SiVEST SA (PTY) LTD

PROPOSED CONSTRUCTION OF THE PATATSKLOOF WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE, NEAR TOUWS RIVER, WESTERN CAPE PROVINCE, SOUTH AFRICA

Avifaunal Specialist Assessment Report

DEFF Reference: TBA
Report Prepared by: **Chris van Rooyen Consulting**
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SiVEST SA (PTY) LTD

PROPOSED CONSTRUCTION OF THE PATATSKLOOF WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE, NEAR TOUWS RIVER, WESTERN CAPE PROVINCE, SOUTH AFRICA

AVIFAUNAL SPECIALIST ASSESSMENT

EXECUTIVE SUMMARY

1. INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as "Mainstream"), has appointed SiVEST SA (Pty) Ltd (hereafter referred to as "SiVEST") to undertake the required BA Processes for the proposed construction of the 250MW Patatskloof WEF and associated grid infrastructure near Touws River in the Western Cape Province.

The overall objective of the development is to generate electricity by means of renewable energy technology capturing wind energy to feed into the National Grid.

It is anticipated that the proposed Patatskloof WEF will comprise thirty-five (35) wind turbines with a maximum total energy generation capacity of up to approximately 250MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line.

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 [GNR 982, 983, 984 and 985) and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DEFF), prior to the commencement of such activities. Specialist studies have been commissioned to assess and verify the project under the new Gazetted specialist protocols.

It is estimated that a total of 135 bird species could potentially occur in the broader area of the proposed Patatskloof Wind Energy Facility. Of these, 18 species are classified as priority species for wind developments, and 38 are classified as sensitive species for powerlines.

2. CONCLUSION AND SUMMARY

2.1 Summary of Findings

2.1.1 Wind Energy Facility

The proposed Patatskloof WEF will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collision mortality caused by the wind turbines in the operational phase.
- Electrocution on the 33kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

2.1.1.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Species which fall in this category are Ludwig's Bustard, Southern Black Korhaan, Karoo Korhaan, Double-banded Courser, Grey-winged Francolin and Spotted Eagle-Owl. Some raptors might also be affected, e.g., Pale Chanting Goshawk which could potentially breed in the small *Vachellia* trees in the drainage lines, and Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. The impact is rated as **medium** but could be mitigated to **low** levels.

2.1.1.2 Displacement due to habitat transformation in the construction phase.

The network of roads is likely to result in significant habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard and Karoo Korhaan, and raptors. Given the current density of the proposed turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the project area of impact (PAOI). The alternative substation locations are all situated in essentially the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore any of the alternative locations will be acceptable. The same goes for the alternative laydown and compound areas. The impact is rated as **low** both pre- and post-mitigation.

2.1.1.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed Patatskloof WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan and Southern Black Korhaan, although generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., raptors such as Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle and Greater Kestrel are most at risk of all the priority species likely to occur regularly at the project site. Verreaux's Eagle might also be at risk to some extent, although the species is unlikely to venture regularly within the PAOI. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

2.1.1.4 Electrocution on the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the poles could potentially pose an electrocution risk to raptors, including Red Data species such as Martial Eagle. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

2.1.1.5 Collisions with the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

2.1.1.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar in nature to the construction phase.

2.1.1.7 Cumulative impacts.

The maximum number of wind turbines which are currently proposed for the wind farms located within a 35km radius in similar habitat around the PAOI is 367. To date, only one (Perdekraal East WEF) has been constructed, and some of the planned projects must still undergo a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that all proposed 367 turbines will be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Patatskloof WEF will consist of up to 35 turbines, which brings the total number of potential turbines within the 35km radius to 402. The 35 turbines of Patatskloof WEF constitute 8.7% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The total affected land parcel area where turbines are planned, including the Patatskloof WEF, amounts to approximately 433km², which constitutes about 9% of the total area (4 584km²) of similar habitat available to birds in the 35km radius around the project. The cumulative impact of the planned wind energy projects at the time of writing is therefore still low as far as the creation of high-risk zones are concerned within the area contained in the 35km radius.

The impact of solar facilities on avifauna lies mainly in the habitat transformation associated with the construction of PV solar panels, which transforms vast areas of natural habitat significantly. The total land parcel area of the currently planned PV facilities amounts to about 166km², which equates to about 3.6% of similar habitat available in a 35km radius around the project site, which is low.

The land parcel area of the proposed Patatskloof WEF (66.2km²) amounts to about 11.5% of the total amount of land parcel area designated for renewable energy developments (577km²), but only approximately 1.4% of the total area of similar habitat available in the 35km radius. The contribution of the Patatskloof WEF to the cumulative impact of all the renewable energy facilities is therefore medium as far as potential displacement of priority species due to habitat transformation is concerned. The combined land parcel area of all the planned renewable energy land parcels (both wind and solar) equates to just over 12% of the available habitat in a 35km radius around the project site. The cumulative impact of all the planned renewable energy facilities in this area is thus assessed to be **medium** pre-mitigation, and **low** post-mitigation

Table 1 summarises the expected impacts of the proposed WEF and proposed mitigation measures per impact.

Table 1: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre -Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	Low
Construction: Displacement due to habitat transformation	Low	(1) Removal of vegetation must be restricted to a minimum and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.	Low
Operational: Collisions with the turbines	Medium	(1) No turbines should be located in the buffer zones around major drainage lines, waterpoints and dams. (2) Any planned turbines within the 3.7 – 5.2km circular medium-risk buffer zone around the Verreaux's Eagle nest must be subjected to an additional year of monitoring to determine the risk that these turbines pose to Verreaux's Eagles, to establish whether they could be effectively mitigated, or will have to be removed. (3) Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. (4) If at any time estimated collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the mortality threshold determined by	Low

		the avifaunal specialist after consultation with other avifaunal specialists and BirdLife South Africa, additional measures will have to be implemented which could include shut down on demand or other proven measures.	
Operational: Electrocutions on the 33kV MV network	Medium	(1) Underground cabling should be used as much as is practically possible. (2) If the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted timeously to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformers. (3) Regular inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to look for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).	Low
Operational: Collisions with the 33kV MV network	Medium	Bird flight diverters must be installed on all the overhead line sections for the full span length according to the latest Eskom standard.	Low
Decommissioning: Displacement due to disturbance	Medium	1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	Low
Cumulative impacts	Medium	All the mitigation measures listed in the various bird specialist studies compiled for the eleven (11) renewable energy facilities within a 35km radius around the project.	Low

3.1.1 Grid connection components

The proposed Patatskloof WEF grid connection will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collisions with the overhead line in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

3.1.1.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. There are currently no large raptor nests on the section of the Bacchus-Droërivier 1 400kV transmission line that will run next to the proposed 132kV grid connection; therefore no disturbance of large breeding raptors is expected. There might be some level of disturbance for other species breeding on the existing powerline i.e. Pied Crow, Rock Kestrel and Greater Kestrel. Large terrestrial species might also be affected by displacement due to disturbance. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

3.1.1.2 Displacement due to habitat transformation in the construction phase.

During the construction of power lines, service roads (jeep tracks) and substations, habitat destruction/transformation inevitably takes place. These activities could impact on birds breeding, foraging, and roosting in or in close proximity of the proposed onsite substations through transformation of habitat, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the substation yard is unavoidable. Fortunately, due to the nature of the vegetation, and judged by the existing power lines, very little if any vegetation clearing will be required in the power line servitudes. The habitat in the study area is extensive, very uniform, and largely untransformed from a bird impact perspective; therefore, the loss of a few hectares of habitat for priority species due to direct habitat transformation associated with the construction of the proposed substation is likely to have a low impact on them. While all birds will be affected by the loss of habitat, the species most likely to be more heavily impacted would be small, common, non-Red Data species which happen to be resident in those few hectares of natural scrub habitat. The impact is rated as **low** pre-mitigation and post-mitigation.

3.1.1.3 Electrocution on the overhead line in the operational phase.

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed power lines, no electrocution risk is envisaged because the proposed design of the 132kV line, namely the steel monopole and self-supporting lattice structures, should not pose an electrocution threat to any of the priority species which are likely to occur in the study area.

3.1.1.4 Collisions with the overhead line in the operational phase.

The line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and remains **medium** post-mitigation.

3.1.1.5 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar in nature to the construction phase.

3.1.1.6 Cumulative impacts.

The proposed Patatskloof WEF grid infrastructure equates to a maximum length of about 25km (Power Line Corridor Option 4 is approximately 25km in length). There are between 200 and 300 kilometres of existing and planned high voltage lines within the 35km radius around the Patatskloof WEF. The Patatskloof WEF project will thus increase the total number of planned and existing high voltage lines by between 7% and 11%. The cumulative impact of the planned Patatskloof WEF grid connection is considered to be low from a potential bird collision perspective, before and after mitigation. However, the combined cumulative impact of the existing and planned power lines within a 35km radius is considered to be **medium** before and after mitigation.

The cumulative impact of displacement due to habitat transformation in the onsite substations associated with the renewable energy projects is considered to be **low** before and after mitigation, due to the small size of the footprints, and the availability of similar habitat within the 35km radius area. The cumulative impact of potential electrocutions in the substation yards of the onsite substations is also likely to be **low** before and after mitigation, as it is expected to be a rare event.

Table 2 summarises the expected impacts of the proposed grid connection and proposed mitigation measures per impact.

Table 2: Overall Impact Significance for the grid connection (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted.	Low
Construction: Displacement due to habitat transformation	Low	1) A site-specific Construction Environmental Management Programme (CEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. (2) The minimum footprint areas for infrastructure should be used. (3) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	Low
Operational: Collisions with the overhead grid connection	Medium	(1) Bird flight diverters should be installed on all the whole line for the full span length according to the applicable Eskom standard at the time.	Medium
Decommissioning: Displacement due to disturbance	Medium	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted	Low
Cumulative impacts	Medium	All the mitigation measures listed in the various bird specialist studies compiled for the eleven (11) renewable energy facilities' grid connections within a 35km radius around the project.	Medium

3.2 Conclusion and Impact Statement

3.2.1 Wind Energy Facility

The proposed Patatskloof WEF will have a moderate impact on avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation. The alternative substation and laydown locations are all situated in essentially the same habitat, i.e. Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore any of the alternative locations will be acceptable. No fatal flaws were discovered during the onsite investigations. The development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

3.2.2 Grid connection components

The proposed Patatskloof WEF grid connection will have a moderate impact on avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation. Out of the six (6) grid corridor alternatives, Corridor Option 3 and Corridor Option 6 are most preferred from an avifaunal perspective. The development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

4. FINAL LAYOUT

In November 2022, the specialists were presented with a final buildable area which incorporates all of the proposed sensitivity buffers (Figure 3). The final buildable area was assessed accordingly from an avifaunal impact perspective, and the impact ratings and conclusions (see Section 8.2.1) reached in this study as far as the WEF infrastructure is concerned, remain unchanged.

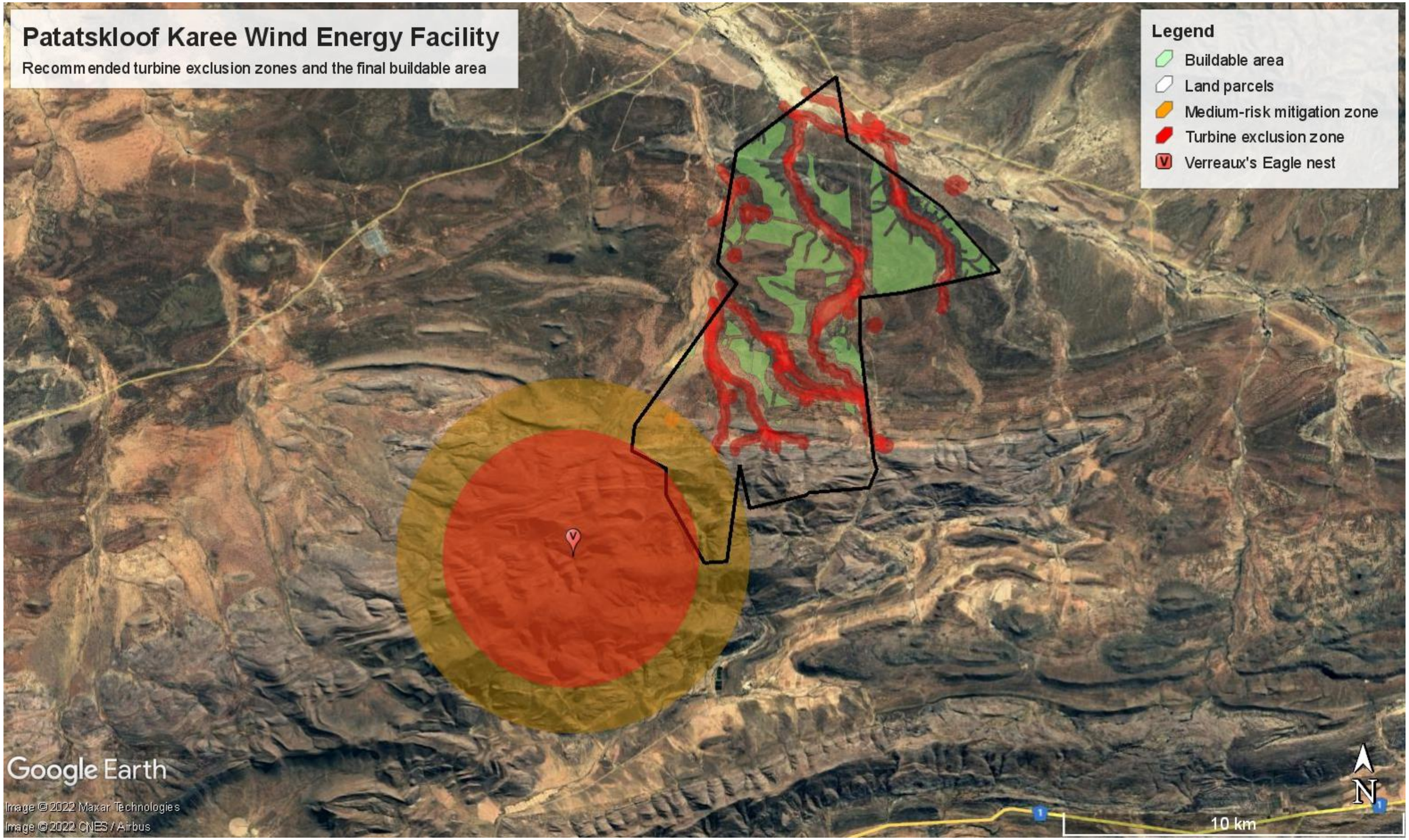

Figure 3: Final lay-out and avifaunal sensitivities for the Patatskloof WEF project.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 10
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Appendix 9,10,11
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 7
g) an identification of any areas to be avoided, including buffers;	Section 7
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 7
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Section 9
k) any mitigation measures for inclusion in the EMPr;	Appendix 7 and Appendix 8

l) any conditions for inclusion in the environmental authorisation;	Appendix 7 and Appendix 8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Appendix 7 and Appendix 8
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
q) any other information requested by the competent authority.	Not applicable
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	All sections

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Glossary of Terms

Definitions	
Broader area	A consolidated data set for a total of 15 pentads where the application site is located.
Powerline priority species	Priority species were defined as species which could potentially be impacted by power line collisions or electrocutions, based on specific morphological and/or behavioural characteristics[1]. Priority species were further subdivided into raptors, waterbirds, terrestrial birds and corvids.

[1] Other species were also considered in the case of potential displacement due to disturbance associated with the construction of the grid.

Wind priority species	Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).

List of Abbreviations

BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BLSA	BirdLife South Africa
DEFF	Department of Forestry, Fisheries and the Environment
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
HV	High voltage
IBA	Important Bird Area
IKA	Index of Kilometric Abundance
IUCN	International Union for Conservation of Nature
kV	Kilovolt
MV	Medium voltage
NEMA	National Environmental Management Act (Act 107 of 1998, as amended)
OHL	Overhead line
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SABAP 1	South African Bird Atlas 1
SABAP 2	South African Bird Atlas 2
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African Biodiversity Institute
SAPAD	South Africa Protected Areas Database
WEF	Wind Energy Facility

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

AVIFAUNAL IMPACT ASSESSMENT: PROPOSED CONSTRUCTION OF THE KAREE WIND ENERGY FACILITY AND PATATSKLOOF WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE, NEAR CERES, WESTERN CAPE PROVINCE, SOUTH AFRICA

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447, Pretoria, 0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House, 473 Steve Biko Road, Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:				
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 2	Percentage Procurement recognition	
Specialist name:	Chris van Rooyen			
Specialist Qualifications:	BA LLB			
Professional affiliation/registration:	I work under the supervision and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003			
Physical address:	6 Pladda Drive, Plettenberg Bay			
Postal address:	PO Box 2676, Fourways, 2122			
Postal code:	2055	Cell:	0824549570	
Telephone:	0824549570	Fax:		
E-mail:	Vanrooyen.chris@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Christiaan Stephanus van Rooyen, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Name of Company: Afrimage Photography t/a Chris van Rooyen Consulting

10 November 2022

Date

Details of Specialist, Declaration and Undertaking Under Oath

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3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Christiaan Stephanus van Rooyen, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Afrimage Photography (Pty) Ltd t/a Chris van Rooyen Consulting

Name of Company

10 November 2022

Date

Sgt. Nesgwarumbe 2114043-1

Signature of the Commissioner of Oaths

SOUTH AFRICAN POLICE SERVICE
PLETTENBERG BAY
2022 -11- 10
PLETTENBERGBAAI
SOUTH AFRICAN POLICE SERVICE

2022-11-10

Date

Details of Specialist, Declaration and Undertaking Under Oath

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PROPOSED CONSTRUCTION OF THE PATATSKLOOF WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE, NEAR TOUWS RIVER, WESTERN CAPE PROVINCE, SOUTH AFRICA

1. INTRODUCTION

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The overall objective of the development is to generate electricity by means of renewable energy technology capturing wind energy to feed into the National Grid.

It is anticipated that the proposed Patatskloof WEF will comprise thirty-five (35) wind turbines with a maximum total energy generation capacity of up to approximately 250MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line.

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 [GNR 982, 983, 984 and 985) and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DEFF), prior to the commencement of such activities. Specialist studies have been commissioned to assess and verify the project under the new Gazetted specialist protocols.

1.1 Terms of Reference

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts;
- Give a considered opinion whether the project is fatally flawed from an avifaunal perspective; and
- If not fatally flawed, recommend mitigation measures to reduce the expected impacts.

For the general Terms of Reference for all specialist report, please see Appendix 1

1.2 Specialist Credentials

Please see Appendix 2 Specialist CVs

1.3 Assessment Methodology

The following methods and sources were used to compile this report:

- The primary area of impact (PAOI) of the proposed 132kV grid was defined as 1km area around the proposed alignments.
- The primary area of impact (PAOI) of the proposed WEF was assumed to extent to a 1km area around the perimeter of the outer most turbines.
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), as a means to ascertain which species occurs within the broader area i.e. within a block consisting of 15 pentads (see Table 1). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 82 full protocol lists (i.e. surveys lasting a minimum of two hours each) have been completed for this area. In addition, 97 ad hoc protocol lists (i.e. surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF application site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018 beta2) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2022) was used in order to view the broader area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the project area of impact (PAOI).
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of a pre-construction programme conducted over four seasons at the proposed Patatskloof WEF application site. The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see Appendix 3 for a detailed explanation of the monitoring methods).
- Information gained from pre-construction monitoring at the proposed wind farm site assisted in providing a

comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.

Table 1: The number of SABAP2 lists completed for the broader area

Pentad	Number of full protocol lists	Ad hoc protocol lists
3300_1950	8	**2**
3300_1955	3	**1**
3300_2000	5	**7**
3300_2005	9	**17**
3300_2010	2	**11**
3305_1950	5	**2**
3305_1955	10	**6**
3305_2000	10	**17**
3305_2005	6	**13**
3305_2010	9	**11**
3310_1950	1	**1**
3310_2000	7	**2**
3310_1955	3	**2**
3310_2005	2	**5**
3310_2010	1	**0**
Total	**82**	**97**

2. ASSUMPTIONS AND LIMITATIONS

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring conducted over four seasons.
- Conclusions in this study are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- To date, only one peer-reviewed scientific paper has been published on the impacts wind farms have on birds in South Africa (Perold *et al*. 2020). The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage,

lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."

- According to the specifications received from the proponent, the 33kV medium-voltage lines will be buried next to the roads where practically feasible. It was therefore assumed that there could be 33kV overhead lines which could pose an electrocution risk to priority species.

3. TECHNICAL DESCRIPTION

3.1 Project Location

The proposed WEF and associated grid infrastructure is located approximately 18km and 25km north-east respectively of Touws River in the Western Cape Province and is within the Witzenberg Local Municipality, in the Cape Winelands District Municipality (**Error! Reference source not found.**).

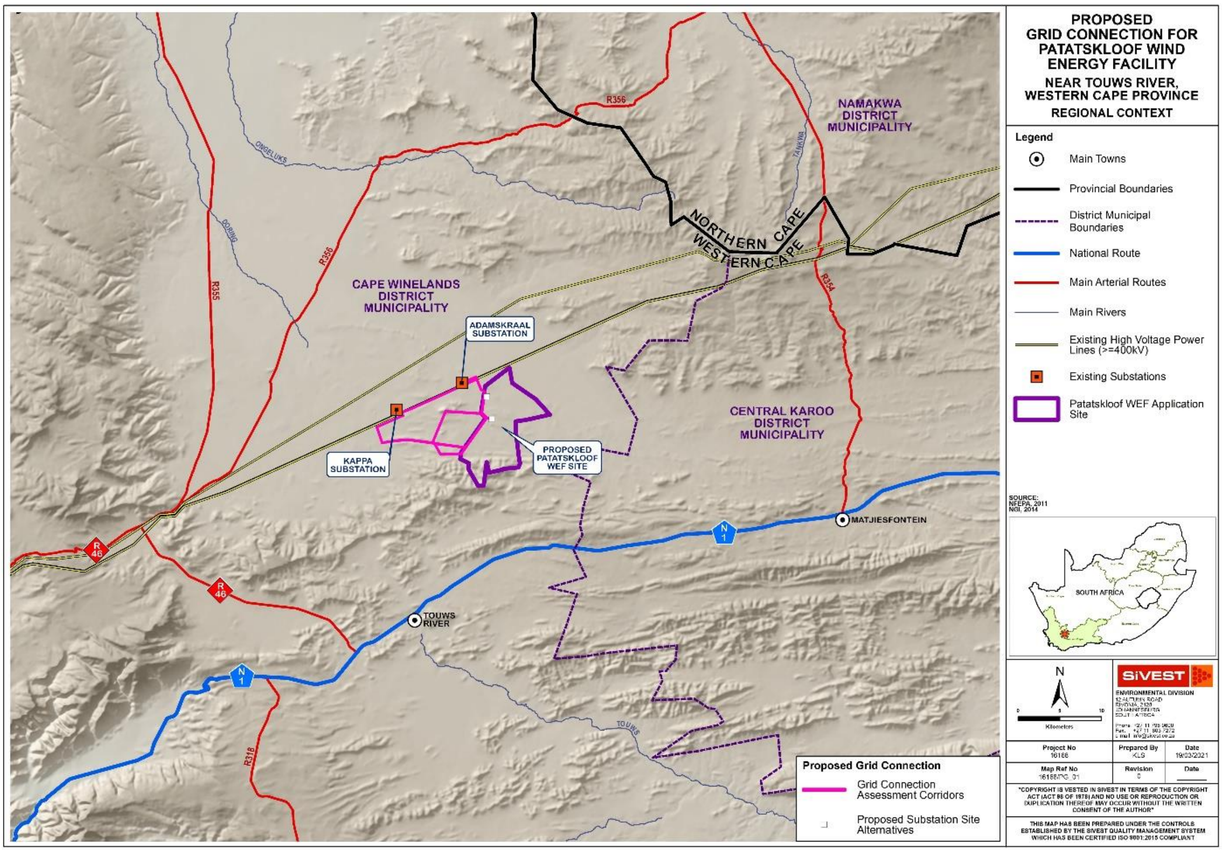


Figure 1: Regional Context Map

3.1.1 WEF

The WEF application site as shown on the locality map below (Figure 2) is approximately 6 612 hectares (ha) in extent and incorporates the following farm portions:

- Remainder of the Farm Upper Stinkfontein No 246
- Remainder of the Farm Upper Melkbosch Kraal No 250; and

▪ Portion 1 of the Farm Drinkwaters Kloof No 251.

A smaller buildable area (2 905.4 ha) has however been identified as a result of a preliminary suitability assessment undertaken by Mainstream and this area is likely to be further refined with the exclusion of sensitive areas determined through various specialist studies being conducted as part of the BA process.

