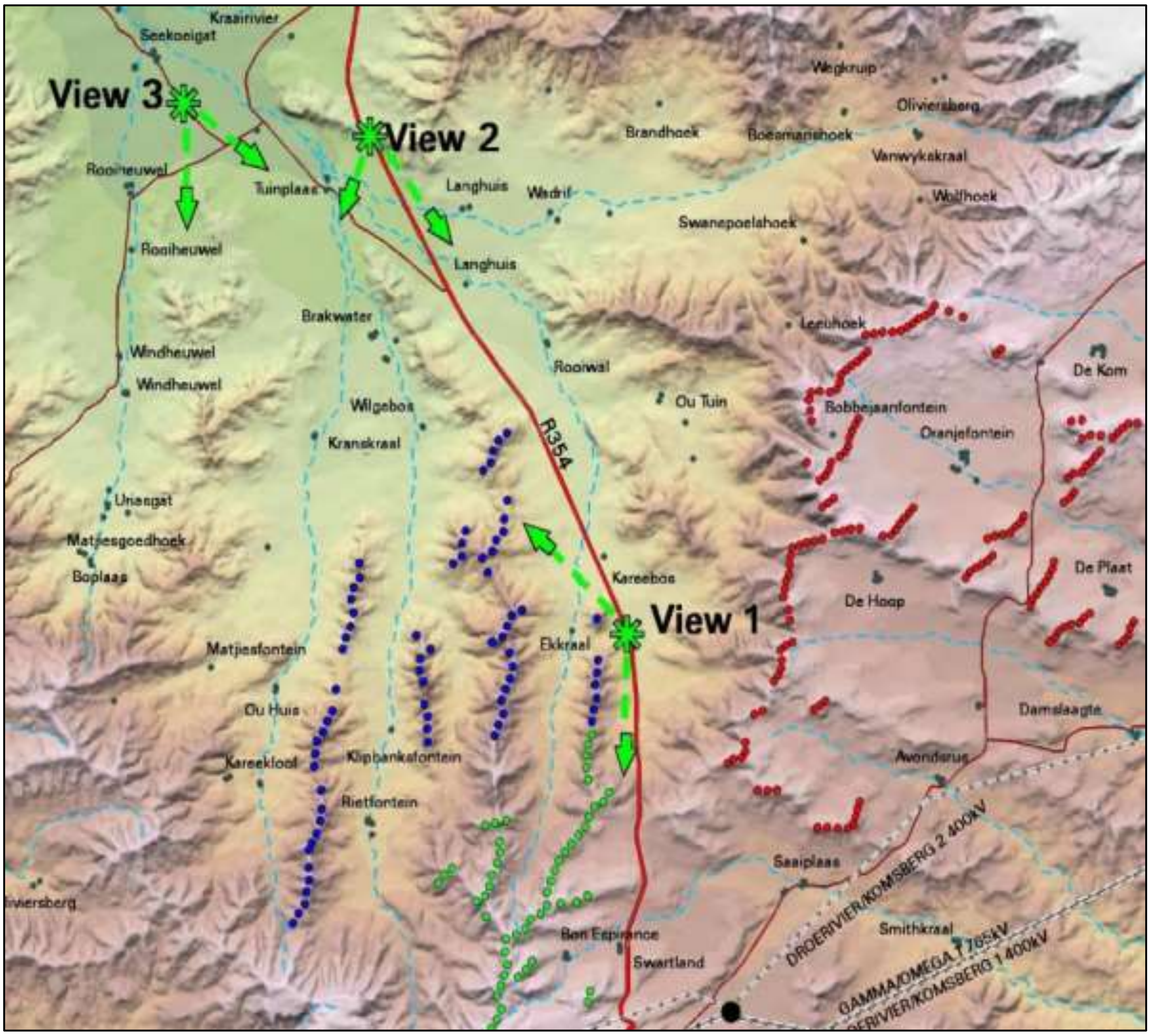


Figure 8.11: Photograph positions for photo simulations

View 1

Viewpoint 1 is located on the R354 arterial road to the east of the proposed wind farm. The point is located approximately 1.2km away from the closest turbine (lone turbine on Ekkraal-se-Kop) of the Karreebosch Wind Farm. The viewing direction is west and south, and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling along this road between Sutherland and Matjiesfontein. Approximately **33** turbines from both phases are fully or partially visible in the landscape (Figure 8.12b and 8.12c).

Figure 8.12a: Pre-construction panoramic view from Viewpoint 1.

Figure 8.12b: Post construction panoramic view from Viewpoint 1 (indicating Roggeveld Phase 1 turbines in green and Karreebosch (Phase 2) turbines in blue).

Figure 8.12c: Post construction panoramic view from Viewpoint 1.

View 2

Viewpoint 2 is located on the R354 arterial road to the north of the proposed wind facility. The point is located approximately 10.7km away from the closest turbine of the Karreebosch Wind Farm. The viewing direction is south and is representative of a medium distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Virtually all the Karreebosch turbines are fully or partially visible in the landscape, with Roggeveld Phase 1 turbines protruding in the background (Figure 8.13b and c). Turbines from the Hidden Valley Wind Farm will also become visible to the east (left of the image on Figure 8.13b and c)).

Figure 8.13a: Pre-construction panoramic view from Viewpoint 2.

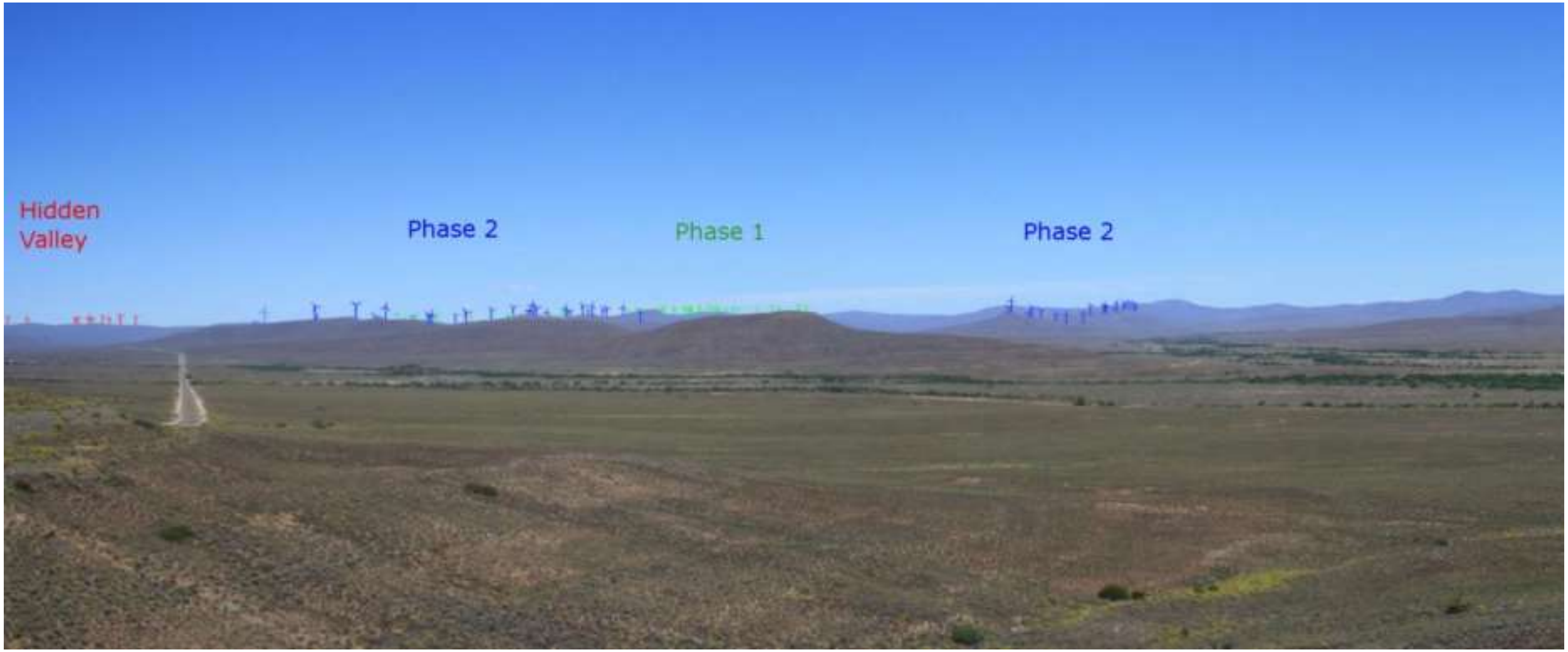


Figure 8.13b: Post construction panoramic view from Viewpoint 2 (indicating Hidden Valley wind facility turbines in red, Roggeveld Phase 1 turbines in green and Phase 2 turbines in blue).

Figure 8.13c: Post construction panoramic view from Viewpoint 2.

View 3

Viewpoint 3 is located on the secondary road near the Seekoeigat homestead north-north-west of the Karreebosch Wind Facility. The viewing direction is south-east and is representative of a long distance view that residents of local homesteads and visitors to the area will experience while travelling along this secondary road. A large number of turbines from the Karreebosch Wind Farm will be visible in the distance (approximately 15.8km at the closest), with the Roggeveld Phase 1 turbines virtually indistinguishable in the far background (Figure 8.14b and c). The potential cumulative exposure brought about by the Hidden Valley wind facility turbines becomes apparent as the rows of turbines along the *Kleinroggeveldberge* protrude above the skyline.

Figure 8.14a: Pre-construction panoramic view from Viewpoint 3

Figure 8.14b: Post construction panoramic view from Viewpoint 3 (indicating Hidden Valley WEF turbines in red, Roggeveld Phase 1 turbines in green and Karreebosch Phase 2 turbines in blue).

Figure 8.14c: Post construction panoramic view from Viewpoint 3

8.6.2. Visual Impact Assessment

a) Primary Impacts of the Wind Farm

Operational Phase Impacts

Potential visual impact on observers travelling along arterial and secondary roads in close proximity to the proposed wind farm.

Nature:
The potential visual impact on users of the R354 and secondary roads in close proximity of the proposed wind farm (i.e. within 10km) is expected to be of **major** significance. No mitigation of this impact is possible, but measures are recommended as best practice to minimise impacts.
Impact Magnitude –**Major**
- **Extent:** The extent of the impact is **local,** the impacts are predominantly limited to the site boundaries but may extend to the immediate vicinity of the site.
- **Duration:** Long term.
- **Intensity:** High.
- **Likelihood –** definite.

Impact Significance (Pre-mitigation) – Major, (Post-mitigation) – Major
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned.
Irreplaceable Loss of Resources: No
Mitigation:

Construction:
» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint.

Operations:
» Maintain the general appearance of the facility as a whole.

Decommissioning:
» Remove infrastructure not required for the post-decommissioning use of the site.
» Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Potential visual impact on residents of settlements and homesteads in close proximity to the proposed wind farm.

Visual Impact on Observers residing in close proximity to the proposed facility.

Nature: The potential visual impact on residents of settlements and homesteads within a 10km radius of the proposed wind facility is expected to be of **moderate** to **major** significance. No mitigation of this impact is possible, but measures are recommended as best practice to minimise impacts.

- **Impact Magnitude** –**Major - Moderate**
- **Extent:** The extent of the impact is **local,** the impacts are predominantly limited to the site boundaries but may extend to the immediate vicinity of the site.

- **Duration:** Long term.
- **Intensity:** High to Medium.
- **Likelihood –** Definite/Likely.

Impact Significance (Pre-mitigation) – Moderate-Major, (Post-mitigation): Moderate

Degree of Confidence: The degree of confidence is **high**.

Reversibility: High, impact will exist until facility is decommissioned.

Irreplaceable Loss of Resources: No

Mitigation:

Construction:

» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.

Operations:

» Maintain the general appearance of the facility as a whole.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Visual Impact on Sensitive visual receptors within the region

Nature: The visual impact on the users of roads and the residents of settlements and homesteads within the region (i.e. beyond the 10 km radius) is expected to be of moderate significance, considering the generally remote location of the proposed wind facility. The potential future development of wind energy facilities in the region may drastically change the overall cumulative visual impact within the region.

Currently, the relatively low incidence of visual receptors within this environment reduces the probability of this impact occurring. No mitigation of this impact is possible, but measures are recommended as best practice to minimise impacts.

- **Impact Magnitude** –**Medium**
- **Extent:** Regional.
- **Duration:** Long term.
- **Intensity:** Medium.
- **Likelihood: –**Likely.

Impact Significance (Pre-mitigation): Moderate; (Post-mitigation): Moderate

Degree of Confidence: The degree of confidence is **high**.

Reversibility: High, impact will exist until facility is decommissioned.

Irreplaceable Loss of Resources: Yes

Mitigation:

Construction:

» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.

Operations:

» Maintain the general appearance of the facility as a whole.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

b) Primary Impacts of ancillary infrastructure

Potential visual impact of internal access roads and ancillary infrastructure on observers in close proximity to the proposed wind facility.

Nature: On-site ancillary infrastructure associated with the wind facility includes the smaller substations (inverters), 33kV overhead cabling and 132kV line, internal access roads, workshop and office. This infrastructure will be located within the facility footprint, but may still be visible to visual receptors in close proximity to the proposed wind facility.

The roads have the potential of manifesting as landscape scarring especially where they traverse steep slopes. Other infrastructure has the potential of creating visual clutter, contributing to cumulative impacts, therefore having the potential of visual impact within the viewshed areas. The anticipated visual impact resulting from this infrastructure is likely to be of moderate significance both before and after mitigation.

- **Impact Magnitude** –**Medium**
  - **Extent:** Local.
  - **Duration:** Long term.
  - **Intensity:** Medium.
  - **Likelihood: –**Likely.

Impact Significance (Pre-mitigation): Moderate; (Post-mitigation): Moderate
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned.
Irreplaceable Loss of Resources: No

Mitigation:
Planning:
» Plan ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised.
» Consolidate existing infrastructure as far as possible, and make use of already disturbed areas rather than pristine sites wherever possible.
»
Construction:
» Rehabilitation of all disturbed areas should be undertaken as soon as possible after construction is completed in an area.
» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.
» Ensure that vegetation is not cleared unnecessarily to make way for access roads and ancillary buildings.
Operation:
» Maintenance of roads must be undertaken throughout the operational phase to minimise the potential for erosion and suppress dust.
Decommissioning:
» Removal of infrastructure and roads not required for post decommissioning use and rehabilitation of the footprint areas.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Potential visual impact of the overhead power lines and on-site substation(s) on observers in close proximity to the proposed wind facility (all alternatives)

Nature: The anticipated visual impact resulting from this alignment is likely to be of **moderate** significance. No mitigation of this impact is possible, but measures are recommended as best practice.

- **Impact Magnitude** –**Medium**
- **Extent:** Local.
- **Duration:** Long term.
- **Intensity:** Medium.
- **Likelihood: –**Likely.

Impact Significance (Pre-mitigation): Moderate; (Post-mitigation): Moderate
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned.
Irreplaceable Loss of Resources: No

Mitigation:

Planning:

» Plan ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised.
» Consolidate existing infrastructure as far as possible, and make use of already disturbed areas rather than pristine sites wherever possible.

Construction:

» Rehabilitation of all disturbed areas should be undertaken as soon as possible after construction is completed in an area.
» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.
» Ensure that vegetation is not cleared unnecessarily to make way for access roads and ancillary buildings.

Operation:

» Maintenance of roads must be undertaken throughout the operational phase to minimise the potential for erosion and suppress dust.

Decommissioning:

» Removal of infrastructure and roads not required for post decommissioning use and rehabilitation of the footprint areas.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

c) Shadow flicker

Under certain light conditions the moving shadow cast by revolving wind turbine blades can result in a flickering effect. This transient effect is known as shadow flicker and is experienced on the ground or inside dwellings with narrow aperture windows when the direction and angle of incident sunlight align. Shadow flicker is not a concern during the construction phase as it only has the potential to occur during operation of a wind farm.

Impact Characteristics: Shadow Flicker

Summary	Construction	Operation
Project Aspect/ activity	N/A	Operation of wind turbines
Impact Type	N/A	Direct negative
Stakeholders/ Receptors Affected	N/A	Affected landowners or those living on site

Shadow flicker can be a nuisance, particularly when the receptor is in a building, as the contrast between light and shade is most noticeable through windows and doors. Flickering and strobing can potentially trigger an epileptic fit in cases of photosensitive epileptics. A survey carried out by Epilepsy Action[21] in the UK, concluded that wind turbines may create circumstances where photosensitive seizures can be triggered, however it does appear that this risk is minimal. Furthermore they state that "*newer wind turbines are usually built to operate at a frequency of 1 Hz or less. These flicker rates are unlikely to trigger a seizure.*"[22]

The following physical circumstances need to apply simultaneously before shadow flicker can occur:

» the receptor must be within 10 rotor diameters of the turbine;
» there must be a sufficient level of sunlight;
» the wind turbine must be operating (wind speeds must therefore be at least about 2.5m s^{-1});
» the moving shadow cast by rotating blades must be seen from within a building, particularly when viewed through a narrow window;
» the orientation of the turbine and its angle of elevation to the observer must coincide with the angle and the position of the sun in relation to the building so that the shadow falls onto the receptor; and
» since the origin of the effect is the sun, receptors that may be affected must lie to the south of the point where the sun rises and sets.

Where these circumstances pertain, the exact position of shadows can be calculated very accurately for each sensitive location for the key times of day and year to determine the potential for shadow flicker. The turbine diameter for the proposed Wind Farm would be approximately 140 m. A receptor would therefore need to be ~1000 m from the turbine to experience shadow flicker.

Operational Impact: Shadow Flicker

Nature: The impact of shadow flicker would be a **direct negative** impact on people within dwellings.

21 Epilepsy Action online, available at http://www.epilepsy.org.uk/campaigns/survey/windturbines
22 Epilepsy Action online, available at http://www.epilepsy.org.uk/info/photosensitive/triggers

- **Impact Magnitude** – **Low**
- **Extent:** The shadow flicker would occur at the **onsite** level, as this impact would impact people within dwellings located within a 1 km radius of the proposed turbines.
- **Duration:** This impact would be **long-term** throughout the operational phase of the Wind Farm, 25 years.
- **Intensity:** The intensity would be **medium** as the dwellings are places of residence.
- **Likelihood –** It is **unlikely** that this impact would occur during the operational phase, as the dwellings are located over 1km south of the proposed turbine locations.

Impact Significance (Pre-Mitigation) – Negligible
Degree of Confidence: The degree of confidence is **medium** as the exact locations of the proposed turbines have not as yet been micro-sited.
Reversibility: High, impact only lasts for operational lifespan of facility
Irreplaceable Loss of Resources: No

Mitigation:
» None required

d) Lighting impacts

Potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the proposed wind facility.

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, are the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Sky glow is also a potential lighting impact. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow.

This anticipated impact is likely to be of **moderate** significance, and may be mitigated to **minor**.

Potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the proposed wind facility.

Nature: Direct, negative and potentially cumulative visual impact.

- **Impact Magnitude** –**Medium**
- **Extent:** Local.
- **Duration:** Long term.
- **Intensity:** Medium to low.
- **Likelihood: –**Likely.

Impact Significance (Pre-mitigation): Moderate; (Post-Mitigation): Minor
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned.
Irreplaceable Loss of Resources: No

Mitigation:
Planning & operation:

» Limit aircraft warning lights to the turbines on the perimeter, thereby reducing the overall requirement.
» Shield the sources of light by physical barriers (walls, vegetation, or the structure itself).
» Limit mounting heights of lighting fixtures, or alternatively use foot-lights or bollard level lights.
» Make use of minimum lumen or wattage in fixtures.
» Make use of down-lighters, or shielded fixtures.
» Make use of Low Pressure Sodium lighting or other types of low impact lighting.
» Make use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Potential visual impact of operational, safety and security lighting of the facility at night on observers within the region, with specific reference to the South African Large Telescope (SALT) near Sutherland.

The SALT is situated at the South African Astronomical Observatory (SAAO) field station 14km east of the town of Sutherland. The site is ~50km to the north east of the proposed wind farm and lies on an elevated plateau. The wind turbines associated with the Karreebosch Wind Farm are all located below the escarpment and are not expected to be visible from the observatory due to the topography and the significant distance.

"From previous interactions with relevant stakeholders on the adjacent Roggeveld wind farm (phase 1), SALT nevertheless prefers no or very low intensity night lighting which is in direct conflict with the requirements of the Civil Aviation Authority. In recent discussions with representatives from the CAA, DST Astronomy Management Authority and SAAO, stakeholders agreed that the best solution to this problem would be the installation of standard intensity aviation lighting on top of selected turbines (as normally determined by the CAA), but which are usually switched OFF. A special trigger system is then installed at the wind farm which lets approaching aircraft switch on the lighting system on demand via remote control. Therefore a similar system is proposed as the mitigation measure to minimise impacts on the SALT's operations. Comments on this proposal are to be sought from the SALT/SAAO, and should they concur this measure will be integrated into the EMPr.

e) Construction Impacts

Potential visual impact of construction on visual receptors in close proximity to the proposed wind facility and power line.

During the construction period, there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and land owners in the area. Dust from construction work could also result in potential visual impact. This anticipated impact is likely to be of **moderate** significance, and may be mitigated to **minor.**

Potential visual impact of construction activities on visual receptors in close proximity to the proposed wind facility and power line

Nature: Direct and negative visual impact.

- **Impact Magnitude** –**Medium**
- **Extent:** Local.
- **Duration:** Short term.
- **Intensity:** Medium to low.
- **Likelihood: –**Likely.

Impact Significance (Pre-mitigation): Moderate ; (Post-mitigation): Minor
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact during construction only
Irreplaceable Loss of Resources: No

Mitigation:
Planning:
Retain and maintain natural vegetation in all areas outside of the development footprint.
Construction:

» Ensure that vegetation is not unnecessarily removed during the construction period.
» Reduce the construction period through careful logistical planning and productive implementation of resources.
» Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
» Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
» Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.

» Reduce and control construction dust using approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
» Restrict construction activities to daylight hours whenever possible in order to reduce lighting impacts.
» Rehabilitate all disturbed areas immediately after the completion of construction works.

f) Visual Impact Assessment – Secondary Impacts

<u>Karreebosch Wind Farm and ancillary infrastructure</u>

Potential visual impact of the facility on the visual character of the Karoo landscape and sense of place of the region.

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.), play a significant role.

An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

The anticipated visual impact of the individual facility on the regional visual quality, and by implication, on the sense of place, is expected to be of **minor** significance.

The low incidence of visual receptors within this environment and the relatively remote location of the proposed facility reduces the probability of this impact occurring. However, the future development of neighbouring facilities (such as the Roggeveld Phase 1 and Hidden Valley wind facilities) may change the overall visual impact on the sense of place within the region, potentially increasing the visual impact significance to **moderate**. No mitigation of this impact is possible, but measures are recommended as best practice.

Potential visual impact of the wind facility on the visual character of the Karoo landscape and sense of place of the region

Nature: Direct, negative and potentially cumulative visual impact.

- **Impact Magnitude** –**Medium**
- **Extent:** Regional.
- **Duration:** Long term.
- **Intensity: Low -** Medium.
- **Likelihood: –**Likely.

Impact Significance (Pre-mitigation and Post-Mitigation): Minor (Individual Wind Farm) to Moderate (Cumulative exposure of up to 3 wind farms)
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned
Irreplaceable Loss of Resources: Yes

Mitigation:
Construction:
» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.

Operations:
» Maintain the general appearance of the facility as a whole.

Decommissioning:
» Remove infrastructure not required for the post-decommissioning use of the site.
» Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

8.5.3. Power lines and substations

From a visual perspective, Alternative 1 with sub-alternative 1b (the shortest route) would be favoured, as these options generally aid in consolidating the substation infrastructure on the site (one substation), and only traverses the R354 once.

8.5.4. Conclusions and Recommendations

The primary visual impact, namely the appearance of the wind energy facility (the wind turbines and associated infrastructure) is not possible to mitigate. The functional design of the turbines cannot be changed in order to reduce visual impacts. The positions of the turbines (on ridges and hilltops) are similarly not likely to be a changed due to the absence of the wind resource at alternative locations (i.e. in lower-lying areas).

Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*".

Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact.

The overall potential for mitigation is therefore generally low or non-existent. The following mitigation is, however possible:
» It is recommended that vegetation cover (i.e. either natural or cultivated) be maintained in all areas outside of the actual development footprint, both

during construction and operation of the proposed facility. This will minimise visual impact as a result of cleared areas, power line servitudes and areas denuded of vegetation.

» Existing roads should be utilised wherever possible. New roads should be planned taking due cognisance of the topography to limit cut and fill requirements where possible. Construction/upgrade of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.
» In terms of on-site 3.1ancillary buildings, it is recommended that the substation and workshop be planned so that clearing of vegetation is minimised. This implies consolidating this infrastructure as much as possible and making use of already disturbed areas rather than undisturbed sites wherever possible.
» No mitigation is possible for visual impacts associated with the on-site monitoring and telecommunications masts.
» The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact.
» Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility. The correct specification and placement of lighting and light fixtures for the proposed wind facility and ancillary infrastructure will go far to contain rather than spread the light. Mitigation measures include the following:
  - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
  - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
  - Making use of minimum lumen or wattage in fixtures;
  - Making use of down-lighters, or shielded fixtures;
  - Making use of Low Pressure Sodium lighting or other types of low impact lighting.
  - Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.
» Mitigation of visual impacts associated with the construction phase, albeit temporary, would entail proper planning, management and rehabilitation of the construction site. Recommended mitigation measures include the following:
  - Ensure that vegetation is not unnecessarily cleared or removed during the construction period.
  - Reduce the construction period through careful logistical planning and productive implementation of resources.

- Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
- Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
- Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
- Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
- Rehabilitate all disturbed areas, construction areas, roads, slopes etc. immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.

» During operation, the maintenance of the turbines and ancillary structures and infrastructure will ensure that the facility does not degrade, thus aggravating the visual impact.

» Roads must be maintained to forego erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as a when required.

» Once the facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications.

» All rehabilitated areas should be monitored for at least a year following decommissioning, and remedial actions implemented as and when required.

» Secondary impacts anticipated as a result of the proposed wind farm (i.e. visual character and sense of place) are not possible to mitigate. There is also no mitigation to ameliorate the negative visual impacts on tourist routes and tourist destinations within the region.

» Where sensitive visual receptors are likely to affected, it is recommended that the developer enter into negotiations regarding the potential screening of visual impacts at the receptor site. This may entail the planting of vegetation, trees or even the construction of screens. Ultimately, visual screening is most effective when placed at the receptor itself.

Good practice requires that the mitigation of both primary and secondary visual impacts as listed above be implemented and maintained on an ongoing basis. Provided these mitigation measures are employed, the visual impact ratings could be reduced.

The visual environment surrounding the site, especially within a 5-10km radius, will be visually impacted upon for the anticipated operational lifespan of the facility (i.e. 20 - 30 years).

This impact is applicable to the individual Karreebosch Wind Farm and to the cumulative visual impact of the three wind farms (Roggeveld Phase 1, Karreebosch and Hidden Valley) located within close proximity to one another, where the combined frequency of visual impact and area of impact may be greater.

The following is a summary table of visual impacts remaining, assuming mitigation as recommended is exercised:

Impact	**Significance**[23]
Potential visual impact on users of the R354 and secondary roads in close proximity of the proposed wind farm (i.e. within 5-10km)	**Major** significance.
The potential visual impact on residents of settlements and homesteads within a 5-10km radius of the proposed wind farm	**Moderate** to **major** significance
The visual impact on the users of roads and the residents of settlements and homesteads within the region (i.e. beyond the 10 km radius) considering the generally remote location of the proposed wind farm. The potential future development of neighbouring wind farm (two authorised applications) may drastically change the overall cumulative visual impact within the region.	**Moderate** significance
On-site ancillary infrastructure associated with the wind farm including inverters, 33kV overhead cabling, internal access roads, workshop and office,	More localised and generally **moderate** potential visual impact.
The visual impact assessment favours the Alternative 1 with sub-alternative 1b (shortest route) for the 132kV overhead power line	**Moderate** significance
The significance of shadow flicker	**Negligible**.
The anticipated visual impact of operational, safety and security lighting	**Moderate** significance, and may be mitigated to **minor**
The anticipated visual impact of construction activities on sensitive visual receptors	**Moderate** significance, and may be mitigated to **minor**.

» The proposed Karreebosch Wind Farm is not expected to be visible from the South African Large Telescope (SALT) and is therefore not expected to visually impact on the observatory.

[23] There are no separate pre-mitigation and post-mitigation significance ratings in this table as the majority of visual impacts are not possible to mitigate

» The potential visual impact of the facility on the visual character of the Karoo landscape and sense of place of the region may be of **minor** significance for the Karreebosch Wind Farm when viewed in isolation, but may be of **moderate** significance when viewed together with the Roggeveld Phase 1 and Hidden Valley wind facilities. This impact on the visual character of the Karoo (specifically the Tankwa River sub-catchment) may ultimately reach impact levels of **major** significance with the addition of another large scale wind facility.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from **major** to **minor** significance. Anticipated visual impacts on sensitive receptors in close proximity to the proposed facility remain high, but are, nonetheless not considered to be fatal flaws for the proposed wind energy facility.

The main consideration in this regard is the overall contained extent of potential visual impact within the region (i.e. the Tankwa River sub-catchment) and the fact that limited sensitive receptors and tourist routes are likely to be affected.

In addition, the anticipated visual impacts of major significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are generally limited in extent.

Considering all factors, it is recommended that the development of the facility as proposed be supported; subject to the implementation of the recommended mitigation measures and management programme.

Where sensitive visual receptors are likely to be affected (i.e. residents of homesteads and settlements in within a 5km radius), it is recommended that the developer enter into negotiations regarding the potential screening of visual impacts at the receptor site. This may entail the planting of vegetation, trees or even the construction of screens. Ultimately, visual screening is most effective when placed at the receptor itself.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Karreebosch wind facility would be considered to be acceptable from a visual perspective.

8.7. Assessment of Potential Noise Impacts

This impact assessment section on noise impacts considers the information collected during the assessment undertaken by Jongens Keet Associates.

The environmental noise impact investigation and assessment of the noise emanating from the wind farm was conducted in accordance with Section 8 of SANS 10328:2008.

Residual Sound Levels

A residual L_{Aeq} of 33 dBA was measured on a farm track more than 2 000 m from the R354 between 17h00 and 17h30 on a Saturday during a light wind with an average wind speed of approximately 2 m/s. The sound level spectrum is displayed in Figure 8.15. No road traffic or other man-made noise was audible. The only audible sound was that of the occasional chirping of a bird in the distance. The measured level was considered to be representative of that on all land far removed from the R354.

8.7.1. Results of Wind Turbine Noise Calculations

The predicted L_{Aeq} contours at a height of 2 m above local ground level due to operation of the wind turbines during a wind speed of 10 m/s are displayed in Figure 8.15. The respective contour L_{Aeq} values have been denoted by numerals on a white background with a lowest value of 20 dBA. This is well below the residual L_{Aeq} value measured in the study area. Areas that would be exposed to levels less than 20 dBA contain no colour shading.

Five occupied buildings or caravans and an unoccupied farm house are depicted by a building symbol coloured green each with a black identification number.

Summary of predicted noise impact on dwellings within the Karreebosch Wind Farm site boundaries

	Dwellings	L_{Aeq},dBA	Excess, dB	Noise impact
1	Caravan 5 people	28	-	Negligible
2	Farmhouse 10 people	21	-	Negligible
3	Workers' dwelling occupied	38	5	Low
4	Farmhouse	36	3	Low
5	Shepherds' quarters 2 people	31	-	Negligible
6	Workers' dwelling 4 people	32	-	Negligible

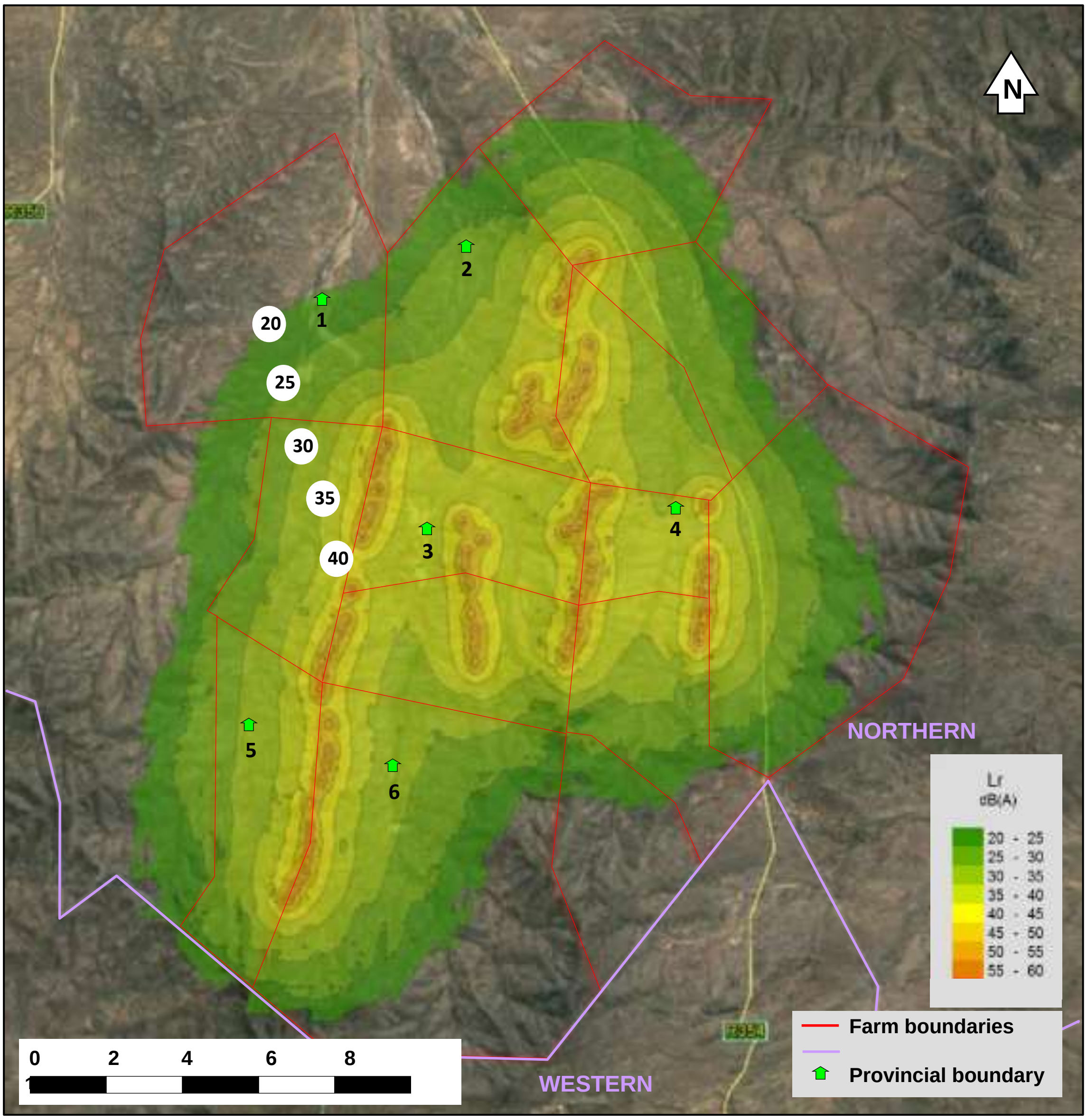


Figure 8.15: Predicted L_{Aeq} contours 2 m above local ground level due to operation of the wind turbines during a wind speed of 10 m/s. Karreebosch Wind Farm site boundaries demarcated by red lines; farm dwellings demarcated by blue circles; provincial boundary in pink; and calculated L_{Aeq} contours due to noise from wind turbines.

Noise Impact on surrounding land beyond the wind farm boundaries

From Figure 8.15 it is apparent that the predicted L_{Aeq} would be less than 33 dBA on all land beyond the wind facility boundaries with an associated **negligible** intensity of noise impact. In terms of the NCR-WC and NCR-N no noise mitigation procedures would need to be implemented.

Figure 8.13 contains a summary of predicted noise impact on land beyond the proposed Karreebosch Wind Farm site boundaries in terms of SANS 10103:2008.

Summary of predicted noise impact on land beyond the Karreebosch Wind Farm site boundaries

Nature: Noise impact on dwellings beyond the boundaries of the site
Impact Magnitude –**Medium**

- **Extent:** Local.
- **Duration:** Long term.
- **Intensity: Negligible**
- **Likelihood: –**unlikely.

Impact Significance Negligible
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned
Irreplaceable Loss of Resources: No

Mitigation:

» No mitigation required.

Noise impact at dwellings within the site boundaries

Nature: The calculated L_{Aeq} due to wind turbine noise at the identified numbered dwellings shown in Figure 8.15, the excess over the measured residual level of 33 dBA and the predicted intensity of noise impact in terms of SANS 10103:2008.
Impact Magnitude –**Medium**

- **Extent:** Local.
- **Duration:** Long term.
- **Intensity: High**
- **Likelihood:** –High

Impact Significance Negligible
Degree of Confidence: The degree of confidence is **high**.
Reversibility: High, impact will exist until facility is decommissioned
Irreplaceable Loss of Resources: No

Mitigation:

» No mitigation required in terms of the noise control regulations.

All of the overall, single-figure L_{Aeq} values would comply with the NCR-WC and NCR-N. Therefore no noise mitigation procedures would need to be implemented at any of the dwellings.

However, the single-figure values contain no information with which to determine whether the wind turbine noise at a receptor (dwelling) would still be audible or whether it would be masked by the residual noise. A more detailed analysis was required, as is outlined below:

The equivalent continuous A-weighted sound pressure level in each 1/3rd octave frequency band (noise level spectrum) was calculated at each of the identified dwellings within the Karreebosch Wind facility site boundaries. The overall, single-figure L_{Aeq} value for each of dwellings appears in the legend. Figure 8.16 below provides a comparison of the noise level spectrum of wind turbine noise at each dwelling location with that of the average daytime residual noise for wind speeds up to 5 m/s measured on "Karoo" land. This comparison was considered to represent a best estimate assuming that the wind speeds at the wind turbines, located on elevated land at least 200 m above that of the dwellings, would be higher than at the dwellings.

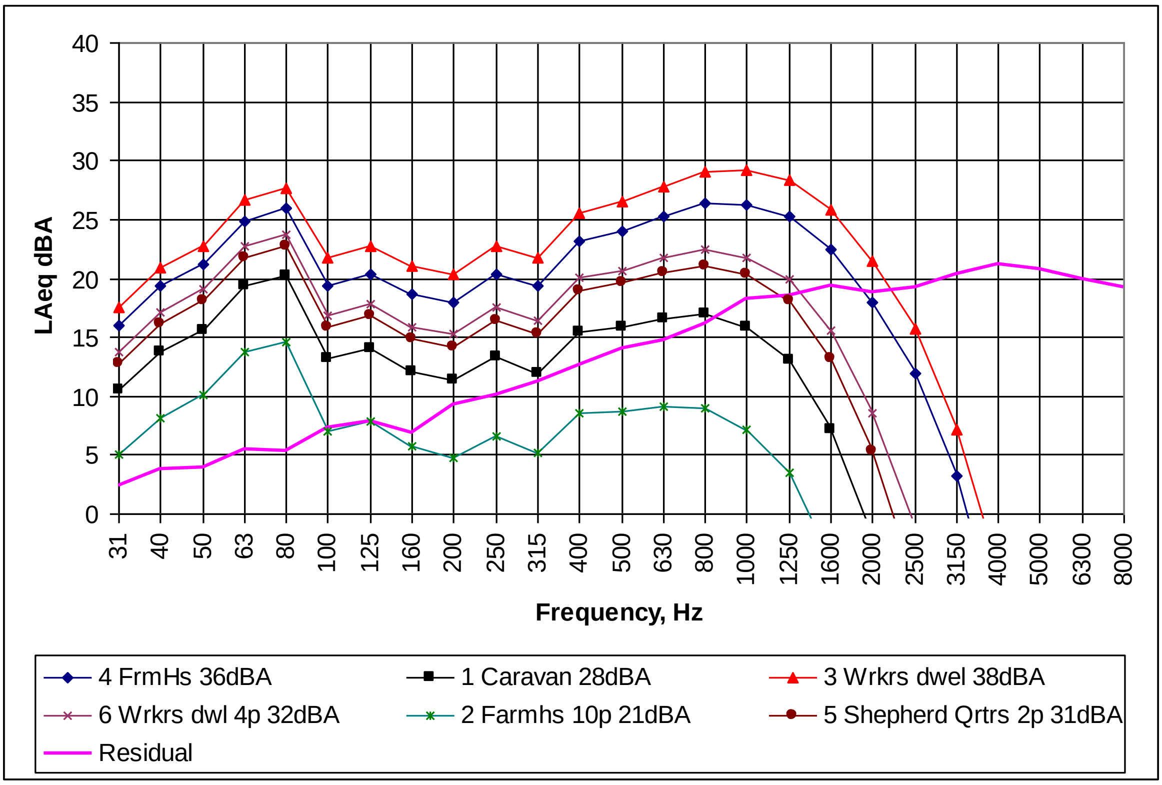


Figure 8.16: Calculated noise level spectrum of wind turbine noise at each of the identified dwellings and average measured daytime noise level spectrum of residual noise.

Inspection of the results in Figure 8.16 indicates that at all dwellings, other than the farmhouse with 10 people, the outdoor spectrum levels due to turbine noise would significantly exceed that of the residual noise by more than 10 dB at low frequencies centred on 80 Hz. Under such conditions low frequency turbine noise would probably be distinctly audible both outside and within the dwellings.

8.7.2. Conclusions and Recommendations

The results of the NIA indicated that the predicted L_{Aeq} values on land surrounding the proposed Karreebosch Wind Farm boundaries as well as at the identified noise sensitive receptors (dwellings) within the property boundaries would comply with the NCR legal requirements. Therefore, there would be no obligation to implement noise mitigation procedures.

Notwithstanding the legal compliance, a more detailed analysis indicated that low frequency turbine noise would probably be distinctly audible both outside and within the identified dwellings located within the wind farm. It is recommended that the owners/occupiers of the dwellings identified in this study be made aware of the fact that low frequency noise may be distinctly audible within the dwellings and mitigation be put in place to reduce this impact if possible. The Noise Impact specialist has recommended that this be included in the EMPr.

8.8. Assessment of Potential Impacts on Archaeology, Palaeontology and Cultural Heritage Resources

The assessment of impacts on archaeology, palaeontology and heritage resources is based on the findings of the Heritage Impact Assessment conducted by ACO Associates cc (Appendix K).

Archaeology

Figure 8.17 shows the distribution of recorded heritage sites on and around the site. None of these heritage artefacts/sites occur within the proposed wind turbine development footprint. The pre-colonial heritage of the area as manifested by archaeological traces is extremely sparse. Very little material was identified and no particular mitigation is suggested.

The colonial archaeological heritage of the study area is confined to areas along river banks, and valleys which appear to have been the focus of settlement during the last two centuries (refer to Appendix 1 of Heritage Impact Assessment (Appendix K)).

If any of the valley bottoms are to be impacted or the valley bottom roads widened, then this area will need to be thoroughly surveyed and all heritage sites recorded and mapped on the landscape. Sensitive areas must be flagged so that these can be protected from construction related activities. These heritage artefacts/sites are briefly described below:

» **Pre-colonial and Colonial Archaeology:** No recommendations are made with respect to pre-colonial heritage. The most important colonial archaeological sites in the study area are associated with Ekkraal Valley, the Rietfontein-Wilgebosch River valley and the Krans Kraal-Karrekraal valley. The valley bottoms are archaeologically sensitive and should be avoided wherever possible.
  Graves - A number of cemeteries have been encountered in valley bottoms. The widening of the roads within the valley bottom will need to be done with care to ensure that these are avoided. Consideration should be made to

cordoning these off to avoid the potential for impact. It is possible that unmarked graves may be encountered during trenching and excavations. In the event of this happening work in the immediate area should cease and the finds reported to the heritage authority and an archaeologist. Human remains must not be removed from the find-site, but the area cordoned off until a formal investigation and exhumation can be put in place. Graves tend to be located close to settlements. In addition to the identified ones with typical surface identifiers such as cairns and/or head stones, there are likely to be others that never had any, or which have been lost over time. If human remains/burials are uncovered during the construction phase, work in the specific location should cease, and HWC/SAHRA should be notified. They would in all likelihood request an archaeologist to investigate and implement mitigation, in the form of exhumation. The mitigation of human remains from the colonial period requires a permit to be issued by the SAHRA Burials Unit

» **Built Environment and cultural landscape -** Re-use of empty farm houses for project infrastructure is encouraged as long as renovations carried out are subject to the approval of the relevant heritage compliance authority (where buildings are older than 60 years). It is suggested that the services of a conservation architect are sought if any farm houses are to be altered for re-use. Kraals, walls, stone features and ruins must be left in-tact on the landscape.

The proposed wind energy facility will not be visible from any major transport routes (N1) but there will be visibility from tertiary roads in the area and especially the R354 between Matjiesfontein and Sutherland, a scenic tourism route. This will affect the sense of wilderness for a portion of the region. Conservation-worthy buildings or places of celebrated heritage significance are limited in the area. The presence of existing 400 kV and 765 kV lines as well as further planned 765 kV transmission lines are destined to lead to further industrial clutter in the area. The landscape grading of the study area ranges from Grade IIIA to Grade II (refer to specialist study in Appendix K for definition) The visual impact of the turbine positions has been assessed by a separate Visual Impact Assessment with the finding that receptors in the study area including the regional roads will experience a significant impact, although this is dependent on the distance from the facility.

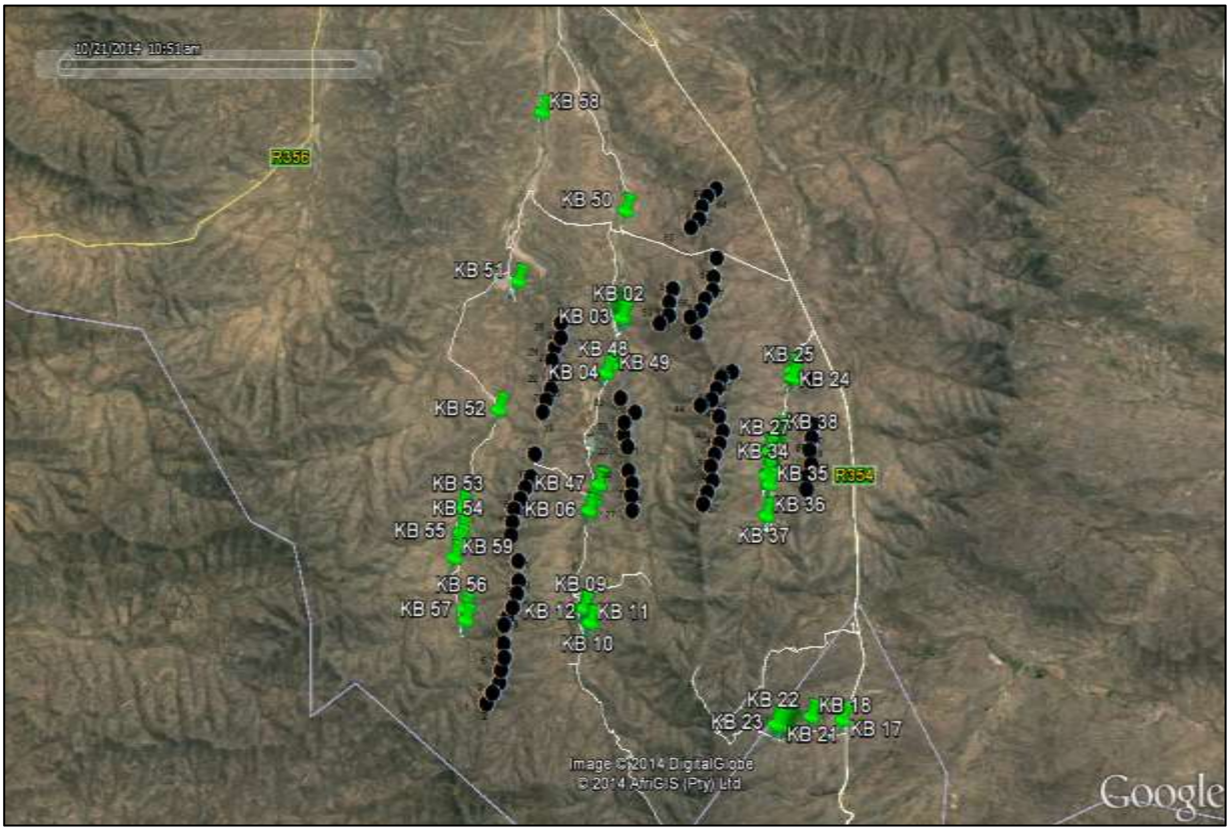


Figure 8.17: Distribution of recorded heritage sites (green) and proposed turbine layout (black) for Karreebosch Wind facility

Palaeontology

The majority of fossil sites recorded in the study region lie outside the anticipated development footprint. The common trace fossil assemblages identified in this study are of widespread occurrence within the Abrahamskraal Formation (*i.e.* not unique to the study area). Construction of the Karreebosch Wind Farm and associated infrastructure is therefore unlikely to entail significant impacts on local fossil heritage resources; *i.e.* the impact significance of the wind farm project is assessed as minor. The impact significance of both power line route options to Komsberg Substation is likewise assessed as minor and there is no marked preference for either route option on palaeontological grounds. These mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for the Karreebosch Wind Farm and associated power lines.

Given the low impact significance of the proposed Karreebosch Wind Farm near Sutherland (including alternative transmission line corridors to Komsberg Substation) as far as palaeontological heritage is concerned, no further specialist palaeontological heritage studies or mitigation are considered necessary for this project, pending the discovery or exposure of substantial new fossil remains during development. This recommendation applies provided that no substantial infrastructure, apart from the proposed transmission lines and associated access roads, is constructed within the portion of the study area east of the R354 which has not been directly assessed through fieldwork.

During the construction phase all deeper (> 1 m) bedrock excavations should be monitored for fossil remains by the responsible Environmental Officer (EO). Should substantial fossil remains such as vertebrate bones and teeth, plant-rich fossil lenses, fossil wood or dense fossil burrow assemblages be exposed during construction, the responsible EO should safeguard these, preferably *in situ*, and alert SAHRA, *i.e.* The South African Heritage Resources Authority, as soon as possible so that appropriate action can be taken by a professional palaeontologist, at the developer's expense.

Provided that the recommended mitigation measures are carried through, it is likely that any potentially negative impacts of the proposed power line development on local fossil resources will be substantially reduced. Furthermore, they will be partially offset by the *positive* impact represented by increased understanding of the palaeontological heritage of the broader study region.

8.8.1. Impact Assessment

Wind Turbines

The areas selected for the proposed construction of turbines are the tops of the large longitudinal ridges that are generally orientated north-south through the study area. These wind-swept mountain tops are generally remote, exposed and inhospitable. During the course of this study many kilometres of ridge top landscape were traversed and found to be largely sterile of any form of human made heritage material.

There are some 16 turbines within 3 km of the R354 which will be highly visible from the R354 between Sutherland and Matjiesfontein occupying some 14 linear km of landscape on the western side of the road. This means that together with Phase 1 of the Roggeveld project almost 30 km of the R354 will be subject to direct landscape impacts.

While the R354 is not a heritage resource as such, it does link two heritage rich communities which are strongly contextually linked with the Karoo experience, hence the proposed development could impact the sense of place associated with both towns. The degree to which this potential impact will be perceived by people depends on the perceptions and aesthetic inclinations of the user of the R354. The historic pass to Sutherland via Karoopoort lies about 18km to the east of the closest turbine row. The impact to this heritage resource and scenic route will be minimal as the turbines will only be marginally visible under the clearest of conditions.

The study area has little amenity or intrinsic active tourism value at the present time (although it is highly scenic), which means that assigning a high degree of impact in terms of sense of place is unjustified. On the other hand, it is these very qualities that impart the area its wilderness value. It must be noted that the development proposal will potentially sterilise the area in terms of any future development of wild life experiences or outdoors orientated tourism, while the visual impact from the R354 will change the experience of people using the route to Sutherland, a locality that has become a popular tourist destination on account of SALT (South African Large Telescope). It must be noted however that there are already a number of authorised facilities in the area (3 of which are preferred bidder projects). It is therefore unlikely that this particular project will 'sterilise the area' as such as it will already be impacted by other facilities by the time this project is developed.

The area is fossiliferous which means that palaeontological material may be impacted by excavation of footings for turbines. Provided that suitable mitigation is carried out, this is not necessarily a negative impact as gains in terms of contributions to scientific knowledge may result from any new observations made. If mitigation is not carried out, negative impacts will result as potentially significant scientific evidence will be lost.

<u>Substations</u>

Impacts on heritage resources due to the substations are not expected however new industrial intrusions may impact aesthetic qualities of farms. Final substation footprints must be surveyed prior to construction commencing. Physical impacts will be minimal.

<u>Connecting Electrical Lines</u>

Power lines will be required to connect 'the on-site substations to the Eskom Komsberg Substation. Turbines in turn will need to be connected with substations by means of a network of underground cables. Impacts to person-made heritage are not expected. The intention to use above ground connecting lines between turbines and transformers presents a new vertical intrusion in the landscape which will add further to the industrialised character presented by the proposed facility in general. In terms of physical heritage the use of above ground lines will decrease the potential impact on both archaeology and palaeontology. In terms of power line options, no particular power line option is preferred from a heritage point of view. This is a visual impact which should be addressed from that discipline. Final layouts must be assessed during the Environmental Management Programme (EMPr).

Borrow Pits

The borrow pit locations are satisfactory from a heritage perspective.

Access Roads

A network of roads will be needed for construction and servicing of turbines. The proposal is to use as many existing farm roads as possible to limit damage to the veld. New roads will need to be constructed to gain access to the high ridges and turbine rows. Farm roads will need to be upgraded to a width of 12m in places. Cuttings in slopes may be needed to produce gradient that are negotiable for heavy vehicles and abnormal loads. The overall effect will be increased visibility of the road system on the landscape and scarring of hill slopes. Final road alignments must be surveyed prior to construction. Heritage findings indicate that the proposed access roads will have a low impact on physical heritage, however any widening of the roads down the valley bottoms must avoid impacting historical sites and graves.

a) Impact Description and Assessment

Construction Phase

i. Archaeology

The pre-colonial heritage of the area as evident by archaeological traces is extremely sparse. The colonial archaeological heritage of the study area is also sparse, but forms two distinct clusters. Areas along river banks and valleys appear to have been the focus of settlement during the last two centuries.