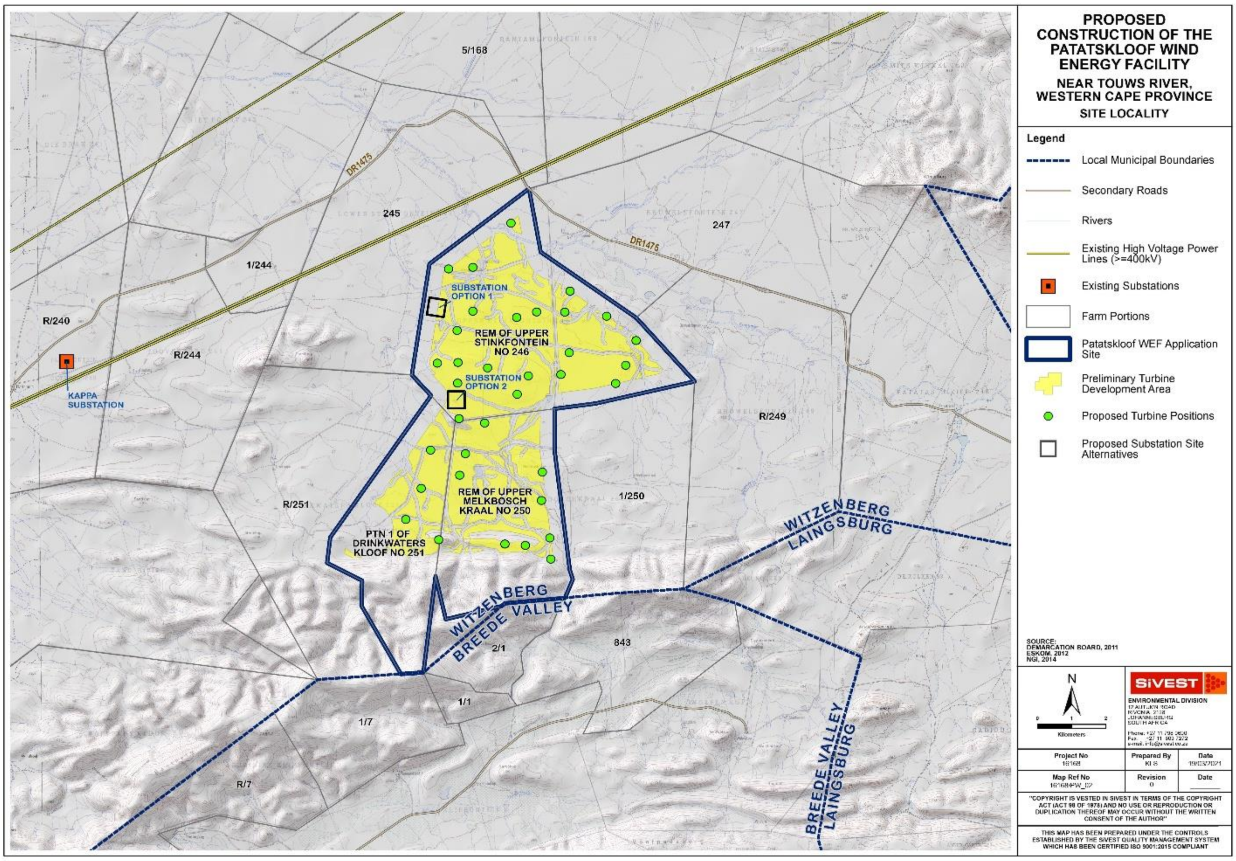


Figure 2: Patatskloof WEF Site Locality

3.1.2 Grid Connection

At this stage, it is proposed that the 132kV power lines will connect the Pataskloof WEF on-site substation to the national grid, either via Kappa Substation or via the Adamskraal substation (Figure 3).

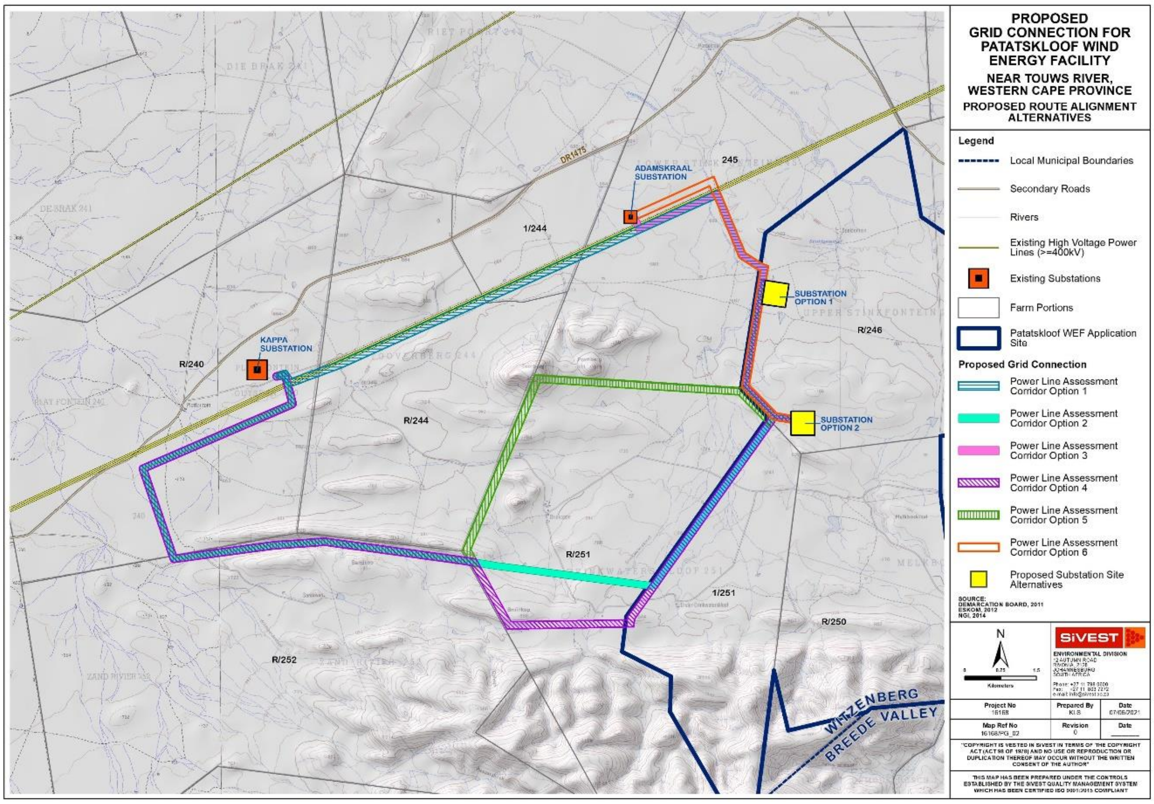


Figure 3: Proposed 132kV Power Line Route Alignment Alternatives

3.2 Project Description

It is anticipated that the proposed Patatskloof WEF will comprise up to thirty-five (35) wind turbines with a maximum total energy generation capacity of up to approximately 250MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line. The 132kV overhead power line will however require a separate EA and is subject to a separate BA process, which is currently being undertaken in parallel to the WEF BA process.

3.2.1 Wind Farm Components

- Up to 35 wind turbines, each between 4MW and 6.6MW, with a maximum export capacity of approximately 250MW. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The final number of turbines and layout of the WEF will, however, be dependent on the outcome of the Specialist Studies conducted during the BA process;
- Each wind turbine will have a hub height of between 120m and 200m and rotor diameter of up to approximately 200m;
- Permanent compacted hardstanding areas / platforms (also known as crane pads) of approximately 100m x 100m (total footprint of approx. 10000m2) per turbine during construction and for on-going maintenance purposes for the lifetime of the proposed development;

- Each wind turbine will consist of a foundation of up to approximately 30m in diameter. In addition, the foundations will be up to approximately 3m in depth;
- Electrical transformers (690V/33kV) adjacent to each wind turbine (typical footprint of up to approximately 2m x 2m) to step up the voltage to between 11kV and 33kV;
- One (1) new 11kV - 33/132kV on-site substation including associated equipment and infrastructure, occupying an area of approximately 2ha (i.e. 20 000m^2). The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has been included in the WEF BA and in the grid infrastructure (substation and 132kV overhead power line) BA to allow for handover to Eskom. Following construction, the substation will be owned and managed by Eskom. The current applicant will retain control of the low voltage components (i.e. 33kV components) of the substation, while the high voltage components (i.e. 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction;
- A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation and included in the 2ha substation area. The storage capacity and type of technology would be determined at a later stage during the development phase, but most likely comprise an array of containers, outdoor cabinets and/or storage tanks;
- The wind turbines will be connected to the proposed substation via 11 to 33kV underground cabling and overhead power lines.
- Road servitude of 8m and a 20m underground cable or overhead line servitude.
- Internal roads with a width of up to approximately 5m wide will provide access to each wind turbine. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary. Turns will have a radius of up to 50m for abnormal loads (especially turbine blades) to access the various wind turbine positions. It should be noted that the proposed application site will be accessed via the DR1475 District Road and DR1475, MR316 and MR319 WCG provincial Roads;
- One (1) construction laydown / staging area of up to approximately 3ha to be located on the site identified for the substation. It should be noted that no construction camps will be required in order to house workers overnight as all workers will be accommodated in the nearby town;
- Operation and Maintenance (O&M) buildings, including offices, a guard house, operational control centre, O&M area / warehouse / workshop and ablution facilities to be located on the site identified for the substation. This will be included in the 2ha substation area.
- A wind measuring lattice (approximately 120m in height) mast has already been strategically placed within the wind farm application site in order to collect data on wind conditions;
- No new fencing is envisaged at this stage. Current fencing is standard farm fence approximately 1-1.5m in height. Fencing might be upgraded (if required) to be up to approximately 2m in height; and
- Water will either be sourced from existing boreholes located within the application site or will be trucked in, should the boreholes located within the application site be limited.
- Optic fibre overhead or underground line from the Adamskraal Substation to the proposed on-site substation.

3.2.2 Grid Components

The proposed grid connection infrastructure to serve the Patatskloof WEF will include the following components:

- One (1) new 11-33/132kV on-site substation, situated on a site of occupying an area of up to approximately 2ha. The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has been included in both the BA for the WEF and in the BA for the grid infrastructure to allow for handover to Eskom. The applicant will remain in control of the low voltage components (i.e. 33kV components) of the substation, while the high voltage components (i.e. 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction; and
- One (1) new 132kV overhead power line connecting the on-site substation to either Kappa Substation or Adamskraal Substation and thereby feeding the electricity into the national grid. Power line towers being considered for this development include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. Maximum tower height is expected to be approximately 25m.

3.3 Layout alternatives

3.3.1 Wind Energy Facility

No other activity or site alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view and a wind energy facility is considered suitable for this site due to the high wind resource in this area.

The choice of technology selected for the Patatskloof WEF is based on environmental constraints and technical and economic considerations. No other technology alternatives are being considered as wind energy facilities are more suitable for the site than other forms of renewable energy due to the high wind resource.

The size of the wind turbines will depend on the development area and the total generation capacity that can be produced as a result. The choice of turbine to be used will ultimately be determined by technological and economic factors at a later stage.

Design and layout alternatives will be considered and assessed as part of the EIA. These include alternatives for the Substation locations and also for the construction / laydown area. The proposed preliminary layout is shown in **Error! Reference source not found.** below.

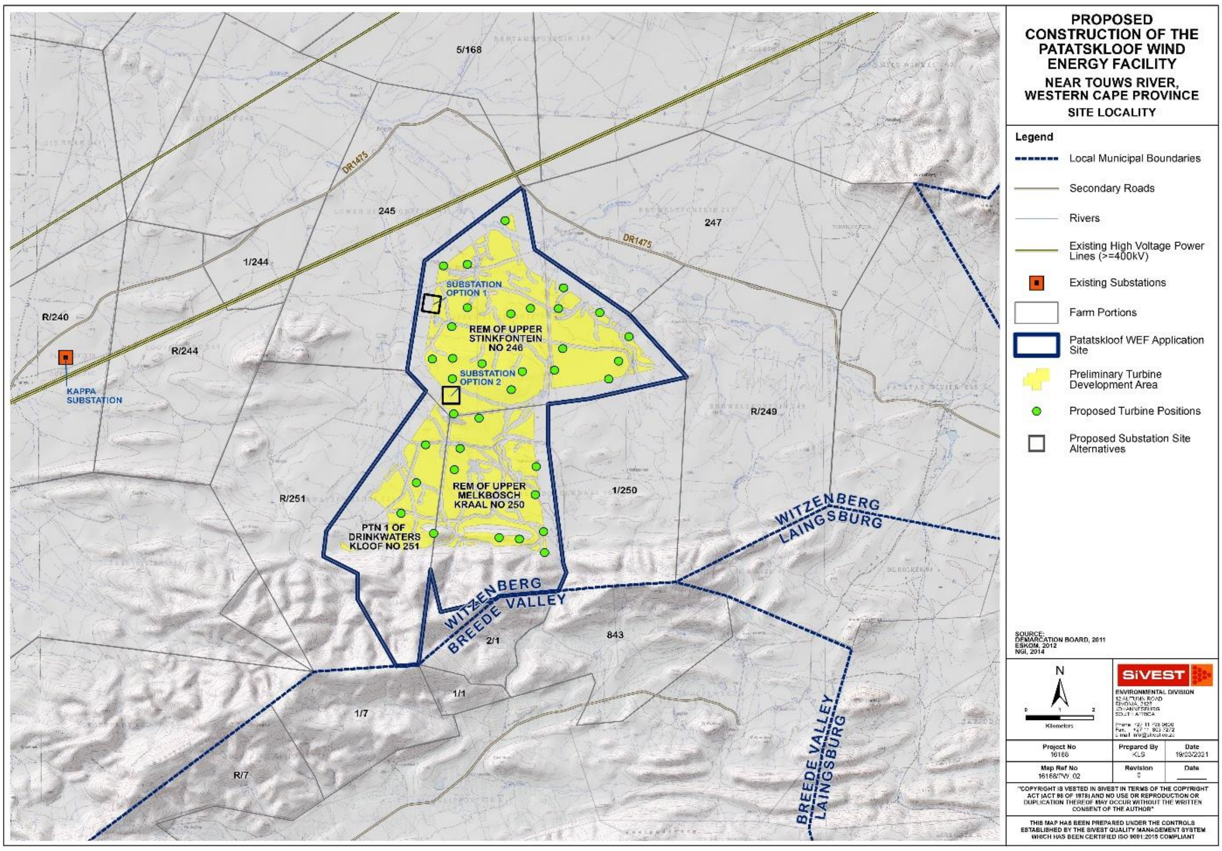


Figure 4: Preliminary Turbine layout and development area

3.3.2 Grid Components

The grid connection infrastructure proposals include two (2) substation site alternatives, each of which are 25 hectares in extent, and six (6) power line route alignment alternatives (**Figure 5**). These alternatives will be considered and assessed as part of the BA process and will be amended or refined to avoid identified environmental sensitivities.

All power line route alignments will be assessed within a 150m wide assessment corridor (75m on either side of power line). These alternatives are described below:

- Power Line Corridor Option 1 is approximately 16km in length, linking either Substation Option 1 or Substation Option 2 to Kappa Substation.
- Power Line Corridor Option 2 is approximately 24km in length, linking either Substation Option 1 or Substation Option 2 to Kappa Substation.
- Power Line Corridor Option 3 is approximately 8km in length, linking either Substation Option 1 or Substation Option 2 to Adamskraal Substation.
- Power Line Corridor Option 4 is approximately 25km in length, linking either Substation Option 1 or Substation Option 2 to Kappa Substation.

- Power Line Corridor Option 5 is approximately 24km in length, linking either Substation Option 1 or Substation Option 2 to Kappa Substation. It should be noted that the assessment corridor applied to a short section of this route alignment serving Substation Option 2 has been widened to 300m.
- Power Line Corridor Option 6 is approximately 8km in length, linking either Substation Option 1 or Substation Option 2 to Adamskraal Substation.

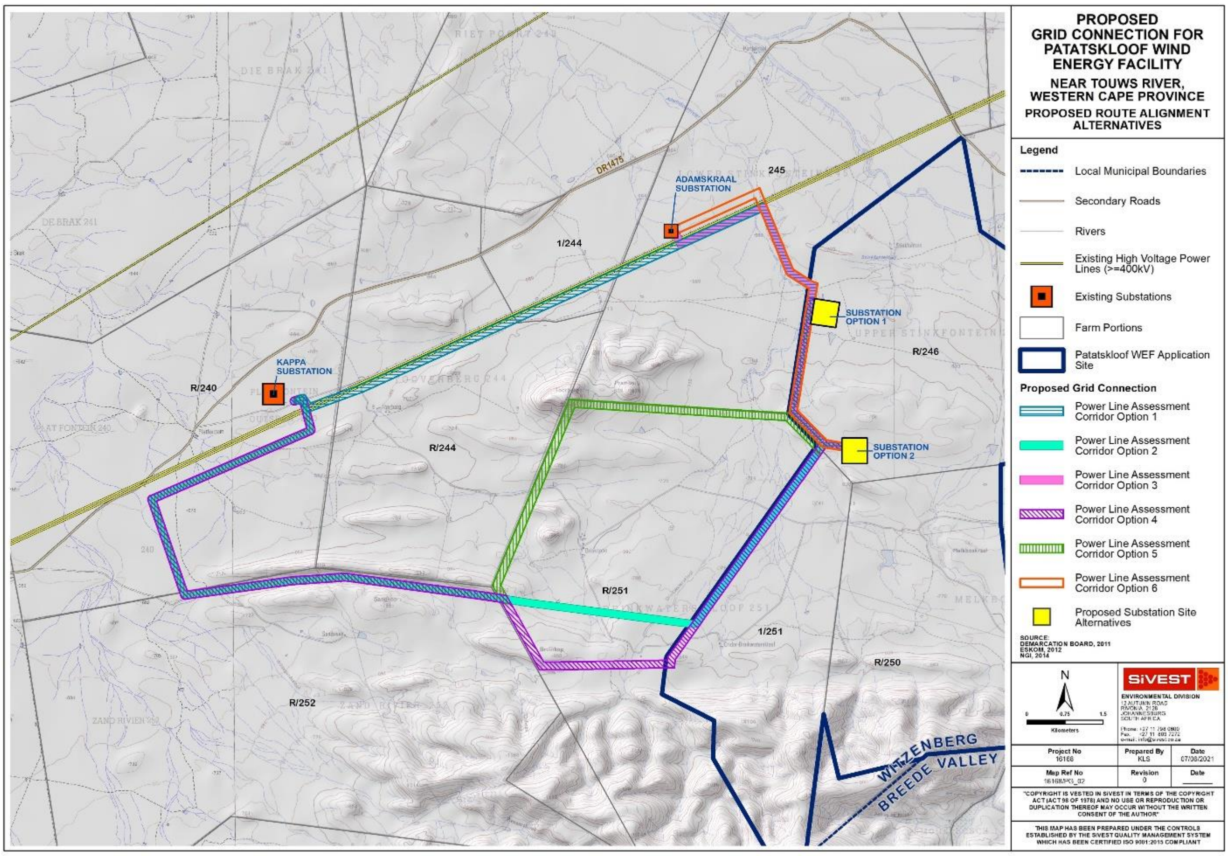


Figure 5: Proposed Substation and Power line options

3.3.3 No-go Alternative

The 'no-go' alternative is the option of not undertaking the proposed grid connection infrastructure projects. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

The 'no-go' option is a feasible option; however, this would prevent the proposed development from contributing to the environmental, social and economic benefits associated with the development of the renewable energy sector.

4. LEGAL REQUIREMENT AND GUIDELINES

Table 2 below lists agreements and conventions which South Africa is party to, and which is directly relevant to the conservation of avifauna (BirdLife International 2020).

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

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global

Convention name	Description	Geographic scope
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

4.1 National legislation

4.1.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

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

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out several guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020) is applicable in the case of powerline developments. In the case of wind energy developments, the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species where the output is 20MW or more (Government Gazette No 43110, 20 March 2020) is applicable.

4.1.3 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act 10 of 2004 read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

4.2 Provincial legislation

4.2.1 Western Cape Nature Conservation Laws Amendment Act, 2000

This statute provides for the amendment of various laws on nature conservation in order to transfer the administration of the provisions of those laws to the Western Cape Nature Conservation Board, which includes various regulations pertaining to wild animals, including avifauna.

4.3 Best Practice Guidelines

The South African “Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy projects in southern Africa” (Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011) are followed for this study. This document was published by the Endangered Wildlife Trust (EWT) and Birdlife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1 Natural environment

The PAOI is located on the border of the Succulent Karoo and Fynbos Biomes. The northern part of the PAOI is located in the Tankwa Karoo, which is one of most arid vegetation units of the Succulent Karoo biome. The plains are very sparsely vegetated with low succulent shrubland, in extreme precipitation-poor years appearing barren, while the slopes of the koppies and adjacent mountains support well-developed medium-tall succulent shrubland. Annual flora becomes conspicuous with sufficient precipitation, while geophytes and grasses play a subordinate role (Mucina & Rutherford 2006). The southern part of the PAOI is very mountainous and is located in the Fynbos Biome. The primary vegetation types are Quartzite Fynbos and Shale Renosterveld. Quartzite Fynbos is a medium dense, medium tall shrubland, structurally classified mainly as asteraceous and proteoid fynbos, although restioid fynbos is also present. Shale Renosterveld is characterised by low, open to medium dense, leptophyllous shrubland with a medium dense matrix of short, divaricate shrubs, dominated by renosterbos (Mucina & Rutherford 2006).

The developments site is located in a winter-rainfall regime: most of the precipitation falls between May and August, while December and January are virtually precipitation-free. The Tankwa Karoo region has high spatial variability of precipitation, with some rain shadows experiencing as little as 40 mm of rainfall per year (in extremely dry years). Mean annual precipitation varies from a low of 72 mm to 122 mm. Mean annual temperature is slightly above 17°C, but in winter the temperature can often fall below the frost mark (15 days in a year). Mean maximum and minimum monthly temperatures of 35.9°C and 5.64°C occur in January and July, respectively (Mucina & Rutherford 2006). The southern part of the PAOI which is located in the Fynbos Biome experiences more rainfall with less severe temperature variation. Mean annual precipitation is in the vicinity of 150–470 mm (mean: 300 mm), peaking slightly from May to August. Mean daily maximum and minimum temperatures are around 27.4°C and 2.4°C for February and July, respectively. Frost occurs 10–40 days per year.

5.2 Modified environment

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

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

- **Water points:** The land use in the broader area is mostly small stock and game farming. The entire area is divided into grazing camps, with associated boreholes and drinking troughs. In this arid environment, open water is a big draw card for birds which use the open water troughs to bath and drink.
- **Dams:** The PAOI contains a few ground dams located in drainage lines. When these dams fill up after good rains, they contain standing surface water for several months, which attracts birds to bath and drink.

- **Transmission lines:** The Bacchus - Droërivier 1 400kV and Kappa – Muldersvlei 1 400kV transmission lines are located along the north-western boundary of the PAOI. The transmission towers are used by raptors for perching and roosting, and for breeding. A Martial Eagle nest is present on tower 642 of the Droerivier - Kappa 1 transmission line, 8km north-east from the closest proposed turbine location, and approximately 7km from the closest border of the proposed PAOI (see Appendix 3). The nest has been inactive for the last three years, but it has been occupied by Lanner Falcons on occasion.

Appendix 4 provides a photographic record of the habitat at the application site.

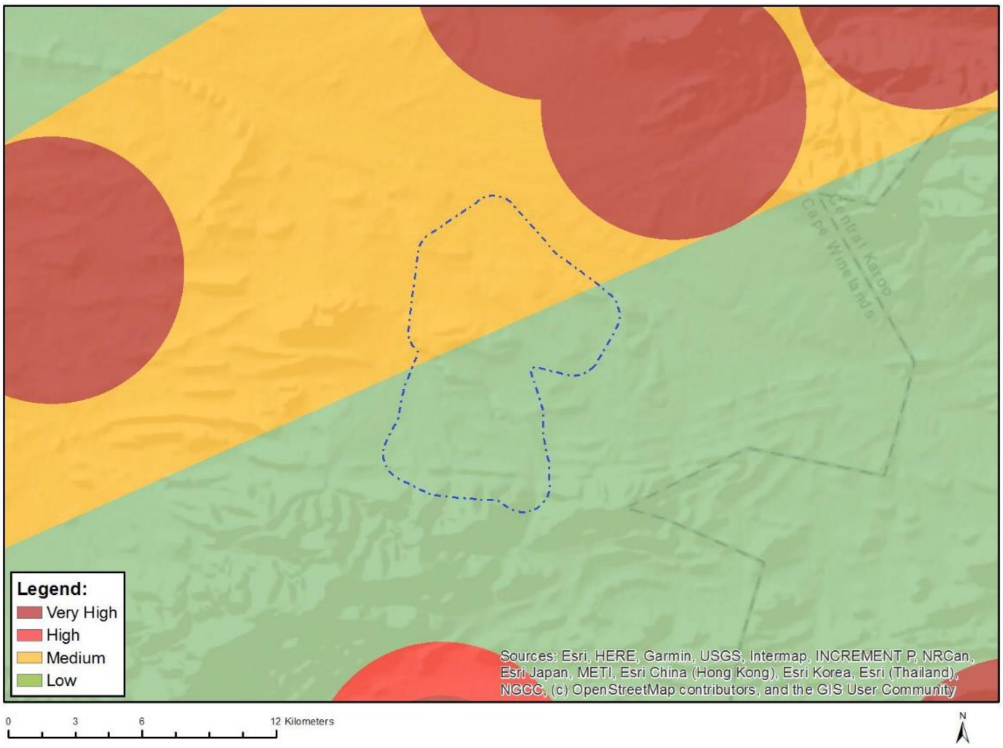
5.3 Important Bird Areas (IBAs)

The Cedarberg - Koue Bokkeveld Complex Important Bird Area (IBA) SA101 is the closest IBA and is located approximately 40km north-west of the development areas at its closest point (Marnewick *et al.* 2015). The development is not expected to have any impact on the avifauna in this IBA due to the distance from the development area.