Construction Impact: Impact on Archaeological Heritage

Potential impact of the construction of the turbines, substations, access roads and power line/s on the pre-colonial and colonial archaeology of the study area

Nature: Construction activities could result in **direct** impacts caused by physical destruction on archaeological material on the wind facility site.

- **Impact Magnitude** – **Low**
- **Extent**: The extent of the impact is **local**.
- **Duration**: The duration would be **long-term** as these resources are non-renewable and once destroyed, they cannot be replaced.
- **Intensity**: Low.
- **Likelihood –** It is **probable** that localised archaeological resources would be lost.

Reversibility: Not reversible

Irreplaceable Loss of Resources: Yes, high
Impact Significance (Pre-Mitigation) – Minor (Pre-Mitigation) – negligible

Mitigation:
» Final infra-structure positions must be field proofed by an archaeologist prior to construction

ii. Built Environment

The built environment of the study area is limited and sparse. Although virtually every farm has generally protected material in its confines, none of these have anything beyond moderate local heritage significance. Direct impacts to any structures are expected to be very limited (the best example of a Karoo historical house lies well outside the study area some 5 km to the south).

The greatest negative impact is on the landscape. This is the industrialisation of a very large expanse of natural landscape adjacent to the R534 which is considered a scenic route. Combined with the impact of up to 5 other similar facilities planned in the general area, the natural amenity qualities of the region will be negatively impacted. The grading of the scenic route between Sutherland and Matjiesfontein will be affected and in all likelihood decrease from Grade lllA to Grade lllc or ungraded. Apart from moving the turbines beyond visual range of the route, no mitigation is possible.

On physical heritage alone, there is no justifiable reason for not supporting the proposal. However the accumulative impacts on the Karoo landscape and its archetypical South African scenery are of deep concern. The proliferations of renewable energy facilities that sterilise vast tracts of landscape will in time alter the economy of the Karoo, and change its identity in the Southern African context.

No significant heritage limitations were encountered during the heritage impact survey, however, the specialist is of the opinion that it will be necessary for an archaeologist to be involved in reviewing and walking down some of the proposed road alignments, especially through the valleys which are the most sensitive areas as part of the EMPr for the project.

The area of greatest concern is the accumulative impact of a large amount of applications for wind energy development in the area which will impact the overall aesthetic qualities of the Roggeveld area and plateaux.

Construction Impact: Impact on Built Environment

Potential Impact of construction of wind farm and ancillary infrastructure on the built environment of the study area.

Nature: Direct impacts caused by physical destruction of buildings, un-authorised demolition, theft of fabric and fixtures or neglect.

- **Impact Magnitude** – **Low**
- **Extent**: The extent of the impact is **local**.
- **Duration**: Long-term.
- **Intensity**: Loss of heritage resources will be permanent, so the magnitude of the change will be **low**.

Reversibility: Not reversible
Irreplaceable Loss of Resources: Yes (if not mitigated)
Impact Significance (Pre-Mitigation): Minor (-), (Post Mitigation): Minor (+)

Mitigation:

» Mitigation of the built environment should involve micro siting turbine positions and associated infrastructure during the EMPr to avoid placing turbines or infrastructure directly over built environment features and buildings or bisecting coherent settlement complexes.
» The sensitive reuse of vacant buildings is encouraged (as long as advice is sought on heritage sensitivities) as this will help sustain them.

iii. Palaeontology

Palaeontology

The Karreebosch Wind Farm project area is located in an area that is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary, age. The construction phase of the proposed wind farm development will entail substantial excavations into the superficial sediment cover and locally into the underlying bedrock as well. Construction of the Karreebosch Wind Farm and associated infrastructure, including proposed new overhead power lines to the Komsberg Substation, is therefore unlikely to entail significant impacts on local fossil heritage resources. Due to the general great scarcity of fossil remains as well as the extensive superficial sediment cover observed within the entire study area, the overall impact significance of the construction phase of the proposed wind farm is assessed as minor. The operational and decommissioning phases of the wind energy facility are very unlikely to involve further adverse impacts on local palaeontological heritage.

No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Karreebosch Wind Farm study area. The majority of fossil sites recorded in the study region lie outside the anticipated development footprint. The common trace fossil assemblages identified in this study are of widespread occurrence within the Abrahamskraal Formation (i.e. not unique to the study area). Irreplaceable loss of fossil heritage is therefore not anticipated, although it should be highlighted that any new vertebrate fossil finds made during construction (e.g. exposed in new bedrock excavations) would be of considerable scientific interest, given their rarity. Should fossil remains be impacted by the proposed development, these impacts can be partially mitigated, as outlined below.

It should be noted that should new fossil remains be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would remain MINOR. Residual negative impacts from loss of fossil heritage are likely to be minor and would be partially offset by an improved palaeontological database for the study region as a direct result of appropriate mitigation. This is a positive outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region would constitute a useful addition to our scientific understanding of the fossil heritage here.

Because of the generally low levels of bedrock exposure within the study area, confidence levels for this palaeontological heritage assessment are only Moderate, following the field assessment of representative rock exposures.

The excavation of the turbine and substation foundations, road construction and installation of cables has the potential to destroy or damage archaeological and palaeontological resources. If appropriate mitigation is implemented, potentially positive impacts may be caused with new palaeontological discoveries.

Construction Impact: Impact to Paleontological Heritage

Direct impacts caused by breaking, crushing or discarding of fossil material during excavation for turbines bases, road cuttings or any other deep excavation

Nature: Direct impacts caused by breaking, crushing or discarding of fossil material during excavation for turbines bases, road cuttings or any other deep excavation.

- **Impact Magnitude** – **Moderate**
- **Extent**: The extent of the impact is **local**.
- **Duration**: The duration would be **long-term** as these resources are non-renewable and once destroyed, they cannot be replaced.
- **Likelihood**: unlikely

Impact Significance (Pre-Mitigation): Minor (-) (Post-Mitigation): Minor (+)
Reversibility: Not reversible (without mitigation), reversible (with mitigation)
Irreplaceable Loss of Resources: Yes (without mitigation), No (with mitigation)

Mitigation

» Mitigation of palaeontological heritage can be achieved by ensuring that trenches and deep rock excavations are checked by the project ECO. The collection of new scientific information is a positive impact.

iv. Cultural Landscape of the Study Area

<u>Construction Impact : impact to sense of wilderness</u>

Direct impacts caused by physical destruction and massive visual intrusion, impacts to sense of wilderness and country.

Nature: Direct impacts caused by physical destruction and massive visual intrusion, impacts to sense of wilderness and country.

- **Impact Magnitude** – **High**
- **Extent**: The extent of the impact is **local**.
- **Duration**: Long-term.
- **Likelihood**: likely

Intensity: Loss of heritage resources will be permanent, so the magnitude of the change will be **high**.

Impact Significance (Pre-Mitigation and Post Mitigation) Major

Reversibility: High, impact only for operational lifespan

Irreplaceable Loss of Resources: Yes

Mitigation:

» The size of the turbines and their massed presence will impact the quality of the Karoo landscape. Good rehabilitation of construction roads and cuttings may mitigate to a small degree.

v. Graves

Human remains can occur at any place on the landscape, but are particularly likely to be found on or close to archaeological sites and settlements. In addition to the identified ones with typical surface identifiers such as cairns and/or head stones, there are likely to be others that never had any, or which have been lost over time. However human remains are usually exposed during construction activities. Such remains are protected by a wide range of legislation including the Human Tissues Act (Act No 65 of 1983), the Exhumation Ordinance of 1980 and the National Heritage Resources Act (Act No 25 of 1999).

If human remains/burials are uncovered during the construction phase, work in the specific location should cease, and HWC/SAHRA should be notified. They would in all likelihood request an archaeologist to investigate and implement mitigation, in the form of exhumation. The mitigation of human remains from the colonial period requires a permit to be issued by the SAHRA Burials Unit.

8.8.2. Impacts within the power line corridors

Connection of the proposed Karreebosch Wind Farm to the Eskom grid will involve approximately 25 km of 33 kV overhead power line and about 25 km of 132 kV overhead power line feeding into the existing Komsberg substation. Two route options for the 132 kV power line are under consideration.

Impacts on heritage are likely to be marginally greater in the case of the longer transmission line route (Alternative 2). However, the impact significance of both transmission line route options is Minor and there is no marked preference for either route option on palaeontological or heritage & archaeology grounds.

8.8.2. Conclusion and Recommendations

The findings of the heritage assessment have revealed that the study area is relatively austere in terms of pre-colonial heritage, however valley bottoms contain evidence of early trekboer cultural landscapes – ruins, graves and occasional middens. These consist of collections of ruined stone and mud buildings, threshing floors and kraals located exclusively in the valley areas between the high longitudinal ridges that characterise the study area. There are a number of existing farm houses that contain 19th century fabric, however very few of these have anything more than moderate heritage significance. Parts of the study area enjoy very high aesthetic qualities.

A summary of the impacts on heritage resources is provided in the table below.

Phase	**Significance (Pre-mitigation)**	**Significance (with-mitigation)**
Construction - Palaeontology	**Minor (negative)**	**Minor (positive)**
Construction – Archaeology	**Minor (negative)**	**Negligible**
Construction – Built Environment	**Minor (negative)**	**Minor (positive)**
Construction and Operation – Cultural Landscape	**Major (negative)**	**Major (negative)**

No significant heritage limitations were encountered during the survey, however it will be necessary for an archaeologist to be involved in reviewing and walking down some of the proposed road alignments, especially through the valleys which are the most sensitive areas as part of the EMP for the project

No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Karreebosch Wind Farm study area. The majority of fossil sites recorded in the study region lie outside the anticipated development footprint. While the geology of the study area is potentially paleontologically sensitive, very few fossils were found by either Dr Duncan Miller or Dr John Almond in the study area. No further work in this respect is recommended, other than reporting of any finds during construction to the heritage authorities. Specialist palaeontological mitigation is only triggered should significant new fossil remains be exposed during the construction phase.

8.9. Assessment of Potential Social Impacts

The potential issues/impact identified by the socio-economic assessment includes:

» Creation of employment and business opportunities, and the opportunity for skills development and on-site training;
» Impacts associated with the presence of construction workers on site and in the area;
» Influx of job seekers to the area;
» Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site;
» Increased risk of veld fires;
» Impact of heavy vehicles, including damage to roads, safety and dust;
» Potential loss of productive farmland associated with construction-related activities.

Benefits for the Local Economy
The development of the wind farm will result in significant spending in South Africa having a positive impact on the national, regional and local economy to varying degrees. Direct benefits such as employment and procurement associated with the project will have the most significant impact when compared to indirect and induced impacts.

However, over time as the renewable sector develops, additional benefits to the national economy may accrue as the supply chain to the renewable energy sector develops. The direct impacts will be most significant during the construction phase of the project, and are likely to have the largest influence on the local economy.

8.9.1. Impact Assessment

Construction Phase
Based on the information from other WEF projects the construction phase for a 140 MW WEF is expected to extend over a period of 18-24 months and create approximately 300 employment opportunities during peak construction. The work associated with the construction phase will be undertaken by contractors and will include the establishment of the WEF and the associated components, including, access roads, substation, services and power line. It is anticipated that approximately 55% (165) of the employment opportunities will be available to low skilled workers (construction labourers, security staff etc.), 30% (90) to semi-skilled workers (drivers, equipment operators etc.) and 15% (45) for skilled personnel (engineers, land surveyors, project managers etc.).

Members from the local community in the area are likely to be in a position to qualify for the majority of the low skilled and semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local Karoo-Hoogland Local Municipality and Laingsburg Local Municipality community. The levels of unemployment in the Karoo-Hoogland Local Municipality and Laingsburg Local Municipality are relatively high. The creation of potential employment opportunities, even temporary employment, will represent a significant, if localised, social benefit. However, in the absence of specific commitments from the developer to maximise local employment targets the potential opportunities for local employment will be limited. In this regard the KHLM Municipal Manager, Mr. Allistar Gibbons, indicated that the experience from the last major construction project in the Sutherland area (SALT, 2001-2004) was that there was no meaningful skills transfer for locals. Locals were employed as unskilled labour, and remained such after SALT was constructed. The majority of the skilled employment opportunities are likely to be associated with the contactors appointed to construct the WEF and associated infrastructure.

The capital expenditure associated with the construction of a 140 MW WEF will be in the region of R 2.5 billion (2015 Rand value). A percentage of the capital expenditure associated with the construction phase has the potential to benefit local companies. However, the opportunities for companies in Sutherland and Laingsburg are likely to be limited. In this regard the benefits are likely to accrue to companies based in towns based further afield, such as Worcester and Cape Town. Implementing the enhancement measures listed below can enhance these opportunities. However, the potential opportunities for local companies are likely to be limited due to the high import content associated with WEF projects.

The movement of heavy construction vehicles during the construction phase has the potential to damage local farm roads and create dust and safety impacts for other road users in the area and also impact on farming activities. The project components will be transported to the site via the N1. The N1 provides the key link between the Western Cape and Gauteng and is an important commercial and tourist route. The transport of components of the WEF to the site therefore has the potential to impact on other road users travelling along the N1.

The presence of construction workers poses a potential risk to family structures and social networks in the town of Sutherland and Laingsburg. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

» An increase in alcohol and drug use;
» An increase in crime levels;
» The loss of girlfriends and/or wives to construction workers;
» An increase in teenage and unwanted pregnancies;
» An increase in prostitution;
» An increase in sexually transmitted diseases (STDs), including HIV.

As indicated above, all of the low skilled (165) and the majority of the semi-skilled (90) work opportunities associated with the construction of a single 140 MW WEF are likely to benefit members from the local community. If these opportunities are taken up by local residents the potential impact on the local community will be low as these workers will form part of the local family and social network. Employing members from the local community to fill the low-skilled job categories will therefore reduce the risk and mitigate the potential impact on the local communities. The use of local residents to fill the low skilled job categories will also reduce the need to provide accommodation for construction workers in Sutherland and Laingsburg. The skilled workers (45) are likely to be accommodated in local guest houses in Sutherland and Laingsburg and surrounds.

Construction Impact: Impact assessment of employment and business creation opportunities during the construction phase

Nature: The benefit to the local economy will be **direct** via employment and procurement of services and **indirect** employment in other industries affected by the project such as accommodation and catering industries; as well as via spending in the local economy due to increase in wages etc.

- **Extent:** local - regional
- **Duration:** short-term
- **Intensity:** low (pre-enhancement) to moderate (post-enhancement)
- **Likelihood –** likely

Impact Significance (Pre-Enhancement) – Minor (+ve) (Post-Enhancement) – Moderate (+ve)
Reversibility: N/A
Irreplaceable Loss of Resources: N/A

Enhancement:

» Where reasonable and practical the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. Due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
» Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria.
» Before the construction phase commences, the proponent should meet with representatives from the KHLM and LLM to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase.

» The local authorities and relevant community representatives should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.
» Where feasible, a training and skills development programmes for local workers should be initiated prior to the initiation of the construction phase.
» The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.
» The proponent should liaise with the KHLM and LLM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors. These companies should be notified of the tender process and invited to bid for project-related work;
» Where possible, the proponent should assist local BBBEE companies to complete and submit the required tender forms and associated information.
» The KHLM and LLM, in conjunction with the local business sector and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.

Construction Impact: Benefit of technical advice for local farmers and municipalities

Nature: Potential benefit for local farmers and municipalities associated with providing advice on installation of small-scale wind energy technology to supplement their energy needs

- **Extent:** local
- **Duration:** long term (with enhancement)
- **Intensity:** low (with enhancement)
- **Likelihood –** likely (with enhancement)

Impact Significance (Pre-Enhancement) – Negligible (Post-Enhancement) – Minor(+ve)

Reversibility: N/A

Irreplaceable Loss of Resources: N/A

Enhancement:

» The proponent in consultation with the contractor should hold a workshop/s with local farmers and representatives from KHLM and LLM to discuss options for installing small-scale wind energy facilities and the technology and costs involved.

Construction Impact: Potential impacts on family structures and social networks associated with the presence of construction workers

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers

- **Extent:** Local to regional
- **Duration:** Short term for community as a whole
  Long term-permanent for individuals who may be affected by STDs etc.
- **Intensity:** Low for community as a whole, high for affected individuals
- **Likelihood:** Likely

Impact Significance (Pre-Mitigation) – Minor(-ve) for community,
(Post-Mitigation) – Minor (-ve) for community

Degree of Confidence: The degree of confidence is medium

Reversibility: Not in the case of HIV AIDS infections

Irreplaceable Loss of Resources: Yes (for affected individuals)

Mitigation:

» Where possible the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories.

» The proponent and contractor/s should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase.

» The construction area should be fenced off before construction commences and no workers should be permitted to leave the fenced off area.

» The contractor should provide transport to and from the site on a daily basis for low and semi-skilled construction workers. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site.

» Where necessary, the contractors should make the necessary arrangements to enable low and semi-skilled workers from outside the area to return home over weekends and/ or on a regular basis. This would reduce the risk posed to local family structures and social networks.

» It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

Construction Impact: Potential impacts on family structures, social networks and community services associated with the influx of job seekers

Nature: Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the manner in which they conduct themselves can impact on the local community.

- **Extent:** Regional
- **Duration:** Short-term, for the duration of the construction phase of the project.
- **Intensity:** Low
- **Likelihood –** Unlikely

Impact Significance (Pre-Mitigation) – Minor (-ve)
(Post-Mitigation) – Minor (–ve)

Reversibility: High

Irreplaceable Loss of Resources: N/A

Mitigation:

It is not possible to prevent job seekers from coming to the area in search of a job. However, as indicated above, the potential influx of job seekers to the area as a result of the proposed WEF is likely to be low. In addition:

- The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities;

- The proponent should implement a policy that no employment will be available at the gate and or in Sutherland and Laingsburg (except for local residents).

Construction Impact: Risk to safety, livestock and farm infrastructure

Nature: Risk to safety, livestock and damage to farm infrastructure The farms are divided into camps and in order to access the full proposed project site it will be necessary for the construction team to travel between camps; requiring them to open and close gates as they move. They will, at times, also be required to travel across/alongside neighbouring farms to reach the selected sites. It is critical that the gates are always closed once the team has passed in order to secure the stock.

The high traffic volumes of light and heavy vehicles that will be passing through the farm camps are likely to cause damage to the gates and fencing. Any damage to this infrastructure could also lead to stock losses.

- **Extent:** local.
- **Duration:** The disruptions will be experienced during the construction phase and as such will be short-term.
- **Intensity:** medium (pre-mitigation) to low (post-mitigation)
- **Likelihood:** Likely

Impact Significance (Pre-Mitigation) – Moderate (-ve)
(Post-Mitigation) – Minor (-ve)

Reversibility: Low (pre-mitigation) to high (post-mitigation)

Irreplaceable Loss of Resources: Yes, if livestock are not replaced or compensated for

Mitigation

» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase proven to be associated with the construction activities for the WEF will be compensated for. The agreement should be signed before the construction phase commences;

» The construction area should be fenced off prior to the commencement of the construction phase. The movement of construction workers on the site should be confined to regulated areas;

» Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. This would reduce the potential risk of trespassing on the remainder of the farm and adjacent properties;

» The proponent should consider the option of establishing a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. This committee should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site;

» The proponent should hold contractors liable for compensating farmers in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below);

» The Environmental Management Programme (EMP) should outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested;
» Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.
» Contractors appointed by the proponent must ensure that construction workers who are found guilty of trespassing, stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation;
» The housing of construction workers on the site should be strictly limited to security personnel.

Construction Impact: Increased risk of grass fires

Nature: The presence of construction workers and construction-related activities on the site poses an increased risk of grass fires that could in turn pose a threat to livestock, crops, and farmsteads in the area. In the process, farm infrastructure may also be damaged or destroyed and human lives threatened.

- **Extent:** Local - regional
- **Duration:** The disruptions will be experienced during the construction phase and as such will be short-term.
- **Intensity:** medium (pre-mitigation) to low (post-mitigation)
- **Likelihood –**likely (pre- mitigation) to unlikely (post-mitigation)

Impact Significance (Pre-Mitigation) – Moderate (-ve)
(Post-Mitigation) – Minor(-ve)

Reversibility: Medium (pre- mitigation) - High (post-mitigation)

Irreplaceable Loss of Resources: Yes, if no compensation paid for losses

Mitigation

» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase proven to be associated with the construction activities for the WEF will be compensated for. The agreement should be signed before the construction phase commences;
» The construction area should be fenced off prior to the commencement of the construction phase. The movement of construction workers on the site should be confined to regulated areas;
» Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. This would reduce the potential risk of trespassing on the remainder of the farm and adjacent properties;
» The proponent should consider the option of establishing a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. This committee should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site;
» The proponent should hold contractors liable for compensating farmers in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also

cover loses and costs associated with fires caused by construction workers or construction related activities (see below);

» The Environmental Management Programme (EMP) should outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested;
» Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.
» Contractors appointed by the proponent must ensure that construction workers who are found guilty of trespassing, stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation;
» The housing of construction workers on the site should be strictly limited to security personnel.

Construction Impact: Loss of farmland

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the WEF and power lines will damage farmlands and result in a loss of farmlands for grazing.

- **Extent:** Local
- **Duration:** Long term to short term (if damaged areas are rehabilitated)
- **Intensity:** The intensity will be high (pre-mitigation) to minor (post-mitigation)
- **Likelihood:** likely to occur during the construction phase.

Impact Significance (Pre-Mitigation) – Moderate (-ve)
(Post-Mitigation) – Minor(-ve)

Reversibility: Low (pre-mitigation), High (post-mitigation)

Irreplaceable Loss of Resources: No, if disturbed areas are rehabilitated

Mitigation

» The location of wind turbines, access roads, laydown areas etc. should be informed by the findings of a soil study. In this regard areas of high potential agricultural soils should be avoided;
» The location of wind turbines, access roads, laydown areas etc. should be discussed with the locally affected landowners in the finalisation process and inputs provided should be implemented in the layout as best as possible;
» Where possible - e.g. on Nuwekraal - the placements should be on still higher ground, above the 1 100 m contour. This would result in a reduction of the area lost from grazing. This step was undertaken together with the landowner and the ecological specialist, following the feedback provided. The process is described in detail in the Ecology specialist report.
» The footprint areas for the establishment of individual wind turbines should be clearly demarcated prior to commencement of construction activities. All construction related activities should be confined to the demarcated area and minimised where possible;
» An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase;
» All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the

construction phase. The rehabilitation plan should be informed by input from a botanist with experience in arid regions;

» The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be drawn up the Environmental Consultants appointed to undertake the EIA;
» The implementation of the Rehabilitation Programme should be monitored by the ECO.
» All workers should receive training/ briefing on the reasons for and importance of not driving in undesignated areas;
» EMP measures (and penalties) should be implemented to strictly limit all vehicle traffic to designated roads and construction areas. Under no circumstances should vehicles be allowed to drive into the veld;
» Disturbance footprints should be reduced to the minimum.

Construction Impact: Impacts associated with construction vehicles

Nature: Potential dust and safety impacts and damage to road surfaces associated with movement of construction related traffic to and from the site

- **Extent:** local - regional
- **Duration:** Employment generated during the construction phase will take place over a 12 to 24 month period and will therefore be short-term.
- **Intensity:** Moderate (pre-mitigation) to Minor (post-mitigation)
- **Likelihood:** likely

Impact Significance (Pre-Mitigation) – Moderate (-ve),
(Post-Mitigation) – Minor (-ve)

Reversibility: Moderate (pre-mitigation), High (post-mitigation)

Irreplaceable Loss of Resources: Yes (pre-mitigation), No (post-mitigation)

Mitigation:

» As far as possible, the transport of components to the site along the N1 should be planned to avoid weekends and holiday periods
» The contractor must ensure that damage caused by construction related traffic to local farm roads is repaired on a regular basis throughout the construction phase. The costs associated with the repair must be borne by the contractor.
» All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.
» The Contractor should ensure that workers are informed that no waste can be thrown out of the windows while being transported to and from the site. Workers who throw waste out windows should be fined.
» Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers.
» The Contractor should be required to collect waste along the R354 road reserve on a weekly basis.
» EMPr measures (and penalties) should be implemented to ensure speed limits are adhered to at all times.

Operational Phase

Direct benefits

Similar to the construction phase, the majority of goods and services will be highly specialised and technical in nature with up to 70% of the operational expenditure being initially imported in the form of expatriate engineers. Locally procured services will include maintenance work for balance of plant facilities, 24-hour security and cleaning contracts resulting in an ongoing investment injection.

Turbine operation is largely automated with routine scheduled services taking place on average twice per annum. There will be a dedicated operations team comprising approximately 30 full time personnel operating the facility in daytime hours.

In addition, there will be a number of contract jobs including skilled balance of plant maintenance personnel for electrical balance of plant works and crane operators/crew. There are likely to be additional jobs including a number of personnel to cover 24-hour site security, as well as some cleaning contracts. These personnel will be sourced locally at the municipal level where possible. If the appropriate skills are not available at the municipal level these services will be sourced regionally.

The affected landowners will receive payments from the developer for the use of the land for the life of the Project and the values of the directly affected farms are likely to increase as a result of the added income stream. The wind farm will occupy approximately 2% to 3% of the farm area, allowing the existing farm activities to continue in certain areas. This will enable the landowner to supplement his existing income as opposed to replacing it; this is possible given that the majority of the farm is being used for grazing activities.

Indirect and induced benefits

Apart from the direct benefits resulting from the operational spend and direct jobs created, the spending of those employed directly would result in a positive indirect impact on the local and regional economy.

These planned improvements and intensification of farming methods will create employment opportunities on the farm and increase spending on goods and services. Especially in cases where the farmers intend to expand cultivation activities. Two of the landowners noted that they wanted to decrease the number of livestock, and increase the area under cultivation by installing irrigation systems.

The supplemental income that the landowners receive for the wind farm will enable them to sustain the farms through difficult years, making their farms, and therefore their livelihoods, more sustainable.

The potential for the proposed project and other future projects to result in greater impacts on local economies and the South African economy as a whole is primarily dependent on economies of scale. Initially import content will be high. However, if the sector grows in size it should provide opportunities for growth of the local supply chain and the additional benefit that would flow from this. The introduction of a large-scale renewable energy programme could provide local economic opportunities for component manufacture, and with an appropriate industrial policy it would be possible to leverage South Africa's relatively cheap steel resources. The distance from other international manufacturers will also confer a competitive advantage, especially for less-specialised large-scale components such as steel towers.

Operational Impact: Impact assessment of employment and business creation opportunities

Nature: Creation of employment and business opportunities associated with the operational phase. Based on information from other wind projects the establishment of a 140 MW WEF would create ~ 30 employment opportunities for over a 20 year period. Of this total approximately 20 will be low skilled, 8 semi-skilled and 2 high skilled positions. The annual wage bill for the operational phase would be ~ R3 million. The majority of employment opportunities associated with the operational phase is likely to benefit HD members of the community.

- **Extent:** Local and regional
- **Duration:** Long-term (During operation)
- **Intensity:** Low
- **Likelihood –** It is likely this impact will occur during the operation phase.

Impact Significance (Pre and Post-Enhancement) – Minor (+VE)
Reversibility: Medium (pre-) to high (post-enhancement)
Irreplaceable Loss of Resources: N/A
Enhancement

» The developer and its appointed contractors to develop an induction programme, including a Code of Conduct, for all workers (the developer and contractors including their workers) directly related to the project. A copy of the Code of Conduct to be presented to all workers and signed by each person.
» The Code of Conduct must address the following aspects:
    * respect for local residents;
    * respect for farm infrastructure and agricultural activities;
    * no hunting or unauthorised taking of products or livestock;
    * zero tolerance of illegal activities by construction personnel including: unlicensed prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting;
    * compliance with the Traffic Management Plan and all road regulations; and

* description of disciplinary measures for infringement of the Code and company rules.

» If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Stock theft should be noted as a dismissible offence.

» The developer will implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to. The developer will respond to all such complaints. Key steps of the grievance mechanism include:
  * circulation of contact details of 'grievance officer' or other key developer contacts;
  * awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works; and
  * establishment of a grievance register to be updated by the developer, including all responses and response times.

» The project developer and its contractors will develop and implement an HIV/AIDS policy and information document for all workers directly related to the project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS. The developer will make condoms available to employees and all contractor workers.

» The construction workers (from outside the area) should be allowed to return home over the weekends or on a regular basis to visit their families; the contractor should make the necessary arrangement to facilitate these visits.

Operational Impact: Benefits associated with the establishment of Community Trust

Nature: Community Trusts provide an opportunity to generate a steady revenue stream that is guaranteed for a 20 year period. This revenue can be used to fund development initiatives in the area and support the local community. The long term duration of the revenue stream (20 plus years) also allows local municipalities and communities to undertake long term planning for the area. The revenue from the proposed wind farm can be used to support a number of social and economic initiatives in the area.

» **Extent:** Local (Regional with enhancement)
» **Duration:** long-term
» **Intensity:** Minor (without mitigation), moderate (with enhancement)
» **Likelihood:** Likely (without mitigation), definite (with enhancement)

Impact Significance (Pre-Enhancement) – Moderate (+ve)
(Post-Enhancement) – Major(+ve)

Reversibility: Medium (without enhancement) and high (with enhancement)

Irreplaceable Loss of Resources: N/A

Enhancement:

In order to maximise the benefits and minimise the potential for corruption and misappropriation of funds the following measures should be implemented:

» The KHLM and LLM should be consulted as to the structure and identification of potential trustees to sit on the Trust. The key departments in the KHLM and LLM that should be consulted include the Municipal Managers Office, IDP Manager and LED Manager.

» Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community;

Operational Impact: Implementation of clean renewable energy

Nature Promotion of clean energy. South Africa currently relies on coal-powered energy to meet more than 90% of its electricity needs. As a result South Africa is the nineteenth largest per capita producer of carbon emissions in the world, and Eskom, as an electricity utility, has been identified as the world's second largest producer of carbon emissions.

The overall contribution to South Africa's total energy requirements of the proposed WEF is relatively small. However, the development of a single 140 MW produced will help to offset the total carbon emissions associated with electricity generation in South Africa.

- **Extent:** Local, Regional and National
- **Duration:** long-term
- **Intensity:** low
- **Likelihood:** Unlikely (pre-enhancement), Definite (post-enhancement)

Impact Significance (Pre-Enhancement) – Minor (-ve)
(Post-Enhancement) – Minor (+ve)

Reversibility: N/A

Irreplaceable Loss of Resources: Yes (no-go option) through impact of climate change on ecosystems

Mitigation

The establishment of the proposed facility is a mitigation measure in itself. In order to maximise the benefits of the proposed project the proponent should:

» Use the project to promote and increase the contribution of renewable energy to the national energy supply;

» Implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's employed

Operational Impact: Visual Impact on sense of place

Nature The components associated with the proposed facility will have a visual impact and, in so doing, impact on the landscape and rural sense of the place of the area. Due to location of the site the turbines will not be clearly visible from the N1 and local farms roads in the area. The visual integrity of the area has also to some extent been impacted by the existing power lines in the area.

- **Extent:** local - regional
- **Duration:** long-term
- **Intensity:** Medium
- **Likelihood –** It is likely that this impact will occur during the operational phase.

Impact Significance (Pre and Post-Mitigation) – Moderate (-ve)

Reversibility: High, impact only during operational lifespan of facility

Irreplaceable Loss of Resources: No (facility can be removed)

Mitigation

» The recommendations contained in the VIA should be implemented.

Operational Impact: Impact on tourism

Nature The N1 is an important tourism route linking Cape Town with Gauteng. However the area is not a tourism destination in itself and visibility of the turbine structures from the N1 is not expected due to the distance of 40km of the closest turbine location. Based on the findings of the SIA there appear to be no major tourism activities and or destinations in the immediate vicinity of the site that would potentially be impacted by the proposed WEF, such as game lodges etc. The impact on tourism in the area is therefore likely to be limited.

- **Extent:** local - regional
- **Duration**: long-term
- **Intensity:** low
- **Likelihood –** It is likely that this impact will occur during the operational phase.

Impact Significance (Pre-Mitigation) – Minor (+ve and -ve)
(Post-Mitigation) – Minor (+ve and -ve)

Reversibility: High, impact only during operational lifespan of facility

Irreplaceable Loss of Resources: No

Mitigation

The recommendations contained in the VIA should also be implemented.

- the winter months it may be preferential to farmers if the schedule could take this into account.
- All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal.
- All directly affected and neighbouring farmers will be able to lodge grievances with the developer using the Grievance Procedure.

Operational Impact: Impact of power line

Nature Potential visual impact and impact on sense of place associated with power line

- **Extent:** local
- **Duration:** long-term
- **Intensity:** low
- **Likelihood –** It is **likely** that this impact will occur during the operational phase.

Impact Significance (Pre-Mitigation) – Minor (-ve)
(Post-Mitigation) – Minor (-ve)

Reversibility: High, impact only during operational lifespan of facility

Irreplaceable Loss of Resources: limited

Mitigation

» The recommendations contained in the VIA should also be implemented during the operational phase of the project.

8.9.2. Power line routes alternatives

The potential social impacts associated with the power lines and grid connections associated with the Karreebosch Wind Farm would be largely linked to the visual impacts. In this regard the visual impacts associated with the proposed power lines will be lower than the visual impacts associated with the wind turbines. The social impacts associated with the proposed power lines will therefore not have a material bearing in the final decision regarding the proposed Karreebosch Wind Farm and does not have any preference from a social perspective.

Decommissioning:

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities.

Decommissioning Impact: Social Impacts Associated with decommissioning

Nature Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning. The number of people employed during the operational phase of a single 140 MW WEF will be in the region of 30. Given the relatively low number of people employed during the operational phase the decommissioning of the facility is unlikely to have a significant negative social impact on the local community. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme.

Extent: local

- **Duration:** Short term depending on how long affected staff take to find alternative employment.
- **Intensity:** low
- **Likelihood –** likely

Impact Significance (Pre-Mitigation) – Minor (-ve)
(Post-Mitigation) – Negligible

Reversibility: Medium (pre-mitigation), high (post-mitigation)

Irreplaceable Loss of Resources: N/A

Mitigation

» The proponent should ensure that retrenchment packages are provided for all staff retrenched when the WEF is decommissioned.

» All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning;

» The proponent should investigate the option of establishing an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 20 year operational life of the facility. The rationale for the establishment of a Rehabilitation Trust Fund is linked to the experiences with the mining sector in South Africa and failure of many mining companies to allocate sufficient funds during the operational phase to cover the costs of rehabilitation and closure. Alternatively, the funds from the sale of the WEF as scrap metal should be allocated to the rehabilitation of the site.

8.9.3. Conclusions and Recommendations

The findings of the SIA indicate that the significance for the majority of the potential negative impacts with mitigation were Minor Negative. The majority of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. In addition, given that the majority of the low and semi-skilled construction workers can be sourced from the local area the potential risk posed by construction workers to local family structures and social networks is regarded as low. However, the impact on individuals who are directly impacted on by construction workers (i.e. contract HIV/ AIDS) was assessed to be of Major Negative significance. The mitigation/enhancement measures listed in the report are also regarded as appropriate. The SIA has no preference for any routing alternative with regards to power line options.

The findings of the SIA undertaken for the proposed Kareebosch WEF indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. The establishment of a Community Trust will also benefit the area. It is therefore recommended that the Kareebosch WEF be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report and other key specialist studies, specifically the VIA and agricultural assessments.

It is therefore recommended that the Kareebosch WEF be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report. The placement of turbines should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

8.10. Residual Impacts

Residual impacts are defined as those impacts that remain following the implementation of mitigation measures. These are detailed in the sections above. The majority of these impacts would, however, be removed following the decommissioning of the site.

The decommissioning phase should attempt to rehabilitate the site with as little disturbance as possible. The major risk associated with the decommissioning phase would be that the site is not adequately restored to its previous potential and a degraded and disturbed ecosystem is left behind. Since the decommissioning of the site will result in a fairly extensive disturbance, it is highly likely that some erosion and alien plant invasion will occur if mitigation measures are not implemented A rehabilitation and revegetation plan is included as part of the EMPr (Appendix M) and must be implemented. If this is implemented residual impacts after the decommissioning of the project will be of negligible significance.

Residual impacts on bat and birds relates to loss of individual birds and bats as a result of collision with turbines, as well as displacement of populations from the area. These impacts are likely to be negligible to low if all recommended mitigation is applied. In addition, following rehabilitation of the site after decommissioning, displaced populations my return to the area.

The visual impact will remain during the operational phase of the project but will be completely removed after decommissioning, provided all the facility infrastructure and ancillary infrastructure is removed and the site rehabilitated as recommended.

Residual negative impacts from loss of archaeological and fossil heritage are likely to be minor and would be partially offset by an improved heritage and palaeontological database for the study region as a direct result of appropriate mitigation.

Social residual impacts will be mainly positive in nature relating to increased wage spending and skills retention in the region, as well as benefits realized through the community trust. Some negative impacts on family and community relations may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent impacts on the affected individuals and/or their families and the community.

8.11. The No Go Alternative

The no go alternative would result in no impacts on the social and biophysical environment. From the studies undertaken as part of this EIA, environmental (natural environment, economic and social) costs can be expected to arise as a result of the project proceeding. This could include:

» Direct loss of biodiversity, flora, fauna and soils due to the clearing of land for the construction and utilisation of land for the wind energy facility (which is limited to the development footprint). The cost of loss of biodiversity has been minimised through the careful location of the development to avoid key areas of sensitivity.

» Visual impacts associated with the wind energy facility. The cost of loss of visual quality to the area is reduced due to the area already being visually impacted to some extent by other developments.
» Change in land-use and loss of land available for agriculture on the development footprint. The cost in this regard is expected to be limited due to the limited footprint of the facility (2-3% of the site), the low agricultural potential of the property and the fact that current agricultural activities can continue on the remainder of the property during construction and operation.

These costs are expected to occur at a local and site level and are considered acceptable provided the mitigation measures as outlined in this EIA and the EMPr are implemented.

The positive implications of establishing the Karreebosch Wind Energy Facility on the demarcated site include:

» The project will result in important economic benefits at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will persist during the preconstruction, construction and operational phases of the project.
» The project contributes towards the Provincial and Local goals for the development of renewable energy as outlined in the respective SDFs and IDPs.
» The project serves to diversify the economy and electricity generation mix of South Africa by addition of wind energy to the mix.
» South Africa's per capita greenhouse gas emissions are amongst the highest in the world due to reliance on fossil fuels. The proposed project will contribute to South Africa achieving goals for implementation of renewable energy and 'green' energy.

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions.

The generation of electricity from renewable energy resources in South Africa offers a number of socio-economic and environmental benefits. These benefits are explored in further by NERSA (March 2009), and include:

» **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of supplementing the power available. In addition, given that renewables can often be deployed in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality, while reducing expensive transmission and distribution losses.

» **Resource saving:** Conventional coal fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres, when compared with wet cooled conventional power stations. This translates into revenue saving of R26.6 million. As an already water stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly as the detrimental effects of climate change on water availability are experienced in the future.
» **Exploitation of our significant renewable energy resource:** At present, valuable national resources (including biomass by-products, solar insulation and wind) remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.
» **Pollution reduction:** The releases of by-products of fossil fuel burning for electricity generation have a particularly hazardous impact on human health, and contribute to ecosystem degradation.
» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner, contributing to the mitigation of climate change through the reduction of greenhouse gas emissions. South Africa as a nation is estimated to be responsible for 1% of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.
» **Support for international agreements and enhanced status within the international community:** The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol, and for cementing its status as a leading player within the international community.
» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities has significant potential for job creation in South Africa.
» **Acceptability to society:** Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.
» **Support to a new industry sector:** The development of renewable energy offers an opportunity to establish a new industry within the South African economy.
» **Protecting the natural foundations of life for future generations:** Actions to reduce our disproportionate carbon footprint can play an important part in ensuring our role in preventing dangerous anthropogenic climate change; thereby securing the natural foundations of life for generations to come.

The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind and that renewable applications are in fact the least-cost energy service in many cases - and more so when social and environmental costs are taken into account.

The benefits of the project are expected to occur at a national, regional and local level. As the costs to the environment have been largely limited through the appropriate placement of infrastructure on the site within lower sensitivity areas, the expected benefits of the project are expected to partially offset the localised environmental costs of the project.

The No-Development option would represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a negative social cost.

However, at both a provincial and national level, it should be noted that the Karreebosch Wind Energy Facility is not unique. In that regard, a significant number of solar and wind energy facility developments are currently proposed in the region. Foregoing the proposed Karreebosch wind energy facility would therefore not necessarily compromise the development of renewable energy facilities in the Northern Cape, Western Cape or South Africa. However, the No-Development option would not contribute towards the objectives of the local municipalities IDP and LED to create employment and support economic development.

ASSESSMENT OF CUMULATIVE IMPACTS CHAPTER 9

As discussed in the previous chapter, wind farm developments may have effects (positive and negative) on natural resources, the social environment and on the people living in a project area. The preceding impact assessment chapter has reported on the assessment of the impacts associated with the Karreebosch Wind Farm largely in isolation (from other similar developmets).

The Department of Energy, under the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, released in 2011 a request for proposals (RfP) to contribute towards Government's renewable energy target and to stimulate the industry in South Africa. The REIPPP Programme has been rolled out in bid windows (rounds) over the past 4 years, in which developers submit proposed renewable energy projects for evaluation and selection. The bid selection process considers a number of qualification and evaluation criteria. The proposed tariff, as well as socio-economic development contributions by the project and the bidder are the main basis for selection after the qualification criteria have been met.

As result of the REIPPP Programme, there has been a substantial increase in interest in wind farm developments in South Africa (largely in the Northern, Western and Eastern Cape provinces), with a number of wind energy facilities already selected as Preferred Bidder projects for implementation, and the first projects are already operational. It is therefore important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts[24] are considered and avoided where possible.

This chapter assesses the potential for the proposed project's potential impacts to become more significant when considered in combination with the other known or proposed wind farm projects within the area.

9.1. Approach Taken to Assess Cumulative Impacts

Significant cumulative impacts that could occur due to the development of wind energy facilities in proximity to each other within the broader study area include impacts such as:

» visual intrusion;

[24] Cumulative impacts in relation to an activity are defined in the Environmental Impact Assessment Regulations (Government Notice R982) as meaning "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".

» change in sense of place and character of the area and heritage impacts;
» social impacts
» an increase in the significance of avifaunal impacts;
» an increase in the significance of the potential impact on bats;
» loss of vegetation and impacts on ecology; and
» temporary traffic impacts during construction.

Figure 9.1 shows the proposed location of the Karreebosch Wind Farm in relation to all other known wind and solar project developments in the broader area. These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR[25] and current knowledge of projects being proposed in the area. In the case of the proposed Karreebosch Wind Farm, there are twelve (12) renewable projects proposed within a 50 km radius of the site (refer to Figure 9.1 and Table 9.1), all at various stages of approval. At the time of writing this EIA report, three projects (the Karusa Wind Farm, the Soetwater Wind Farm, the Perdekraal and the Roggeveld Wind Farm) are the selected preferred bidder projects and are yet to commence construction. Cumulative impacts are summarised below and have been considered within the detailed specialist studies, where applicable (refer to Appendices D – L).

It should be noted that not all the wind farms presently under consideration by various wind farm developers will be eventually be built for operation. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DOE, NERSA and Eskom) and this is because of the following reasons:

» There may be limitations to the capacity of the existing Eskom grid;
» Not all applications will receive a positive environmental authorisation;
» There are stringent requirements to be met by applicants in terms of the REIPPPP;
» Not all proposed wind farms will be viable because of low wind resource on some sites;
» Not all proposed wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately (fatally flawed);
» Not all proposed wind farms will eventually be granted a generation license by NERSA and sign a Power Purchase Agreement with Eskom; and
» Not all proposed wind farms will be successful in securing financial support to advance them further.

[25] Available online at https://dea.maps.arcgis.com/

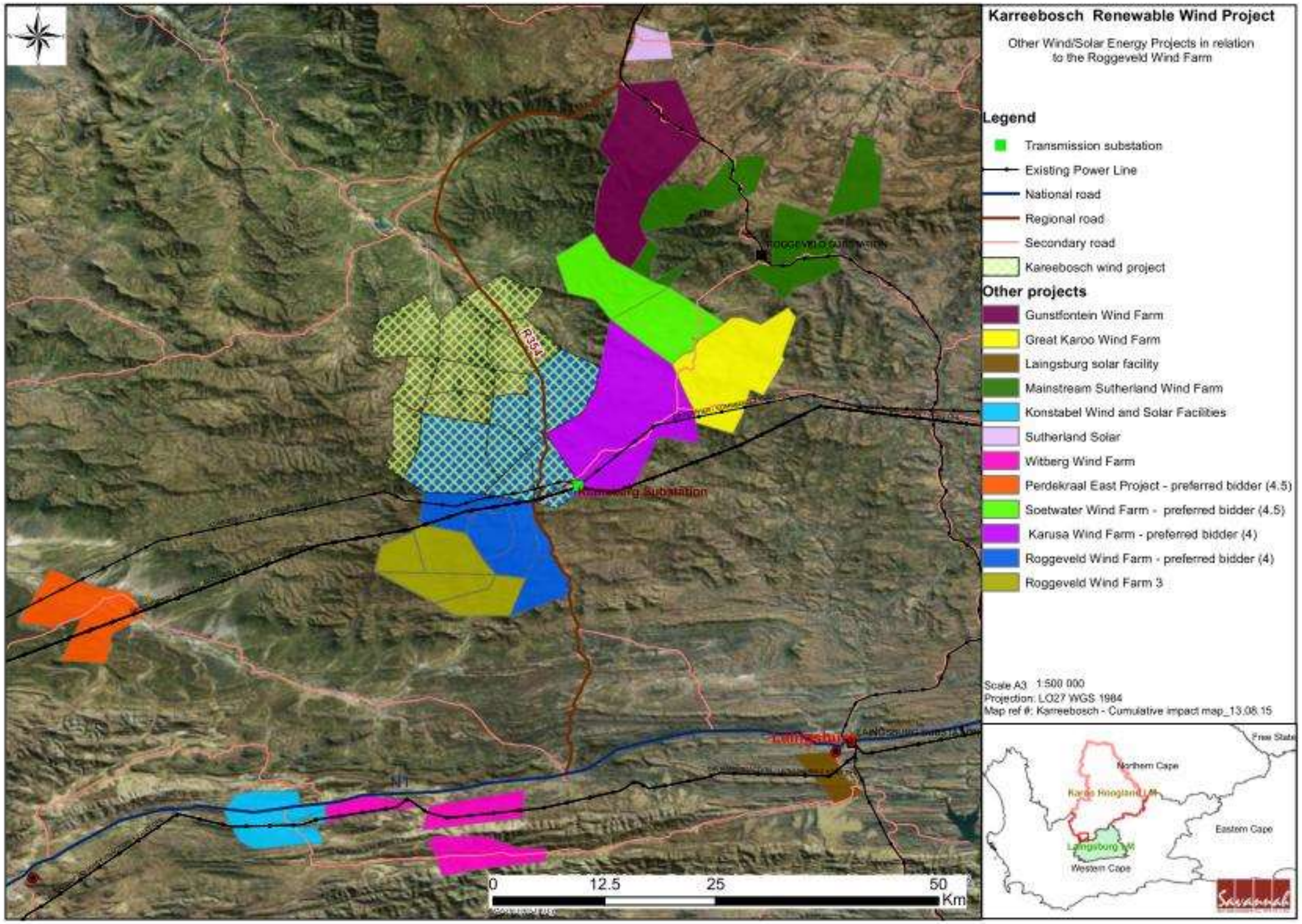


Figure 9.1: Proposed renewable energy facilities in the vicinity of Karreebosch Wind Farm (A3 map included in Appendix N)

Table 9.1: Proposed wind farm developments in the vicinity of the Roggeveld Wind Farm site

Wind Farm (Developer)	No. of turbines	Distance (km)/direction from Karreebosch site	Status of the development	DEA Reference Number
1. Konstabel RE Facility (Mainstream SA)	~ 75	Approximately 30km south of Karreebosch	Authorisation received	12/12/20/1787
2. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Karreebosch	Authorisation received Preferred Bidder Round 4b	12/12/20/1783
3. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Karreebosch	Authorisation received	12/12/20/1966
4. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east of Karreebosch	Authorisation received	12/12/20/1782
5. Suurplaat Wind Farm (Moyeng Energy)	Approximately 400	Approx 60km northeast of Karreebosch	Authorisation received	12/12/20/1583
6. Hidden Valley Wind Energy Facility – three phases (ACED Renewables): Soetwater, Great Karoo, Karusa	Approximately 207	Adjacent to the Karreebosch site	Authorisation received. Soetwater and Karusa: Preferred Bidders Round 4	12/12/20/2370
7. Gunstfontein Wind and Solar	PV = 150MW (2 phases) Wind = up to 100 turbines	Adjacent to the Hidden Valley site	Authorisation received.	Wind Energy Facility - DEA Ref number: 14/12/16/3/3/2/395 Solar Energy Facility – DEA Ref number: 14/12/16/3/3/2/399
8. Roggeveld Wind Farm	58	Adjacent to the Karreebosch site	Authorisation received – Preferred Bidder Round 4	12/12/20/1988
9. Roggeveld Wind Farm 3	Unknown at this stage	Approx 10km south of Karreebosch	Project on hold	12/12/20/1988/3
10. Lainsburg Solar Energy Facility	75MW PV facility	Approx 45km south-east of Karreebosch	Authorisation received	12/12/20/1956

As there is uncertainty as to whether all the above-mentioned developments will be implemented, it is also difficult to quantitatively assess the potential cumulative impacts. The cumulative impacts of other known renewable energy developments (mainly wind and solar) in the broader area and the Karreebosch Wind Farm are therefore qualitatively assessed in this Chapter.

It is important to explore the potential cumulative impacts qualitatively as this will lead to a better understanding of these impacts and the possible mitigation that may be required. The assessment and implementation of mitigatory measures should be led by Government in collaboration with the renewable energy sector and relevant NGOs. As these cumulative impacts are explored in more detail, the trade-offs between promoting renewable energy (and the associated benefits in terms of reduction in CO_2 emissions – a national interest) versus the local and regional environmental and social impacts and benefits (i.e. impacts on bird and bat populations, landscape, tourism, flora, employment etc.) will become evident. It is only when these trade-offs are fully understood, that the true benefits of renewable energy can be assessed.

The scale at which the cumulative impacts are assessed is important. For example the significance of the cumulative impact on the regional or national economy will be influenced by wind farm developments throughout South Africa, while the significance of the cumulative impact on visual amenity may only be influenced by wind farm developments that are in closer proximity to each other, up to 30 km to 50 km apart. For practical purposes a sub-regional scale has been selected.

In the sections below the potential cumulative impacts of several wind farms within a 30 - 50km radius of the proposed Karreebosch Wind Farm are explored. Particular reference is assigned to Roggeveld Phase 1 and the Hidden Valley Wind Farm. This is because of their proximity to the Karreebosch project area as well as the specialist experience in the area and the fact that they are preferred bidder projects.

9.2. Cumulative Impact on Fauna (excluding Avifauna and Bats) and Flora

The renewable energy facilities listed in Table 9.1 are located in the area where the Succulent Karoo Biome and the Fynbos Biome are intermixed. While the majority of the renewable energy sites are likely to be established on existing farms where some disturbance has already occurred, there may be numerous different plant communities present, each associated with different combinations of soil depth and texture, aspect and slope, creating a wide range of potential habitats for resident biota. The sensitivity and conservation worthiness of these areas may differ.

The total land take of each facility is likely to be less than 5% of the total area allocated for the facility. The majority of these facilities are likely to be placed on existing farm lands where grazing takes place. A potential cumulative impact of wind farm developments identified by the specialists is the potential loss of connectivity of the landscape, the disruption of faunal movement pathways and a possible reduction in the ability of plants and animals to respond to climate variability and change. The nature and potential extent of this impact however, is very difficult to quantify. The current development and that within the surrounding wind farms is largely concentrated on the ridges of the sites, which potentially impacts the functioning of the ridge as a corridor for faunal movement. It is feasible to mitigate potential site specific negative impacts on fauna and flora by avoiding sensitive patches of vegetation and habitat within specific site boundaries.

Apart from the Roggeveld Phase 1 Wind Farm immediately south of the site, of particular significance would be the ACED Renewables Hidden Valley development which is located east of the site (comprising three 140MW wind farms – Karusa, Soetwater and Great Karoo). The broad area is quite diverse in terms of the different vegetation types present in the area, with the result that each development tends to impact different vegetation types present in the area as stated above. Exceptions include Roggeveld Shale Renosterveld which occurs on the escarpment north of the site and would be impacted by several different facilities; and Central Mountains Shale Renosterveld, which occurs on the rugged hills and mountains south of the escarpment. Cumulative impacts on Central Mountains Shale Renosterveld appear to be a particular concern as this vegetation type has a relatively limited extent and a significant proportion, especially in the west, falls within renewable energy development application areas.

As wind energy facilities do not have a large footprint in terms of direct transformation, the actual amount of vegetation lost cannot be considered significant in its own right, when considered in the light of the low level of transformation the Shale Renosterveld vegetation type has experienced to date. Therefore, the major concern with regards to cumulative impacts is likely to centre on the potential impact on broad-scale ecological processes such as the disruption of movement and migration pathways of fauna, and the broad scale fragmentation of habitat.

The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets. Portions of the Karreebosch area have been identified as a National Protected Areas Expansion Strategy focus area, indicating that it represents a large currently intact extent of habitat which is considered to have a high biodiversity value. Although all of the vegetation types in the study area are classified as Least

Threatened, they are mostly poorly protected and certain habitats or communities may be disproportionately affected.