5.4 The DFFE National Screening Tool

5.4.1 Wind Energy Facility

According to the DFFE national screening tool, the habitat within the PAOI is classified as **Low** and **Medium** sensitivity for birds according to the Avian Wind theme, and **High** and **Medium** according to the Terrestrial Animal Species theme (



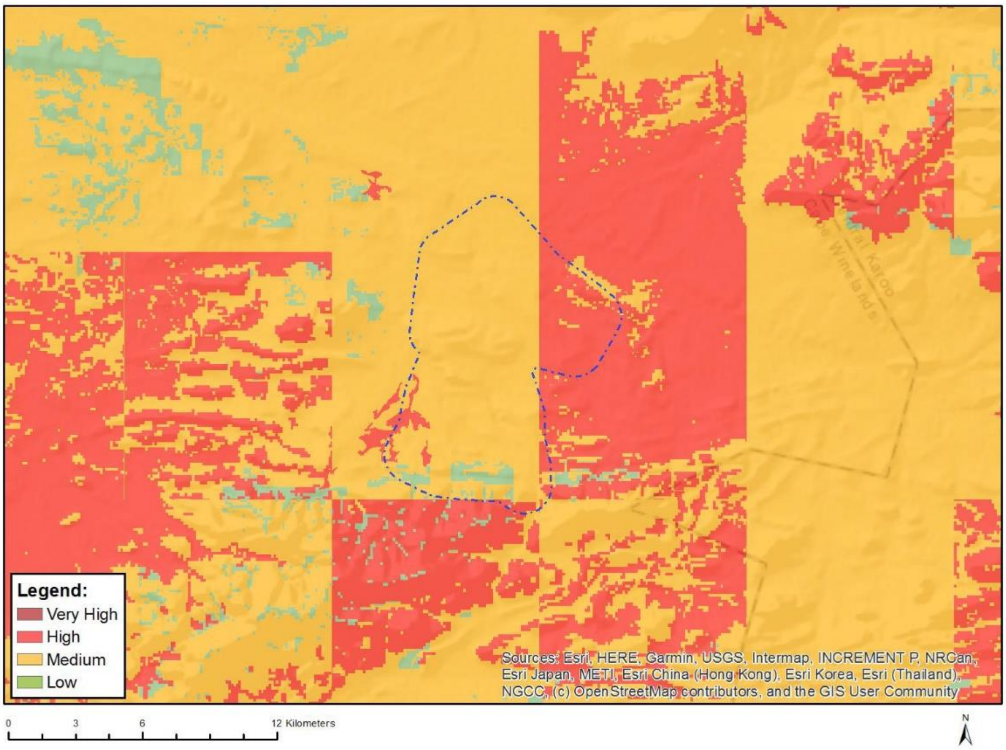
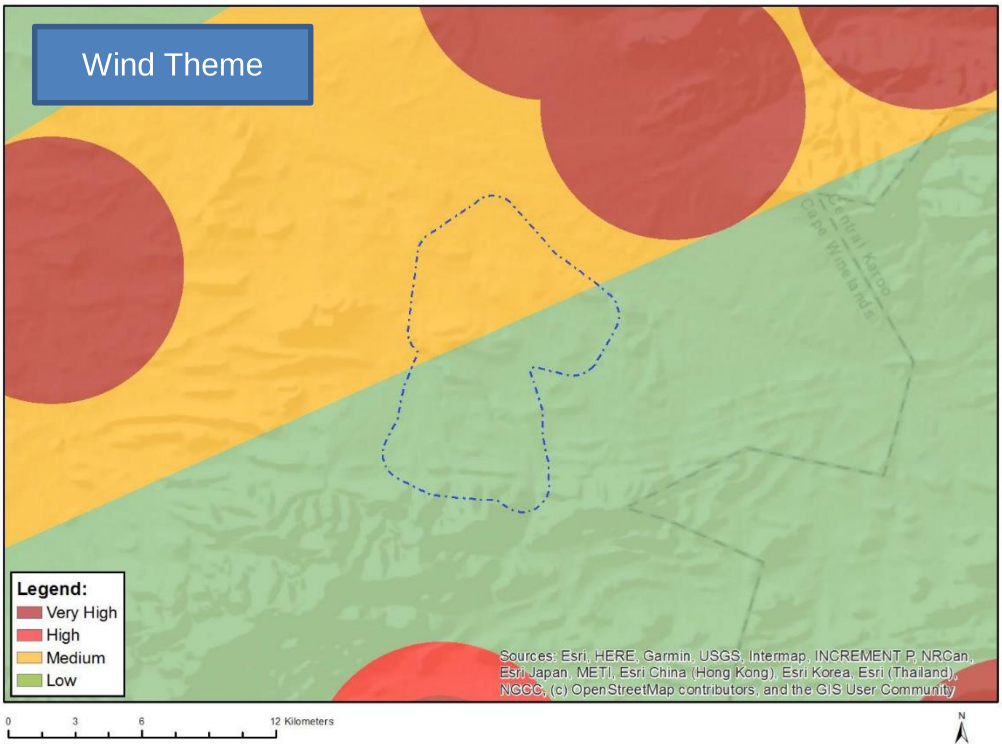


Figure 6**6**). The Medium classification according to the Wind theme is linked to the presence of a powerline of ≥ 132kV within 5km of the PAOI which is likely to attract sensitive raptors into the area. The classification of **High** in the Terrestrial Animal Species theme is linked to the potential presence of species of conservation concern (SCC), namely Southern Black Korhaan *Afrotis afra* (Globally and Regionally Vulnerable), Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable), and Lanner Falcon *Falco biarmicus* (Regionally Vulnerable), and the classification of Medium is linked to the potential presence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Verreaux's Eagle.

The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during the integrated pre-construction monitoring programme, with observations of Ludwig's Bustard, Southern Black Korhaan, Karoo Korhaan and Verreaux's Eagle recorded within the PAOI and its immediate surrounds. Based on the field surveys to date, a classification of **High** sensitivity for avifauna in the screening tool is therefore appropriate.

See Appendix 10 for the SSV report.



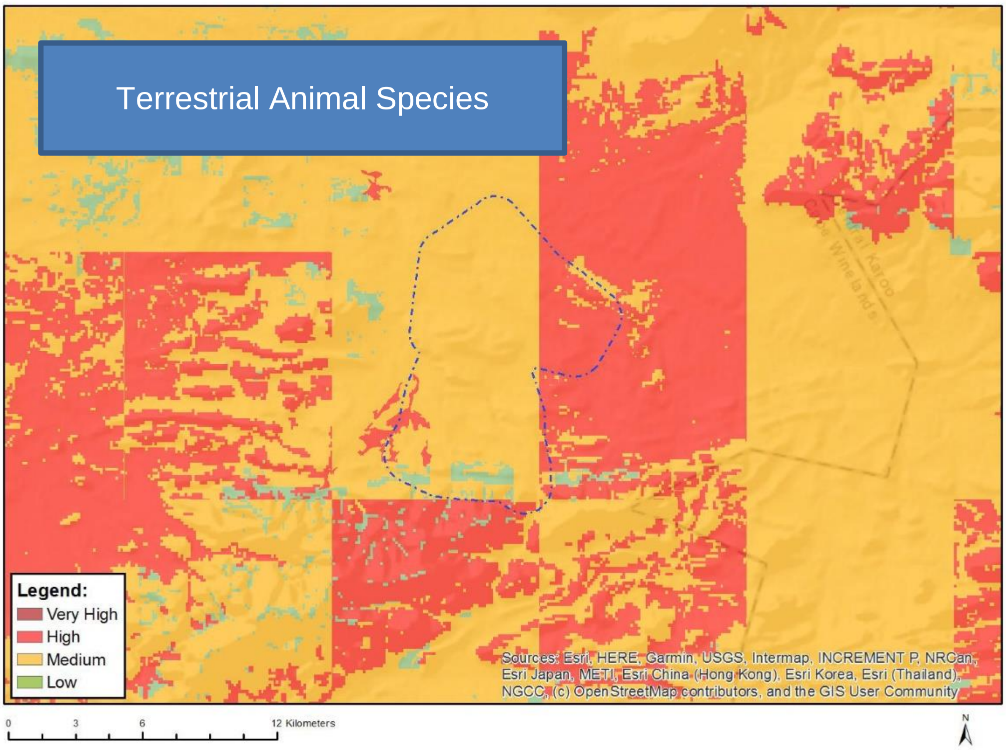


Figure 6: The classification of the PAOI according to the avian theme for wind developments (top) and the terrestrial animal species theme (bottom) in the DFFE National Screening Tool.

5.4.2 Grid components

The PAOI and immediate environment is classified as **Medium** and **High** sensitivity for avifauna according to the Terrestrial Animal Species theme (**Figure 7**)[2]. The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020. The High classification is linked to Ludwig's Bustard (Globally and Regionally Endangered), Lanner Falcon *Falco biarmicus* (Regionally Vulnerable), and Southern Black Korhaan (Globally and Regionally Vulnerable). The Medium sensitivity is linked to Ludwig's Bustard and Southern Black Korhaan.

The occurrence of SCC was confirmed during the surveys i.e. Ludwig's Bustard (Globally and Regionally Endangered) and Martial Eagle (Globally and Regionally Endangered) was recorded in the study area. Based on these criteria, the study area classification of **High** sensitivity for avifauna is confirmed.

See Appendix 11 for the Site Sensitivity Verification report.

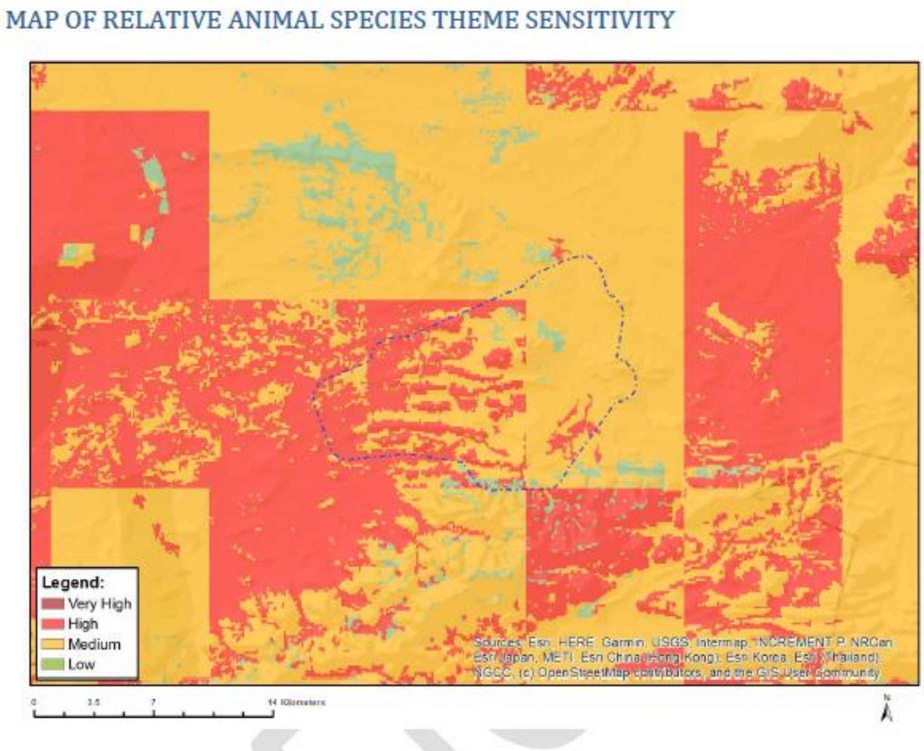


Figure 7: The National Web-Based Environmental Screening Tool map of the application site, indicating sensitivities for the Terrestrial Animal Species theme.

5.5 National Protected Areas

The closest protected areas to the proposed development area are the Inverdoorn Private Nature Reserve (3.8km), the Touw Local Nature Reserve (7.8km), and the Witteberg Nature Reserve (33km). The avifauna in

[2] It should be noted that there is no Avian theme for powerlines in the screening tool.

these protected areas are not expected to be impacted by the proposed development due to the distance from the PAOI.

5.6 Avifauna in the study area

It is estimated that a total of 135 bird species could potentially occur in the broader area. Please refer to Appendix 5 which provides a comprehensive list of all the species in the broader area. Of these, 18 species are classified as priority species for wind development, and 38 are classified as sensitive species for powerlines.

Table 3 and **Table 4** below list all the wind priority and powerline sensitive species and the potential impact on the respective species by the proposed WEF.

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Table 3: Wind energy priority species recorded in the broader area.

Species name	Scientific name	SABAP2 reporting rate		Status			Habitat				Recorded during monitoring	Likelihood of regular occurrence in the PAOI	Impacts				
		Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Karoo & fynbos scrub	Mountains	Dams, water troughs and drainage lines	HV lines			Collision with turbines	Displacement - habitat transformation	Displacement - disturbance	Electrocution on MV lines	Collisions with MV lines
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	x		x			M	x	x		x	
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00				x		x	x	x	M	x	x		x	
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		x			x		L	x	x		x	
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		x	x	x	x	x	M	x	x		x	
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		x		x	x		L	x	x		x	
Double-banded Courser	*Rhinoptilus africanus*	6.17	1.03	-	-		x					M	x	x	x		
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		x			x	x	H	x	x	x	x	
Grey-winged Francolin	*Scleroptila afra*	2.47	1.03	-	-	x		x				L	x	x	x		
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	x	x	x	x	x	H	x	x		x	
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		x				x	H	x	x	x		x
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		x	x	x	x	x	H	x	x		x	
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		x				x	M	x	x	x		x
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		x		x	x		M	x	x		x	
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		x		x	x	x	H	x	x	x	x	
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		x		x			L	x	x			x
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	x				x	H	x	x	x		x
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		x			x		M	x	x	x	x	
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU			x	x	x	x	L	x	x		x	

Table 4: Powerline sensitive species recorded in the broader area.

Species name	Scientific name	SABAP2 reporting rate		Status			Habitat				Recorded during monitoring	Likelihood of regular occurrence in the PAOI	Impacts		
		Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Karoo & fynbos scrub	Mountains	Dams, water troughs and drainage lines	HV lines			Powerline collisions	Displacement – Disturbance during construction	Displacement - Habitat transformation in the substation
Hamerkop	*Scopus umbretta*	1.23	0.00	-	-				x			L	x		
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	x		x			M			x
Black-chested Snake-Eagle	*Circaetus pectoralis*	0.00	0.00				x		x	x	x	M			x
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		x			x		L			x
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		x	x	x	x	x	M			x
Red-knobbed Coot	*Fulica cristata*	3.70	1.03	-	-				x			L	x		
White-breasted Cormorant	*Phalacrocorax lucidus*	0.00	1.03	-	-				x			L	x		
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		x		x	x		L			x
Cape Crow	*Corvus capensis*	1.23	0.00	-	-		x			x		L			
Pied Crow	*Corvus albus*	38.27	12.37	-	-		x			x	x	H		x	
African Darter	*Anhinga rufa*	1.23	0.00	-	-				x			L	x		
Yellow-billed Duck	*Anas undulata*	1.23	0.00	-	-				x			L	x		
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		x			x	x	H		x	x
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	x	x	x	x	x	H			x
Western Cattle Egret	*Bubulcus ibis*	1.23	0.00	-	-				x			L	x		
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		x				x	H	x	x	x
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		x	x	x	x	x	H			x
Egyptian Goose	*Alopochen aegyptiaca*	13.58	3.09	-	-				x	x	x	H	x		
Spur-winged Goose	*Plectropterus gambensis*	1.23	0.00	-	-				x	x		L	x		

Species name	Scientific name	SABAP2 reporting rate		Status			Habitat				Recorded during monitoring	Likelihood of regular occurrence in the PAOI	Impacts		
		Full protocol	**Ad hoc protocol**	**Global status**	**Regional status**	**Endemic (SA)**	**Karoo & fynbos scrub**	**Mountains**	**Dams, water troughs and drainage lines**	**HV lines**			**Powerline collisions**	**Displacement – Disturbance during construction**	**Displacement - Habitat transformation in the substation**
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		x				x	M	x	x	x
Great Crested Grebe	*Podiceps cristatus*	0.00	1.03	-	-				x			L	x		
Little Grebe	*Tachybaptus ruficollis*	2.47	0.00	-	-				x			L	x		
Helmeted Guineafowl	*Numida meleagris*	2.47	1.03	-	-		x		x	x		L		x	x
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		x		x	x		M			x
Black-headed Heron	*Ardea melanocephala*	1.23	0.00	-	-		x		x	x		L	x		x
Grey Heron	*Ardea cinerea*	2.47	0.00	-	-				x			L	x		
African Sacred Ibis	*Threskiornis aethiopicus*	1.23	0.00	-	-				x	x		L	x		
Hadada Ibis	*Bostrychia hagedash*	13.58	1.03	-	-				x	x		L	x		
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		x		x	x	x	H		x	x
Rock Kestrel	*Falco rupicolus*	16.05	6.19	-	-		x	x		x	x	H		x	x
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		x		x			L	x	x	x
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	x				x	H	x	x	x
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		x			x		M		x	x
White-necked Raven	*Corvus albicollis*	13.58	3.09	-	-		x	x	x	x	x	H		x	x
South African Shelduck	*Tadorna cana*	11.11	1.03	-	-				x		x	M	x	x	
African Spoonbill	*Platalea alba*	1.23	1.03	-	-				x			L	x		
Red-billed Teal	*Anas erythrorhyncha*	1.23	0.00	-	-				x			L	x		
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU			x	x	x	x	L		x	x

5.7 Results of pre-construction bird monitoring

The monitoring protocol for the sites was designed according to the latest version (2015) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

Monitoring surveys were conducted during the following periods:

- 17-21 November 2020
- 23 - 26 February 2021
- 4 – 11 May 2021
- 30 August – 5 September 2021.

Table 5 and **Table 6**, and **Figure 8** and **Figure** 9 below present the results of the pre-construction monitoring conducted at the application site and control area.

5.7.1 Transects

The results of the transect counts are tabled in Tables 6 and 7:

Table 5: The results of the transect counts at the WEF site

Species composition	
All Species	46
Priority Species (11%)	5
Non-Priority Species	41
Total count	
Drive transects	443
Walk transects	522
Total	965

Table 6: The results of the transect counts at the control site

Species composition	
All Species	35
Priority Species (9%)	3
Non-Priority Species	32
Total count	
Drive transects	282
Walk transects	300
Total	582

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transects over all four seasons (**Figures 8 and 9**).

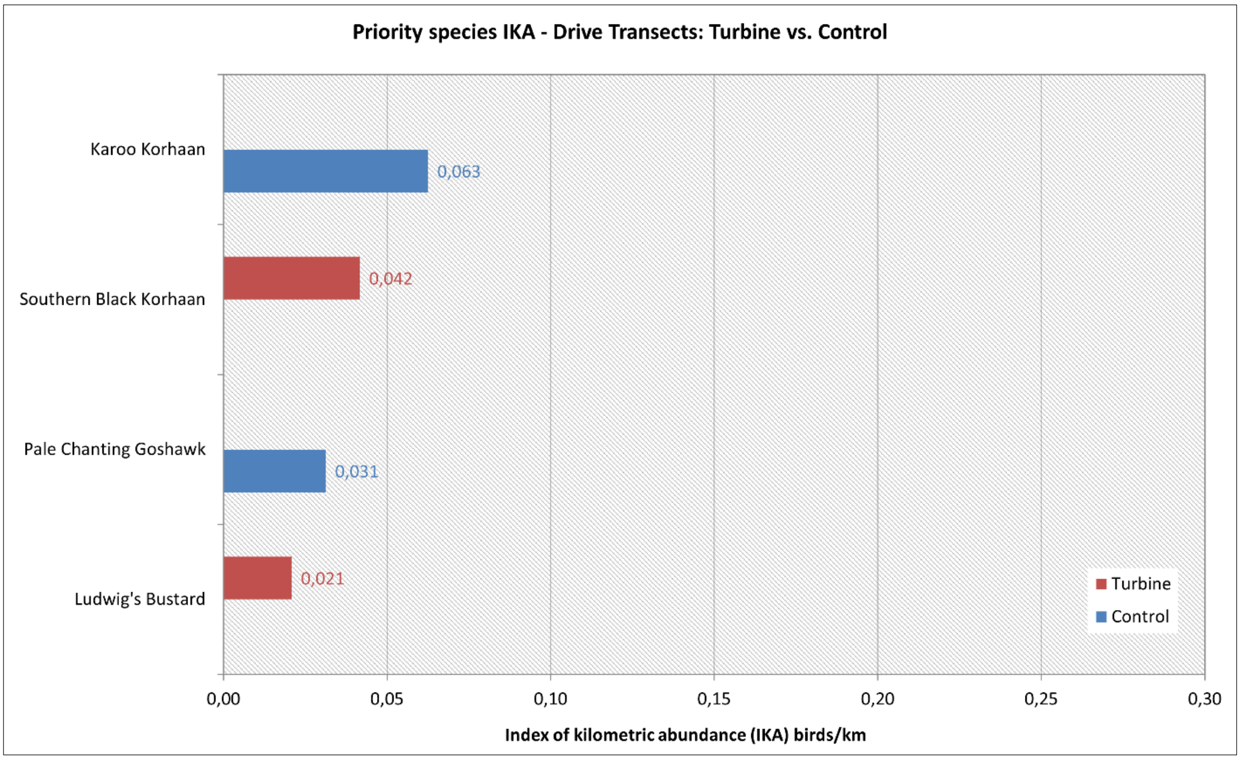


Figure 8: Index of kilometric abundance of priority species recorded at the WEF and control site through drive transect surveys across all four seasons.

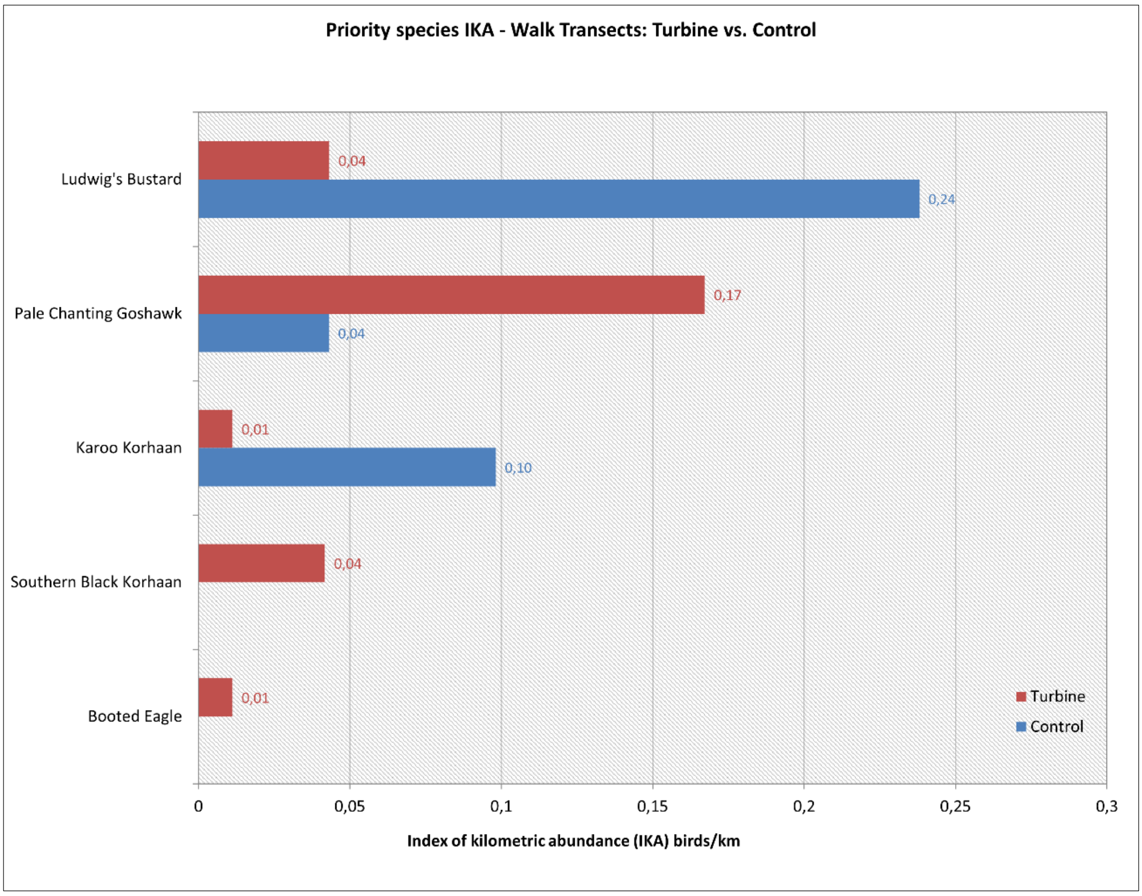


Figure 9: Index of kilometric abundance of priority species recorded at the WEF site through walk transect survey across all four seasons.

Figure 10 below shows the spatial distribution of the priority species recorded during transect counts and incidental sightings over all four seasons.

Figure 10: The location of priority species recorded at the proposed WEF through transect counts and incidental sightings.

5.7.2 Focal points

See **Table 7** below for a summary of the focal point surveys during four seasons of monitoring. Four potential focal points (FPs) of bird activity were identified, three are earth dams, and one is a Pale Chanting Goshawk nest. A control focal point, a Martial Eagle nest on a transmission tower approximately 10km away from the site, was also identified and was monitored.

Table 7: Summary of focal point surveys during the pre-construction monitoring

SURVEY 1: November 2020				
Survey	Focal Point	Description	Species	Notes
1	FP1	Earth dam	-	Dam was about 1% full. No priority species recorded.
1	FP2	Earth dam	-	Dam was dry. No priority species recorded.
1	FP3	Earth dam	-	Dam was dry. No priority species recorded.
1	CFP	Nest on pylon	-	No birds recorded.
SURVEY 2: February 2021				

Survey	Focal Point	Description	Species	Notes
2	FP1	Earth dam	-	Dam was dry. No priority species recorded.
2	FP2	Earth dam	-	Dam was dry. No priority species recorded.
2	FP3	Earth dam	-	Dam was dry. No priority species recorded.
2	CFP	Nest on pylon	-	No birds recorded.
SURVEY 3: May 2021				
Survey	Focal Point	Description	Species	Notes
3	FP1	Earth dam	-	Dam was dry. No priority species recorded.
3	FP2	Earth dam	-	Dam was dry. No priority species recorded.
3	FP3	Earth dam	-	Dam was dry. No priority species recorded.
3	CFP	Nest on pylon	-	No birds recorded.
SURVEY 4: September 2021				
Survey	Focal Point	Description	Species	Notes
4	FP1	Earth dam	-	Dam was about 1% full. No priority species recorded.
4	FP2	Earth dam	-	Dam was dry. No priority species recorded.
4	FP3	Earth dam	-	Dam was dry. No priority species recorded.
4	FP4	Nest in tree	Pale Chanting Goshawk	A breeding pair of Pale Chanting Goshawks were recorded on the nest.
4	CFP	Nest on pylon	Lanner Falcon	One female Lanner Falcon was recorded on the nest with signs of breeding.

See Appendix 3 for the location of the focal points and **Figure 11** for the location of a Verreaux's Eagle nest that was recorded during nests searches that were conducted in March 2022.