The loss of high elevation ridgeline habitat will impact species associated with this habitat as well as potentially disrupt the connectivity of the landscape for such species which may have consequences for gene flow and the maintenance of subpopulations. As the ridgeline habitat is restricted in nature, the level of impact to this habitat is disproportionate and a significant proportion of the ridgelines will be lost to transformation even though the footprint of wind energy facilities is relatively low and the total amount of habitat loss may appear to be relatively minor.

At a more local scale, the Roggeveld Phase 1 Wind Farm which occurs immediately south of the Karreebosch Wind Farm site is of highest relevance as the environment impacted by the two facilities is similar. In addition, these facilities occupy the northern extent of the Klein Roggeveld and as the turbines are restricted to the high-lying ridges, there would be a high local cumulative impact on these areas and the connectivity of the landscape may be disrupted for fauna and flora which utilise these areas. In the current case, areas above 1000m are limited and the impact from the current development as well as the authorised (and Preferred Bidder) Roggeveld Phase 1 Wind Farm on these areas would be high compared to that on the site in general. The high-lying areas have a disproportionate abundance of species of conservation concern and the cumulative impact must be considered in light of these areas rather than the less sensitive areas which are in fact little impacted by the development. Within the areas above 1000m, the direct impact of habitat loss is considered the major impact, while at a broader scale, the major concern with regards to cumulative impacts would be the potential impact on broad-scale ecological processes such as the disruption of movement and migration pathways of fauna, and the broad scale fragmentation of habitat. As such, the direct impact of the development on habitat loss within these areas is likely to exceed 10% which is considered a significant impact of concern for the development potential of the site.

While the cumulative impact is uncertain, dependant on the number of facilities which are constructed, and assuming site specific mitigation can avoid sensitive habitats, it is likely that the negative **cumulative impact on fauna** (excluding bats and birds) **and flora** resulting from the development of several renewable energy facilities in proximity to the proposed Karreebosch Wind Farm will be of a **minor to major (-ve) significance**[26]. From the ecologist specialist's perspective, such cumulative impacts on the ridgeline habitat would be at an acceptable level if mitigation measures are implemented.

[26] Rated on cumulative impact on CBAs and broad-scale ecological processes and loss of ridgeline habitat and impact on species of conservation concern.

On the positive side, farmers may become less reliant on income from stock and/or crop farming as a result of increased incomes accruing to them from leasing their land to renewable energy developers. This may result in a decrease in numbers of animals per hectare which could ultimately result in an improvement in the flora and surrounding habitat due to reduced grazing pressure. However, should farming intensity increase (additional stock or increase in crops lands/orchards) because of the increased income, some would argue that this could have a negative cumulative impact as additional land take may impact sensitive habitats. On the other hand the country is in need of increased agricultural productivity and food security and it could also be argued that positive impacts would result from increased agricultural activity as there will be more jobs created for the unemployed communities of the Laingsburg Local Municipality.

9.3. Cumulative Impacts on Birds

There are several forms of cumulative effects on bird communities relative to wind farm developments. One is when a bird species resident in a proposed wind farm is likely to be affected by not one but several impacts. Another is the effect of impacts in the immediate neighbourhood of the proposed farm. This may be from the development of other wind farms – as proposed for areas around the Karreebosch project area - or other significant land use changes. A third is when changes at some distance (even continentally) have the effect of depressing the population of a bird species which is then further impacted through loss of habitat or collision mortality at the wind farm. All these cumulative effects can be subject to further cumulative effects over time.

The Karreebosch Wind Farm, the Roggeveld Wind Farm and the Hidden Valley Wind Farm have been the subject of avifaunal studies that included observations across the areas from many observation points over at least 12 month periods that encompassed all seasons. Despite these relatively intense surveys, only a single breeding site of any large raptor has been found. This is the Verreaux’s Eagle nest on the boundary of the Karreebosch and Roggeveld wind farms, a site where no active breeding was recorded in either 2013 or 2014. Nor have red-listed species been recorded in other than small numbers and then generally infrequently.

Food resources for birds across these three wind farm areas, as well as across adjacent areas likely to be developed, are limited. Accordingly the diversity, and number of large, high collision risk, bird species are low. They are known to be lower than in the mountains some 70 km south of the Karreebosch project site where higher rainfall provides support for a greater abundance of suitable prey for raptors, and a greater exposure of cliffs provide suitable nest sites for raptors.

The situation in the vicinity of the Karreebosch project site is of far lower bird diversity and numbers, including those of red-listed species, than in lowland areas.

Given the low numbers and diversity of birds in the region of these proposed wind facilities, the cumulative impact on birds in this broken terrain on the periphery of the Karoo is likely to be lower than most areas across Southern Africa. This includes any wind facilities proposed for the much flatter Karoo plateau area some 60 km to the north of the Karreebosch Wind Farm.

The single Verreaux's Eagle breeding locality in the region lies along the Central Ridge that will house turbines for both the Roggeveld and Karreebosch wind energy facilities. A no-go area of 1.3 km (prescribed for the authorised Roggeveld wind farm – Phase 1) is designated along the Central Ridge on either side of the breeding locality. There will also be turbines on the two adjacent ridges so in a sense the eagle nest at this locality will be "flanked". However, due to the established paucity of prey for eagles along the summit ridges, most eagle activity will be within the valleys and so below the turbine ridges. This is particularly the case when the eagles are foraging and so might be distracted. Observations in both the Roggeveld and Karreebosch avian assessments showed that these eagles generally occurred at turbine blade heights during strong winds but that they used updraughts from the valley sides and so flew primarily above the lip of the ridge summits and not where the turbines are proposed to be located. BirdLife (in litt.) accepts that to date there is have no evidence of how Verreaux's Eagles will react to turbines. Apparently, in North America, Golden Eagles (the closest equivalent to Verreaux's Eagles) have shown signs of adequately avoiding turbines. Whether this will be the case with Verreaux's Eagles is still unknown. The most publicised eagles mortalities in North America occurred mainly where long strings of turbines were aligned across a migration route, and for smaller, fast rotating wind turbines. This is not the situation in the Karreebosch-Roggeveld area.

From on-site observations in the area, it was noted that two eagles still frequented the identified breeding locality in 2013-2014. However, despite several observations directly into the two old nests in 2013 and observation of the nesting cliff from several vantage points across 6 days in 2014 there was no indication of active breeding in either 2013 or 2014. This is surprising as rainfall in the area had been excellent in 2013 and observations indicated an associated rebound in the numbers of potential prey. That there was no breeding indicates that this is a marginal locality for these eagles. As such it cannot be considered a critical locality for the species. It is better for wind farms to be established in this area, accepting the potential risk of losing of this breeding pair, than for wind farms to be established in other areas where there are more successful breeding pairs of this eagle.

Overall the **cumulative effects** on the regional avifauna is considered of very **low** significance. Reasons for this appraisal are:

1. The paucity of both bird numbers and diversity on the ridges where turbines are proposed to be established - as further confirmed by Dr Simmons' observations (refer to Appendix 9 of the avifauna report in Appendix G);
2. Extremely few bird species recorded flying at heights that would bring them into risk of collision with turbine blades within all facilities in close proximity to the Karreebosch facility and within the Karreebosch site itself;
3. The few priority species that do occur at blade heights along the ridges are adapted to montane conditions. These conditions require fine flight control to avoid collision with solid features (cliffs etc.) even in strong winds with often unpredictable shifts in wind strength and direction; and
4. Due to the lack of food resources along the ridge summits these birds forage mainly in the valleys at the site. When they do fly over the ridges they are not distracted by foraging needs and so can be anticipated to be more alert to their surroundings and more likely to avoid large structures including the blur of moving blades.

9.4. Cumulative Impacts on Bats

The many proposed wind farms within the region are significant in terms of potential cumulative impacts on bats, increasing the risks for fatalities. It also increases the risks for clashes with bat migration routes. Five different species were detected by the monitoring systems, with only *Miniopterus natalensis* having a Near Threatened conservation status. The other species have a conservation category of Least Concern. *Neoromicia capensis* and *Tadarida aegyptiaca* are the most common and abundant insectivorous bat species found across South Africa. They dominated the bat assemblage detected by all of the monitoring systems across all the sites monitored. These common and more abundant species are of high value to the local ecosystems as they provide greater ecological services than the more rare species, due to their greater abundance.

Although *M. natalensis, E. hottentotus* and *S. petrophilus* were not detected nearly as frequently as the other two aforementioned species, they were detected in sufficient numbers to suggest healthy populations of these species on site. Hence, their value in terms of biodiversity cannot be ignored. Moreover, *M. natalensis* is a migratory species and occurs in large numbers when nearby cave-roosts are available. Therefore this species should be specifically monitored for migration events during the operational phase. However no such migration events were found in this study, and the proposed initial mitigation measures are applicable to all five bat species found on site.

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. A sensitivity map was drawn up indicating potential roosting and foraging areas. Turbines within the High Sensitivity Buffers will either require relocating or to be removed from the layout as these are 'no-go' areas. They 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. The High sensitivity valley areas can also serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several wind facilities in an area. The turbines within Moderate Sensitivity areas and buffers can either be relocated or must receive special attention during operational monitoring, not excluding all other turbines from operational monitoring. It is essential that project specific mitigation measures 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. 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 flying insects at night. On a project specific level, insect numbers in a certain habitat can increase if significant numbers of bats are lost. However, 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.

In addition, if migrating bats are killed it can have detrimental effects on the ecology of the caves that a specific colony utilises. This is due to the fact that bat guano is the primary form of energy input into a cave ecology system, given that no sunshine that allows photosynthesis exists in cave ecosystems.

The impact of a single wind energy facility on the resident and migratory bat populations in South Africa is not currently well understood but, if properly mitigated, is no expected to eopardise viable populations. However, as wind energy facilities become substantially more numerous and begin to populate certain areas, bat fatalities and thus biologically-significant impacts to the populations will increase. Bats have low reproductive rates and wind farms may impact them to the point of elimination from the local area. Since population estimates re poorly known, it is difficult to determine whether bat fatalities due to wind turbines are a significant threat to South African bat populations.

There are nine proposed wind farms within the area. A number of these projects will undergo division into smaller entities. It must be noted that not all of the listed wind farms have been approved and those that have will become operational. The uncertainty as to which projects will be constructed, hampers the assessment of the cumulative impacts. Thus adopting the precautionary approach assumes worst case scenario of all of the approved projects becoming operational.

The impact significance of destruction of bat habitat after application of recommended mitigations for Karreebosch WEF is considered negligible. However the destruction of bat roosts and potential roosting space will be remain of moderate significance when considering the cumulative earthworks and blasting to be carried out with the adjacent wind farms.

The cumulative impact of artificial lighting with adjacent wind farms remains negligible due to the short term and low intensity nature of the impact.

The prime foraging habitat for bats in this area are the lower lying valley areas. It is assumed that majority of turbine placement in the greater area will be on higher mountainous areas. Thus the impact on foraging habitat is minor for the Karreebosch WEF. However the greater the foraging area to be cleared for wind energy facility development over such a broad scale as is proposed, the more severe the impact will be on bat populations. Thus the cumulative impact will be of a moderate significance.

It is common knowledge that the greater the number of turbines in an area, the greater the risk of collision by bat species. The cumulative impact across the general area will be major unless there is strict implementation of site specific mitigations advised by the relevant Bat Specialists applied to all wind farms.

The **cumulative impact on bats** in general is expected to be **moderate significance** which can be mitigated to a minor significance if areas of high and moderate bat sensitivity and their buffers are avoided and/or mitigated appropriately.

9.5. Cumulative Impact on Soils and Agricultural Potential

The cumulative impact in terms of loss of agricultural land is unlikely to be significant due to the limited land take and in most cases agricultural activities would be allowed to continue following completion of construction activities. However, once the renewable energy sector is saturated, property prices that are dependent on the sense of place value rather than on the agricultural potential may be compromised due to the changes in landscape and sense of place.

The cumulative impacts on soils due to other proposed projects in the area are regarded as having low significance. This is because the wind farm developments have good spacing between different units of infrastructure allowing for continuation of agricultural activities between the project components. During construction of a wind farm only a very small percentage of the site is disturbed (typically in the region of 5%), and during operation grazing can continue between the turbine structures. Even with multiple projects planned for the area this impact is considered of low significance. Cumulative impacts associated with impacts on soils and agricultural potential are therefore considered to be low.

9.6. Cumulative Visual Impacts

The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain, as at the time the assessment was undertaken the details of the final layouts of adjacent or neighbouring facilities were not available and could therefore not be quantitatively assessed. It is important to note that the construction of wind turbines together with the associated infrastructure will increase the cumulative visual impact of industrial type infrastructure within the region. This is relevant in light of the power line infrastructure already present in the area as well as other authorised renewable energy facilities proposed in the region (as reflected in Figure 9.1)

Many of the sites and surrounds of the proposed Karreebosch Wind Farm have a wilderness or rural farmland character, typical of the Karoo landscapes. Most of the sites are remote and sparsely populated, which adds to their attraction as getaway destinations. The sheer scale of many of the wind farm projects could result in a loss of scenic views and inspiring open space related to these landscapes. The alteration of the landscape from wilderness or rural farmland character to a more industrial type character will have an impact on the sense of place which in turn could have an impact on tourism and associated activities. A single renewable energy facility located in an area of wilderness or rural farmland character is likely to attract interest, resulting in some positive benefits. However, it could be argued that it is unlikely that several such facilities in relatively close proximity are likely to have the same outcome.

The degree of cumulative impact is a product of the number of and distance between individual wind farms, the overall character of the landscape and its sensitivity to wind farms, and the siting and design of the wind farms themselves[27]. Cumulative impacts need to be considered from both a visual amenity and landscape character perspective, while the impact on these may also have a bearing on the enjoyment of the natural heritage.

The potential cumulative visual exposure of the Roggeveld Phase 1, Karreebosch Wind Farm and Hidden Valley Wind Farm have been considered further due to the close proximity of these facilities to one another. The combined visual impact or cumulative impact of these three wind energy facilities is expected to significantly

[27] Scottish Natural Heritage Guidance Cumulative Effects of Windfarms Version 2 revised 13.04.05

increase the area of potential visual impact within the area, while the facilities proposed in the region will increase the visual impact at a broader level.

The turbines associated with the Roggeveld Phase 1 and Karreebosch Wind Farms primarily impact on observers residing (or travelling through) the Tankwa River catchment or along elevated south facing slopes north of these facilities. The skyline surrounding the Karreebosch Wind Farm acts as a visual barrier, shielding the turbine structures from observers beyond the catchment boundary. Visibility to the south is therefore very constrained with only a few areas expected to have limited exposure to the wind turbines.

Additional exposure within this catchment, where wind turbines from all three wind facilities may be visible, may largely be due to the construction of wind turbines (Hidden Valley wind facility) along the Kleinroggeveldberge.

The predominant area of exposure is further north-wards along the Tankwa River valley and from south-facing slopes within this catchment. The visual exposure within a **5km** radius of the structures is largely contained to the farms earmarked for the Karreebosch Wind Farm and along the R354 arterial road traversing the site. Observers residing within a 5km radius of the development (not associated with the project), with potential exposure to the structures include: *Matjiesfontein* (homestead west of the proposed facility) and *Langhuis*.

Exposure within a **5km to 10km** radius of the structures include: *Brakwater, Langhuis, Wadrif* and *Ou Tuin*, as well as a sections of the R354 arterial and secondary roads. Observers residing at these locations or travelling along these roads are expected to be visually exposed to the wind farm infrastructure.

Further north and beyond a **10km** (to 20km) radius of the facility, the residents of the following homesteads may experience longer distance views of the turbine structures: *Windheuwel, Rooiheuwel, Seekoeigat, Klein Ashoek, Kraairivier* and *Brandhoek*. The frequency of visual exposure may also increase with distance away from the wind farm as more turbines become visible. Observers travelling along the secondary roads and the R354 may also be visually exposed to the project infrastructure.

The visibility of the wind turbine structures is expected to subside beyond a radius of **20km** from the structures, although views of the facility may still be possible, especially on clear days.

It is expected that the cumulative visual exposure will affect the same observers (i.e. residents of homesteads within the catchment and observers travelling along the arterial and secondary roads), potentially aggravating the potential visual impacts associated with wind facilities' developments within the region. This cumulative exposure (and potential cumulative visual impact) of wind turbine structures is further illustrated in Figure 9.2a and 9.2b as well as the other photo simulations provided in the Visual Impact Assessment specialist report (Appendix J).

Figure 9.2a: Potential cumulative visual exposure of the Roggeveld Phase 1, Karreebosch, and Hidden Valley wind energy facilities.

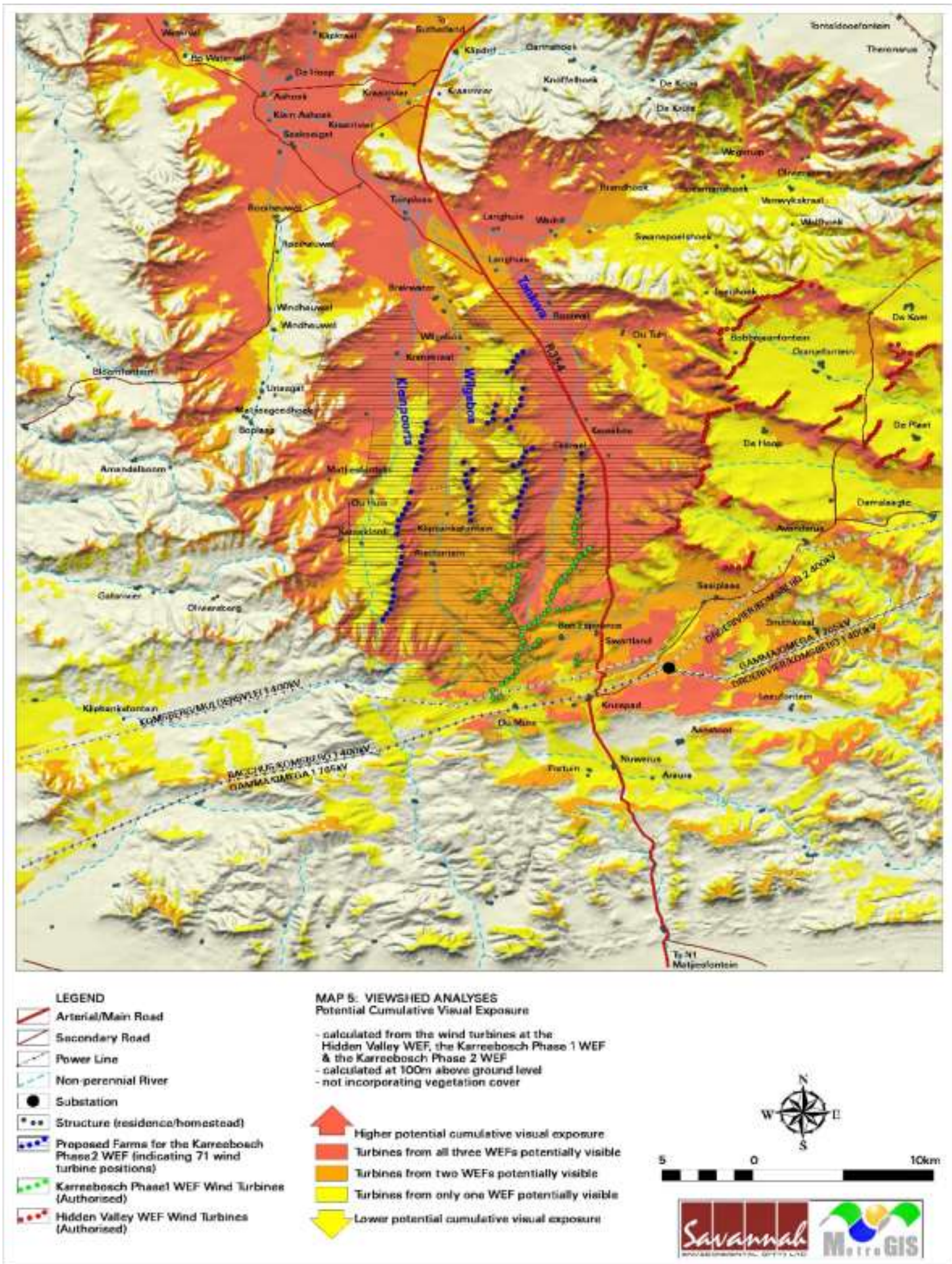


Figure 9.2b: Potential cumulative visual exposure of the Roggeveld Phase 1, Karreebosch, and Hidden Valley wind energy facilities.

In the context of the recommendations of the Provincial Government of the Western Cape's guideline document for wind energy developments[28] it is encouraged that large concentrated wind farms should be developed rather than small dispersed locations where the distance between large wind farms is at least 30km, and ideally exceeding 50km. At a provincial level the development of multiple wind farms in the same area supported.

Should all the proposed wind projects be constructed, the combined effect of the Karreebosch and the other wind farms listed in Table 9.1 will have a cumulative visual impact and impact on the landscape character. The construction of the overhead power lines will increase the cumulative visual impact of industrial type infrastructure within the region. This is relevant in light of existing power lines already present in close proximity to the Komsberg Substation.

The visual impact assessment expresses the opinion that the Tankwa River sub-catchment may be reaching its visual saturation point, and that additional wind farm developments may irrevocably alter the landscape character. The intensity of visual impact (number of turbines visible) to exposed receptors located within the Tankwa sub-catchment, especially those located within a 10-15km radius, is expected to be greater than it would be for a single wind farm. The **cumulative visual impact** and impact on landscape character resulting from the other known wind farms in the surrounds of the Karreebosch Wind Farm is difficult to assess, but may be of **major significance**.

This should also be viewed within the context of the identification of the area as a renewable energy development zone. The area has therefore been identified as an area where renewable energy should be concentrated. It is also possible that due to the proximity of the neighbouring renewable energy sites that the separate wind facilities could be viewed as a single large wind facility as opposed to a number of separate wind facilities. While viewing these wind facilities as a single large facility, as opposed to three separate facilities, does not necessarily reduce the overall visual impact on the scenic character of the area, it does reduce the potential cumulative impact on the landscape. Viewing each of the proposed wind facilities as a single, large wind facilities eliminates the cumulative impacts associated with combined visibility (whether two or more wind farms will be visible from one location) and sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail). This therefore reduces the potential cumulative impact of the wind facilities on the landscape. The proximity of the wind facilities also has the benefit of concentrating the visual impacts on the areas sense of place in to one area as opposed to impacting on a number of more spread out areas.

[28] Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape Provincial Government of the Western Cape and CNdV Africa, 2006.

Potential mitigation factors for the Karreebosch Wind Farm includes the fact that the facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The cumulative visual impact could be reduced to **moderate** with the implementation of recommended mitigation measures .

9.7. Cumulative Heritage Impacts

On physical heritage alone, there is no justifiable reason for not supporting the proposal. However, from a cultural heritage perspective of the Karoo landscape and its archetypical South African scenery is a reason for assessing cumulative impacts. The many proposals for wind farms or renewable energy facilities in the Karoo surrounds has been seen as bringing industrialisation to the Karoo, with potential consequences for the aesthetic qualities of the region, as discussed above. The need to conserve the South African landscape cannot be under-estimated. The vast horizons of the country, and the variety and qualities of the landscape, contribute significantly to our communal identity. They are also key to drawing visits that make the country a primary tourism destination. However, it is also critical that renewable energy is encouraged. It is therefore necessary to identify and conserve iconic landscapes, but also allow some latitude so that more marginal areas can be utilised.

The Sutherland area and the Great Escarpment and foothills have numerous applications for renewable energy projects within this highly scenic landscape, which, up to now, has a wilderness landscape character. The cumulative impact will involve significant sterilisation of the aesthetic qualities of the landscape, the Karoo heritage and its character and sense of place. The nation's open landscapes and wilderness qualities are unique, the Karoo as a landform and a landscape is unequalled and a quintessential aspect of the nation's character. The accumulative impact of massed adjoining renewable energy facilities is required to be considered, given that the National Heritage Resources Act 25 of 1999 clearly protects places of aesthetic significance. This should however be viewed within the context of the identification of the area as a renewable energy development zone.

It is however also possible that due to the proximity of the neighbouring renewable energy sites that the separate wind facilities could be viewed as a single large wind facility, thus reducing the cumulative visual impact.

It is expected that the cumulative impact on the central Karoo as a physical and scenic heritage resource will be significant and negative. The proposed Karreebosch Wind Energy Facility is considered a moderate contributor to the potential impact on landscape quality in this area of the country when considering the number of facilities already authorised in the area. If all of the proposed wind and solar facilities are developed, there will be a clear change in the sense of place of the region and a sense of industrialisation of a rural landscape. This may have further impacts to fluctuating sustainability of local tourism. The heritage grading of the landscape is likely to be affected causing a shift from Grade lllA to Grade lllC or ungraded. Cumulative negative impacts on heritage resources will be a **moderate significance**.

No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Karreebosch Wind Farm study area. The majority of fossil sites recorded in the study region lie outside the anticipated development footprint. In the absence of comprehensive palaeontological data on further alternative energy or other developments in the broader study region, it is impossible to realistically assess cumulative impacts on fossil heritage resources. Given the scarcity of significant fossil remains in the region, cumulative impacts are likely to be **Minor**.

9.8. Cumulative Social Impacts

The potential for cumulative impacts on the social environment relate mainly to those associated with combined visibility (whether two or more renewable facilities will be visible from one location) and sequential visibility (e.g. the effect of seeing two or more renewable energy facilities along a single journey, e.g. road or walking trail) is therefore high. However, this should be viewed within the context of the identification of the area as a renewable energy development zone. The area has therefore been identified as an area where renewable energy should be concentrated.

Benefits to the local, regional and national economy through employment and procurement of services could be substantial should many of the renewable energy facilities proceed. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the renewable energy facilities to be manufactured in South Africa. Furthermore at municipal level, the cumulative impact could be positive and could incentivise operation and maintenance companies to centralise and expand their activities towards education and training and more closely to the projects. In this regard, the establishment of a number of wind farms in the area will create a number of socio-economic opportunities for the local economy and communities.

As mentioned in the visual and heritage sections above, it is also possible that due to the proximity of the neighbouring renewable energy sites that the separate wind facilities could be viewed as a single large wind facility as opposed to a number of separate wind facilities. this therefore reduces the potential cumulative impact of the wind facilities on the landscape. The proximity of the wind facilities also has the benefit of concentrating the visual impacts on the areas sense of place in to one area as opposed to impacting on a number of more spread out areas.

The significance of the potential cumulative impact on the local economy is typically High Positive. The establishment of a number of solar and wind facilities in the area will create employment, skills development and training opportunities, creation of downstream business opportunities. The positive cumulative impacts include creation of employment, skills development and training opportunities, creation of downstream business opportunities. This benefit is rated as Major Positive with enhancement.

9.9. Cumulative Hydrological Impacts

Downstream alteration of hydrological regimes due to the increased run-off from the area is the major cumulative impact on surface water. However due to low mean annual runoff within the region this is not anticipated due to the nature of the development together with the proposed layout. This is also coupled to the fact that surrounding developments would impact on a different catchment in the neighbouring water management area. The impact is considered to be **low negative.**

9.10. Cumulative Noise Impacts

The results of the noise impact assessment (NIA) indicated that noise values on land surrounding the proposed Karreebosch Wind Farm boundaries as well as at the identified noise sensitive receptors (dwellings) within the property boundaries would comply with the National Noise Control Regulations (NCR) legal requirements. The NCR governs the control of noise in the Northern Cape Province. Therefore there would be no obligation to implement noise mitigation procedures. In accordance with Standard procedures the associated noise impact would be negligible. Notwithstanding the legal compliance, a more detailed analysis indicated that low frequency turbine noise would probably be distinctly audible both outside and within the identified dwellings located within the Karreebosch Wind Farm boundaries.

The cumulative noise impact was considered for wind farms located to the south and east of the proposed Karreebosch Wind Farm (i.e. specifically Roggeveld Wind Farm (Phase 1) and the Hidden Valley Wind Farm).

Based on the findings of the NIA, the impact of Roggeveld Phase 1 and Karreebosch Wind Farms combined would be **negligible** within and beyond their boundaries (refer to discussion below). However, it was predicted that noise emanating from the Hidden Valley wind farm would result in a **high** cumulative noise impact within the Karreebosch Wind Farm boundary (refer to discussion below).

Roggeveld Wind Farm Phase 1 and Karreebosch Wind Farm

The proposed Roggeveld Wind Farm Phase 1[29] contains wind energy turbines directly contiguous with those of the proposed Karreebosch Wind Farm. Combining the results of both NIA (Roggeveld Phase 1 and Karreebosch Wind Farm) indicated that the predicted L_{Aeq} values on land beyond the boundaries of the two phases as well as at the noise sensitive receptors (dwellings) within the property boundaries would comply with the legal requirements of both the National Noise Control Regulations (NCR-N) and the Noise Control Regulations applicable to the Western Cape Province (NCR-WC).

A study of the results of both wind farms confirmed that there would be no cumulative noise impact within and beyond the site boundaries.

Hidden Valley Wind Energy Facility and Karreebosch Wind Farm

The Hidden Valley wind facility comprises 3 phases. Phase 1, the proposed Karusa Wind Farm is located immediately to the east of the farm Appelsfontein of the Karreebosch Wind Farm and shares a common boundary.

Numerous wind turbines of the proposed Karusa Wind Farm are located on and close to the common boundary with Appelsfontein farm. According to the results displayed in Figure 7.4 of the NIA (Hidden Valley NIA, de Jager, 2012) noise levels in excess of 45 dBA were predicted within the Appelsfontein farm.

In terms of the NCR-N if the levels of noise emanating from the Hidden Valley wind facility exceed the ambient level by 7 dBA or more beyond the property projection plane, such noise constitutes a disturbing noise. The ambient noise levels (residual L_{Aeq}) measured within the Karreebosch Wind Farm were 33 dBA. The predicted 45 dBA contained in the previous paragraph would exceed the ambient level by 12 dBA From the available information it is apparent that noise intruding from Phase 1 of the Hidden Valley wind farm (Karusa) would constitute

[29] The findings of the NIA for Roggeveld Phase 1 are contained in a previous report (Jongens, 2013).

a disturbing noise with an associated high noise impact on the farm Appelsfontein of the Karreebosch Wind Farm.

By contrast the wind energy turbines of the Karreebosch Wind Farm would be well within the property boundaries with no intrusion of noise predicted beyond its boundaries. The cumulative noise impact of Roggeveld Phase 1 and Karreebosch Wind Farms combined would be **negligible** within and beyond their boundaries. From information provided it was predicted that noise emanating from the Hidden Valley Wind Farm would result in a **Major** cumulative noise impact within the Karreebosch Wind Farm boundary. This however should be placed in context: other wind farms are proposed for the area. The cumulative impact for Appelsfontein and other farm portions outside the development area of both Hidden valley and the Karreebosch / Roggeveld site is considered to be localized.

9.11. Conclusion regarding Cumulative Impacts

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The confidence in the degree of significance of these cumulative impacts is moderate. This however, is beyond the scope of this study. The current study assesses the cumulative impacts on the basis of current and best available information, with precautionary assumptions taken into account.

The alignment of renewable energy developments with the IRP and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant. However, there is a lack of understanding of the cumulative impacts on other environmental and social receptors such as birds and bats, visual amenity and landscape character of the affected areas.

There is a need for strategic planning and co-operation to better understand the cumulative impacts that may result from promoting renewable energy. In this regard the Department Environmental Affairs has initiated a Strategic Environmental Assessment to identify Renewable Energy Development Zones (REDZ), expected to be Gazetted in the near future. The Karreebosch project site is located within one of the study areas identified as part of the Strategic Environmental Assessment (SEA)[30]. The SEA project was initiated by the Department of Environmental Affairs (DEA) and conducted by the CSIR with intent to "*identify geographical areas best suited for the rollout of wind and solar PV energy projects and the supporting electricity grid network".* Through consultation with various stakeholders including the wind energy industry, the

[30] http://www.csir.co.za/nationalwindsolarsea/

CSIR identified prioritised locations that that are potential REDZ which projects a development timeline of 5, 10 and 15 years. This implies that projects of the same nature will be consolidated in one area creating a node, and ultimately aiming to reduce the potential for cumulative impacts associated with such developments when spatially fragmented. This would respond directly to the main issues raised by both the Heritage and the Visual cumulative impact assessment. The location of the Karreebosch Wind Farm site is within a prioritised REDZ. Furthermore, the Endangered Wildlife Trust and BirdLife South Africa have facilitated working groups to engage the wind energy sector on these issues. In order to better understand cumulative impacts, it is helpful to understand location of the various proposed and approved wind farm developments at any one time. In this regard, the South African Wind Energy Association is collating spatial information on the approved and proposed wind farm developments of its members.

It is also important to reiterate that it is unlikely that all proposed wind farms located in the 30-50km radius will be built due to various reasons, including those mentioned in the introductory section. Considering the findings of the specialist assessments undertaken for the project, the cumulative impacts for the proposed Karreebosch Wind Energy Facility will be acceptable and vary between **minor and major significance** (refer to Table 9.2).

Table 9.2: Summary of cumulative impact significance for Karreebosch Wind farm

Specialist report	Cumulative Impact Significance (Pre-Mitigation)	Cumulative Impact Significance (Post Mitigation)
Fauna: Ecology	Moderate – Major (-ve)	Moderate-Minor
Avifauna	Minor	Minor
Bats	Major	Minor
Visual Impact	Moderate	Moderate
Agriculture and soils	Minor	Negligible
Hydrology	Minor	Minor
Heritage Impact	Moderate	Low
Socio-Economic	Major (+ve) and Major (-ve)	Major (+ve) and moderate (-ve)
Noise	Major	Negligible

ctures and social networks is regarded as low. However, the impact on individuals who are directly impacted on by construction workers (i.e. contract HIV/ AIDS) was assessed to be of Major Negative significance. The mitigation/enhancement measures listed in the report are also regarded as appropriate. The SIA has no preference for any routing alternative with regards to power line options.

The findings of the SIA undertaken for the proposed Kareebosch WEF indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. The establishment of a Community Trust will also benefit the area. It is therefore recommended that the Kareebosch WEF be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report and other key specialist studies, specifically the VIA and agricultural assessments.

It is therefore recommended that the Kareebosch WEF be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report. The placement of turbines should be informed by the findings of the other specialist studies, specifically the VIA and agricultural assessment.

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 10

Karreebosch Wind Farm (Pty) Ltd proposes to construct a wind energy facility on a site located approximately 40km north of Matjiesfontein, and approximately 40 km south of Sutherland. The site falls within the Karoo Hoogland Local Municipality, Northern Cape and Laingsburg Local Municipality, Western Cape. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid. This final **EIA report pertains to Karreebosch Wind Farm.** Karreebosch Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme.

The site for Karreebosch Wind Farm includes the following eighteen farm portions:

Portion Farm Name Farm No	Local Municipality	Province
The Farm Appelsfontein 201	Karoo Hoogland Municipality	Northern Cape
The Remainder of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Ek Kraal 199	Karoo Hoogland Municipality	Northern Cape
The Remainder of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karreebosch 200	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Karre Kloof 196	Karoo Hoogland Municipality	Northern Cape
The Remainder of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
Portion 1 of Klipbanksfontein 198	Karoo Hoogland Municipality	Northern Cape
The Farm Kranskraal 189	Karoo Hoogland Municipality	Northern Cape
The Farm Oude Huis 195	Karoo Hoogland Municipality	Northern Cape
The Farm Rietfontein 197	Karoo Hoogland Municipality	Northern Cape
The Farm Roode Wal 187	Karoo Hoogland Municipality	Northern Cape
Portion 2 of Standvastigheid 210	Karoo Hoogland Municipality	Northern Cape
The Remainder of Wilgebosch Rivier 188	Karoo Hoogland Municipality	Northern Cape
The Farm Aprils Kraal 105	Laingsburg Municipality	Western Cape
The Remainder of Bon Espirange 73	Laingsburg Municipality	Western Cape
Portion 1 of Bon Espirange 73	Laingsburg Municipality	Western Cape

In summary, the infrastructure to be constructed as part of the wind energy facility includes the following:

- Up to 71 wind turbines (2MW to 3.3MW in capacity each), each with a foundation of 25m in diameter and 4m in depth.
- The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
- Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
- Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
- Internal access roads up to 12 m wide.
- Approximately 25km of 33kV overhead power lines linking the turbine strings to each other and to the on-site substations
- Approximately 25km of 132kV overhead power lines from the on-site substation to Eskom's Komsberg Substation.
- Up to two electrical substations on-site (33/132 kV substations with a footprint of 100m x 200m each) The on-site substation complex would also house site offices, storage areas and ablution facilities. Two alteratives are considered within this report:
  - Alternative 1: 1 x 33/132kV Substation:
    The 33/132kV substation will collect all cables at one central point to the south of Turbine 27 with 1 x 132kV line connecting to the existing 400kV substation located adjacent to the Komsberg substation. This substation is referred to as Alternative 1 Substation.
  - Alternative 2: 2 x 1 x 33/132kV Substations
    The two substations are referred to as Alternative 2 Substation West (western ridge north of Turbine 18) and Alternative 2 Substation Centre (centre ridge saddle between Turbine 47 and 49). Power line route alternative 2 (detailed below) will connect the two proposed 33/132kV substations with 1x132kV line and continue towards the existing 400kV substation located adjacent to the Komsberg substation.
- Extension of the existing 400kV Eskom substation next to Komsberg Substation.
- Underground park cabling between turbines buried along the internal access roads, where feasible.
- An operations and maintenance building (O&M building).
- Up to 4 x 100m tall wind measuring masts.
- Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (footprint size 300m x 300m).
- A borrow pit for locally sourcing aggregates required for construction (~3ha).

Two alternatives for up to two on-site 33/132 kV substation (100m x 200m): The on-site substation complex would also house site offices, storage areas and ablution facilities.

* Alternative 1: 1 x 33/132kV Substation:
  The 33/132kV substation will collect all cables at one central point to the south of Turbine 27 with 1 x 132kV line connecting to the existing 400kV substation located adjacent to the Komsberg substation. This substation will be referred to as Alternative 1 Substation.
* Alternative 2: 2 x 1 x 33/132kV Substations
  The two substations will be called Alternative 2 Substation West (western ridge north of Turbine 18) and Alternative 2 Substation Centre (centre ridge saddle between Turbine 47 and 49). Power line route alternative 2 (detailed below) will connect the two proposed 33/132kV substations with 1x132kV line and continue towards the existing 400kV substation located adjacent to the Komsberg substation.

The EIA process for the proposed Karreebosch Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN38282 of December 2014, in terms of Section 24(5) of NEMA (Act No. 107 of 1998), and includes an assessment of the above-mentioned infrastructure.

10.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - N provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the Karreebosch Wind Farm. This chapter concludes the final EIA Report by providing a summary of the conclusions of the assessment. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental team during the course of the EIA, and forms an informed opinion regarding the environmental impacts associated with the proposed project.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by Karreebosch Wind Farm (Pty) Ltd. This layout included 71 wind turbines as well as all associated infrastructure, including the substation and power line options. No environmental fatal flaws associated with the proposed wind energy facility were identified through the EIA process. However the potential for mitigation of impacts of major and high significance was identified. Measures recommended for the mitigation/avoidance of the impacts primarily entail the relocation and removal of certain turbines and associated infrastructure from areas of concern, as well as measures to be implemented during the construction phase. These mitigation/avoidance measures are discussed in more detail in the sections that follow. Where impacts cannot be mitigated or avoided during the planning phase, appropriate environmental management measures are required to be implemented to further mitigate the impacts. A detailed list of environmental specifications for the management of potential impacts is provided in the draft Environmental Management Programme (EMPr) included within Appendix M.

The following sections provide a summary of the most significant environmental impacts associated with the proposed project, as identified through the EIA.

10.2. Summary of All Impacts

Tables 10.1 and 10.2 indicate the significance ratings for the potential environmental and social impacts associated with the project.

The most significant impacts predicted to result from the construction and operational phases of the proposed development of Karreebosch Wind Farm (without the use of mitigation measures) are those on flora, fauna and visual landscape. The significance of other pre-mitigation impacts assessed during the process is mainly moderate and minor. The application of mitigation measures ensures that the identified impacts for the proposed project are reduced to an acceptable level.

Table 10.1: Summary of pre-mitigation and residual impacts of the bio-physical and socio-economic environment during the **planning and construction phase** of the project

Environmental Aspect	**Impact**	**Pre-mitigation Significance**	**Residual Impact Significance**
Flora and Fauna	Impacts on vegetation and listed or protected plant species	**MAJOR (-)**	**MODERATE (-)**
	Faunal impacts – Construction Disturbance	**MODERATE (-)**	**MODERATE (-)**
	Soil Erosion risk during construction	**MAJOR (-)**	**MINOR (-)**
Birds	Habitat loss	**MINOR (-)**	**MINOR (-)**
	Disturbance	**MINOR (-)**	**MINOR (-)**
Bats	Destruction of bat roosts due to earthworks and blasting	**MODERATE (-)**	**NEGLIGIBLE**
	Artificial lighting	**MINOR (-)**	**NEGLIGIBLE**
	Loss of foraging habitat	**MODERATE (-)**	**MINOR**
Soils and Agriculture,	Erosion	**MODERATE (-)**	**MINOR (-)**
	Dust Generation	**MODERATE (-)**	**MINOR (-)**
	Power Line Construction	**MODERATE (-)**	**MINOR (-)**
Hydrology	Impact on localized surface water quality	**MODERATE (-)**	**MINOR (-)**
	Impact on riparian systems through the possible increase in surface water runoff from hard surfaces and or roads on riparian form and function	**MODERATE (-)**	**MINOR (-)**
	Loss of riparian systems and water courses	**MODERATE (-)**	**MINOR (-)**
Visual	Potential visual impact of construction activities on visual receptors in close proximity to the proposed facility	**MODERATE (-)**	**MINOR (-)**
Heritage	Disturbance or damage to paleontological resources	**MINOR (-)**	**MINOR (+)**
	Physical destruction of archaeological material.	**MINOR (-)**	**NEGLIGIBLE**
	physical destruction of buildings, un-authorised demolition, theft of fabric and fixtures or neglect	**MINOR (-)**	**MINOR (+)**

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Social	Employment and business creation opportunities during the construction phase	**MINOR (+)**	**MODERATE (+)**
	Benefit of technical advice for local farmers and municipalities	**NEGLIGIBLE**	**MINOR (+)**
	Impact of construction workers	**MINOR (-) for communities**	**MINOR (-) for communities**
	Influx of job seekers	**MINOR (-)**	**MINOR (-)**
	Risk to safety, livestock and damage to farm infrastructure	**MODERATE (-)**	**MINOR (-)**
	Increase risk of veld fires	**MODERATE (-)**	**MINOR (-)**
	Impact of construction vehicles on roads	**MODERATE (-)**	**MINOR (-)**
	Loss of agricultural land	**MODERATE (-)**	**MINOR (-)**

Table 10.2: Summary of residual biophysical and social residual impacts during the **operation phase** of the project

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Flora and Fauna	Impact on Fauna & Flora	**MODERATE (-)**	**MINOR (-)**
	Erosion Risks	**MAJOR (-)**	**MINOR (-)**
	Alien Plant Invasion	**MODERATE (-)**	**MINOR (-)**
Birds	Displacement and disturbance	**MINOR (-)**	**MINOR (-)**
	Mortality through Collision on power lines	**MINOR- MODERATE (-)**	**MINOR (-)**
	Mortality through Collision with turbines	**MINOR**	**MINOR (-)**
Bats	Mortality due to Collision of bats with turbines or Barotrauma	**MAJOR (-)**	**MINOR (-)**
Soils and Agriculture,	Loss of high agricultural potential land	**MINOR (-)**	**NEGLIGIBLE**
Hydrology	Increase in sedimentation and erosion within the development footprint	**MODERATE (-)**	**MINOR (-)**
Hydrology	Impact on localized surface water quality	**MODERATE (-)**	**MINOR (-)**

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
	Increase in sedimentation and erosion within the development footprint	**MODERATE (-)**	**MINOR (-)**
	Impact on riparian systems through the possible increase in surface water runoff from hard surfaces and or roads on riparian form and function	**MODERATE (-)**	**MINOR (-)**
	Loss of riparian systems and water courses	**MODERATE (-)**	**MINOR (-)**
Visual Impact	Visual impact on observers travelling along arterial and secondary roads in close proximity to the proposed wind farm.	**MAJOR (-)**	**MAJOR (-)**
	Visual impact on observers residing in close proximity to the proposed facility.	**MODERATE -MAJOR (-)**	**MODERATE (-)**
	Visual impact on sensitive visual receptors within the region	**MODERATE (-)**	**MODERATE (-)**
	Visual impact of ancillary infrastructure	**MODERATE (-)**	**MODERATE (-)**
	Visual impact of overhead power line and substation	**MODERATE (-)**	**MODERATE (-)**
	Visual impact of Shadow Flicker	**NEGLIGIBLE**	**NEGLIGIBLE**
	Visual impact of Lighting	**MODERATE (-)**	**MINOR (-)**
	Visual impact of the wind facility on the visual character	**MINOR – MODERATE (-)**	**MINOR – MODERATE (-)**
	Visual impact of night-lighting on SALT	**NEGLIGABLE**	**NEGLIGIBLE**
Noise Impact	Wind turbine noise during operation (beyond the boundary)	**NEGLIGIBLE**	**NEGLIGIBLE**[1]
	Wind turbine noise during operation (within the site)	**NEGLIGIBLE**	**NEGLIGIBLE**[2]
Heritage	Cultural heritage visual or sense of place	**MAJOR (-)**	**MAJOR (-)**

[1] While the recorded noise levels comply with the NNR legal requirements and thus require no mitigation, the NIA found that turbine noise wo0075ld probably be distinctly audible both outside and within the dwellings. Refer to Appendix (I) for NIA.

[2] While the recorded noise levels comply with the NNR legal requirements and thus require no mitigation, the NIA found that turbine noise wo0075ld probably be distinctly audible both outside and within the dwellings. Refer to Appendix (I) for NIA.

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Social	Employment and business creation opportunities	**MINOR (+)**	**MINOR (+)**
	Community trust benefits	**MODERATE(+)**	**MAJOR (+)**
	Promotion of clean renewable energy	**MINOR (-)**	**MINOR (+)**
	Sense of place impacts	**MODERATE (-)**	**MODERATE (-)**
	Impact on tourism	**MINOR (+ and -)**	**MINOR (+ and -)**

Table 10.3: Summary of residual biophysical and social residual impacts during the **decommissioning phase** of the project

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Flora and Fauna	Inadequate rehabilitation following decommissioning	**MODERATE –**	**MINOR (-)**
Birds	Habitat loss	**MINOR (-)**	**MINOR (-)**
	Disturbance	**MINOR (-)**	**MINOR (-)**
Bats	Artificial lighting	**MINOR (-)**	**NEGLIGIBLE**
	Loss of bat foraging habitat	**MINOR (-)**	**NEGLIGIBLE**
Soils and Agriculture,	Erosion	**MODERATE (-)**	**MINOR (-)**
Hydrology	Impact on localized surface water quality	**MODERATE (-)**	**MINOR (-)**
Visual	Potential visual impact of decommissioning activities on visual receptors in close proximity to the proposed WEF.	**MODERATE (-)**	**MINOR (-)**
Heritage	Disturbance or damage to archaeological resources	**MINOR (-)**	**NEGLIGIBLE**
	Disturbance or damage to built environment	**MINOR (-)**	**MINOR (-)**
	Disturbance or damage to cultural landscape	**MAJOR (-)**	**MAJOR (-)**
Social	Social impacts associated with decommissioning	**MINOR (-)**	**NEGLIGABLE (-)**

10.3. Preferred Grid Option

Up to two 132kV substation options (which have no preference or priority to each other) are proposed for Karreebosch Wind Farm. 2 power line routing alternatives were considered for each substation option. The power line routes are largely located through the lower sensitivity lowlands but also traverse more sensitive hills. The main impacts associated with the power line and substation options relate to ecology, avifauna and heritage resources. These impacts have been assessed and described in Chapter 8, together with proposed mitigation measures. Associated impacts are generally considered acceptable.

The 132kV overhead power line proposed to connect the facility to the Komsberg substation will have a low impact on ecology. Although the power line traverses several drainage lines, the pylon foundations placement can be adjusted, where necessary, to avoid impact to drainage lines or any other sensitive features.

Power lines can cause bird injury and/or mortality as a result of collisions with power lines and electrocution. The risk of collision where the power line cross upper valley slopes is considered greater for birds prevalent in the valleys than with the turbines on the ridges. Furthermore, since more species and movements occur at the lower or downstream parts of the valleys (i.e. farthest from the source of the impact), the proposed power lines should, where feasible, be located as far upstream as possible. Specifically in the Wilgebos Valley power line crossings should be away from the two dams and ideally upstream of the Rietfontein dam. This situation must be mitigated and the placing of bird diverters on those power lines that are installed. Alternative 2a is the preferred option from an avifaunal perspective and will be more so if it is feasible to locate the substation on the Western Ridge farther to the north than currently planned. With the use of mitigation measures the impact of the power line on avifauna will be of minor to moderate significance.

An ecological and avifaunal pre-construction walk-through for the power line is recommended.

The power lines for the intended wind farm present vertical intrusion in the landscape, in addition to the industrialised character presented by the proposed facility in general. In terms of physical heritage the use of above ground lines will decrease the potential impact on both archaeology and palaeontology. The power line route alternatives (1 and 2) are both underlain by very similar geology and no sensitive fossil sites have been identified along or close to the power line corridors. Due to the general scarcity of fossil remains, as well as the extensive superficial sediment cover observed within the study area, the overall impact significance of the construction phase of the proposed power lines is assessed as minor. Impacts on fossil heritage due to disturbance of potentially fossiliferous bedrocks (excavations for pylon footings, access roads) are likely to be marginally greater in the case of the longer power line route (Alternative 2). However, the impact significance of both power line route options is minor. It is therefore recommended by the Heritage Impact Assessment that a final walk-through of the power line routes and substations be conducted by a contracted archaeologist, prior to and during construction.

As can be seen from the table below, the majority of specialist studies concluded that there was no preference between the power line alternatives. As the impacts on birds associated with the power line is considered to be the most significant (in terms of potential mortality of bird species in the area), this factor has been given he greatest weighting in considering the preferred alternative recommendation. The preferred alternative for the grid connection for the project based on technical feasibility and environmental impacts is, therefore, Alternative 2, Substations and power line alternative 2a (as described in Chapter 4).

Table 10.4: Comparison of power line alternatives

Specialist	Preferred Nominated Alternative
Ecology	Alternative 1a slightly preferred
Birds	Alternative 2a power line and Alternative 2 Substation preferred
Bats	No Preference
Soils	No preference
Hydrology	No preference
Heritage and palaeontology	No preference
Noise	No preference
Visual	Alternative 1b slightly preferred
Social	No preference

» <u>Alternative 2a Power line and Alternative 2 Substations</u>[33]<u>:</u> This power line route will connect the project to the 2 x 33/132kV Substation option – referred to as Alternative 2 Substation West and Alternative 2 Substation Centre.
   » Alternative 2 Substation West and Alternative 2 Substation Centre, are located on the Western Ridge, north of Turbine 18 and on the Centre Ridge, between Turbine 48 and 49 respectively.
   » Alternative 2a connects Alternative 2 Substation West with Alternative 2 Substation Centre via a 132kV power line in a northeast direction and continues as one single 132kV line towards the R354 in the southeast and ends at Komsberg in the south. Alternative 2b links Alternative 2 Substation Centre with Alternative 2 Substation West in the southwest

[33] Referred to as Option 2 in specialist reports.

via a 132kV power line and routes one single 132kV line to Komsberg in a southeast direction. Where possible the line will follow the line routing of the authorised Roggeveld Phase 1 project for approximately 7km.

Alternative 2a power line and Alternative 2 substations have been selected as the final electrical infrastructure alternative based on technical and environmental considerations. The reasons for the selection of this option are as follows:

1. Alternative 2a is shorter than alternative 2b.
2. Preliminary technical feasibility studies have shown that electrical losses as well as the lengths of both underground and overhead lines can be significantly reduced with the construction of a second transformer substation as provided in the Alternative 2a layout. This will not only reduce the use of materials such as copper, but will also have a positive effect on the project's footprint due to less cable trenches for underground lines, single pole structures for overhead lines and roads accompanying any overhead power line for servicing purposes. Moreover, any reduction in materials and losses will also raise the efficiency and competitiveness of the project.
3. Alternative 1 would entail the construction of up to 4 very low hanging 33kV overhead lines from the western ridge to the substation south of turbine 27. This Alternative 1 line routing would cross the sensitive valley of Wilgebosch Rivier in greater risk height for all residing and commuting waterbirds at the present farm dams which may increase the impact on the avian population. Instead, the avian specialist suggests one single larger and higher 132kV line as the preferred Alternative 2a. Furthermore Alternative 2a avoids the sensitive Verreaux's Eagle buffer around the nests south of Turbine 36 as well as some high flight activity areas in their close vicinity.
4. While the ecologist recommendation favoured the 132kV line for Alternative 1a, this argument was not feasible as it took into account Roggeveld Phase 1 which is to be developed as a separate project. Moreover, the ecology report did not identify any significant impacts for either power line options. Thus the risks and mitigation measures raised by the Avifaunal study were seen as more critical to the development and have been applied according to the precautionary principle.

10.4. Cumulative Impacts

Cumulative impacts are detailed in Chapter 10. Due to the recent substantial increase in interest in wind farm developments in South Africa, it is important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts are considered and avoided where possible. Significant cumulative impacts that could result from the development of Karreebosch Wind Farm and other wind energy facilities in the area include:

- visual intrusion;
- change in sense of place and character of the area;
- an increase in the significance of avifaunal impacts;
- an increase in the significance of the potential impact on bats;
- loss of vegetation; and
- temporary traffic impacts during construction.

Considering the findings of the specialist assessments undertaken for the project, **cumulative impacts** range from a **minor to major significance** (on a landscape level in this region of the Northern and Western Cape. The use of the EMPr and mitigation measures would assist in mitigating these negative impacts to an acceptable level.