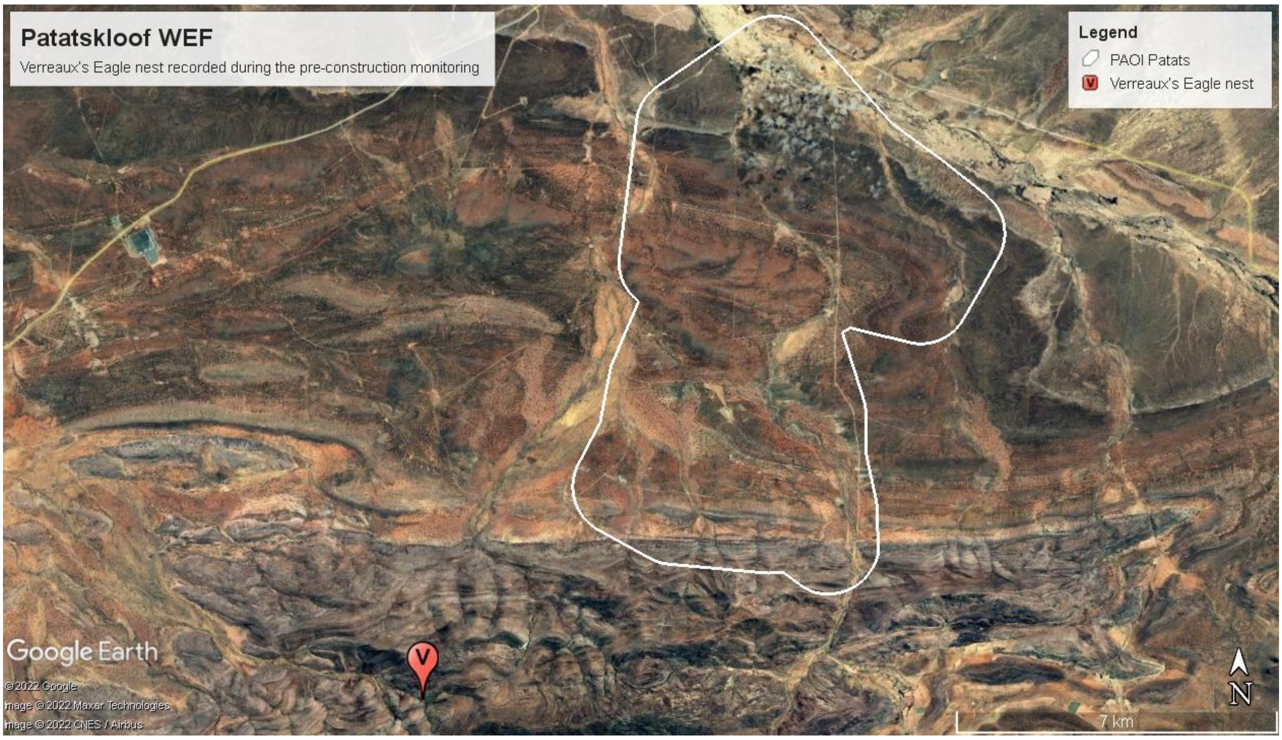


Figure 11: Verreaux's Eagle nest recorded during nest searches conducted in March 2022. The white lined polygon indicates the project area of impact (PAOI).

5.7.3 Incidental counts

Table 8 provides an overview of the incidental sightings of priority species during the four seasonal surveys.

Table 8: Incidental sightings of priority species made during the four (V1-V4) seasonal surveys

Species	Scientific name	Survey 1	Survey 2	Survey 3	Survey4	Grand Total
Pale Chanting Goshawk	*Melierax canorus*	1	4	7	4	16
Greater Kestrel	*Falco rupicoloides*		1			1
Booted Eagle	*Hieraaetus pennatus*		1			1
Southern Black Korhaan	*Afrotis afra*				1	1
Ludwig's Bustard	*Neotis ludwigii*				3	3
Karoo Korhaan	*Eupodotis vigorsii*				1	1
Jackal Buzzard	*Buteo rufofuscus*				1	1

See Appendix 5 for a list of all species recorded during the pre-construction monitoring.

5.7.4 Vantage point observations

Across the four seasons of monitoring, flight patterns of priority species have been recorded for 144 hours (12 hours per VP) at 3 vantage points at the turbine site in three bands (high ~ above rotor altitude; medium~ at rotor altitude; low ~ below rotor altitude). Approximate flight altitude was visually judged by an observer with the aid of binoculars. A total of 18 minutes of medium altitude flights i.e. ~ within rotor altitude, were recorded. Priority species were observed for 37 minutes during the observation periods.

See **Figure 12** below for the duration of flights for each priority species[3].

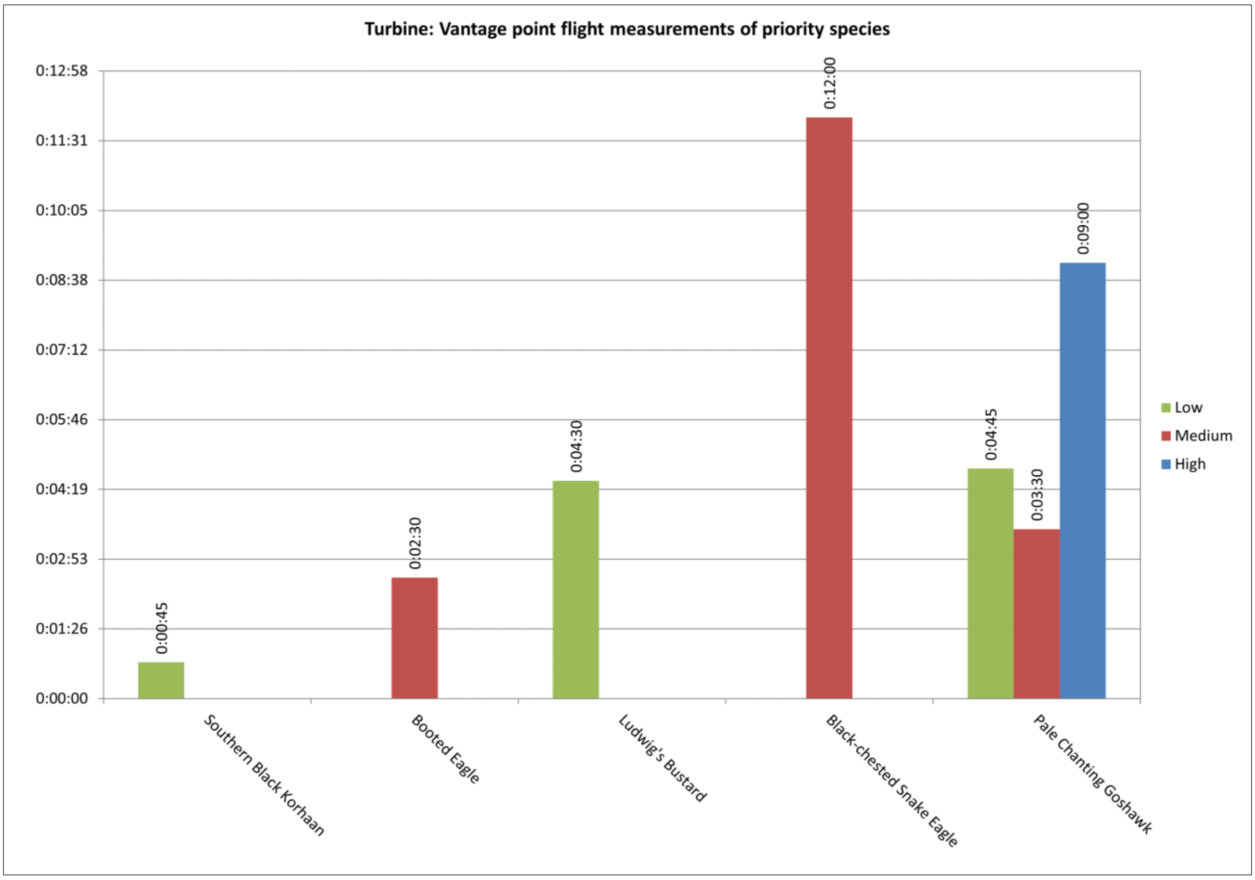


Figure 12: Recorded flight times and altitudes of priority species.

5.7.5 Site specific collision risk rating

A site-specific collision risk rating for each priority species recorded during VP watches was calculated to give an indication of the likelihood of an individual of the specific species to collide with the turbines at these sites. This was calculated taking into account the following factors:

- The duration of rotor (medium) altitude flights;
- The susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief *et al*. 2012); and
- The number of turbines.

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

This was done in order to gain some understanding of which species are likely to be most at risk of collision. The formula used is as follows[4]:

Duration of flights (in decimal hours) x collision ratings in the Avian Wind Farm Sensitivity Map x number of turbines ÷100.

The results are presented in **Table 9** and **Figure 13** below.

Table 9: Site specific collision risk rating

Species	Duration of rotor altitude flights (hr)	Avian Wind Farm Sensitivity Map collision susceptibility rating	Site specific collision risk rating
Ludwig's Bustard		85	0,00
Southern Black Korhaan		60	0,00
Booted Eagle	0,002	85	0,05
Pale Chanting Goshawk	0,002	70	0,06
Black-chested Snake Eagle	0,008	85	0,25
Average	***0.004***	***77***	***0.07***

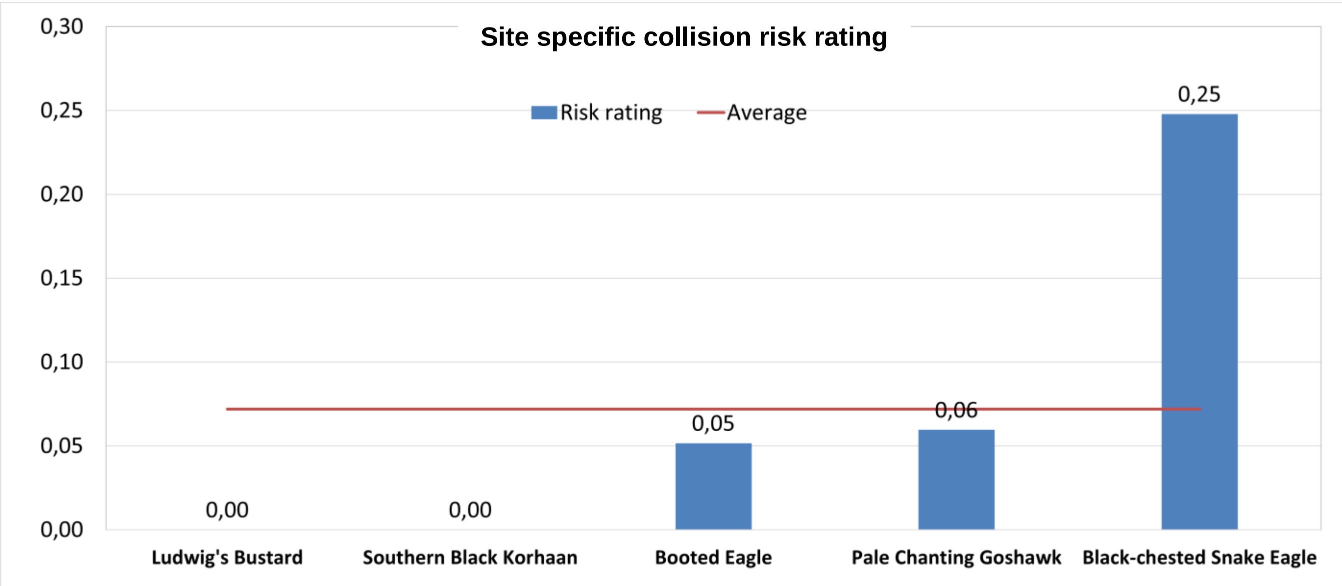


Figure 13: Site specific collision risk rating for priority species. The red line indicates the average collision risk rating for priority species at the application site, based on recorded flight behaviour in six seasonal surveys.

[4] It is important to note that the formula does not incorporate avoidance behaviour. This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of bird flights will successfully avoid the turbines (SNH 2010).

5.7.6 *Spatial distribution of flights over the turbine area*

Flight maps were prepared for the species with higher than zero collision risk indices, indicating the spatial distribution of flights observed from the various vantage points. This was done by overlaying a 100m x 100m grid over the survey area. Each grid cell was then given a weighting score (Very High; High; Medium; Low) taking into account the flight intensity i.e. the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell, in order to give an indication where the observed flight activity was most concentrated (see **Figure 14**, **Figure 15**, and **Figure 16**).

Figure 14: Intensity of flight activity of Black-chested Snake Eagle over four seasons of monitoring

Figure 15: Intensity of flight activity of Booted Eagle over four seasons of monitoring

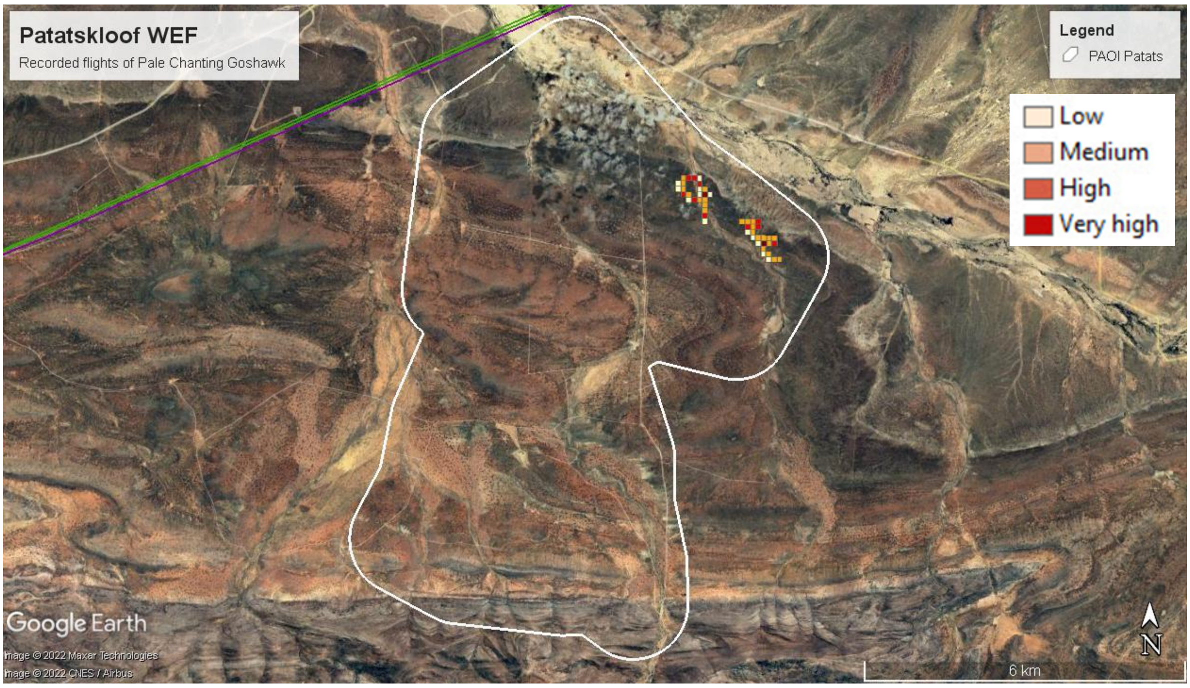


Figure 16: Intensity of flight activity of Pale Chanting Goshawk over four seasons of monitoring

6. SPECIALIST FINDINGS AND ASSESSMENT OF IMPACTS

6.1 Wind energy facility (WEF)

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision):

- Mortality due to collisions with the wind turbines
- Displacement due to disturbance during construction and operation of the wind farm
- Displacement due to habitat change and loss at the wind farm
- Mortality due to electrocution on the electrical infrastructure

It should be noted that the assessment is made on the *status quo* as it is currently on site. The possible change in land use in the broader PAOI is not taken into account because the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is however highly unlikely that the land use will change in the foreseeable future due to climatic limitations.

6.1.1 Collision mortality on wind turbines[5]

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur *et al.*, 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a main ecological drawback to wind energy (Drewitt and Langston, 2006).

Collisions with wind turbines appear to kill fewer birds than collisions with other man-made infrastructures, such as power lines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant

[5] This section is based largely on a (2014) review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira,Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. *Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies*. Biological Conservation 179 (2014) 40– 52.

impact at the population level(e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.* 1998).

High bird fatality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles (*Aquila chrysaetos*), Tarifa in Southern Spain for Griffon vultures (*Gyps fulvus*), Smøla in Norway for White-tailed eagles (*Haliaatus albicilla*), and the port of Zeebrugge in Belgium for gulls (*Larus* sp.) and terns (*Sterna* sp.) (Barrios and Rodríguez, 2004; Drewitt and Langston, 2006; Everaert and Stienen, 2008; May *et al.* 2012a; Thelander *et al.* 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for a large number of fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull *et al.* 2013; May *et al.* 2012b). An understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures.

Species-specific factors

- Morphological features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. Janss (2000) identified weight, wing length, tail length and total bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wing span squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas *et al.* 2008; Herrera-Alsina *et al.* 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture (*Gyps fulvus*), seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards (*Buteo buteo*) and Short-toed Eagles (*Circaetus gallicus*), and this pattern is not related with their local abundance (Barrios and Rodríguez, 2004; De Lucas *et al.* 2008). High wing-loading is associated with low flight manoeuvrability (De Lucas *et al.* 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

Information on the wing loading of the priority species potentially occurring regularly at the Patatskloof WEF was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are bustards, making them less manoeuvrable (Keskin *et al.* 2019).

- Sensorial perception

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt and Langston, 2008; Erickson *et al.* 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Krijgsveld *et al.* 2009). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin, 2011; McIsaac, 2001). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin, 2011). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps sp.) cranes and bustards (Martin and Katzir, 1999; Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Furthermore, for some species, their high resolution vision areas are often found in the lateral fields of view, rather than frontally (e.g. Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin et.al, 2010; Martin, 2011).

Some of the regularly occurring priority species at the proposed Patatskloof WEF have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the bustards and korhaans. The exceptions to this are the priority raptors which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better.

- Phenology

Recent studies have shown that, within a wind farm, raptor collision risk and fatalities are higher for resident than for migrating birds of the same species. An explanation for this may be that resident birds generally use the wind farm area several times while a migrant bird crosses it just once (Krijgsveld *et al.* 2009). However, other factors like bird behaviour are certainly relevant. Katzner *et al.* (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes.

South Africa is at the end of the migration path for summer migrants; therefore, the phenomenon of migratory flyways where birds are concentrated in large numbers for a limited period of time, e.g. the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the landscape. The migratory priority species which could occur at the proposed Patatskloof WEF with some regularity, e.g., Booted Eagle, will behave much the same as the resident birds once they arrive in the area. The same is valid for local migrants such as the Ludwig's Bustard. It is expected that, for the period when they are present, these species will be exposed to the same risks as resident species.

- Bird behaviour

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight (hanging in the wind with almost motionless wings), which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed Hawks *Buteo jamaicensis* at APWRA (Hoover and Morrison, 2005), and could also be a factor in contributing to the high collision rate for Jackal Buzzards in South Africa (Ralston-Paton & Camagu 2019). The hovering behaviour exhibited by Common Kestrels *Falco tinnunculus* when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios and Rodríguez, 2004). This may also explain the high mortality rate of Rock Kestrels *Falco rupicolus* at wind farms in South Africa (Ralston-Paton & Camagu 2019). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover and Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). In the case of raptors, aggressive interactions may play an important role in turbine fatalities, in that birds involved in these interactions are momentarily distracted, putting them at risk. At least one eye-witness account of a Martial Eagle getting killed by a turbine in South Africa in this fashion is on record (Simmons & Martins 2016)

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña 2012a). Similarly, in South Africa, only two bustard collisions with wind turbines have been reported to date, both Ludwig's Bustards (Ralston-Paton & Camagu 2019). No Denham's Bustards *Neotis denhami* turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

The priority species which could occur with some regularity at the proposed Patatskloof WEF can be classified as either terrestrial species, soaring species or occasional long-distance fliers. Terrestrial species spend most of the time foraging on the ground. They do not fly often and when they do, they generally fly for short distances at low to medium altitude. At the application site, Ludwig Bustard, Southern Black Korhaan, Karoo Korhaan and Double-banded Courser are included in this category. Occasional long-distance fliers generally behave as terrestrial species but can and do undertake long distance flights on occasion. Species in this category is Ludwig's Bustard. Soaring species spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering and gliding at medium to high altitudes. At the project site, these include all the raptors which could occur i.e., Lanner Falcon, Booted Eagle, Martial Eagle, Greater Kestrel, Pale Chanting Goshawk, Secretarybird, Verreaux's Eagle and Black-chested Snake-Eagle. Based on the time spent potentially flying at rotor height, soaring species are likely to be at greater risk of collision.

- Avoidance behaviours

Two types of avoidance have been described (Furness *et al.*, 2013): 'macro-avoidance' whereby birds alter their flight path to keep clear of the entire wind farm (e.g. Desholm and Kahlert, 2005; Plonczkier and Simms, 2012; Villegas-Patraca *et al.* 2014), and 'micro-avoidance' whereby birds enter the wind farm but take evasive actions to avoid individual wind turbines (Band *et al.* 2007). This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010).

It is anticipated that most birds at the proposed Patatskloof WEF will avoid the wind turbines, as is generally the case at all wind farms (SNH 2010). Exceptions already mentioned are raptors that engage in hunting which might serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and intraspecific aggressive interaction. Complete macro-avoidance of the wind farm is unlikely for any of the priority species likely to occur at the proposed WEF.

- Bird abundance

Some authors suggest that fatality rates are related to bird abundance, density or utilization rates (Carrete *et al.* 2012; Kitano and Shiraki, 2013; Smallwood and Karas, 2009), whereas others point out that, as birds use their territories in a non-random way, fatality rates do not depend on bird abundance alone (e.g. Ferrer *et al.* 2012; Hull *et al.* 2013). Instead, fatality rates depend on other factors such as differential use of specific areas within a wind farm (De Lucas *et al.* 2008). For example, at Smøla, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl *et al.* 2013). In the APWRA, Golden Eagles, Red-tailed Hawks and American Kestrels (*Falco spaverius*) have higher collision fatality rates than Turkey Vultures (*Cathartes aura*) and Common Raven (*Corvus corax*), even though the latter are more abundant in the area (Smallwood *et al.* 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas *et al.* 2008).

The abundance of priority species at the proposed Patatskloof WEF will fluctuate depending on the season of the year, and especially in response to rainfall e.g., Ludwig's Bustard.

Site-specific factors

- Landscape features

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly. Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios and Rodríguez, 2004; Drewitt and Langston, 2008; Katzner *et al.* 2012; Thelander *et al.* 2003). In APWRA, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander *et al.* 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano and Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

The PAOI does not contain many landscape features as it is situated on a vast plain. Bordering the PAOI to the south is a series of rugged mountains. The most significant landscape features at the PAOI from a collision risk perspective are the ground dams, drinking troughs and the drainage lines (when flowing). Surface water attracts many birds, including Red Listed species such as Martial Eagle, Lanner Falcon and Verreaux's Eagle.

- Flight paths

For territorial raptors like Golden Eagles (and Verreaux's Eagles – see Ralston-Patton 2017)), foraging areas are preferably located near to the nest, when compared to the rest of their home range. For example, in Scotland 98% of Golden Eagle movements were registered at ranges less than 6 km from the nest, and the core areas were located within a 2 - 3 km radius (McGrady *et al.* 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas close to ridges, can be used to predict the areas used by the species to forage (McLeod *et al.* 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright *et al.* 2006).

The only distinctive potential flight paths identified at the PAOI are the drainage lines, which may serve as a flight path for waterbirds when they flow. However, they are dry most of the time.

- Food availability

Factors that increase the use of a certain area or that attract birds, like food availability; also play a role in collision risk. For example, the high density of raptors at the APWRA and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover and Morrison, 2005; Smallwood *et al.* 2001). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). It is speculated that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the availability of food (Smallie 2015).

The current very low levels of bird activity at the proposed Patatskloof WEF could be partially attributed to the lack of food, brought about by the drought conditions which were prevalent during the pre-construction monitoring. This could change significantly if the site experiences average to above average rainfall for a number of years, which would result in better foraging conditions.

- Summary

The proposed Patatskloof WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan and Southern Black Korhaan, although generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., raptors such as Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle and Greater Kestrel are most at risk of all the priority species likely to occur regularly at the project site. Verreaux's Eagle might also be at risk to some extent, although the species is unlikely to venture regularly into the PAOI.

In summary, the following priority species could be at risk of collisions with the turbines:
EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	M
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00				M
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		L
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		M
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		L
Double-banded Courser	*Rhinoptilus africanus*	6.17	1.03	-	-		M
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Grey-winged Francolin	*Scleroptila afra*	2.47	1.03	-	-	x	L
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	H
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H

Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		M
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		H
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU		L

6.1.2 Displacement due to disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance in effect can amount to habitat loss. Displacement may occur during both the construction and operation phases of wind farms and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before- and-after and control-impact (BACI) assessments. Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). The same situation seems to prevail at wind farms in the Eastern Cape where Denham's Bustard are still using wind farm sites as leks.[6] Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens et.al 2013, Hale et.al 2014). There also seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins et. al 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al*. 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of

[6] Personal communication by Wessel Rossouw, bird monitor based in Jeffreys Bay, from on personal observations in the Kouga municipal area.

the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15– 53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Species which fall in this category are Ludwig’s Bustard, Southern Black Korhaan, Karoo Korhaan, Double-banded Courser, Grey-winged Francolin and Spotted Eagle-Owl. Some raptors might also be affected, e.g., Pale Chanting Goshawk which could potentially breed in the small *Vachellia* trees in the drainage lines, and Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines.

In summary, the following priority species are expected to be vulnerable to displacement due to disturbance:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Double-banded Courser	*Rhinoptilus africanus*	6.17	1.03	-	-		M
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Grey-winged Francolin	*Scleroptila afra*	2.47	1.03	-	-	x	L
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		H

Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M

6.1.3 Displacement due to habitat loss

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general, it is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total PAOI (Fox *et al.* 2006 as cited by Drewitt & Langston 2006), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

However, the results of habitat transformation may be more subtle, whereas the actual footprint of the wind farm may be small in absolute terms, the effects of the habitat fragmentation brought about by the associated infrastructure (e.g. power lines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under power lines, but a study done in Spain (Lane *et al.* 2001 as cited by Raab *et al.* 2009) indicates that the total observation of Great Bustard flocks was significantly higher further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes select nesting sites away from roads. This means that power lines and roads also cause loss and fragmentation of the habitat used by the population in addition to the potential direct mortality. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab *et al.* 2010). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Alan *et al.* 1997).