10.5. Environmental Sensitivity Mapping

From the specialist investigations undertaken for the proposed Karreebosch Wind Farm, a number of sensitive areas were identified (refer to Figure 10.1 below and the A3 map in Appendix R). The following sensitive areas/environmental features have been identified on the site:

- Prominent horizontal ridges/slopes.
- Priority ridges in terms of ecology[34]
- Drainage lines and associated riparian vegetation.
- Avifaunal sensitive areas:
  - Five saddles (the lowest areas along ridge sections). Many bird species, including the Ludwig's Bustard (vulnerable species), often use saddles when crossing ridges, especially when this requires them to fly into headwinds. The risk of collision mortalities can be mitigated by leaving a 100 m gap between successive turbines across the five saddles designated from monitoring observations.
  - Valleys between the turbine ridges – populations of bird species greater in the valleys than elsewhere in the Karreebosch area. This is especially true for the Wilgebos Valley where species prone to collisions occur.
  - Verreaux's Eagles nesting areas - to minimise the risk of disturbance to, and collision mortality risk of, no turbines should be located nearer than 1.3 km from the established nesting area.
- Areas of high bat sensitivity:

[34] Three different ridgelines are identified as priority areas, with the majority of this area being restricted to one of the larger eastern ridges of the site. The higher-lying ridges of the site are the most important in terms of species and habitats of conservation concern.

- * Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line.
- * Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines.
- * Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
- * Valleys and lower altitudes are expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats.

» Heritage sites (although outside the development footprint and of low heritage significance).

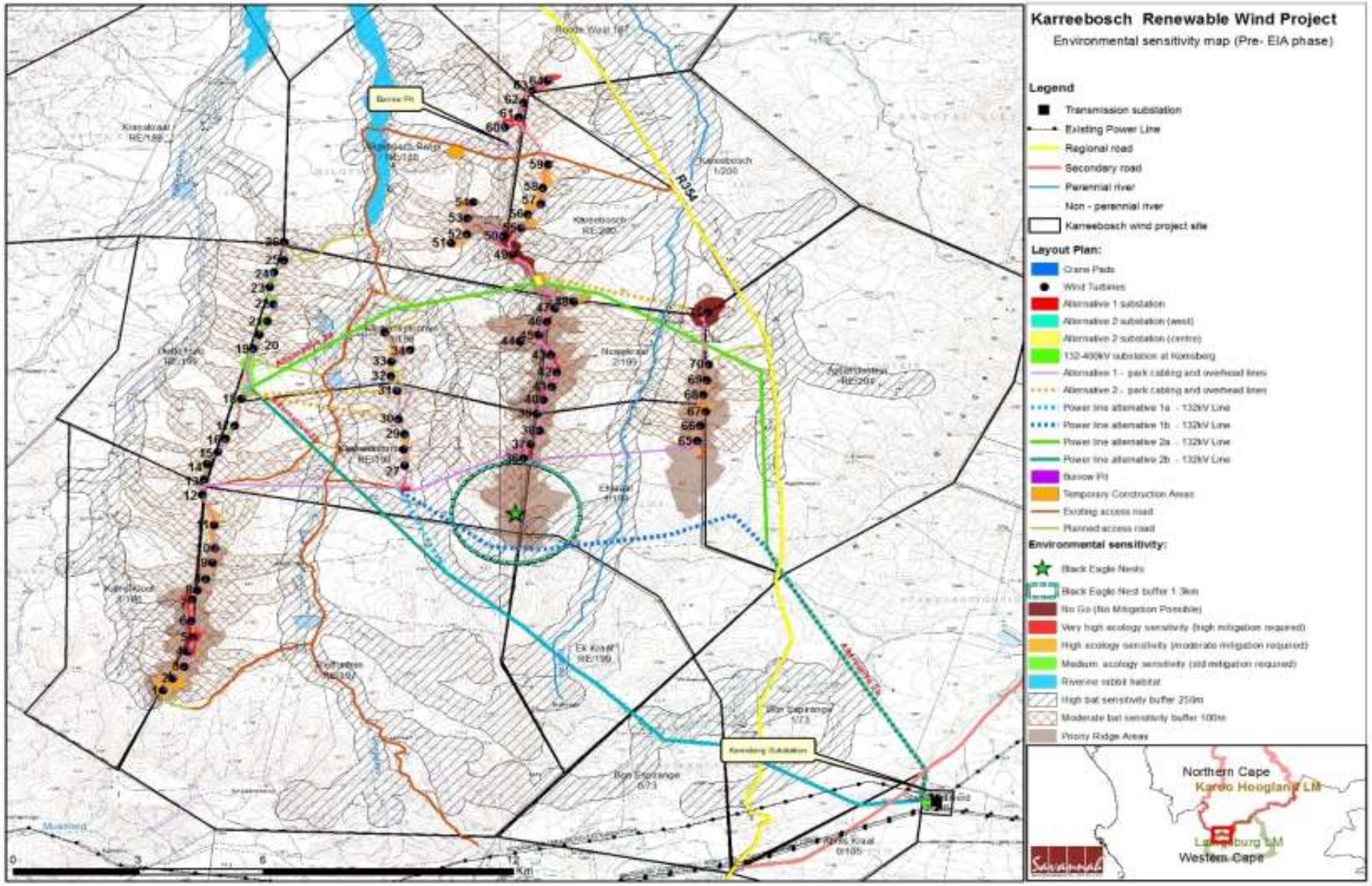


Figure 10.1: Environmental sensitivity map (pre-mitigation strategy) for the project study area illustrating sensitive areas in relation to the proposed development footprint for Karreebosch Wind Farm (Phase 2 of the Roggeveld Wind Farm **(Appendix R contains an A3 map)**

10.6. Recommendations for Micro-Siting of Turbines

The recommendations and findings of the specialist studies have been assessed and included in the mitigation strategy presented in this section of the report in order to avoid significant impacts where reasonable and feasible. The developer has taken these findings into account in order to produce the revised and final layout.

The specialist studies assessed the Karreebosch layout and the following conclusions and recommendations were made:

» **Ecology (flora, fauna and drainage lines):**
- ∗ The ecological walk-through survey and assessment of the initial layout of Karreebosch wind farm revealed that the majority of the turbines were located within physically and ecologically acceptable areas.
- ∗ Broad scale ecological sensitivity indicated that the central ridges are more sensitive than those in the west where there may be some localized areas of higher sensitivity. The power line routes are largely located through the lower sensitivity lowlands but also traverse more sensitive hills. However, as their footprint is small, significant impacts on sensitive hills are considered unlikely.
- ∗ Access roads would be the primary source of impact associated with the wind farm development and specific mitigation measures to limit the ecological impact of the roads will be required. The access roads onto the ridges frequently traverse steep areas where the risks of erosion would be high.
- ∗ No highly significant impacts on the terrestrial environment are expected from the power line options, provided standard mitigation and avoidance are implemented. A preconstruction walk-through survey of the power line route would ensure that any species of conservation concern within the footprint can be avoided.
- » The ecological walk-through survey of the initial layout of Karreebosch wind farm revealed that a section within the central part of the site has several turbines within a sensitive environment, and the developer was encouraged to alter the final layout of the development in response to these findings.
- ∗ Turbine 71 is located on top of an isolated hill in a No-Go zone due to the presence of species of conservation concern, as it is a unique ridgeline habitat, and also has high erosion risk. Within the No-Go zones, there is no possibility of adequate mitigation adequate mitigation due to the presence of species of conservation concern or disproportionate levels of impact. Turbines 49 and 50 are also located in No-Go zones due to the presence of species of conservation concern, uniqueness of the ridgeline habitats and high erosion risk. Within the No-Go zones, there is no possibility of adequate mitigation adequate mitigation due to the presence of species of

conservation concern or disproportionate levels of impact. These turbines should therefore be relocated

* Turbines 49, 50 and 71 and associated infrastructure are deemed likely to generate unacceptably high impacts and it is recommended that they are either relocated outside of the demarcated area or excluded from the layout entirely.

» **Birds:**

* No turbines are to be located nearer than 1.3 km from the established Verreaux's Eagles breeding cliff on Beacon Hill.
* Siting of turbines in the flatter middle part of the ridge will minimise risk of collision.
* Siting turbines closer than 50 m from the lowest point of upper valley saddles is not encouraged as with increasing ridge height, birds increase their selection of the lowest points that provide exits from the upper reaches of the valleys.
* Flight paths of the Black Harrier near Turbine 60 are not of concern as the birds were observed quartering which was often below collision risk height.
* The area around turbines 17 and 18 is both a soaring area (for raptors) and a passage route for birds commuting from one set of dams in the west to those in the east. Thus turbines nearby may have the potential for impacting more birds than other placements along the ridge.
* All turbines are generally spaced by a minimum of 3 x rotor diameter (i.e. up to 420m apart).

» **Bats:**

* No proposed turbines are located within High bat sensitive areas and their respective buffer zones.
* Turbine 57 and 52 (marginally) is located in High bat sensitivity buffer.
* Areas of High sensitivity and their buffers are 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.
* Turbines within or close to Moderate Bat Sensitivity areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
* Turbine 27 is located in moderate bat sensitivity area
* Turbine 4 and 25 located in moderate bat sensitivity buffer

» **Heritage Sites**

* Archaeological sites of low heritage significance occur outside the development footprint therefore no mitigation is required

» **Palaeontological Sites**
- No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Karreebosch Wind Farm study area. The majority of fossil sites recorded in the study region lie outside the anticipated development footprint therefore no mitigation is required.

» **Noise**
- Based on the assessed layout, no noise mitigation procedures would need to be implemented (under the Noise Control Regulations) neither at the turbines themselves nor at any of the dwellings located within or the neighboring properties outside the Karreebosch Wind Farm site boundaries.

There are no visual or social turbine micro-siting recommendations.

As part of the planning mitigation strategy, the applicant has considered all the above-mentioned findings and sensitivities, and duly made the necessary amendments to the layout in order to reduce impacts to an acceptable level.

Figure 10.2 (a-j) below provides details on each of the turbines which are proposed to be removed or relocated, along with changes to crane pad and access road footprints. The detail pertaining to each required removal or relocation is provided in Table 10.5. Mitigation measures as detailed in the specialist studies, this EIA report and the **Draft EMPr (Appendix M**) are to be applied during the various stages of development of the wind farm. The revised layout allows for avoidance of negative impacts on sensitive areas and is considered acceptable from an environmental and social perspective and is shown below in Figure 10.3 and 10.4. Specialists have been consulted with and are in support of the revised layout. Letters confirming this acceptance are included in Appendix O. This revised layout is nominated as the preferred option for implementation.

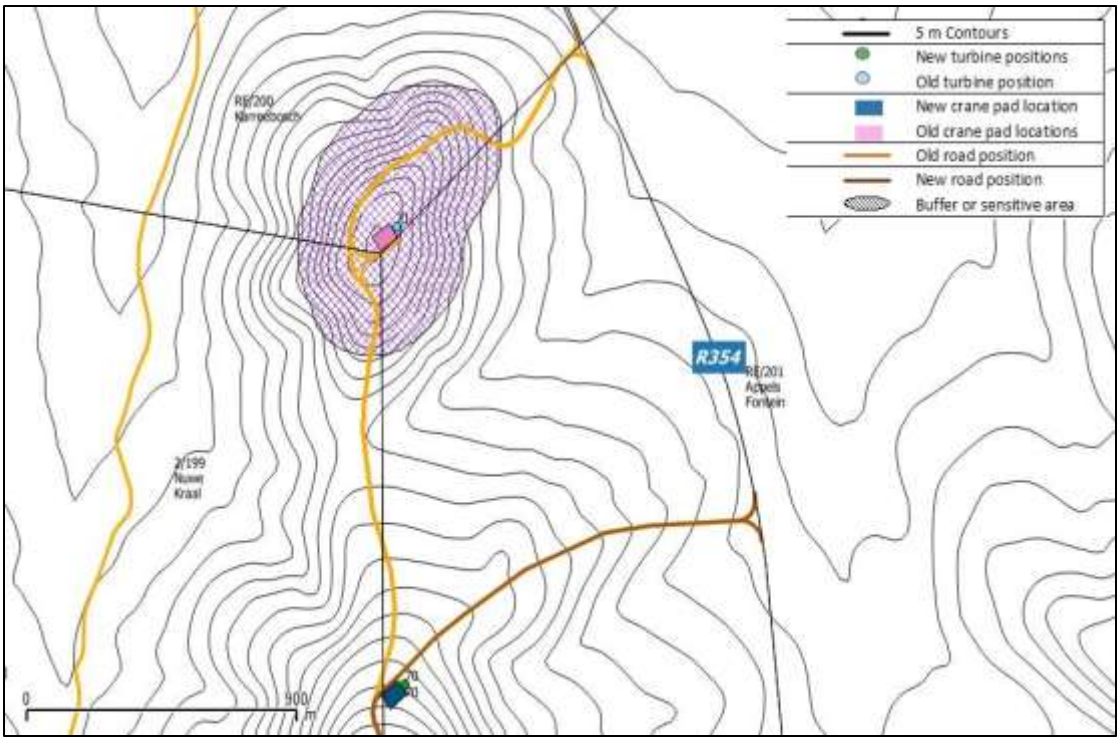


Figure 10.2a: Image illustrating the removal of turbine 71 on the basis of the findings of the draft EIR for the final development layout. The purple hatched polygon represents the ecological No-Go Zone.

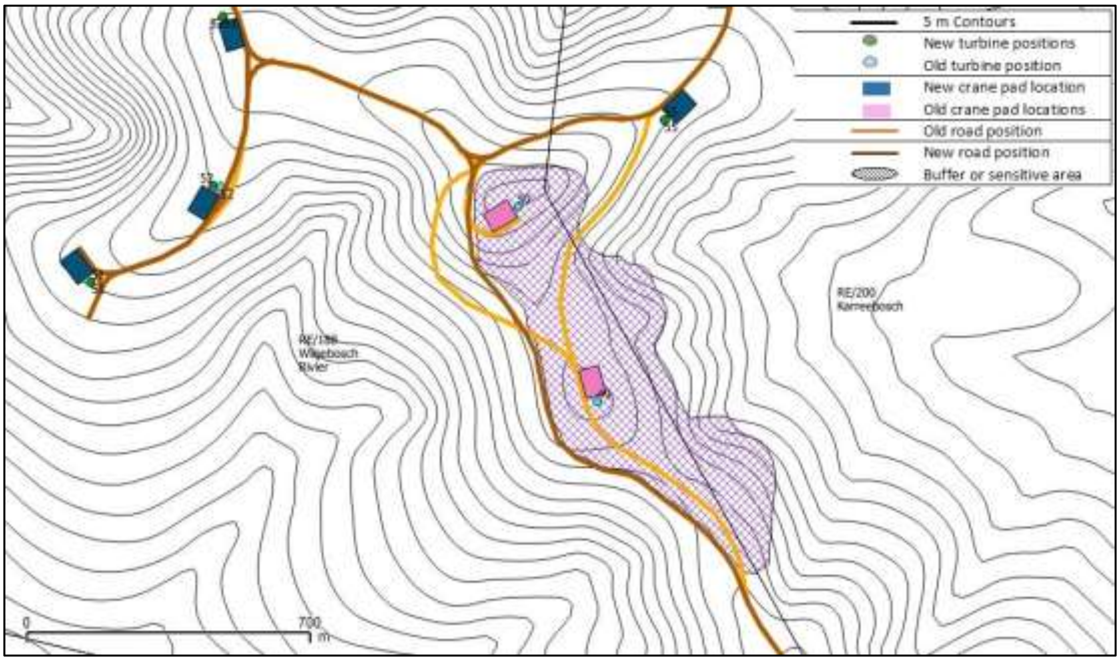


Figure 10.2b: Image illustrating the removal of turbine 49 and 50 on the basis of the findings of the draft EIR for the final development layout. The purple hatched polygon represents the ecological No-Go Zone. The road was further realigned to avoid the ecological sensitive area.

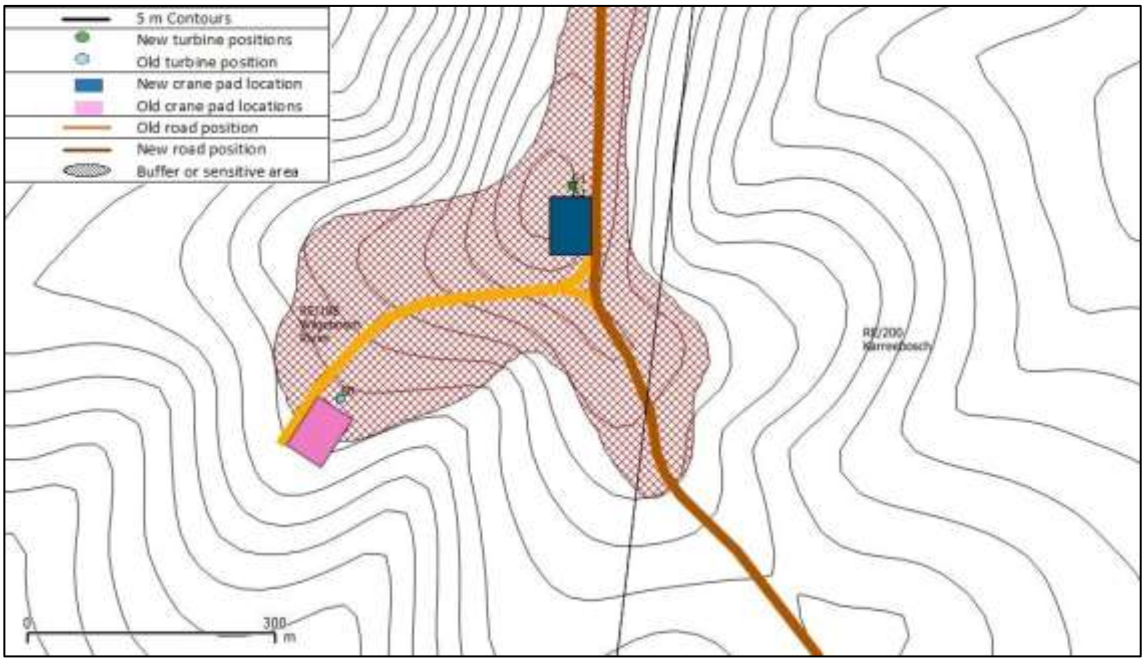


Figure 10.2c: Image illustrating the removal of turbine 60 on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents the ecological Very High Sensitivity Zone.

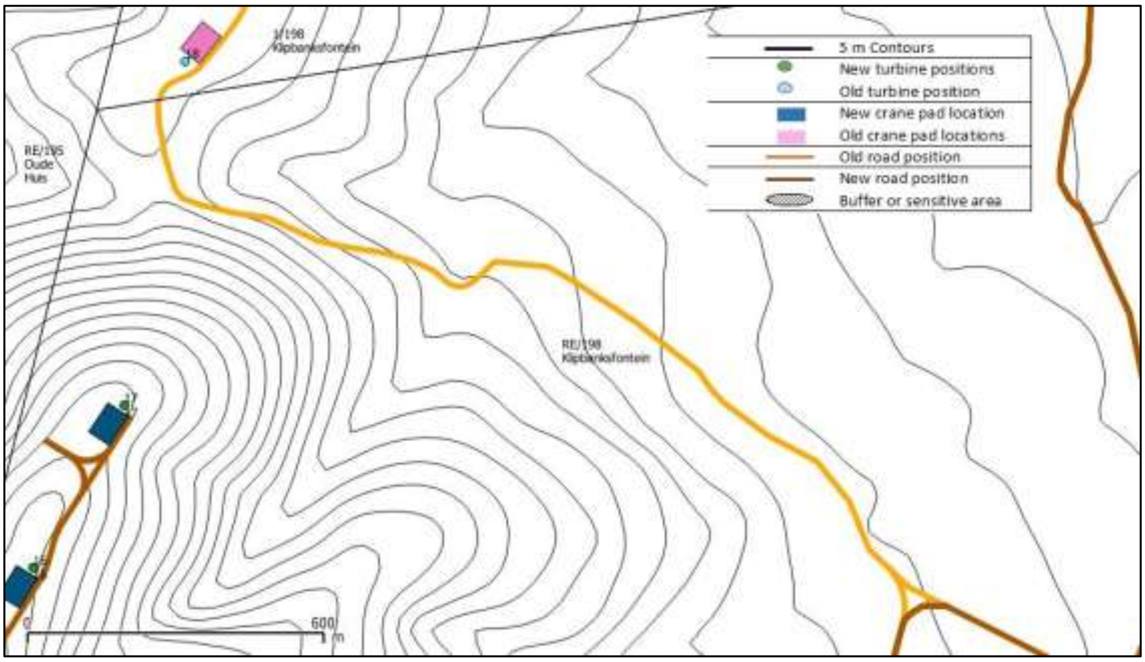


Figure 10.2d: Image illustrating the old turbine and crane pad position of turbine 18 on the basis of the findings of the draft EIR for the final development layout. This was based on avifaunal findings. Furthermore the access road to the ridge was removed to reduce the general impact on vegetation.

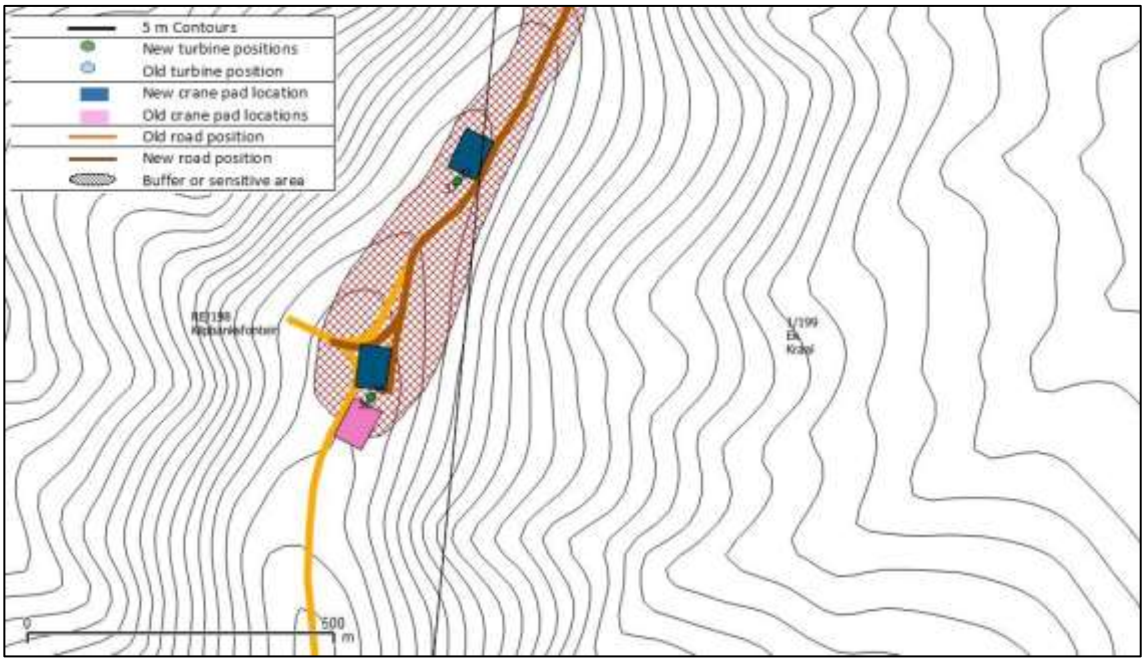


Figure 10.2e: Image illustrating the reduced footprint of the access road and crane pad changes around Turbine 36 on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents a 'Very High Sensitivity' ecological zone.

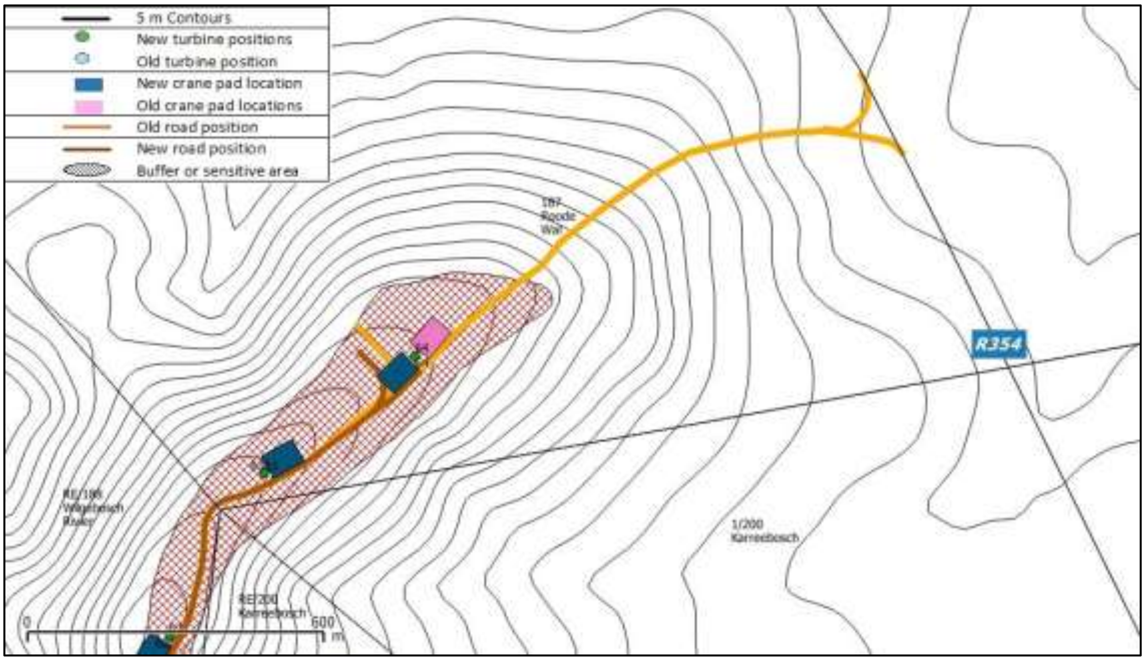


Figure 10.2f: Image illustrating the reduced footprint of the access road and crane pad changes around Turbine 64 on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents a 'Very High Sensitivity' ecological zone.

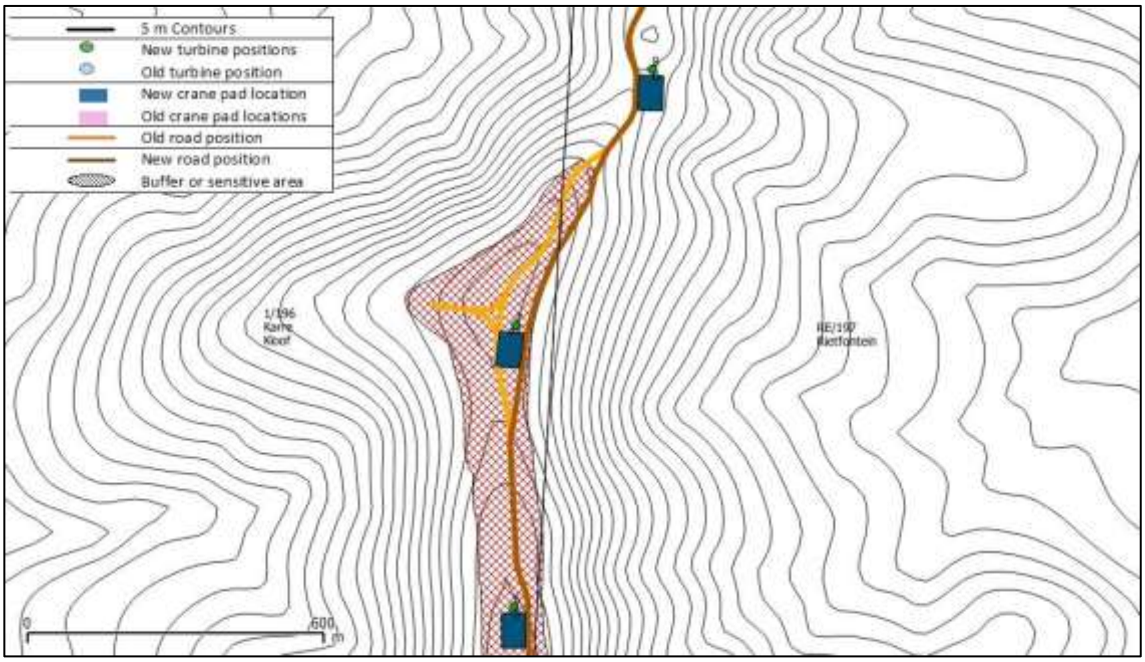


Figure 10.2g: Image illustrating the reduced footprint of the access road between Turbine 7 and 9 on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents a 'Very High Sensitivity' ecological zone.

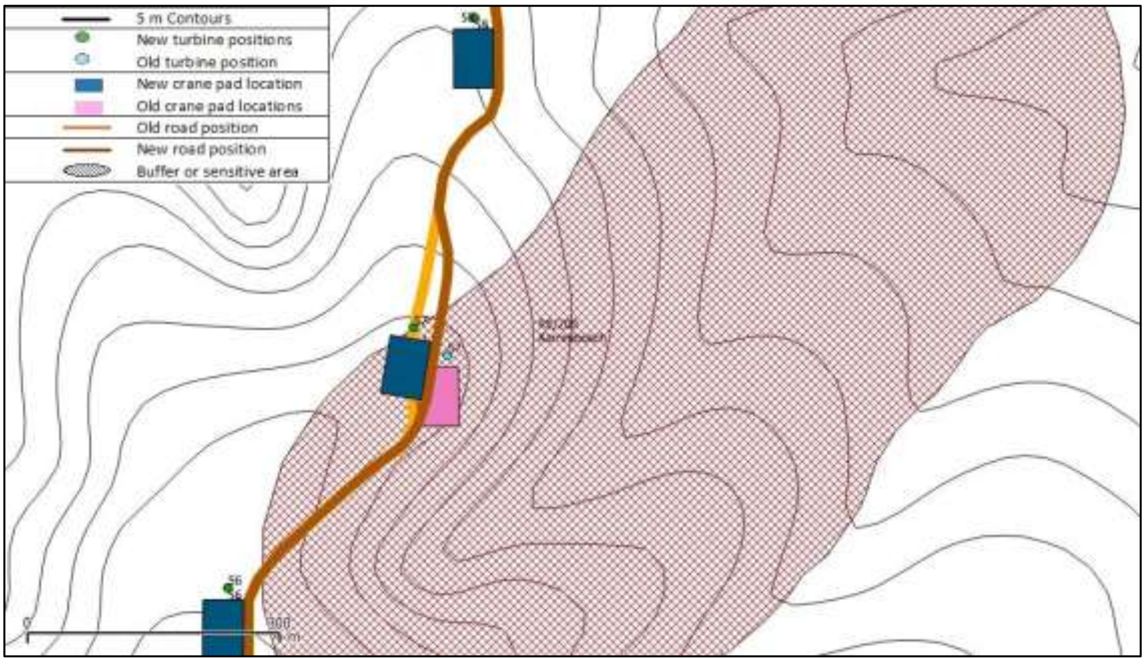


Figure 10.2h: Image illustrating the shifting of turbine 57, the change of the crane pad locations and access road on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents a 'High Sensitivity' bat buffer zone applying to the placement of turbines.

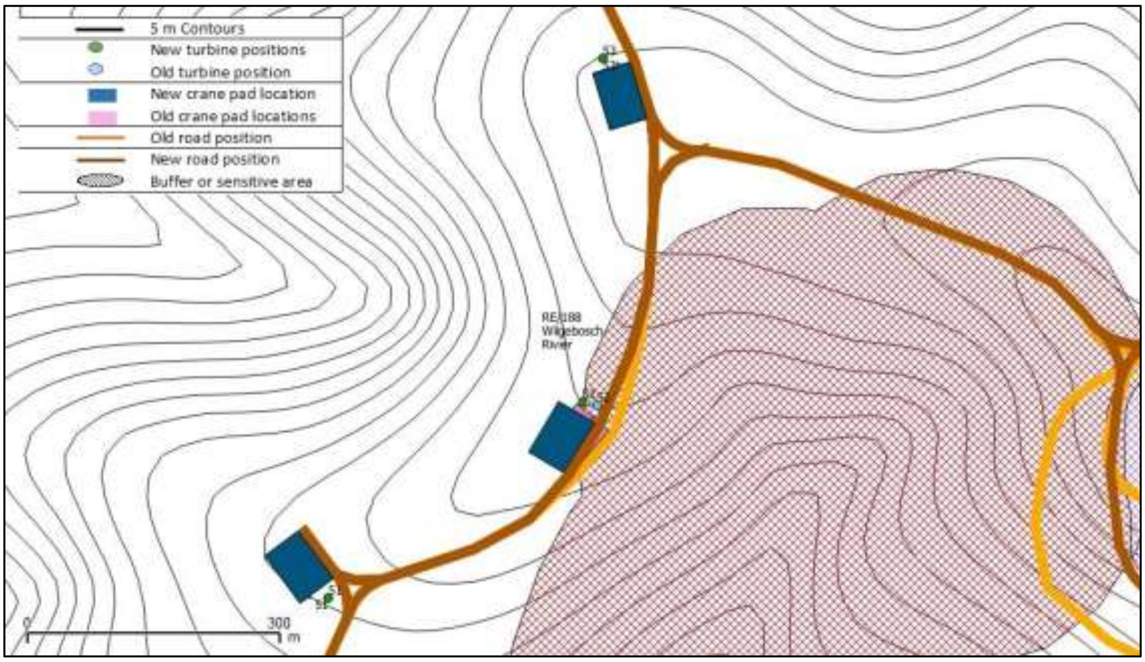


Figure 10.2i: Image illustrating the shifting of turbine 52, the change of the crane pad locations and access road on the basis of the findings of the draft EIR for the final development layout. The red hatched polygon represents a 'High Sensitivity' bat buffer zone applying to the placement of turbines.

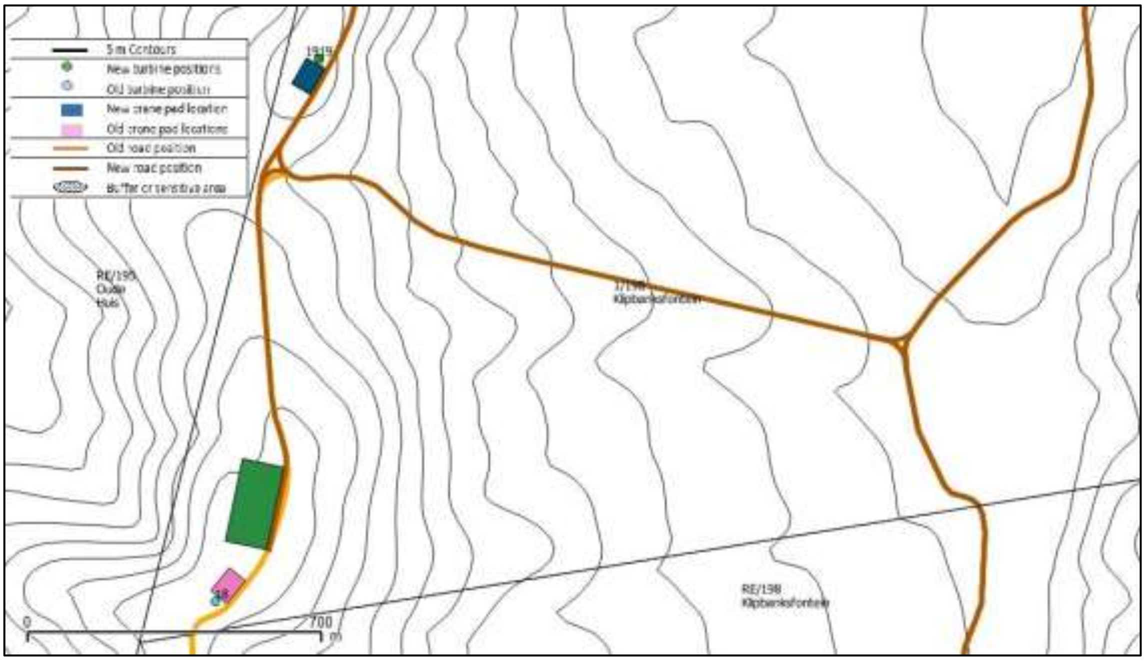


Figure 10.2j: Image illustrating the reduction of the road footprint south of turbine 19 due to the removal of turbine 18 (see Figure 10.2d). The green polygon represents the new location of the western substation.

Table 10.5: Details of infrastructure relocation or loss based on findings of specialist studies

Turbine Name/ Close to turbine	Shift [metres]	Direction of Shift	Description of Change	Reason for Change	Reference figure
71	none	none	Turbine removed together with adjacent crane pad and ~ 2.5km of access road	Avoidance of ecological no-go zone	Figure 10.2a
49 and 50	none	none	Turbines removed together with adjacent crane pad. Some access roads removed, others rerouted to achieve complete avoidance	Avoidance of ecological no-go zone	Figure 10.2b
60	none	none	Turbine 60 removed together with adjacent crane pad and about 460m of access road	Reducing footprint in ecological very high sensitivity zone	Figure 10.2c
18	none	none	Removed turbine 18 together with its crane pad and 3.3km of associated access road	precautionary measure due to proximity to topographical saddle used by birds	Figure 10.2d
36	n/a	n/a	10.4km of access road removed from R354 going south along eastern valley to connect with central ridge at turbine 36, rerouting turning area to utilise crane pad, moved crane pad to other side of turbine to reduce road length	Reducing footprint in ecological very high sensitivity zone	Figure 10.2e
64	n/a	n/a	Removed north-eastern most access road (~1.1km), rerouting turning area to utilise crane pad, moved crane pad to other side of turbine to reduce road length	Reducing footprint in ecological very high sensitivity zone	Figure 10.2f
7	n/a	n/a	Rerouted access road	Reducing footprint in ecological very high sensitivity zone	Figure 10.2g
57	50	North West	Turbine 57 shifted approx. 50m north-west, alignment of the crane pad and accordingly rerouting of the road	Avoiding the high sensitivity bat buffer	Figure 10.2h
52	20	West	Turbine 52 shifted approx. 20m west, alignment of	Avoiding the high sensitivity bat	Figure 10.2i

Turbine Name/ Close to turbine	Shift [metres]	Direction of Shift	Description of Change	Reason for Change	Reference figure
			the crane pad and accordingly rerouting of the road	buffer	
19	n/a	n/a	The initial road between Turbine 17 and 19 was removed. A shorter road servicing the substation west will remain which is now approx. 1km shorter	Reduction of footprint of overall road layout and medium sensitive ecological areas	Figure 10.2j

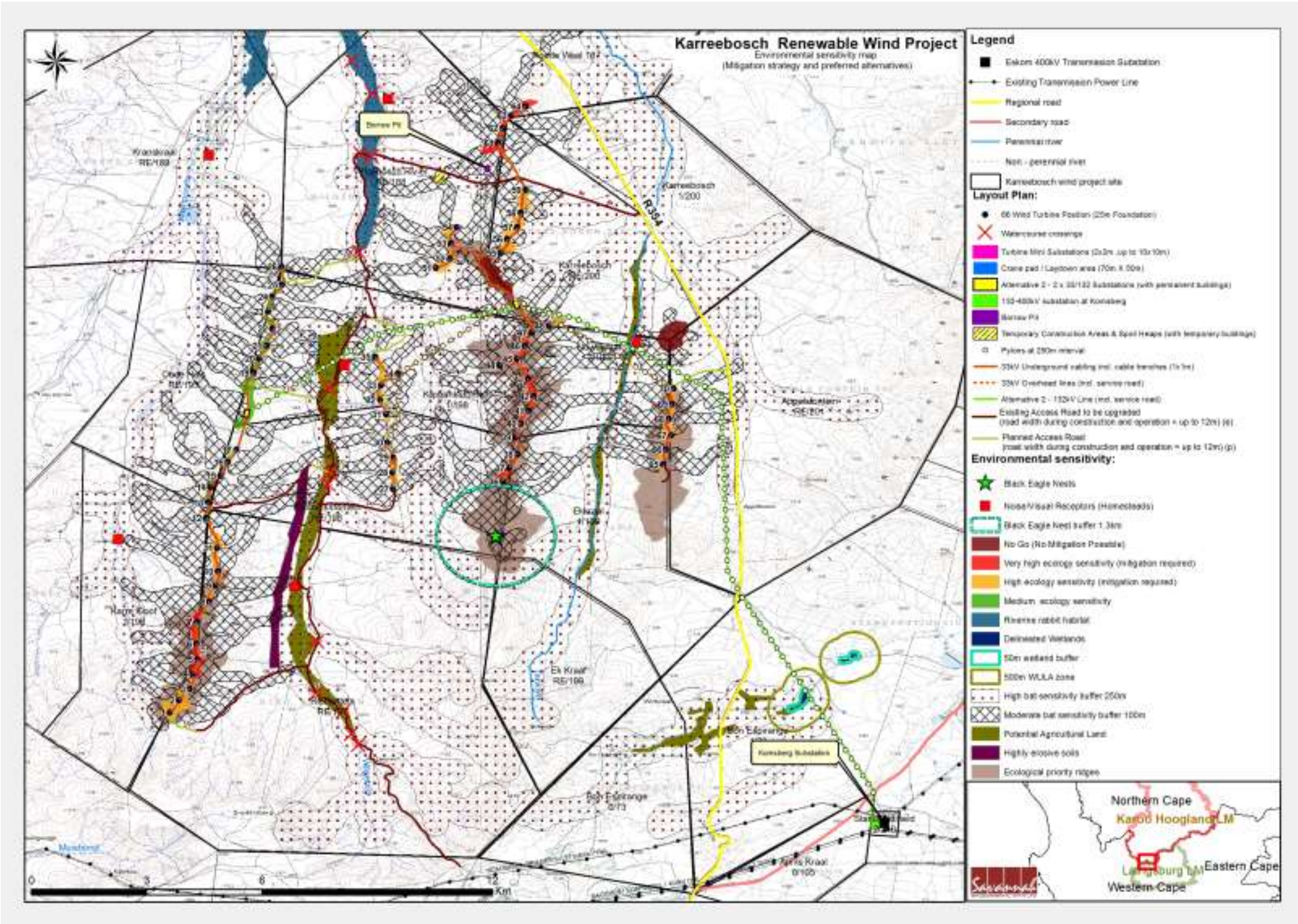


Figure 10.3: Revised layout for the Karreebosch Wind Farm overlain onto the environmental sensitivity map, based on the findings of the draft EIA report **(Appendix R contains an A1 map)**

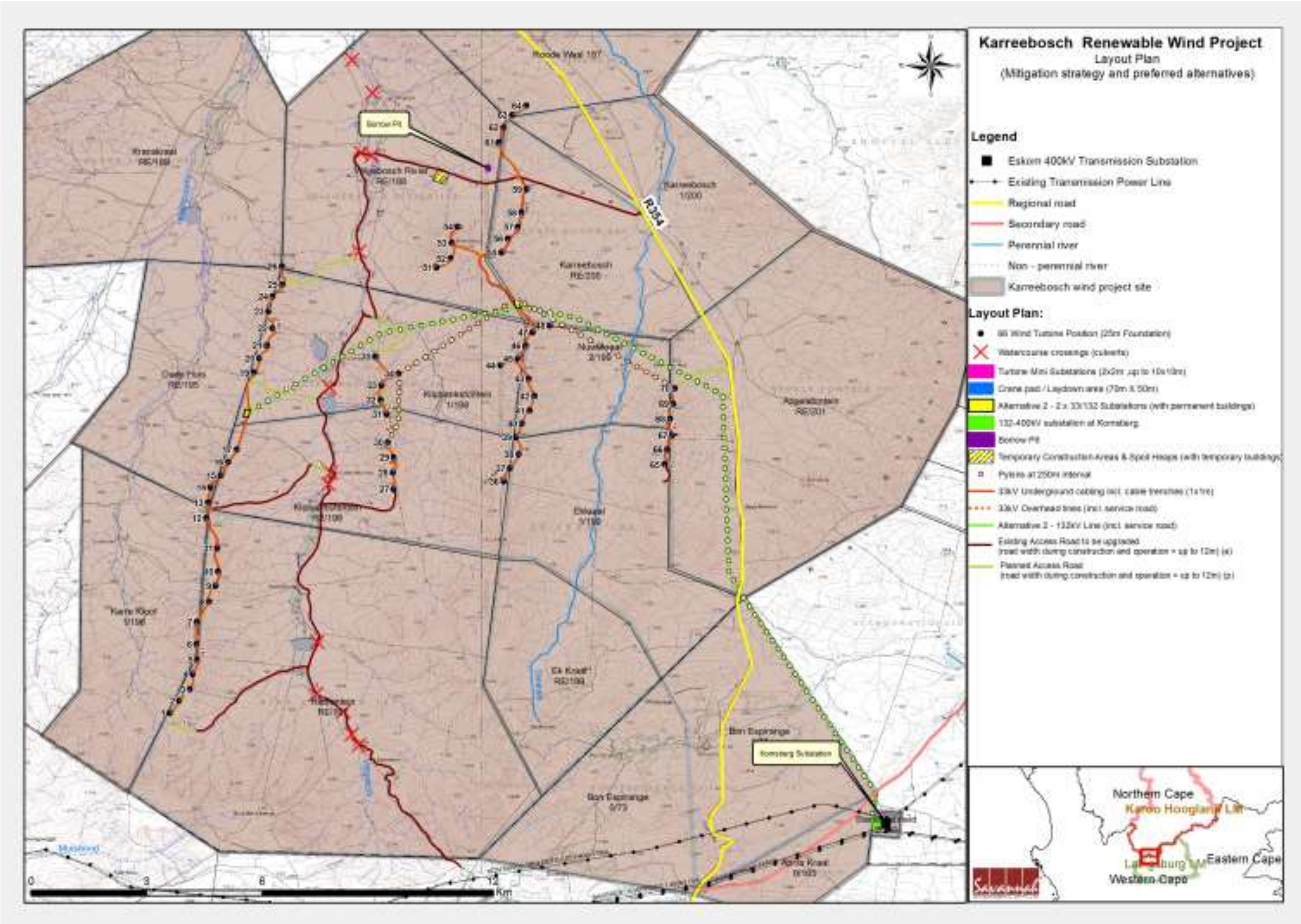


Figure 10.4: Revised layout for the Karreebosch Wind Farm overlain onto topographical map, based on the findings of the draft EIA report **(Appendix R contains an A1 map)**

10.7. Overall Conclusion (Impact Statement)

The need for development of renewable energy facilities, including wind energy developments, stems from the internationally increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of finite resources. In order to meet the long-term goal of a sustainable renewable energy industry in South Africa, 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) through the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation capacity being derived from renewable energy forms by 2030.

Through pre-feasibility assessments and research, the viability of establishing the Karreebosch Wind Farm has been established by Karreebosch Wind Farm (Pty) Ltd. This project is intended to be developed in response to this need for renewable energy. The positive implications of establishing a wind energy facility on the demarcated site include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise wind energy resources on this site would be realised.
» The National electricity grid in the Northern Cape and Western Cape would benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa.
» Wind energy can offer a competitive tariff in comparison to electricity generated from coal power.
» Implementing a wind farm is a faster process than than to implement a coal or nuclear power station (2 years versus ~ 5 years or more respectively).
» Wind projects contribute indirectly to the municipalities' Integrated Development Plans (IDPs) and local economic development targets.
» Creation of local employment, skills development and business opportunities for the area.
» Contribution to job creation (direct and indirect) in the area, and also improving the local economic activity.

The findings of the specialist studies undertaken within this EIA for Karreebosch Wind Farm conclude that:

» With the implementation and adoption of the recommended mitigation, monitoring and management measures, there are no environmental grounds or fatal flaws that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site.

» The most significant impacts associated with the construction and operational phases of the development of the Karreebosch wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.
» Majority of the environmental and social impacts associated with development Karreebosch wind energy facility will be of moderate significance and of acceptable levels (refer to summary tables above).
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. These mitigation measures have been taken into account and a revised layout has been produced (Figure 10.4). With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **high**.

10.8. Overall Recommendation

Based on the nature and extent of the proposed 140MW wind farm, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Karreebosch Wind Farm and associated infrastructure can be mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the detailed design of the project. The primary impacts relate to visual, ecology, avifauna and bats, each having relevant mitigation.

The Environmental Authorization should specify the timeframe until construction is completed. It is requested that commencement should occur within 10 years of the receipt of the EA (unless a process to amend the EA contemplated in regulation 32 is followed).

The EIA project team recommends that the competent authority considers that the visual impact and impact on heritage sense of place as well as the impact on vegetation remain of major - moderate significance. This should however be viewed within the context of the identification of the area as a renewable energy development zone. It is also possible that due to the proximity of the neighbouring renewable energy sites that the separate wind facilities could be viewed as a single large wind facility, thus reducing the cumulative visual impact.

This should then be weighed up against the benefits to the local economy as well as the government's commitments in terms of renewable energy targets. If promoting renewable or alternative energy is an important consideration for the SA Government (also because of the associated benefits in terms of reduction in CO_2 emissions) it may become important that some **trade-offs and choices** would need to be made between promoting renewable energy versus the local and regional environmental and social impacts and benefits of the proposed wind farm.

Following the mitigation strategy as detailed in this chapter of the report, the infrastructure below is recommended to be included in the environmental authorisation issued for Karreebosch wind farm project:

» **66 turbines**[35] (2MW to 3.3MW in capacity each) with a foundation of 25m in diameter and 4m in depth, following layout revisions based on specialist input,
» The hub height of each turbine will be up to 100 metres, and the rotor diameter up to 140 metres.
» Permanent compacted hardstanding areas / crane pads for each wind turbine (70mx50m).
» Electrical turbine transformers (690V/33kV) at each turbine (2m x 2m footprint typical but up to 10m x 10m at certain locations)
» Internal access roads up to 12 m wide.
» Approximately 25 km of 33kV overhead power lines and approximately 25km of 132kV overhead power lines to Eskom's Komsberg substation.
» Power line alternative 2a and Alternative 2[36] substations: The power line route connects to 2 x 33/132kV Substations – referred to as Alternative 2 Substation West and Alternative 2 Substation Centre (as described in Chapter 4).
» Extension of the existing 400kV Substation at Komsberg with several electrical components to be defined by Eskom (e.g. additional feeder bay, transformer bay) on the existing substation property.
» Underground park cabling between turbines buried along internal access roads.
» An operations and maintenance building (O&M building) next to the on-site substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction Phase includes construction lay down areas and a construction camp up to 9ha (300m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~3ha).

[35] The number of turbines has been reduced (from 71) to 66 turbines
[36] Referred to as Option 2 in specialist reports.

The following conditions would be required to be included within an environmental authorisation for the project:

» The preferred layout for implementation is as indicated in Figure 10.4.
» Mitigation measures detailed within this report should be considered to minimise environmental impact. These are either already taken into account in the design of the final layout or are incorporated into the EMPr.
» The draft Environmental Management Programme (EMPr) as contained within Appendix M of this report should be approved and form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» The detailed engineering design of the facility must be submitted to DEA for prior to the commencement of construction.
» Should there be any changes to the location of the wind turbines and associated infrastructure (including power lines) that fall within identified sensitive areas (if any), walk - through surveys must be undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
» An ecological and avifaunal pre-construction walk-through for the power line to be undertaken.
» Preconstruction ecology walk-through of the development footprint for species of conservation concern that can be translocated. Before construction commences individuals of listed species within the development footprint should be marked and translocated to similar habitat outside the development footprint under the supervision of a suitably qualified person or ecologist. Permits from the relevant provincial authorities will be required to relocate listed plant species.
» Feasible mitigation measures as recommended by the fauna and flora specialist report should be implemented. This includes the recommendation of releasing grazing pressure along priority ridgelines in an effort to improve habitat quality and species diversity and reduce the long term impact of the development on listed and protected plant species.
» Feasible mitigation measures as recommended by the pre-construction bird monitoring programme to be implemented. Mitigation measures, as outlined in the Avifaunal report, in terms of bird collisions with cross-valley power lines should be implemented. Electrocution risk should be prevented with use of approved types of installations.
» A heritage walk through survey must be undertaken for the proposed road alignments, especially through the valleys which are the most sensitive areas in terms of heritage.

» Feasible mitigation measures as recommended by the pre-construction bat monitoring programme to be implemented.
» Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect, quantify and remove any alien plant species that may become established.
» Implement site specific erosion and stormwater control measures to prevent excessive surface runoff from the site (turbines and roads).
» Should any heritage site, human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility. If fossil material is encountered, the palaeontologist must be given sufficient time and access to resources to recover at least a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. In the event of human bones being found on site, SAHRA must be informed immediately and the remains removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.
» Applications for all other relevant and required permits if required to be obtained by the developer must be submitted to the relevant regulating authorities. This includes, where necessary, permits for the transporting of all components (abnormal loads) to site, water use licence for disturbance to any water courses/ drainage lines near wetlands, permits for disturbance of protected vegetation and borrow pit/s.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» It is recommended that Karreebosch Wind Farm continues consultations and cooperation with SAAO/SALT and the Civil Aviation Authority to ensure that the potential light pollution impacts on SALT activities are mitigated prior to construction of the wind energy facility. As a condition of approval, such consultation with SAAO/SALT and CAA must mandated to ensure that the potential light pollution impacts on SALT activities are mitigated

The anticipated impacts regarding the proposed wind facility project have been assessed and presented in the findings of the specialist studies undertaken within this EIA. In accordance with the findings of this study, it is concluded that there are no environmental grounds or fatal flaws which should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures. These are included within the EMPr to ensure that these areas receive special attention.

It was determined during the EIA that the proposed wind facility will result in minor - major potential negative impacts and certain positive impacts. The site layout alternative is considered to be environmentally acceptable. Further to the above, it has been demonstrated in the final EIR that a detailed public participation process was followed during the EIA process which conforms to the public consultation requirements as stipulated in the EIA Regulations. All issues raised by I&APs on the Draft Environmental Impact Report (DEIR) are captured in this Final EIR and where possible, mitigation measures provided in the EMPr to address these concerns. As sustainable development requires all relevant factors to be considered, including the principles contained in section 2 of NEMA, the EIR has strived to demonstrate that where impacts were identified, these have been considered in the determination of the preferred site layout.

It is therefore put forward that the EIR provides the reviewing authority with adequate information to make an informed decision regarding the proposed project based on the factors below:

» The preferred site layout is considered as environmentally acceptable as long as mitigation measures are implemented for any sensitive features.
» A preferred grid access has been identified which is less environmentally sensitive compared to the other considered grid access alternative.
» Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the wind facility can be mitigated to acceptable levels.

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