Marques *et al.* (2021) reviewed 71 peer-reviewed studies on displacement and compiled: (1) information on the geographical areas, type of wind farm, study design and bird groups studied; and (2) the evidence of displacement effects on different bird groups. They found that most studies have been conducted in Europe and North America, particularly in agricultural areas. About half of the studies did not find any effects, for wind farms both on land and at sea, while many studies (40.6%) found displacement effects, and a small proportion (7.7%) detected attraction, i.e., an increased abundance of birds around the wind farms. Relevant to this project, they found that waterfowl and raptors were significantly affected.

The network of roads is likely to result in significant habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard, Karoo Korhaan, and raptors. Given the current density of the proposed turbine layout and associated road infrastructure, it is not expected that any priority species will be permanently displaced from the PAOI. The alternative substation locations are all situated in essentially the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore any of the alternative locations will be acceptable. The same goes for the alternative laydown and compound areas.

In summary, the following priority species are expected to be vulnerable to displacement due to habitat transformation:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	M
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00				M
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		L
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		M
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		L
Double-banded Courser	*Rhinoptilus africanus*	6.17	1.03	-	-		M
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Grey-winged Francolin	*Scleroptila afra*	2.47	1.03	-	-	x	L
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	H
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		M
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		H
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU		L

6.1.4 Electrocution on the 33kV medium voltage network

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2000). The electrocution risk is largely determined by the design of the electrical hardware.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the poles could potentially pose an electrocution risk to raptors.

In summary, the following priority species are expected to be vulnerable to electrocution:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High, M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	M
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00				M
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		L
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		M
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		L
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	H
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		H
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		M
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU		L

6.1.5 Collisions with the 33kV medium voltage network

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species. The topic of collisions is extensively covered under 6.2.2 below and will not be repeated here. In summary, the following priority species could be vulnerable to collisions with the 33kV medium voltage lines[7]:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H

[7] These include both wind and powerline priority species.

6.2 Grid connection components

Negative impacts on avifauna by electricity infrastructure generally take two main forms namely electrocution and collisions (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Van Rooyen 2004; Jenkins *et al*. 2010). Displacement due to habitat destruction and disturbance associated with the construction of the electricity infrastructure is another impact that could potentially impact on avifauna.

6.2.1 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed power lines, no electrocution risk is envisaged because the proposed design of the 132kV line, namely the steel monopole and self-supporting lattice structures, should not pose an electrocution threat to any of the priority species which are likely to occur in the study area.

6.2.2 Collisions

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

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

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

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

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

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see **Figure 17** below).

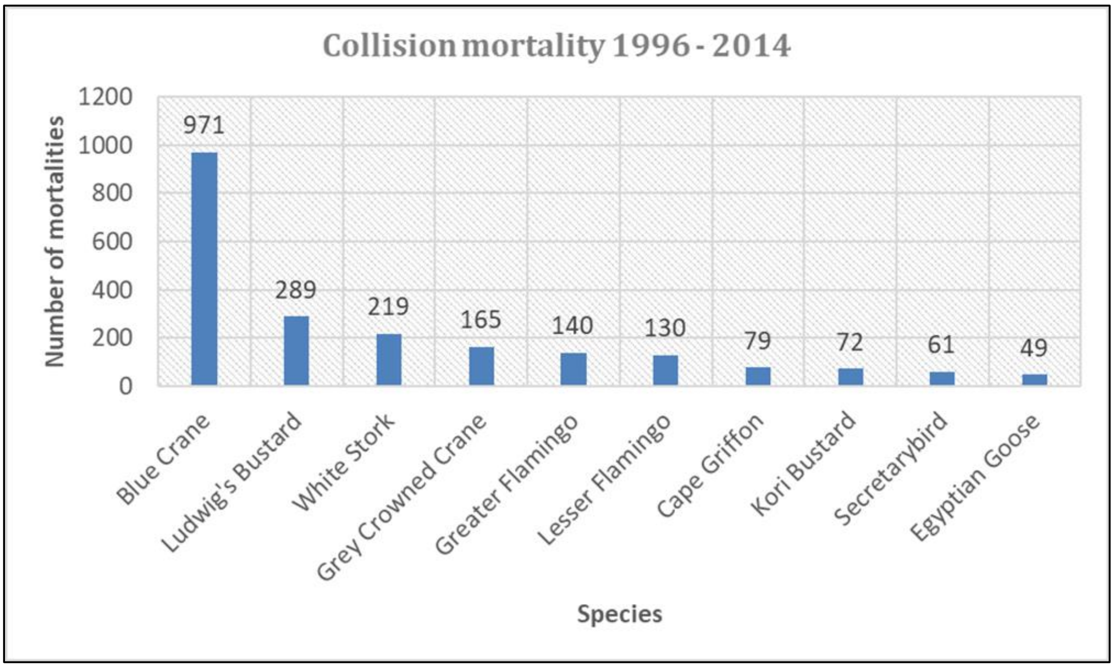


Figure 17: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

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

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

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al*. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Bernardino *et al.* 2018; Sporer *et al.* 2013, Barrientos *et al*. 2011; Jenkins *et al*. 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al*. 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al*. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al*. 2010).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw *et al*. 2017).

The priority species which are potentially vulnerable to this impact are the following:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High, M = Medium, L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Hamerkop	*Scopus umbretta*	1.23	0.00	-	-		L
Red-knobbed Coot	*Fulica cristata*	3.70	1.03	-	-		L
White-breasted Cormorant	*Phalacrocorax lucidus*	0.00	1.03	-	-		L
African Darter	*Anhinga rufa*	1.23	0.00	-	-		L
Yellow-billed Duck	*Anas undulata*	1.23	0.00	-	-		L
Western Cattle Egret	*Bubulcus ibis*	1.23	0.00	-	-		L
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Egyptian Goose	*Alopochen aegyptiaca*	13.58	3.09	-	-		H
Spur-winged Goose	*Plectropterus gambensis*	1.23	0.00	-	-		L
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Great Crested Grebe	*Podiceps cristatus*	0.00	1.03	-	-		L
Little Grebe	*Tachybaptus ruficollis*	2.47	0.00	-	-		L
Black-headed Heron	*Ardea melanocephala*	1.23	0.00	-	-		L
Grey Heron	*Ardea cinerea*	2.47	0.00	-	-		L
African Sacred Ibis	*Threskiornis aethiopicus*	1.23	0.00	-	-		L
Hadada Ibis	*Bostrychia hagedash*	13.58	1.03	-	-		L
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
South African Shelduck	*Tadorna cana*	11.11	1.03	-	-		M
African Spoonbill	*Platalea alba*	1.23	1.03	-	-		L
Red-billed Teal	*Anas erythrorhyncha*	1.23	0.00	-	-		L

6.2.3 Displacement due to habitat destruction

During the construction of power lines, service roads (jeep tracks) and substations, habitat destruction/transformation inevitably takes place. The construction activities will constitute the following:

- Site clearance and preparation;
- Construction of the infrastructure (i.e. the on-site substation, OHL and service road);
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site;
- Removal of vegetation for the proposed substation and stockpiling of topsoil and cleared vegetation;
- Excavations for infrastructure;

These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed onsite substations through transformation of habitat, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the substation yard is unavoidable. Fortunately, due to the nature of the vegetation, and judged by the existing power lines, very little if any vegetation clearing will be required in the power line servitudes. The habitat in the study area is extensive, very uniform and largely untransformed from a bird impact perspective; therefore, the loss of a few hectares of habitat for priority species due to direct habitat transformation associated with the construction of the proposed substation is likely to have a low impact on them. While all birds will be affected by the loss of habitat, the species most likely to be more heavily impacted would be small, common, non-Red Data species which happen to be resident in those few hectares of natural scrub habitat.

The priority species which are potentially vulnerable to this impact are the following:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	M
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00				M
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-		L
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-		M
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-		L
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	H
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M

Helmeted Guineafowl	*Numida meleagris*	2.47	1.03	-	-		L
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN		M
Black-headed Heron	*Ardea melanocephala*	1.23	0.00	-	-		L
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-		H
Rock Kestrel	*Falco rupicolus*	16.05	6.19	-	-		H
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M
White-necked Raven	*Corvus albicollis*	13.58	3.09	-	-		H
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU		L

6.2.4 Displacement due to disturbance

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. There are currently no large raptor nests on the section of the Bacchus-Droërivier 1 400kV transmission line that will run next to the proposed 132kV grid connection, therefore no disturbance of large breeding raptors are expected. There might be some level of disturbance for other species breeding on the existing powerline i.e. Pied Crow, Rock Kestrel and Greater Kestrel. Large terrestrial species might also be affected by displacement due to disturbance.

The priority species which are potentially vulnerable to this impact are listed below:

EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, H = High M = Medium L = Low

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic (SA)	Likelihood of regular occurrence in the PAOI
Pied Crow	*Corvus albus*	38.27	12.37	-	-		H
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-		H
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT		H
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN		M
Helmeted Guineafowl	*Numida meleagris*	2.47	1.03	-	-		L
Rock Kestrel	*Falco rupicolus*	16.05	6.19	-	-		H
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU		L
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-		M

6.3 The identification and assessment of potential impacts: Wind Energy Facility

The potential impacts on avifauna identified during the study are listed and assessed in the tables below. The impact criteria are explained in Appendix 6.

6.3.1 *Construction Phase*

- Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.
- Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.
-

Table 10: Rating of impacts: Construction Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.	1	4	2	3	1	3	33		Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	1	4	2	3	1	2	22		Low
Avifauna	Displacement due to habitat	1	3	2	2	3	2	22		Low	(1) Removal of vegetation must be	1	2	2	2	3	2	20		Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
	transformation associated with the construction of the wind turbines and associated infrastructure.										restricted to a minimum and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.									

6.3.2 Operational Phase

- Mortality due to collisions with the wind turbines.
- Mortality due to electrocutions on the overhead sections of the internal 33kV cables.
- Mortality due to collisions with the overhead sections of the internal 33kV cables.

Table 11: Rating of impacts: Operational Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Operation Phase																				
Avifauna	Mortality of priority species due to collisions with the wind turbines.	2	3	2	3	3	3	39		Medium	(1) No turbines should be located in the buffer zones around major drainage lines, waterpoints and dams. (2) Any planned turbines within the 3.7 – 5.2km circular medium-risk buffer zone around the Verreaux's Eagle nest must be subjected to an additional year of monitoring to determine the risk that these turbines pose to Verreaux's Eagles, to establish whether they could be effectively mitigated, or will have to be removed[8]. (3) Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.*	2	2	2	2	3	2	22		Low

[8] There are currently no turbines planned in this zone

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											2015) to assess collision rates. (4) If at any time estimated collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the mortality threshold determined by the avifaunal specialist after consultation with other avifaunal specialists and BirdLife South Africa, additional measures will have to be implemented which could include shut down on demand or other proven measures.									
Avifauna	Mortality of priority species due to electrocutions on the overhead sections of the internal 33kV cables.	2	3	1	3	3	2	24		Medium	(1) Underground cabling should be used as much as is practically possible. (2) If the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted timeously to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g., insulation of live components to	2	2	1	2	3	1	10		Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											prevent electrocutions on terminal structures and pole transformers. (3) Regular inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to look for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).									
Avifauna	Mortality due to collisions with the overhead sections of the internal 33kV cables.	2	3	2	3	3	2	26		Medium	Bird flight diverters should be installed on all the overhead line sections for the full span length according to the applicable Eskom standard at the time.	2	1	1	2	3	1	9		Low

6.3.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning (dismantling) of the wind turbines and associated infrastructure.

Table 12: Rating of impacts: Decommissioning Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	Displacement due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.	1	4	1	2	1	2	18		Low	(1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	1	3	1	2	1	2	16		Low

6.4 The identification and assessment of potential impacts: Grid components

The potential impacts on avifauna identified in the course of the study are listed and assessed in the tables below. The impact criteria are explained in Appendix 6.

6.4.1 Construction Phase

- Displacement of priority species due to habitat destruction in the substation footprint.

Table 13: Rating of impacts: Construction Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to habitat destruction in the substation footprint	1	1	3	4	3	1	12	_	Low	(1) A site-specific Construction Environmental Management Programme (CEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction.	1	1	3	4	3	1	12	_	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											(2) The minimum footprint areas for infrastructure should be used. (3) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.									
Avifauna	Displacement of priority species due to disturbance associated with the construction activities	1	3	2	3	1	3	30	_	Medium	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted.	1	2	2	1	1	2	14	_	Low

6.4.2 Operational Phase

- Mortality of priority species due to collisions with the 132kV OHL
-

Table 14: Rating of impacts: Operational Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Operational Phase																				
Avifauna	Mortality of priority species due to collisions with the 132kV OHL	1	3	2	4	3	2	26	_	Medium	Bird flight diverters should be installed on the whole line for the full span length according to the applicable Eskom standard at the time.	1	2	2	4	3	2	24	_	Medium

6.4.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning (dismantling) of the grid connection.

Table 15: Rating of impacts: Decommissioning Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	Displacement due to disturbance associated with the dismantling of the grid connection.	1	4	1	2	1	2	18		Low	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted.	1	3	1	2	1	2	16		Low

6.5 The identification of environmental sensitivities: Wind Energy facility

The following environmental sensitivities were identified from an avifaunal perspective for the proposed wind energy facility:

6.5.1 High sensitivity No-turbine buffer: Surface water.

Included in this category are areas within 200m of water troughs and earth dams, and 150m from all major drainage lines. Surface water in this arid habitat is crucially important for priority avifauna, including several Red Data species such as Martial Eagle, Lanner Falcon and Secretarybird, and many non-priority species, including several waterbirds. Drainage lines when flowing attract waterbirds on occasion, as do the large pools that remain in the channel after the flow has stopped. Wind turbines that are placed near these sources of surface water pose a collision risk to birds using the water for drinking and bathing, and drainage lines, when flowing, are natural flight paths for birds.

6.5.2 Medium sensitivity Restricted turbine buffer: Red Data species nests.

Any planned turbines within the 3.7 – 5.2km circular medium-risk buffer zone around the Verreaux's Eagle nest (-33.190167° 20.071768°) to the south-west of the PAOI must be subjected to an additional year of monitoring to determine the risk that these turbines pose to Verreaux's Eagles, to establish whether they could be effectively mitigated, or will have to be removed. If they cannot be removed, pro-active mitigation must be implemented at these turbines in the form of proven measures such as Shutdown on Demand (SDoD).[9]

See **Figure 18** for a map indicating the avifaunal sensitivity buffers.

[9] There are currently no turbines planned within this zone.

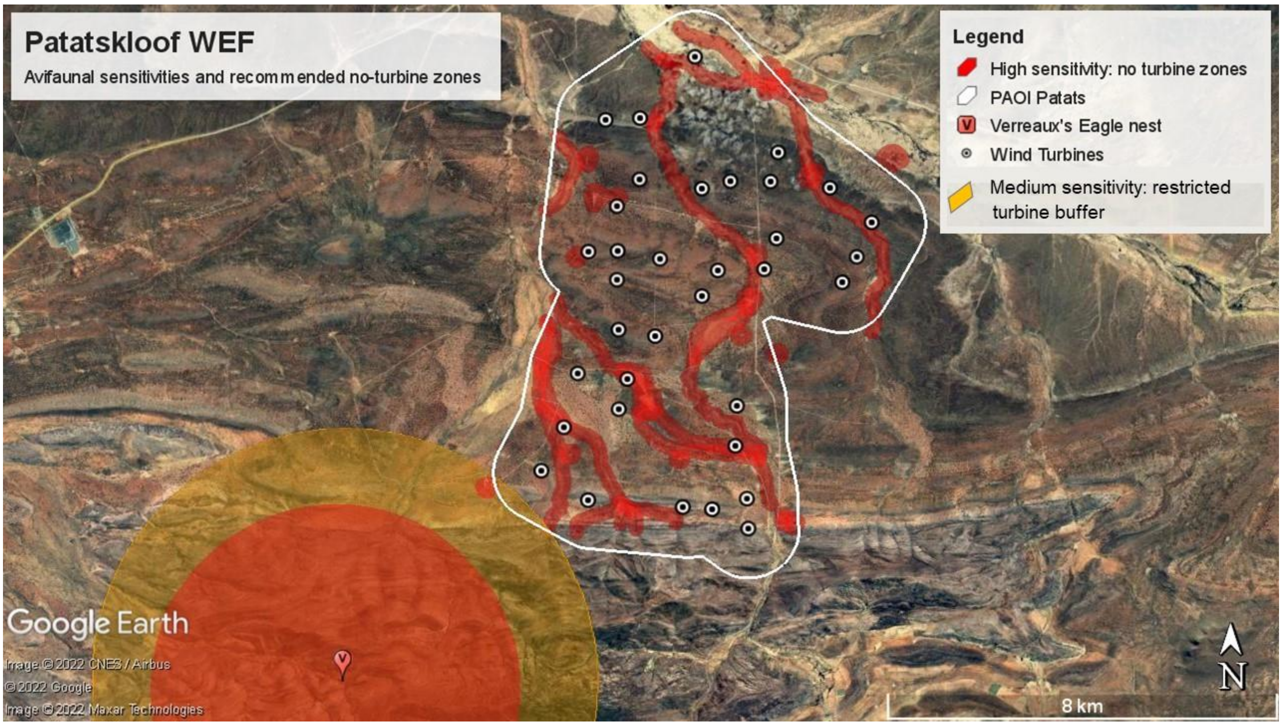


Figure 18: Proposed avifaunal sensitivity zones.

6.6 The identification of environmental sensitivities: Grid components

The following environmental sensitivities were identified from an avifaunal perspective for the proposed grid connection:

6.6.1 High sensitivity: Line marking required.

The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during the integrated pre-construction monitoring programme, with observations of Ludwig's Bustard, Southern Black Korhaan, Karoo Korhaan and Verreaux's Eagle recorded within the PAOI and its immediate surrounds. Based on the field surveys to date, a classification of High sensitivity for avifauna in the screening tool is therefore appropriate. The appropriate mitigation measure would be to mark the entire line with Bird Flight Diverters.

6.7 Cumulative impacts

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities. The assessment of cumulative effects therefore needs to consider all planned (both authorised and in process) renewable energy facilities (REFs) within a 35km radius of the proposed site.

6.7.1 Wind Energy Facility

Eleven proposed renewable energy projects were considered within a 35km radius of the proposed development as shown in **Figure** 19**19**, and **Table 16** below. The authorised projects were identified using the Renewable Energy EIA Application Database for SA from the Department of Fisheries, Forestry and Environment (DFFE), in conjunction with information provided by Independent Power Producers (IPPs) operating in the broader region. It should be noted that this list is based on information available at the time of writing this report and as such there may be other renewable energy projects proposed within the study area.

Table 16: Proposed renewable energy developments within a 35km radius of the proposed Patatskloof WEF.

Applicant	Project	Technology	Capacity	Number of turbines	Status of Application / Development
Oya Energy (Pty) Ltd	Oya Energy Facility	Hybrid (Solar / Fuel-Based)	305MW	-	EIA Process underway
Brandvalley Wind Farm (Pty) Ltd	Brandvalley WEF	Wind	140MW	70	Approved
Kudusberg Wind Farm (Pty) Ltd	Kudusberg WEF	Wind	325W	56	Approved
South Africa Mainstream Renewable Power Perdekraal West (Pty) Ltd	Perdekraal West WEF & Associated Grid Connection Infrastructure	Wind	150M	47	Approved
South Africa Mainstream Renewable Power Perdekraal East (Pty) Ltd	Perdekraal East WEF & Associated Grid Connection Infrastructure	Wind	110MW	47	Operational
South Africa Mainstream Renewable Power Developments (Pty) Ltd	Karee WEF	Wind	140MW	27	EIA Process underway
Rietkloof Wind Farm (Pty) Ltd	Rietkloof WEF	Wind	186MW	51	Approved
ENERTRAG SA (Pty) Ltd	Tooverberg WEF & Associated Grid Connection Infrastructure	Wind	140MW	44	Approved

Applicant	Project	Technology	Capacity	Number of turbines	Status of Application / Development
Witberg Wind Power (Pty) Ltd	Witberg WEF	Wind	120MW	25	Approved
Montgue Road Solar (Pty) Ltd	Montgue Road Solar	Solar PV	75MW	-	Approved
Touwsrivier Solar	Touwsrivier Solar	Solar PV	36MW	-	Approved

Figure 19 shows the location of all planned renewable energy projects within a 35km radius around the proposed Patatskloof WEF.

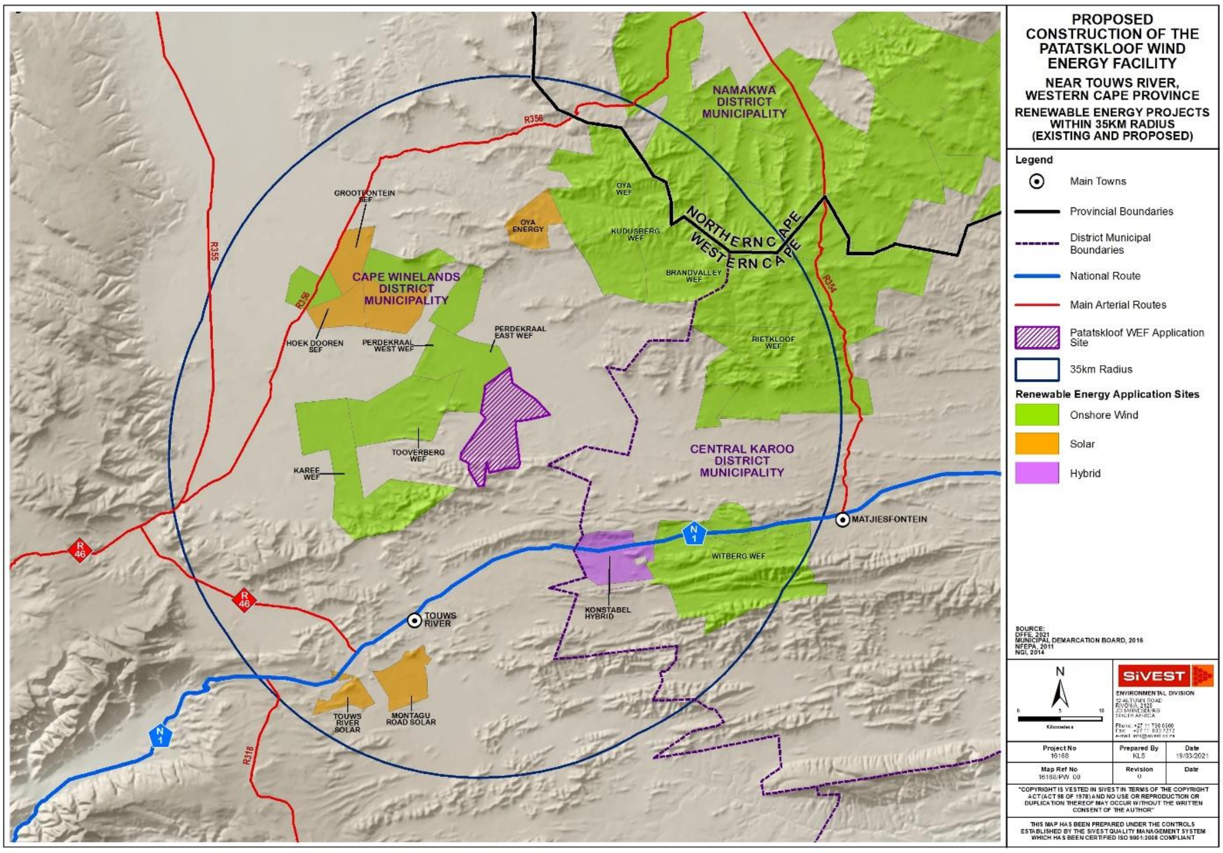


Figure 19: Proposed renewable energy projects within a 35km radius around the proposed Patatskloof WEF.

The maximum number of wind turbines which are currently proposed for the wind farms located within a 35km radius in similar habitat around the PAOI is 367. To date, only one (Perdekraal East WEF) has been constructed, and some of the planned projects must still undergo a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that all proposed 367 turbines will be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Patatskloof WEF will consist of up to 35 turbines, which brings the total number of potential turbines within the 35km radius to 402. The 35 turbines of Patatskloof WEF constitute 8.7% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The total affected land parcel area where turbines are planned, including the Patatskloof WEF, amounts to approximately 433km², which constitutes about 9% of the total area (4 584km²) of similar habitat available to birds in the 35km radius around the project. The cumulative impact of the planned wind energy projects at the time of writing is therefore still low as far as the creation of high-risk zones are concerned within the area contained in the 35km radius.

The impact of solar facilities on avifauna lies mainly in the habitat transformation associated with the construction of PV solar panels, which transforms vast areas of natural habitat significantly. The total land parcel area of the currently planned PV facilities amounts to about 166km², which equates to about 3.6% of similar habitat available in a 35km radius around the project site, which is low.

The land parcel area of the proposed Patatskloof WEF (66.2km²) amounts to about 11.5% of the total amount of land parcel area designated for renewable energy developments (577km²), but only approximately 1.4% of the total area of similar habitat available in the 35km radius. The contribution of the Patatskloof WEF to the cumulative impact of all the renewable energy facilities is therefore medium as far as potential displacement of priority species due to habitat transformation is concerned. The combined land parcel area of all the planned renewable energy land parcels (both wind and solar) equates to just over 12% of the available habitat in a 35km radius around the project site. The cumulative impact of all the planned renewable energy facilities in this area is thus assessed to be **medium** pre-mitigation, and **low** post-mitigation (see **Table 17** below).

Table 17: Rating of cumulative impacts: WEF

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Cumulative impacts																				
Avifauna	(1) Mortality due to collisions with the wind turbines (2) Displacement due to disturbance during construction and operation of the wind farm (3) Displacement due to habitat change and loss at the wind farm (4) Mortality due to electrocution on the electrical infrastructure	1	4	2	3	3	3	39	-	Medium	All the mitigation measures listed in the various bird specialist studies compiled for the eleven (11) renewable energy facilities within a 35km radius around the project.	1	2	2	3	3	2	22	-	Low

6.7.2 Grid connection infrastructure

Figure 20 shows the location of all planned renewable energy projects within a 35km radius around the proposed Patatskloof WEF.

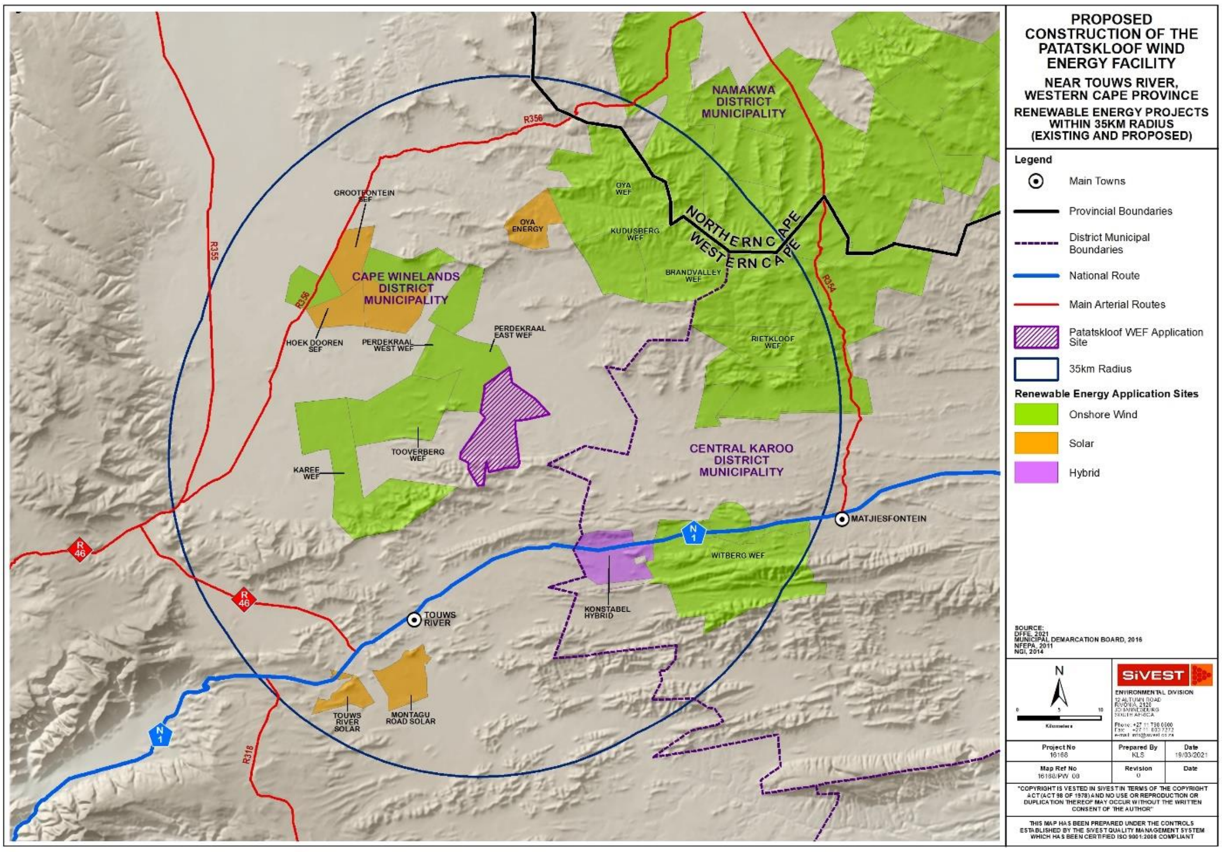


Figure 20: Proposed renewable energy projects within a 35km radius around the proposed Patatskloof WEF.

Eleven proposed renewable energy projects were considered within a 35km radius of the proposed development as shown in **Figure 200** and **Table 16**. Only one (Perdekraal East WEF) has been constructed to date, and some of the planned projects must still be subject to a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It should be noted that this list is based on information available at the time of writing this report and as such there may be other renewable energy projects proposed within the study area. All of these projects require overhead grid connections, but information on the length of these grid connections could not be attained in all instances.

The proposed Patatskloof WEF grid infrastructure equates to a maximum length of about 25km (Power Line Corridor Option 4 is approximately 25km in length). There are between 200 and 300 kilometres of existing and planned high voltage lines within the 35km radius around the Patatskloof WEF. The Patatskloof WEF project will thus increase the total number of planned and existing high voltage lines by between 7% and 11%. The cumulative impact of the planned Patatskloof WEF grid connection is considered to be low from a potential bird collision perspective, before and after mitigation. However, the combined cumulative impact of the existing and planned power lines within a 35km radius is considered to be **medium** before and after mitigation.

The cumulative impact of displacement due to habitat transformation in the onsite substations associated with the renewable energy projects is considered to be **low** before and after mitigation, due to the small size of the footprints, and the availability of similar habitat within the 35km radius area. The cumulative impact of potential electrocutions in the substation yards of the onsite substations is also likely to be **low** before and after mitigation, as it is expected to be a rare event (**Table 18**).

Table 18: Rating of cumulative impacts: Grid connection components

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Cumulative impacts																				
Avifauna	(1) Displacement of priority species due to habitat destruction in the substation footprint (2) Displacement of priority species due to disturbance associated with the construction activities. (3) Mortality of priority species due to collisions with the 132kV OHL. (4) Displacement of priority species due to disturbance associated with the	2	4	3	3	3	3	45	_	Medium	All the mitigation measures proposed by the avifaunal specialists for the grid connections of the proposed renewable energy facilities should be implemented.	2	3	3	3	3	2	28	_	Medium

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
	decommissioning activities.																			

6.8 Conditions for inclusion in the EMPr: WEF

Please see Appendix 7 for the monitoring requirements to be included in the EMPr for the WEF.

6.9 Conditions for inclusion in the EMPr: Grid connection components

Please see Appendix 8 for the monitoring requirements to be included in the EMPr for the grid connection components.

7. COMPARATIVE ASSESSMENT OF ALTERNATIVES

7.1 Wind Energy Facility

Table 19 below provides a summary of the proposed alternatives relating to the WEF and associated infrastructure, namely the two onsite substation options.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 19: Comparative assessment of WEF components

Alternative	Preference	Reasons
SUBSTATION SITE ALTERNATIVES		
Substation Option 1	The alternative will result in equal impacts	Both the options are located in similar habitat namely Succulent Karoo shrub. There is therefore no specific preference for one site above the other, due to the impacts being identical in scope and nature. Both options are acceptable.
Substation Option 2	The alternative will result in equal impacts	Both the options are located in similar habitat namely Succulent Karoo shrub. There is therefore no specific preference for one site above the other, due to the impacts being identical in scope and nature. Both options are acceptable.

7.2 Grid components

Table 20 below provides a summary of the proposed alternatives relating to the alternative grid options. Both options are practically identical in length.

Table 20: Comparative assessment of the six grid corridor options for Patatskloof WEF

Alternative	Preference	Reasons (incl. potential issues)
TRANSMISSION LINE SITE ALTERNATIVES		
Corridor Option 1	The alternative will result in more habitat transformation/disturbance and a higher collision risk to birds due to the length of the proposed transmission line.	All options are located in similar habitat namely Succulent Karoo shrub. This option is least preferred due to the length of the transmission line and it does not run along existing transmission lines.
Corridor Option 2	The alternative will result in more habitat transformation/disturbance and a higher collision risk to birds due to the length of the proposed transmission line.	All options are located in similar habitat namely Succulent Karoo shrub. This option is least preferred due to the length of the transmission line and it does not run along existing transmission lines.
Corridor Option 3	Preferred option due to relatively short length of proposed transmission line and will run along existing transmission lines.	All options are located in similar habitat namely Succulent Karoo shrub. Shorter length of transmission line will result in less habitat transformation and disturbance.
Corridor Option 4	The alternative will result in more habitat transformation/disturbance and a higher collision risk to birds due to the length of the proposed transmission line.	All options are located in similar habitat namely Succulent Karoo shrub. This option is least preferred due to the length of the transmission line and it does not run along existing transmission lines.
Corridor Option 5	The alternative will result in more habitat transformation/disturbance and a higher collision risk to birds due to the length of the proposed transmission line.	All options are located in similar habitat namely Succulent Karoo shrub. This option is least preferred due to the length of the transmission line and it does not run along existing transmission lines.
Corridor Option 6	Preferred option due to relatively short length of proposed transmission line and will run along existing transmission lines.	All options are located in similar habitat namely Succulent Karoo shrub. Shorter length of transmission line will result in less habitat transformation and disturbance.

7.3 No-Go Alternative

7.3.1 Wind Energy Facility

The no-go alternative will result in the current *status quo* being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to sensitive avifauna, especially Red Data species. The no-go option would eliminate any additional impact on the ecological integrity of the proposed PAOI as far as avifauna is concerned.

7.3.2 Grid connection components

The no-go alternative will result in the current *status quo* being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to sensitive avifauna, especially Red Data species. The no-go option would eliminate any additional impact on the ecological integrity of the proposed PAOI as far as avifauna is concerned.

8. CONCLUSION AND SUMMARY

8.1 Summary of Findings

8.1.1 Wind Energy Facility

The proposed Patatskloof WEF will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collision mortality caused by the wind turbines in the operational phase.
- Electrocution on the 33kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

8.1.1.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Species which fall in this category are Ludwig's Bustard, Southern Black Korhaan, Karoo Korhaan, Double-banded Courser, Grey-winged Francolin and Spotted Eagle-Owl. Some raptors might also be affected, e.g., Pale Chanting Goshawk which could potentially breed in the small *Vachellia* trees in the drainage lines, and Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. The impact is rated as **medium** but could be mitigated to **low** levels.

8.1.1.2 Displacement due to habitat transformation in the construction phase.

The network of roads is likely to result in significant habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard and Karoo Korhaan, and raptors. Given the current density of the proposed turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the PAOI. The alternative substation locations are all situated in essentially the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore any of the alternative locations will be acceptable. The same goes for the alternative laydown and compound areas. The impact is rated as **low** both pre- and post-mitigation.

8.1.1.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed Patatskloof WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan and Southern Black Korhaan, although generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., raptors such as Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle and Greater Kestrel are most at risk of all the priority species likely to occur regularly at the project site. Verreaux's Eagle might also be at risk to some extent, although the species is unlikely to venture regularly within the PAOI. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.1.1.4 Electrocution on the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the poles could potentially pose an electrocution risk to raptors, including Red Data species such as Martial Eagle. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.1.1.5 Collisions with the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.1.1.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar in nature to the construction phase.

8.1.1.7 Cumulative impacts.

The maximum number of wind turbines which are currently proposed for the wind farms located within a 35km radius in similar habitat around the PAOI is 367. To date, only one (Perdekraal East WEF) has been constructed, and some of the planned projects must still undergo a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that all proposed 367 turbines will be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Patatskloof WEF will consist of up to 35 turbines, which brings the total number of potential turbines within the 35km radius to 402. The 35 turbines of Patatskloof WEF constitute 8.7% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The total affected land parcel area where turbines are planned, including the Patatskloof WEF, amounts to approximately 433km², which constitutes about 9% of the total area (4 584km²) of similar habitat available to birds in the 35km radius around the project. The cumulative impact of the planned wind energy projects at the time of writing is therefore still low as far as the creation of high-risk zones are concerned within the area contained in the 35km radius.

The impact of solar facilities on avifauna lies mainly in the habitat transformation associated with the construction of PV solar panels, which transforms vast areas of natural habitat significantly. The total land parcel area of the currently planned PV facilities amounts to about 166km², which equates to about 3.6% of similar habitat available in a 35km radius around the project site, which is low.

The land parcel area of the proposed Patatskloof WEF (66.2km²) amounts to about 11.5% of the total amount of land parcel area designated for renewable energy developments (577km²), but only approximately 1.4% of the total area of similar habitat available in the 35km radius. The contribution of the Patatskloof WEF to the cumulative impact of all the renewable energy facilities is therefore medium as far as potential displacement of priority species due to habitat transformation is concerned. The combined land parcel area of all the planned renewable energy land parcels (both wind and solar) equates to just over 12% of the available habitat in a 35km radius around the project site. The cumulative impact of all the planned renewable energy facilities in this area is thus assessed to be **medium** pre-mitigation, and **low** post-mitigation.

Table 21 summarises the expected impacts of the proposed WEF and proposed mitigation measures per impact.

Table 21: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	Low
Construction: Displacement due to habitat transformation	Low	(1) Removal of vegetation must be restricted to a minimum and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.	Low
Operational: Collisions with the turbines	Medium	(1) No turbines should be located in the buffer zones around major drainage lines, waterpoints and dams. (2) Any planned turbines within the 3.7 – 5.2km circular medium-risk buffer zone around the Verreaux's Eagle nest must be subjected to an additional year of monitoring to determine the risk that these turbines pose to Verreaux's Eagles, to establish whether they could be effectively mitigated, or will have to be removed. (3) Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. (4) If at any time estimated collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the mortality threshold determined by the avifaunal specialist after consultation with other avifaunal specialists and BirdLife South Africa,	Low

		additional measures will have to be implemented which could include shut down on demand or other proven measures.	
Operational: Electrocutions on the 33kV MV network	Medium	(1) Underground cabling should be used as much as is practically possible. (2) If the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted timeously to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformers. (3) Regular inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to look for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).	Low
Operational: Collisions with the 33kV MV network	Medium	Bird flight diverters must be installed on all the overhead line sections for the full span length according to the latest Eskom standard.	Low
Decommissioning: Displacement due to disturbance	Medium	1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry.	Low
Cumulative impacts	Medium	All the mitigation measures listed in the various bird specialist studies compiled for the eleven (11) renewable energy facilities within a 35km radius around the project.	Low

8.1.2 Grid connection components

The proposed Patatskloof WEF grid connection will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collisions with the overhead line in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

8.1.2.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. There are currently no large raptor nests on the section of the Bacchus-Droërivier 1 400kV transmission line that will run next to the proposed 132kV grid connection; therefore, no disturbance of large breeding raptors is expected. There might be some level of disturbance for other species breeding on the existing powerline i.e. Pied Crow, Rock Kestrel and Greater Kestrel. Large terrestrial species might also be affected by displacement due to disturbance. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.1.2.2 Displacement due to habitat transformation in the construction phase.

During the construction of power lines, service roads (jeep tracks) and substations, habitat destruction/transformation inevitably takes place. These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed onsite substations through transformation of habitat, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the substation yard is unavoidable. Fortunately, due to the nature of the vegetation, and judged by the existing power lines, very little if any vegetation clearing will be required in the power line servitudes. The habitat in the study area is extensive, very uniform and largely untransformed from a bird impact perspective; therefore, the loss of a few hectares of habitat for priority species due to direct habitat transformation associated with the construction of the proposed substation is likely to have a low impact on them. While all birds will be affected by the loss of habitat, the species most likely to be more heavily impacted would be small, common, non-Red Data species which happen to be resident in those few hectares of natural scrub habitat. The impact is rated as **low** pre-mitigation and post-mitigation.

8.1.2.3 Electrocution on the overhead line in the operational phase.

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed power lines, no electrocution risk is envisaged because the proposed design of the 132kV line, namely the steel monopole and self-supporting lattice structures, should not pose an electrocution threat to any of the priority species which are likely to occur in the study area.

8.1.2.4 Collisions with the overhead line in the operational phase.

The line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and remains **medium** post-mitigation.

8.1.2.5 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar in nature to the construction phase.

8.1.2.6 Cumulative impacts.

The proposed Patatskloof WEF grid infrastructure equates to a maximum length of about 25km (Power Line Corridor Option 4 is approximately 25km in length). There are between 200 and 300 kilometres of existing and planned high voltage lines within the 35km radius around the Patatskloof WEF. The Patatskloof WEF project will thus increase the total number of planned and existing high voltage lines by between 7% and 11%. The cumulative impact of the planned Patatskloof WEF grid connection is considered to be low from a potential bird collision perspective, before and after mitigation. However, the combined cumulative impact of the existing and planned power lines within a 35km radius is considered to be **medium** before and after mitigation.

The cumulative impact of displacement due to habitat transformation in the onsite substations associated with the renewable energy projects is considered to be **low** before and after mitigation, due to the small size of the footprints, and the availability of similar habitat within the 35km radius area. The cumulative impact of potential electrocutions in the substation yards of the onsite substations is also likely to be **low** before and after mitigation, as it is expected to be a rare event.
Table 22 summarises the expected impacts of the proposed grid connection and proposed mitigation measures per impact.

Table 22: Overall Impact Significance for the grid connection (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted.	Low
Construction: Displacement due to habitat transformation	Low	1) A site-specific Construction Environmental Management Programme (CEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. (2) The minimum footprint areas for infrastructure should be used. (3) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	Low
Operational: Collisions with the overhead grid connection	Medium	(1) Bird flight diverters should be installed on all the whole line for the full span length according to the applicable Eskom standard at the time.	Medium
Decommissioning: Displacement due to disturbance	Medium	(1) No off-road driving should be allowed. (2) Existing roads should be used as much as possible. (3) Measures to control noise must be implemented according to industry best practice (4) Access to the rest of the property must be restricted	Low
Cumulative impacts	Medium	All the mitigation measures listed in the various bird specialist studies compiled for the eleven (11) renewable energy facilities' grid connections within a 35km radius around the project.	Medium

8.2 Conclusion and Impact Statement

8.2.1 Wind Energy Facility

The proposed Patatskloof WEF will have a moderate impact on avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation. The alternative substation and laydown locations are all situated in essentially the same habitat, i.e. Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore any of the alternative locations will be acceptable. No fatal flaws were discovered in the course of the onsite investigations. The development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

8.2.2 Grid connection components

The proposed Patatskloof WEF grid connection will have a moderate impact on avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation. Out of the six (6) grid corridor alternatives, Corridor Option 3 and Corridor Option 6 are most preferred from an avifaunal perspective. The development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

9. POST CONSTRUCTION PROGRAMME

The new procedures and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA came into force in March 2020. According to these regulations, a detailed post-construction monitoring programme must be included as part of the bird specialist study. See Appendix 9 for a proposed programme.

10. FINAL LAYOUT

In November 2022, the specialists were presented with a final buildable area which incorporates all of the proposed sensitivity buffers (**Figure 21**). The final buildable area was assessed accordingly from an avifaunal impact perspective, and the impact ratings and conclusions (see Section 8.2.1) reached in this study as far as the WEF infrastructure is concerned, remain unchanged.

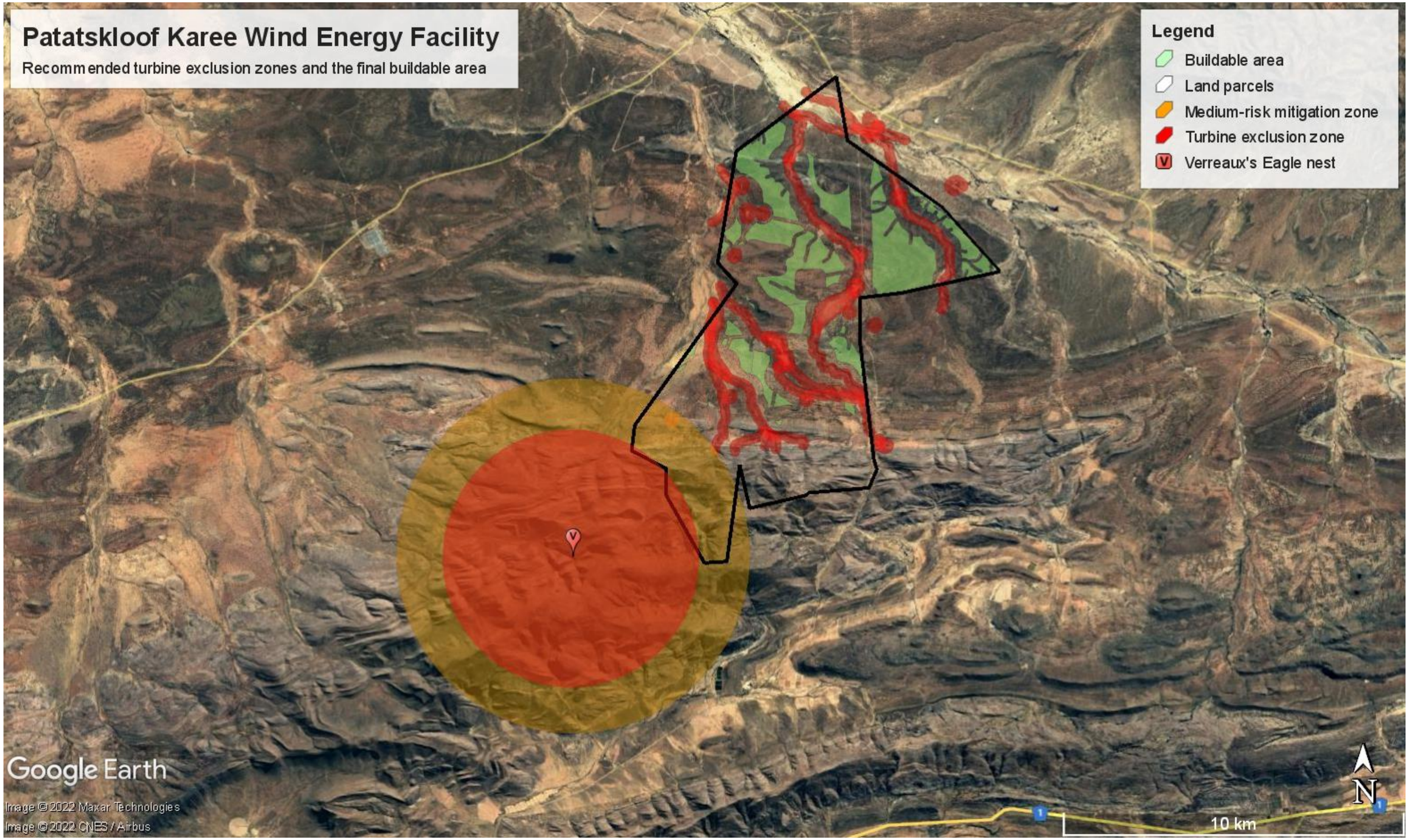


Figure 21: Final lay-out and avifaunal sensitivities for the Patatskloof WEF project.

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APPENDIX 1: TERMS OF REFERENCE

1. SPECIALIST REPORT REQUIREMENTS

1.1 Site Sensitivity Verification and Reporting

The requirements for Specialist Studies being undertaken in support of applications for Environmental Authorisation are specified in **Appendix 6** of the 2014 NEMA EIA Regulations (as amended), as well as the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. These protocols stipulate the Procedures for the Assessment and Minimum Criteria for reporting on identified environmental themes in terms of Sections 24(5)(A) and (H) and 44 of the NEMA, when applying for EA.

The Assessment Protocols as per GN320 are as follows:

- **PART A:** This relates to the Site Sensitivity Verification (SSV) and Reporting requirements where a Specialist Assessment is required but no specific Assessment Protocol has been prescribed. In this instance, specialist assessment must comply with **Appendix 6** of the 2014 NEMA EIA Regulations (as amended). However, the current use of the land and the environmental sensitivity of the site under consideration as identified by the DFFE Screening Tool must be verified and confirmed and an SSV report must be compiled and included as an appendix to the Specialist Assessment. Where there are no sensitivity layers on the Screening Tool for a particular Specialist Assessment, then this must be stated in the actual Specialist Assessment and in the accompanying SSV report.
- **PART B:** This relates to the Site Sensitivity Verification (SSV) and Reporting requirements where a Specialist Assessment is required and a specific Assessment Protocol has been prescribed. The following Assessment Protocols are relevant to the proposed project:
    - Agriculture
    - Terrestrial Biodiversity
    - Aquatic Biodiversity
    - Avifauna
    - Civil Aviation
    - Defence
    - Noise Assessment
    - Terrestrial Plant Species
    - Terrestrial Animal Species

1.2 Specialist Assessment Reports / Compliance Statements

Specialists are requested to provide ***one (1)*** scoping phase report and / or compliance statement that provides an assessment of the proposed PATATSKLOOF WEF ***and*** the associated grid connection infrastructure (132kV overhead power line on-site switching / collector substation). The report should however include separate assessment and impact rating chapters/sections for the WEF and the grid connection proposals respectively.

During the EIA phase, specialists will be required to update the scoping phase specialist report to provide a review of their findings in accordance with revised site layouts and to address any comments or concerns arising from the public participation process.

The specialist assessment reports and / or compliance statements should include the following sections:

1.2.1 Project Description

The specialist report must include the project description as provided above.

1.2.2 Terms of Reference

The specialist report must include an explanation of the terms of reference (TOR) applicable to the specialist study. Where relevant, a table must be provided at the beginning of the specialist report, listing the requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended) and cross referencing these requirements with the relevant sections in the report. An MS Word version of this table will be provided by SiVEST.

1.2.3 Legal Requirements and Guidelines

The specialist report must include a thorough overview of all applicable best practice guidelines, relevant legislation, prescribed Assessment Protocols and authority requirements.

1.2.4 Methodology

The report must include a description of the methodology applied in carrying out the specialist assessment.

1.2.5 Specialist Findings / Identification of Impacts

The report must present the findings of the specialist studies and explain the implications of these findings for the proposed development (e.g. permits, licenses etc.). This section of the report should also identify any sensitive and/or 'no-go' areas on the PAOI or within the power line assessment corridors. These areas must be mapped clearly with a supporting explanation provided.

This section of the report should also specify if any further assessment will be required.

1.2.6 Environmental Impact Assessment

The impacts (both direct and indirect) of the proposed WEF and the proposed grid connection infrastructure (during the Construction, Operation and Decommissioning phases) are to be assessed and rated *separately* according to the methodology developed by SiVEST. Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose, and *separate tables* must be provided for the WEF and for the grid connection infrastructure respectively. **Please note that the significance of Cumulative Impacts should also be rated in this section.** Both the methodology and the rating matrix will be provided by SiVEST.

Please be advised that this section must include mitigation measures aimed at minimising the impact of the proposed development.

1.2.7 Input To The Environmental Management Programme (EMPr)

The report must include a description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the project for inclusion in the Environmental Management Programme (EMPr) or Environmental Authorisation (EA).

Please make use of the Impact Rating Table (in Excel format) for each of the phases i.e. Design, Construction, Operation and Decommissioning.

1.2.8 Cumulative Impact Assessment

Cumulative impact assessments must be undertaken for the proposed WEF and associated grid connection infrastructure to determine the cumulative impact that will materialise if other Renewable Energy Facilities (REFs) and large scale industrial developments are constructed within 35kms of the proposed development.

The cumulative impact assessment must contain the following:

- A cumulative environmental impact statement noting whether the overall impact is acceptable; and
- A review of the specialist reports undertaken for other REFs and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered.

In order to assist the specialists in this regard, SiVEST will provide the following documentation/data:

- A summary table listing all REFs identified within 35kms of the proposed WEF;
- A map showing the location of the identified REFs; and
- KML files.

It should be noted that it is the specialist's responsibility to source the relevant EIA / BA reports that are available in the public domain. SiVEST will assist, where possible.

1.2.9 No Go Alternative

Consideration must be given to the "no-go" option in the EIA process. The "no-go" option assumes that the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would be preserved.

1.2.10 Comparative Assessment of Alternatives

As mentioned, alternatives for the Substation location, construction / laydown area and power line route alignment have been identified. These alternatives are being considered as part of the EIA / BA processes and as such specialists are required to undertake a comparative assessment of the alternatives mentioned above as per the latest table provided by SiVEST.

1.2.11 Conclusion / Impact Statement

The conclusion section of the specialist report must include an Impact Statement, indicating whether any fatal flaws have been identified and ultimately whether the proposed development can be authorised or not (i.e. whether EA should be granted / issued or not).

1.2.12 Executive Summary

Specialists must provide an Executive Summary summarising the findings of their report to allow for easy inclusion in the EIA / BA reports.

1.2.13 Specialist Declaration of Independence

A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures, must be appended to all Draft and Final Reports. This form will be provided to the specialists. *Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner* of Oaths.

APPENDIX 2: SPECIALIST CV

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	26 years

Key Experience

Chris van Rooyen has twenty-six years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)

21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).
54. PATATSKLOOF and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
55. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
56. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
57. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
58. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
59. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring

(Enertrag SA)
62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
67. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia
15. Dayson Klip PV Facility near Upington, Northern Cape
16. Geelkop PV Facility near Upington, Northern Cape
17. Oya PV Facility, Ceres, Western Cape
18. Vrede and Rondawel PV Facilities, Free State
19. Kolkies & Sadawa PV Facilities, Western Cape
20. Leeuwbosch PV1 and 2 and Wildebeeskuil PV1 and 2 Facilities, North-West
21. Kenhardt PV 3,4 and 5, Northern Cape
22. Wittewal PV, Grootfontein PV and Hoekdoornen PV Facilities, Touws River, Western Cape

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV

18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV

74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV

131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba's Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation
Biology) Nationality	:	South African
Years of experience	:	24 years

Key Qualifications

Albert Froneman (*Pr.Sci.Nat*) has more than two decades of experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

KEY PROJECT EXPERIENCE

Renewable Energy Facilities – avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oysterbay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskopvlakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring

project

13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Aletta Wind Energy Facility 12-month bird monitoring (Biotherm)
28. Maralla Wind Energy Facility 12-month bird monitoring (Biotherm)
29. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
30. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
31. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
32. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
33. KurumanWind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
34. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
35. Klipheuwel-Dassiefontein Wind Energy Facility, Caledon, Western Cape – Operational phase bird monitoring – Year 5 (Klipheuwel-Dassiefontein Wind Energy Facility)
36. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
37. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). PATATSKLOOF and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
38. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
39. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
40. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
41. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
42. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre- construction monitoring (Mainstream)
43. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
44. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
45. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)

46. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
47. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
48. Kappa Solar PV facility, Touwsrivier, Western Cape, pre-construction monitoring (Veroniva)
49. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
50. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
51. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
52. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
53. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).
54. Iphiko Wind Energy facilities, Laingsburg, Western Cape, screening and pre- construction monitoring (G7 Energies)
55. Kangnas Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
56. Perdekraal East Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
57. Aberdeen 1, 2 & Aberdeen Kudu (3&4) Wind Energy Facilities, Eastern Cape, 12- month pre-construction monitoring (Atlantic Renewable Energy Partners)
58. Loxton / Beaufort West Wind Energy Facilities, Northern Cape, 12-month pre- construction monitoring (Genesis Eco-Energy Developments)
59. Ermelo & Volksrust Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
60. Aardvark Solar PV facility, Copperton, Northern Cape, 12-month pre-construction monitoring (ABO)
61. Bestwood Solar PV facility, Kathu, Northern Cape, pre-construction monitoring (AMDA)
62. Boundary Solar PV facility, Kimberley, Northern Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
63. Excelsior Wind Energy Facility, Swellendam, Western Cape, Operational Phase 2 years avifaunal monitoring & implementation of Shut Down on Demand (SDOD) pro-active mitigation strategy (Biotherm)
64. De Aar cluster Solar PV facilities, De Aar, Western Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
65. Rinkhals Solar PV facilities, Kimberley, Northern Cape, Pre-construction monitoring (ABO)
66. Kolkies Sadawa Solar PV facilities, Touwsrivier, Western Cape, pre-construction monitoring (Mainstream)
67. Leeudoringstad Solar PV facilities, Leeudoringstad, North West, Pre-construction monitoring (Upgrade Energy)
68. Noupoort Umsobomvu Solar PV facilities, Noupoort, Northern Cape, Pre-construction monitoring (EDF Renewables)
69. Oya Solar PV facilities, Matjiesfontein, Western Cape, pre-construction monitoring (G7 Energies)
70. Scafell Solar PV facilities, Sasolburg, Free state, pre-construction monitoring (Mainstream)
71. Vrede & Rondawel Solar PV facilities, Kroonstad, Free state, pre-construction monitoring (Mainstream)
72. Gunstfontein Wind Energy Facilities, Sutherland, Northern Cape, additional pre- construction monitoring (ACED)
73. Ezelsjacht Wind Energy Facility, De Doorns, Western Cape, pre-construction monitoring (Mainstream)
74. Klipkraal Wind Energy Facility, Fraserburg, Northern Cape, avifaunal screening (Klipkraal WEF)

75. Pofadder Wind Energy Facility, Pofadder, Northern Cape, pre-construction monitoring (Atlantic Renewable Energy Partners)

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assesment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality
12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports.Bird Impact Assessment Study - Proposed 60 year Ash Disposal Facility near to the Kusile Power Station
19. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
20. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
21. Habitat sensitivity map for Denham’s Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
22. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
23. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
24. Avifaunal Specialist Study – Meerkat Hydro Electric Dam – Hope Town, Northern Cape
25. The Stewards Pan Reclamation Project – Bird Impact Assessment study

26. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation
27. Strategic Environmental Assessment For Gas Pipeline Development, CSIR
28. Avifaunal Specialist Assessment - Proposed monopole telecommunications mast – Roodekrans, Roodepoort, Gauteng (Enviroworks)
29. Gromis-Nama-Aggeneis 400kv Ipp Integration: Environmental Screening - Avifaunal Specialist Desktop Study
30. Melkspruit - Rouxville 132kV Distribution Line - Avifaunal Amendment and Walk-through Report
31. Gamma - Kappa 2nd 765kV transmission line – Avifaunal impact assessment GIS analysis

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Origstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA –GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map productionCity of Tswane – New bulkfeeder pipeline projects x3Map production

37. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
38. ESKOM Geluk Rural Powerline GIS & Mapping
39. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
40. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
41. ESKOM Lephalale CNC – GIS Specialist & Mapping
42. ESKOM Marken CNC – GIS Specialist & Mapping
43. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
44. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping
45. Vlakfontein Filling Station – GIS Specialist & Mapping - EIA
46. Prieska – Hoekplaas Solar PV & BESS - GIS Specialist & Mapping – EIA
47. Mulilo Total Hydra Storage (MTHS) De Aar - GIS Specialist & Mapping – EIA
48. Merensky Uchoba Powerline, Steelpoort - GIS Specialist & Mapping – EIA
49. Douglas Solar Part 2 Amendment – grid connection - GIS Specialist & Mapping – EIA

Professional affiliations

- South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.
- Southern African Wildlife Management Association - Member
- Zoological Society of South Africa - Member

APPENDIX 3: PRE-CONSTRUCTION MONITORING PROTOCOL

1. OBJECTIVES

The objective of the pre-construction monitoring at the proposed Patatskloof Wind Energy Facility (WEF) was to gather baseline data over a period of four seasons on the following aspects pertaining to avifauna:

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

2. METHODS

The monitoring protocol for the sites was designed according to the latest version (2015) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

Monitoring surveys were conducted during the following periods:

- 17-21 November 2020
- 23 - 26 February 2021
- 4 – 11 May 2021
- 30 August – 5 September 2021.

Monitoring is conducted in the following manner:

- One drive transect was identified totalling 7.48km on the turbine site and one drive transect in the control site with a total length of 7km.
- Two monitors travelling slowly (± 10km/h) in a vehicle records all birds on both sides of the transect. The observers stop at regular intervals (every 500m) to scan the environment with binoculars. Drive transects are counted three times per sampling session.
- In addition, 3 walk transects of 1km each were identified at the turbine site, and two at the control site, and counted 4 times per sampling season. All birds are recorded during walk transects.
- The following variables are recorded:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Estimated distance from transect;
  - Wind direction;
  - Wind strength (estimated Beaufort scale);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);

- Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
- Co-ordinates (priority species only).

The aim with drive transects is primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects are primarily aimed at recording small passerines. The objective of the transect monitoring is to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities.

Three vantage points (VPs) were identified from which the majority of the proposed turbine area could be observed (the “VP area”), to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:

- Species;
- Number of birds;
- Date;
- Start time and end time;
- Wind direction;
- Wind strength (estimated Beaufort scale 1-7);
- Weather (sunny; cloudy; partly cloudy; rain; mist);
- Temperature (cold; mild; warm; hot);
- Flight altitude (high ~ above rotor altitude; medium ~ at rotor altitude; low ~ below rotor altitude);
- Flight mode (soar; flap; glide ; kite; hover); and
- Flight time (in 15 second-intervals).

The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms.

Four potential focal points (FPs) of bird activity were identified, three are earth dams, and one is a Pale Chanting Goshawk nest. A control focal point, a Martial Eagle nest on a transmission tower approximately 10km away from the site, was also identified and was monitored.

Figure 1 below indicates the proposed turbine and control areas where monitoring was implemented.

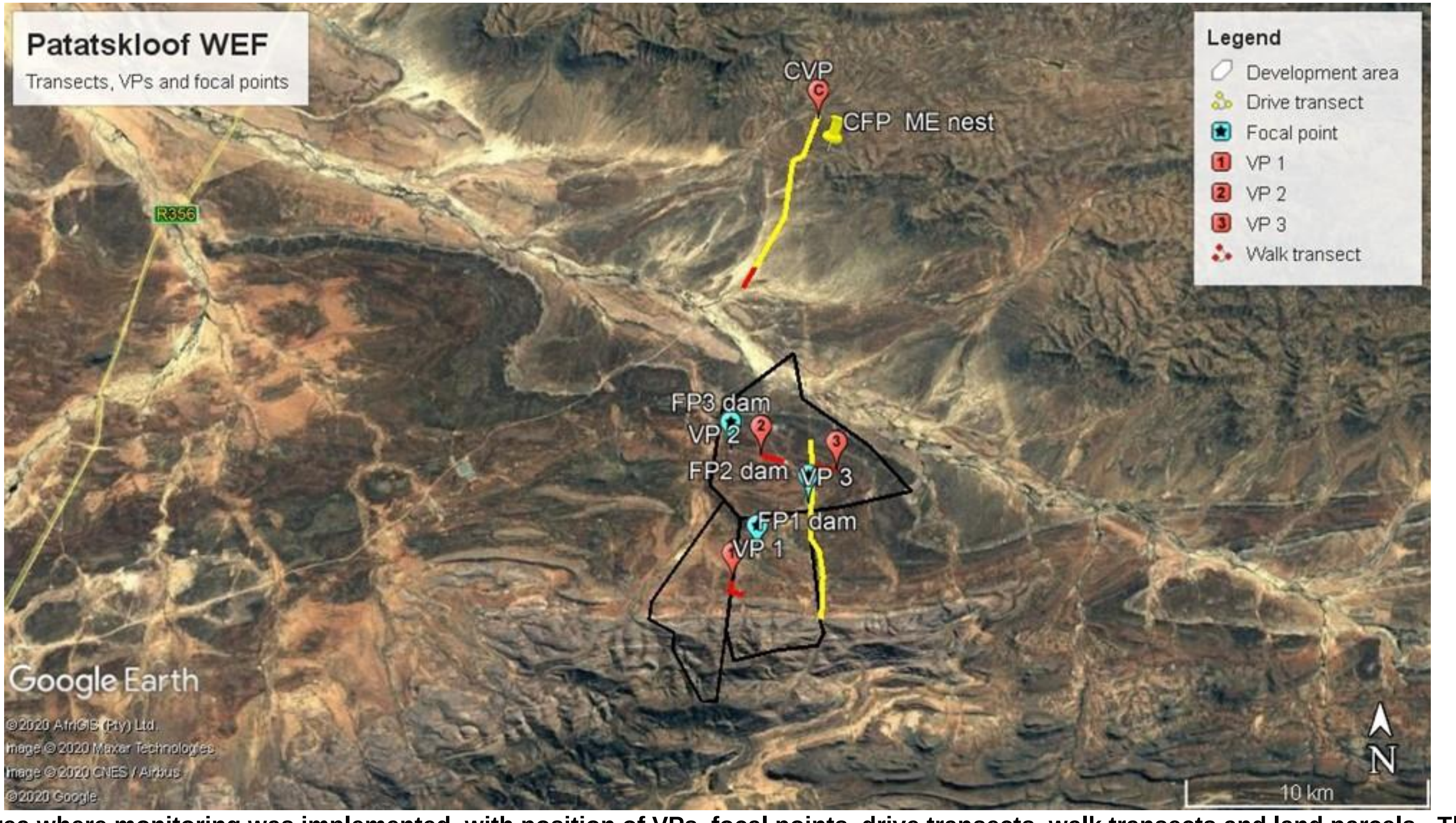


Figure 1: Area where monitoring was implemented, with position of VPs, focal points, drive transects, walk transects and land parcels. The control area is located approximately 10km north of the assessment area.

APPENDIX 4: BIRD HABITAT

Figure 1: Artificial dam at project site.

Figure 2: Karoo scrub habitat at project site

Figure 3: Typical Succulent Karoo habitat at the project site.

Figure 4: Vantage Point 1 area.

APPENDIX 5: SPECIES LIST FOR THE BROADER AREA

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Wind priority	Powerline sensitive
Acacia Pied Barbet	*Tricholaema leucomelas*	19.75	1.03	-	-		
African Black Swift	*Apus barbatus*	1.23	0.00	-	-		
African Darter	*Anhinga rufa*	1.23	0.00	-	-		x
African Hoopoe	*Upupa africana*	3.70	0.00	-	-		
African Pipit	*Anthus cinnamomeus*	3.70	1.03	-	-		
African Reed Warbler	*Acrocephalus baeticatus*	1.23	1.03	-	-		
African Sacred Ibis	*Threskiornis aethiopicus*	1.23	0.00	-	-		x
African Spoonbill	*Platalea alba*	1.23	1.03	-	-		x
African Stonechat	*Saxicola torquatus*	1.23	0.00	-	-		
Alpine Swift	*Tachymarptis melba*	7.41	2.06	-	-		
Ant-eating Chat	*Myrmecocichla formicivora*	12.35	6.19	-	-		
Barn Swallow	*Hirundo rustica*	18.52	2.06	-	-		
Black Harrier	*Circus maurus*	7.41	6.19	EN	EN	x	x
Black-chested Snake-Eagle	Circaetus pectoralis	0.00	0.00			x	x
Black-eared Sparrow-Lark	*Eremopterix australis*	1.23	0.00	-	-		
Black-headed Canary	*Serinus alario*	14.81	7.22	-	-		
Black-headed Heron	*Ardea melanocephala*	1.23	0.00	-	-		x
Blacksmith Lapwing	*Vanellus armatus*	3.70	0.00	-	-		
Black-winged Kite	*Elanus caeruleus*	1.23	0.00	-	-	x	x
Black-winged Stilt	*Himantopus himantopus*	1.23	0.00	-	-		
Bokmakierie	*Telophorus zeylonus*	55.56	23.71	-	-		
Booted Eagle	*Hieraaetus pennatus*	14.81	4.12	-	-	x	x
Brown-throated Martin	*Riparia paludicola*	8.64	1.03	-	-		
Cape Bulbul	*Pycnonotus capensis*	24.69	8.25	-	-		
Cape Bunting	*Emberiza capensis*	50.62	26.80	-	-		
Cape Canary	*Serinus canicollis*	4.94	1.03	-	-		
Cape Crow	*Corvus capensis*	1.23	0.00	-	-		x
Cape Penduline Tit	*Anthoscopus minutus*	8.64	0.00	-	-		
Cape Robin-Chat	*Cossypha caffra*	6.17	0.00	-	-		
Cape Rock Thrush	*Monticola rupestris*	1.23	0.00	-	-		
Cape Sparrow	*Passer melanurus*	59.26	20.62	-	-		
Cape Spurfowl	*Pternistis capensis*	3.70	1.03	-	-		
Cape Sugarbird	*Promerops cafer*	1.23	1.03	-	-		
Cape Turtle Dove	*Streptopelia capicola*	30.86	2.06	-	-		
Cape Wagtail	*Motacilla capensis*	37.04	7.22	-	-		
Cape Weaver	*Ploceus capensis*	11.11	1.03	-	-		
Cape White-eye	*Zosterops virens*	1.23	2.06	-	-		
Capped Wheatear	*Oenanthe pileata*	1.23	1.03	-	-		
Cardinal Woodpecker	*Dendropicos fuscescens*	2.47	0.00	-	-		
Chat Flycatcher	*Melaenornis infuscatus*	1.23	0.00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Wind priority	Powerline sensitive
Chestnut-vented Warbler	*Curruca subcoerulea*	19.75	3.09	-	-		
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*	1.23	0.00	-	-		
Common Buzzard	*Buteo buteo*	1.23	0.00	-	-	x	x
Common Ostrich	*Struthio camelus*	9.88	2.06	-	-		
Common Quail	*Coturnix coturnix*	2.47	0.00	-	-		
Common Starling	*Sturnus vulgaris*	3.70	0.00	-	-		
Common Waxbill	*Estrilda astrild*	11.11	2.06	-	-		
Crowned Lapwing	*Vanellus coronatus*	1.23	0.00	-	-		
Double-banded Courser	*Rhinoptilus africanus*	6.17	1.03	-	-	x	
Dusky Sunbird	*Cinnyris fuscus*	6.17	2.06	-	-		
Egyptian Goose	*Alopochen aegyptiaca*	13.58	3.09	-	-		x
European Bee-eater	*Merops apiaster*	7.41	6.19	-	-		
Fairy Flycatcher	*Stenostira scita*	17.28	2.06	-	-		
Familiar Chat	*Oenanthe familiaris*	30.86	8.25	-	-		
Fiscal Flycatcher	*Melaenornis silens*	7.41	0.00	-	-		
Great Crested Grebe	*Podiceps cristatus*	0.00	1.03	-	-		x
Greater Kestrel	*Falco rupicoloides*	12.35	3.09	-	-	x	x
Greater Striped Swallow	*Cecropis cucullata*	8.64	5.15	-	-		
Grey Heron	*Ardea cinerea*	2.47	0.00	-	-		x
Grey Tit	*Melaniparus afer*	34.57	5.15	-	-		
Grey-backed Cisticola	*Cisticola subruficapilla*	61.73	23.71	-	-		
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	7.41	1.03	-	-		
Grey-winged Francolin	*Scleroptila afra*	2.47	1.03	-	-	x	
Hadada Ibis	*Bostrychia hagedash*	13.58	1.03	-	-		x
Hamerkop	*Scopus umbretta*	1.23	0.00	-	-		x
Helmeted Guineafowl	*Numida meleagris*	2.47	1.03	-	-		x
House Sparrow	*Passer domesticus*	12.35	4.12	-	-		
Jackal Buzzard	*Buteo rufofuscus*	11.11	6.19	-	-	x	x
Karoo Chat	*Emarginata schlegelii*	86.42	52.58	-	-		
Karoo Eremomela	*Eremomela gregalis*	24.69	12.37	-	-		
Karoo Korhaan	*Eupodotis vigorsii*	12.35	0.00	-	NT	x	x
Karoo Lark	*Calendulauda albescens*	74.07	41.24	-	-		
Karoo Long-billed Lark	*Certhilauda subcoronata*	20.99	12.37	-	-		
Karoo Prinia	*Prinia maculosa*	53.09	21.65	-	-		
Karoo Scrub Robin	*Cercotrichas coryphoeus*	61.73	23.71	-	-		
Karoo Thrush	*Turdus smithi*	2.47	2.06	-	-		
Lanner Falcon	*Falco biarmicus*	3.70	2.06	-	VU	x	x
Large-billed Lark	*Galerida magnirostris*	59.26	40.21	-	-		
Lark-like Bunting	*Emberiza impetuani*	9.88	3.09	-	-		
Laughing Dove	*Spilopelia senegalensis*	6.17	0.00	-	-		
Layard's Warbler	*Curruca layardi*	23.46	3.09	-	-		
Levaillant's Cisticola	*Cisticola tinniens*	2.47	0.00	-	-		
Little Grebe	*Tachybaptus ruficollis*	2.47	0.00	-	-		x

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Wind priority	Powerline sensitive
Little Swift	*Apus affinis*	11.11	0.00	-	-		
Long-billed Crombec	*Sylvietta rufescens*	13.58	2.06	-	-		
Ludwig's Bustard	*Neotis ludwigii*	7.41	2.06	EN	EN	x	x
Malachite Sunbird	*Nectarinia famosa*	34.57	15.46	-	-		
Martial Eagle	*Polemaetus bellicosus*	2.47	1.03	EN	EN	x	x
Mountain Wheatear	*Myrmecocichla monticola*	19.75	6.19	-	-		
Namaqua Dove	*Oena capensis*	17.28	5.15	-	-		
Namaqua Sandgrouse	*Pterocles namaqua*	16.05	3.09	-	-		
Namaqua Warbler	*Phragmacia substriata*	13.58	2.06	-	-		
Neddicky	*Cisticola fulvicapilla*	2.47	0.00	-	-		
Orange-breasted Sunbird	*Anthobaphes violacea*	3.70	0.00	-	-		
Pale Chanting Goshawk	*Melierax canorus*	64.20	34.02	-	-	x	x
Pale-winged Starling	*Onychognathus nabouroup*	4.94	1.03	-	-		
Pied Avocet	*Recurvirostra avosetta*	2.47	0.00	-	-		
Pied Crow	*Corvus albus*	38.27	12.37	-	-		x
Pied Starling	*Lamprotornis bicolor*	16.05	1.03	-	-		
Pin-tailed Whydah	*Vidua macroura*	0.00	1.03	-	-		
Pririt Batis	*Batis pririt*	11.11	1.03	-	-		
Red-billed Teal	*Anas erythrorhyncha*	1.23	0.00	-	-		x
Red-capped Lark	*Calandrella cinerea*	7.41	3.09	-	-		
Red-eyed Dove	*Streptopelia semitorquata*	1.23	0.00	-	-		
Red-faced Mousebird	*Urocolius indicus*	6.17	1.03	-	-		
Red-knobbed Coot	*Fulica cristata*	3.70	1.03	-	-		x
Red-winged Starling	*Onychognathus morio*	3.70	0.00	-	-		
Rock Kestrel	*Falco rupicolus*	16.05	6.19	-	-		x
Rock Martin	*Ptyonoprogne fuligula*	56.79	13.40	-	-		
Rufous-eared Warbler	*Malcorus pectoralis*	70.37	28.87	-	-		
Secretarybird	*Sagittarius serpentarius*	1.23	0.00	EN	VU	x	x
Sickle-winged Chat	*Emarginata sinuata*	9.88	4.12	-	-		
South African Shelduck	*Tadorna cana*	11.11	1.03	-	-		x
Southern Black Korhaan	*Afrotis afra*	12.35	5.15	VU	VU	x	x
Southern Double-collared Sunbird	*Cinnyris chalybeus*	33.33	12.37	-	-		
Southern Fiscal	*Lanius collaris*	44.44	20.62	-	-		
Southern Masked Weaver	*Ploceus velatus*	16.05	3.09	-	-		
Southern Red Bishop	*Euplectes orix*	3.70	0.00	-	-		
Speckled Pigeon	*Columba guinea*	29.63	8.25	-	-		
Spike-heeled Lark	*Chersomanes albofasciata*	34.57	18.56	-	-		
Spotted Eagle-Owl	*Bubo africanus*	2.47	1.03	-	-	x	x
Spotted Thick-knee	*Burhinus capensis*	1.23	0.00	-	-		
Spur-winged Goose	*Plectropterus gambensis*	1.23	0.00	-	-		x
Three-banded Plover	*Charadrius tricollaris*	13.58	3.09	-	-		
Tractrac Chat	*Emarginata tractrac*	14.81	2.06	-	-		
Verreaux's Eagle	*Aquila verreauxii*	4.94	3.09	-	VU	x	x

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Wind priority	Powerline sensitive
Western Cattle Egret	*Bubulcus ibis*	1.23	0.00	-	-		x
White-backed Mousebird	*Colius colius*	22.22	3.09	-	-		
White-breasted Cormorant	*Phalacrocorax lucidus*	0.00	1.03	-	-		x
White-necked Raven	*Corvus albicollis*	13.58	3.09	-	-		x
White-rumped Swift	*Apus caffer*	7.41	0.00	-	-		
White-throated Canary	*Crithagra albogularis*	53.09	19.59	-	-		
Yellow Canary	*Crithagra flaviventris*	77.78	43.30	-	-		
Yellow-bellied Eremomela	*Eremomela icteropygialis*	13.58	3.09	-	-		
Yellow-billed Duck	*Anas undulata*	1.23	0.00	-	-		x

APPENDIX 6: ASSESSMENT CRITERIA

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

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

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

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

DURATION (D)
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

APPENDIX 7: ENVIRONMENTAL MANAGEMENT PLAN FOR THE WEF

Environmental Management Programme: WEF

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Mortality due to collisions with the turbines					
Mortality of priority avifauna due to collisions with the wind turbines	Prevent mortality of priority avifauna	The results of the pre-construction monitoring must guide the lay-out of the turbines, especially as far as proposed no-turbine zones are concerned. No turbines must be constructed in the buffer zones which were identified based on the results of the pre-construction monitoring, with a specific view to limiting the risk of collisions to a variety of birds, including several Red Data species.	1. Design the facility with 200m buffers around dams and water troughs, and 150m buffers around major drainage lines.	Once-off during the planning phase.	Project Developer
Avifauna: Mortality due to electrocution					
Electrocution of raptors on the internal 33kV poles	Prevent electrocutions	1. Use underground cabling as much as is practically possible. 2. Where the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformers.	1. Design the facility with underground cabling. 2. Consult with Avifaunal Specialist during the design phase of the overhead lines.	Once-off during the planning phase.	Project Developer

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of priority avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation and rehabilitation of the footprint.	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO
Avifauna: Displacement due to habitat transformation					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the wind turbines and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	1. Develop a Habitat Restoration Plan (HRP) and ensure that it is approved. 2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance. 3. Vehicle and pedestrian access to the site should be controlled and restricted to the facility footprint as much as possible to prevent unnecessary destruction of vegetation.	1. Appointment of rehabilitation specialist to develop Habitat Restoration Plan (HRP). 2. Site inspections to monitor progress of HRP.	1. Once-off 2. Once a year	1. Operations Manager 2. SHE Manager 3. SHE Manager 4. Operations Manager

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Mortality due to collisions with the wind turbines					
Bird collisions with the wind turbines	Prevention of collision mortality on the wind turbines.	1. Formal live-bird monitoring and carcass searches should be implemented at the start of the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al*. 2015) to assess collision rates. The exact time when operational monitoring should commence, will depend on the construction schedule, and should commence when the first turbines start operating. The Best Practice Guidelines require that, as an absolute minimum, operational monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated again in year 5, and again every five years thereafter for the operational lifetime of the facility. 2. If estimated annual collision rates indicate unacceptable mortality levels of priority species, i.e if it exceeds mortality thresholds as determined by the avifaunal specialist in consultation with BLSA and other avifaunal specialists, additional measures will have to be implemented which could include shut down on demand or other proven measures.	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. Design and implement mitigation measures if mortality thresholds are exceeded. 4. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.	1. Once-off 2. Years 1,2, 5 and every five years after that for the duration of the operational lifetime of the facility.	1. Operations Manager 2. Operations Manager 3. Operations Manager 4. Operations Manager
Avifauna: Mortality due to collisions and electrocutions on the 33kV network					
Bird electrocutions on the overhead sections of the internal 33kV cables	Prevention of electrocution mortality on the overhead sections of the 33kV internal cable network.	1. Conduct regular inspections of the overhead sections of the internal reticulation network to look for carcasses.	1. Carcass searchers under the supervision of the Avifaunal Specialist. 2. Design and implement mitigation measures if mortality thresholds are exceeded. 3. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.	1. At least once every two months.	1. Operations Manager

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance associated with the dismantling activities					
The noise and movement associated with the de-commissioning activities at the WEF footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the EMPr.	A site-specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction. The EMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the footprint area is demarcated and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

APPENDIX 8: ENVIRONMENTAL MANAGEMENT PLAN FOR THE GRID CONNECTION

Management Plan for the Planning and Design Phase Grid Connection

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
None					

Management Plan for the Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads, where possible; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Mortality due to collision with the 132kV OHL					
Mortality of avifauna due to collisions with the 132kV OHL.	Reduction of avian collision mortality	Mark the OHL with Eskom approved Bird Flight Diverters (BFDs) according to the latest Eskom standard.	1. Fit Eskom approved Bird Flight Diverters on the earthwire of all the spans.	1. Once-off 2. Once-off	1. Contractor 2. Contractor and ECO

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to habitat transformation in the substations					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance in the onsite substations.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented where possible by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	1. Develop a Habitat Restoration Plan (HRP) and ensure that it is approved. 2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.	1. Appointment of rehabilitation specialist to develop HRP. 2. Site inspections to monitor progress of HRP. 3. Adaptive management to ensure HRP goals are met.	1. Once-off 2. Once a year 3. As and when required	5. Facility operator
Avifauna: Mortality of avifauna due to electrocution in the substations					
Mortality of avifauna due to electrocutions in the substations	Reduction of avian electrocution mortality	1. Monitor the electrocution mortality in the substations. 2. Apply mitigation if electrocution happens regularly .	1. Regular inspections of the substation yard	1. Weekly	1. Facility operator

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance					
The noise and movement associated with the decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Decommissioning EMPr.	A site-specific Decommissioning EMPr (EMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during decommissioning. The EMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that decommissioning personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

APPENDIX 9: OPERATIONAL MONITORING PLAN WEF

1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed WEF must be conducted in accordance with the latest version (2015) of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy facilities in southern Africa* (Jenkins *et al*. 2015)[10].

2 AIM OF POST-CONSTRUCTION MONITORING

The avifaunal post construction monitoring aims to assess the impact of the WEF by comparing pre- and post-construction monitoring data and to measure the extent of bird fatalities caused by the WEF. Post-construction monitoring is therefore necessary to:

- Confirm as far as possible what the actual impacts of the WEF are on avifauna; and
- Determine what mitigation is required if need be (adaptive management).

The proposed post-construction monitoring can be divided into three categories:

- Habitat classification;
- Quantifying bird numbers and movements (replicating baseline pre-construction monitoring)
- Quantifying bird mortalities.

Post-construction monitoring will aim to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- How many birds collide with the turbines? And are there any patterns to this?
- What mitigation is necessary to reduce the impacts on avifauna?

3 TIMING

Post-construction monitoring should commence as soon as possible after the first turbines become operational to ensure that the immediate effects of the facility on resident and passing birds are recorded,

[10] Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy facilities in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

before they have time to adjust or habituate to the development. However, it should be borne in mind that it is also important to obtain an understanding of the impacts of the facility as they would be over the lifespan of the facility. Over time the habitat within the WEF may change, birds may become habituated to, or learn to avoid the facility. It is therefore necessary to monitor over a longer period than just an initial one year.

4 DURATION

Monitoring should take place in Year 1 and 2 of the operational phase, and then repeated in Year 5 and every five years after that. After the first year of monitoring, the programme should be reviewed in order to incorporate significant findings that have emerged. This may entail the revision of the number of turbines to be searched, and the size of the search plots, depending on the outcome of the first year of monitoring. If significant impacts are observed, i.e. exceeding predetermined thresholds, and mitigation is required, the matter should be taken up with the operator to discuss potential mitigation. In such instances the scope of monitoring could be reduced to focus only on the impacts of concern.

5 HABITAT CLASSIFICATION

Any observed changes in bird numbers and movements at a WEF may be linked to changes in the available habitat. The avian habitats available must be inspected at least once a year (at the same time every year), using the same methods which were used during pre-construction.

6 BIRD NUMBERS AND MOVEMENTS

In order to determine if there are any impacts relating to displacement and/or disturbance, all methods used to estimate bird numbers and movements during baseline monitoring must be applied as far as is practically possible in the same way to post-construction work in order to ensure maximum comparability of these two data sets. This includes sample counts of small terrestrial species, counts of large terrestrial species and raptors, focal site surveys and vantage point surveys according to the current best practice.

7 COLLISIONS

The collision monitoring must have three components:

- Experimental assessment of search efficiency and scavenging rates of bird carcasses on the site.
- Regular searches in the immediate vicinity of the wind farm turbines for collision casualties.
- Estimation of collision rates.

8 SEARCHER EFFICIENCY AND SCAVENGER REMOVAL

The value of surveying the area for collision victims is only valid if some measure of the accuracy of the survey method is developed. The probability of a carcass being detected and the rate of removal/decay of the carcass must be accounted for when estimating collision rates and when designing the monitoring protocol. This must be done in the form of searcher and scavenger trails at least twice a year.

9 COLLISION VICTIM SURVEYS

9.1 Aligning search protocols

The search protocol must be agreed upon between the bat and bird specialists to constitute an acceptable compromise between the current best practice guidelines for bird and bat monitoring.

Searches must begin as early in the mornings as possible to reduce carcass removal by scavengers. A carcass searcher must walk in straight line transects, 6 m apart, covering 3 m on each side. A team of searchers and one supervisor must be trained to implement the carcass searches. The searchers must have a vehicle available for transport per site. The supervisor must assist with the collation of the data at each site and to provide the data to the specialist in electronic format on a weekly basis. The specialists must ensure that the supervisor is completely familiar with all the procedures concerning the management of the data. The following must be stored on a cloud-based server on a weekly basis:

- Carcass fatality data (hardcopy scans as well as data entered into Excel spreadsheets);
- Pictures of any carcasses, properly labelled;
- GPS tracks of the search plots walked; and
- Turbine search interval spreadsheets.

When a carcass is found, it must be bagged, labelled and kept refrigerated for species confirmation when the specialist visits the site.

9.2 Estimation of collision rates

Observed mortality rates need to be adjusted to account for searcher efficiency and scavenger removal. There have been many different formulas proposed to estimate mortality rates. The available methodologies must be investigated, and an appropriate method will be applied. The current method which is used widely is the GenEst method.

10 DELIVERABLES

10.1 Annual report

An operational monitoring report must be completed at the end of each year of operational monitoring. As a minimum, the report must attempt to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number birds and species composition changed?
- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- What are the likely drivers of any changes observed?
- How many, and which species of birds collided with the turbines and
- associated infrastructure? And are there any patterns to this?
- What is the significance of any impacts observed?
- What mitigation measures are required to reduce the impacts?

10.2 Quarterly reports

Concise quarterly reports must be provided by the Avifaunal Specialist to the wind farm operator with basic statistics and any issues that need to be addressed.

APPENDIX 10: SITE SENSITIVITY VERIFICATION WEF

RECOINASSANCE REPORT (IN TERMS OF PART B OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

1. INTRODUCTION

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a reconnaissance visit has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

2. SITE SENSITIVITY VERIFICATION

The following methods and sources were used to compile this report:

- The primary area of impact (PAOI) of the proposed WEF was assumed to extent to a 1km area around the perimeter of the outer most turbines.
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), as a means to ascertain which species occurs within the broader area i.e. within a block consisting of 15 pentads. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 82 full protocol lists (i.e. surveys lasting a minimum of two hours each) have been completed for this area. In addition, 97 ad hoc protocol lists (i.e. surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF application site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2022) was used in order to view the broader area on a landscape

level and to help identify sensitive bird habitat.

- Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the project area of impact (PAOI).
- Information gained from pre-construction monitoring at two potential wind farm sites in close proximity to the current site, namely Pienaarspoort WEF 1 and 2 assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of a pre-construction programme conducted over four seasons at the proposed Karee WEF application site. The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings

3. OUTCOME OF SITE RECOINASSANCE

3.1 Natural environment

The PAOI is located on the border of the Succulent Karoo and Fynbos Biomes. The northern part of the PAOI is located in the Tankwa Karoo, which is one of most arid vegetation units of the Succulent Karoo biome. The plains are very sparsely vegetated with low succulent shrubland, in extreme precipitation-poor years appearing barren, while the slopes of the koppies and adjacent mountains support well-developed medium-tall succulent shrubland. Annual flora becomes conspicuous with sufficient precipitation, while geophytes and grasses play a subordinate role (Mucina & Rutherford 2006). The southern part of the PAOI is very mountainous and is located in the Fynbos Biome. The primary vegetation types are Quartzite Fynbos and Shale Renosterveld. Quartzite Fynbos is a medium dense, medium tall shrubland, structurally classified mainly as asteraceous and proteoid fynbos, although restioid fynbos is also present. Shale Renosterveld is characterised by low, open to medium dense, leptophyllous shrubland with a medium dense matrix of short, divaricate shrubs, dominated by renosterbos (Mucina & Rutherford 2006).

The developments site is located in a winter-rainfall regime: most of the precipitation falls between May and August, while December and January are virtually precipitation-free. The Tankwa Karoo region has high spatial variability of precipitation, with some rain shadows experiencing as little as 40 mm of rainfall per year (in extremely dry years). Mean annual precipitation varies from a low of 72 mm to 122 mm. Mean annual temperature is slightly above 17°C, but in winter the temperature can often fall below the frost mark (15 days in a year). Mean maximum and minimum monthly temperatures of 35.9°C and 5.64°C occur in January and July, respectively (Mucina & Rutherford 2006). The southern part of the PAOI which is located in the Fynbos

Biome experiences more rainfall with less severe temperature variation. Mean annual precipitation is in the vicinity of 150–470 mm (mean: 300 mm), peaking slightly from May to August. Mean daily maximum and minimum temperatures are around 27.4°C and 2.4°C for February and July, respectively. Frost occurs 10–40 days per year.

3.2 Modified environment

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

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

- **Water points:** The land use in the broader area is mostly small stock and game farming. The entire area is divided into grazing camps, with associated boreholes and drinking troughs. In this arid environment, open water is a big draw card for birds which use the open water troughs to bath and drink.
- **Dams:** The PAOI contains a few ground dams located in drainage lines. When these dams fill up after good rains, they contain standing surface water for several months, which attracts birds to bath and drink.
- **Transmission lines:** The Bacchus - Droërivier 1 400kV and Kappa – Muldersvlei 1 400kV transmission lines are located along the north-western boundary of the PAOI. The transmission towers are used by raptors for perching and roosting, and for breeding. A Martial Eagle nest is present on tower 642 of the Droerivier - Kappa 1 transmission line, 8km north-east from the closest proposed turbine location, and approximately 7km from the closest border of the proposed PAOI (see Appendix 3). The nest has been inactive for the last three years, but it has been occupied by Lanner Falcons on occasion.

According to the DFFE national screening tool, the habitat within the PAOI is classified as **Low** and **Medium** sensitivity for birds according to the Avian Wind theme. The Medium classification according to the Wind theme is linked to the presence of a powerline of ≥ 132kV within 5km with the associate which is likely to attract sensitive raptors into the area.

3.3 DFFE Screening Tool

The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during the integrated pre-construction monitoring programme, with observations of Ludwig’s Bustard, Southern Black Korhaan, Karoo Korhaan and Verreaux’s Eagle recorded within the PAOI and its immediate surrounds. Based on the field surveys to date, a classification of **High** sensitivity for avifauna in the screening tool is therefore appropriate.

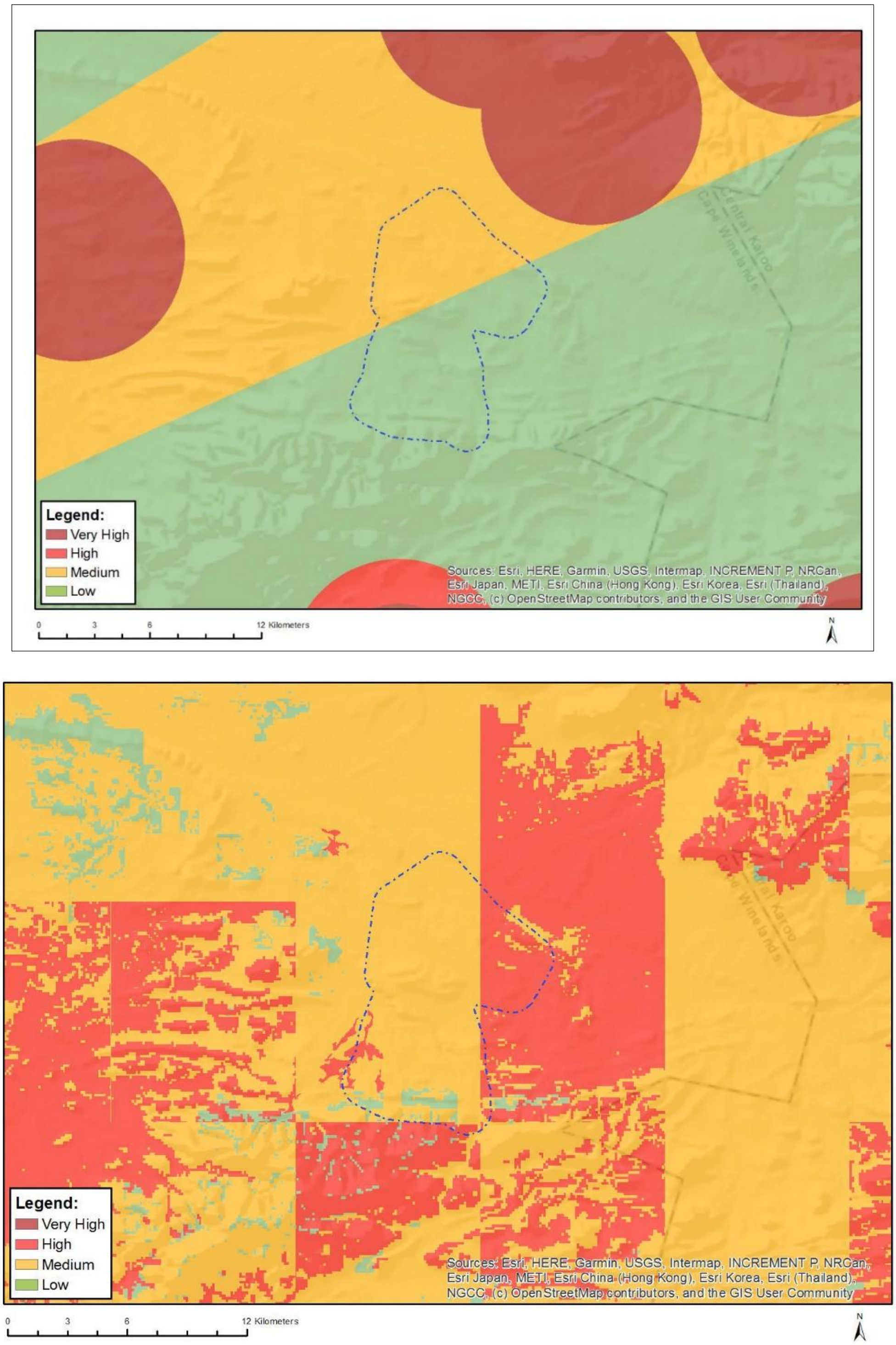


Figure 1: The classification of the PAOI according to the avian theme for wind developments (top) and the terrestrial animal species theme (bottom) in the DFFE National Screening Tool.

4. CONCLUSION

The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during surveys, with observations of Ludwig's Bustard, Southern Black Korhaan and Karoo Korhaan Eagle recorded within the PAOI and its immediate surrounds. The classification of High sensitivity is therefore suggested.

APPENDIX 11: SITE SENSITIVITY VERIFICATION GRID CONNECTION

SITE SENSITIVITY VERIFICATION REPORT (IN TERMS OF THE PROCEDURES FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING ON IDENTIFIED ENVIRONMENTAL THEMES PUBLISHED IN GN 1150 ON 30 OCTOBER 2020)

1. INTRODUCTION

In accordance with the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site verification visit has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

2. SITE SENSITIVITY VERIFICATION

The following methods and sources were used to compile this report:

- The primary area of impact (PAOI) of the proposed 132kV grid was defined as 1km area around the proposed alignments.
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), as a means to ascertain which species occurs within the broader area i.e. within a block consisting of 15 pentads (see Table 1). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 82 full protocol lists (i.e. surveys lasting a minimum of two hours each) have been completed for this area. In addition, 97 ad hoc protocol lists (i.e. surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor et al. 2015), and the latest authoritative summary of southern African bird biology (Hockey et al. 2005).
- The global threatened status of all priority species was determined by consulting the (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF application site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison et al. 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick et al. 2015) was consulted for information on

potentially relevant Important Bird Areas (IBAs).

- Satellite imagery (Google Earth ©2022) was used in order to view the broader area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the project area of impact (PAOI).
- Information gained from pre-construction monitoring at two potential wind farm sites in close proximity to the current site, namely Pienaarspoort WEF 1 and 2 assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of a pre-construction programme conducted over four seasons at the proposed Patatskloof WEF application site. The data gathered during these surveys was also relevant and applicable to the grid connection.

3. OUTCOME OF SITE SENSITIVITY VERIFICATION

3.1 Natural environment

The PAOI is located on the border of the Succulent Karoo and Fynbos Biomes. The northern part of the PAOI is located in the Tankwa Karoo, which is one of most arid vegetation units of the Succulent Karoo biome. The plains are very sparsely vegetated with low succulent shrubland, in extreme precipitation-poor years appearing barren, while the slopes of the koppies and adjacent mountains support well-developed medium-tall succulent shrubland. Annual flora becomes conspicuous with sufficient precipitation, while geophytes and grasses play a subordinate role (Mucina & Rutherford 2006). The southern part of the PAOI is very mountainous and is located in the Fynbos Biome. The primary vegetation types are Quartzite Fynbos and Shale Renosterveld. Quartzite Fynbos is a medium dense, medium tall shrubland, structurally classified mainly as asteraceous and proteoid fynbos, although restioid fynbos is also present. Shale Renosterveld is characterised by low, open to medium dense, leptophyllous shrubland with a medium dense matrix of short, divaricate shrubs, dominated by renosterbos (Mucina & Rutherford 2006).

The developments site is located in a winter-rainfall regime: most of the precipitation falls between May and August, while December and January are virtually precipitation-free. The Tankwa Karoo region has high spatial variability of precipitation, with some rain shadows experiencing as little as 40 mm of rainfall per year (in extremely dry years). Mean annual precipitation varies from a low of 72 mm to 122 mm. Mean annual temperature is slightly above 17°C, but in winter the temperature can often fall below the frost mark (15 days in a year). Mean maximum and minimum monthly temperatures of 35.9°C and 5.64°C occur in January and

July, respectively (Mucina & Rutherford 2006). The southern part of the PAOI which is located in the Fynbos Biome experiences more rainfall with less severe temperature variation. Mean annual precipitation is in the vicinity of 150–470 mm (mean: 300 mm), peaking slightly from May to August. Mean daily maximum and minimum temperatures are around 27.4°C and 2.4°C for February and July, respectively. Frost occurs 10–40 days per year.

3.2 Modified environment

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

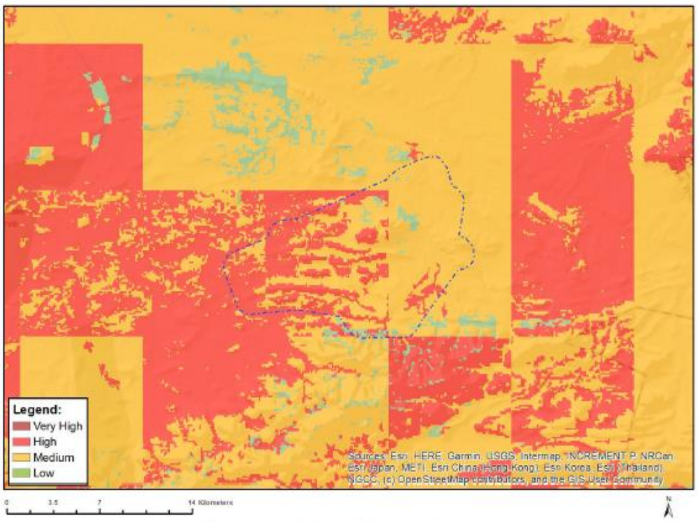
The following avifaunal-relevant anthropogenic habitat modifications were recorded within the PAOI and broader area:

- **Water points:** The land use in the broader area is mostly small stock and game farming. The entire area is divided into grazing camps, with associated boreholes and drinking troughs. In this arid environment, open water is a big draw card for birds which use the open water troughs to bath and drink.
- **Dams:** The PAOI contains a few ground dams located in drainage lines. When these dams fill up after good rains, they contain standing surface water for several months, which attracts birds to bath and drink.
- **Transmission lines:** The PAOI is bisected by the Bacchus - Droërivier 1 400kV high voltage line, and the Kappa – Muldersvlei 1 400kV high voltage line runs approximately 2.5km north of the PAOI. The transmission towers are used by raptors for perching and roosting, and also for breeding. A Martial Eagle nest is present tower 26 of the Kappa – Muldersvlei 1 transmission line approximately 2.8km from the closest border of the proposed PAOI (see Appendix 3). The nest has been inactive for the last three years, but it has been occupied by Lanner Falcons on occasion.

3.3 DFFE Screening Tool

According to the DFFE national screening tool, the habitat within the PAOI is classified as **High** and **Medium** according to the Terrestrial Animal Species theme. The classification of **High** in the Terrestrial Animal Species theme is linked to the potential presence of species of conservation concern (SCC), namely Southern Black Korhaan *Afrotis afra* (Globally and Regionally Vulnerable), Lanner Falcon *Falco biarmicus,* and Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable), and the classification of **Medium** is linked to the potential presence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Falco biarmicus
High	Aves-Aquila verreauxii
High	Aves-Neotis ludwigii
High	Aves-Afrotis afra
High	Mammalia-Bunolagus monticularis
Low	Subject to confirmation
Medium	Aves-Neotis ludwigii
Medium	Aves-Afrotis afra
Medium	Aves-Aquila verreauxii
Medium	Mammalia-Bunolagus monticularis

Figure 1: The National Web-Based Environmental Screening Tool map of the application site, indicating sensitivities for the Terrestrial Animal Species theme. The medium and high sensitivity classification is linked to the potential occurrence of Lanner Falcon *Falco biarmicus*, Ludwig's Bustard *Neotis ludwigii,* Southern Black Korhaan *Afrotis afra*, and Verreaux's Eagle Aquila verreauxii (Regionally Vulnerable).

4. CONCLUSION

The PAOI contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during surveys, with observations of Ludwig's Bustard, Southern Black Korhaan and Karoo Korhaan Eagle recorded within the PAOI and its immediate surrounds. The classification of High sensitivity is therefore suggested.