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

Scoping and Environmental Impact Assessment for the proposed Pofadder Wind Energy Facility 3 Northern Cape Province: Avifaunal Assessment

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.

2. SPECIALIST INFORMATION

Specialist Company Name:	Afrimage Photography (Pty) Ltd t/a Chris van Rooyen Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4		
Specialist name:	Chris van Rooyen			
Specialist Qualifications:	BA LLB			
Professional affiliation/registration:	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.			
Physical address:	6 Pladda Drive, Plettenberg Bay, 2122			
Postal address:	P.O. Box 2676, Fourways			
Postal code:	2055			
Telephone:	0824549570			
E-mail:	Vanrooyen.chris@gmail.com			

3. DECLARATION BY THE SPECIALIST

I, Chris 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

Chris van Rooyen Consulting

Name of Company:

18 March 2022

Date

4. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Chris 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

Name of Company

18 March 2022

Date

Signature of the Commissioner of Oaths

Date

SOUTH AFRICAN POLICE SERVICE
PLETTENBERG BAY
2022 -03- 18
PLETTENBERGBAAI
SUID-AFRIKAANSE POLISIEDIENS

AVIFAUNAL IMPACT STUDY: SCOPING PHASE

Pofadder Wind Energy Facility 3
Northern Cape Province

February 2022

AFRIMAGE Photography (Pty) Ltd t/a:
Chris van Rooyen Consulting
VAT#: 4580238113
email: vanrooyen.chris@gmail.com
Tel: +27 (0)82 4549570 cell

EXECUTIVE SUMMARY

The applicant Pofadder Wind Energy Facility 1 (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 20km south-east of Pofadder within the Kai !Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Pofadder Wind Energy Facility 1 and Pofadder Wind Energy Facility 2.

A preferred project site with an extent of 24 000ha has been identified as a technically suitable area for the development of the three WEF projects. It is proposed that each WEF will comprise of up to 30 turbines with a combined contracted capacity of up to 200MW per WEF.

The project site comprises the following farm portions:

- The Farm Ganna-Poort 202;
- The Farm Lovedale 201; and
- Portion 3 of the Farm Sand Gat 150.

This report deals with the Pofadder Wind Energy Facility 3 (Pofadder WEF 3)

Summarised scoping level assessment of the anticipated impacts are listed in the table below:

AVIFAUNA

The SABAP 2 data indicates that a total of 96 bird species could potentially occur within the broader area. Of these, 18 species are classified as priority species and 11 of these are South African Red List species. Based on the SABAP 2 reporting rates of the species, the habitat at the development area and the species recorded thus far at the site during the surveys, it is estimated that 15 of the priority species occurring in the broader area, have a medium to high chance of occurring regularly in the development area

POTENTIAL IMPACTS

The following potential impacts on avifauna have been identified:

- 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 collisions with the wind turbines
- Mortality due to electrocution on the medium voltage overhead lines
- Mortality due to collisions with the medium voltage overhead lines

<u>Displacement due to disturbance during construction and operation of the wind farm</u>

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. Relative to this assessment, species which fall in this category are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Burchell's Courser, Double-banded Courser, Spotted Eagle-Owl, Sclater's Lark and Red Lark. Some raptors might also be affected, e.g. 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.

Displacement due to habitat change and loss at the wind farm

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, Kori Bustard, Northern Black Korhaan and Karoo Korhaan. Red Lark and Sclater’s Lark could also potentially be impacted. However, given the expected 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 development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the physical footprint. In summary, the following species are likely to be most affected by habitat transformation: Karoo Korhaan, Northern Black Korhaan, Kori Bustard, Ludwig's Bustard, Sclater’s Lark and Red Lark.

Mortality due to collisions with the wind turbines

The proposed WEF will pose a potential collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e. Ludwig’s Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan. Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Booted Eagle, Verreaux’s Eagle, Greater Kestrel, White-backed Vulture and Lappet-faced Vulture. The high voltage powerline to the south of the project site is a focal point for vulture flight activity. No vultures were recorded during surveys in June and October 2021, all the flight activity was recorded during the third survey in February 2022. Indications are that this could a regular pattern, based on experiences at other proposed wind farms in the Northern Cape. The passage rate during the February 2022 survey was 0.3 birds/hour, or just under 4 birds per day. This points to a regular occurrence of vultures, but only during a specific time period, namely the non-breeding season from January to May, with an expected peak in February-March. All the flight activity that has been recorded to date was within 2km of the powerline roost, coming no closer than about 500m from a planned turbine position. Red Larks could also potentially be at risk during display flights. In summary, the following priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture, Burchell’s Courser, Double-banded Courser, Red Lark and Sclater’s Lark.

Mortality due to electrocution on the medium voltage overhead lines

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Raptors and vultures could use these poles as perches. As far as the medium voltage powerlines are concerned, the potential electrocution risk to raptors could be eliminated by using a bird-friendly pole design. Species most at risk of electrocution on the medium voltage network are Greater Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, Lappet-faced Vulture and White-backed Vulture.

Mortality due to collisions with the medium voltage overhead lines

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Likely priority species candidates for collision mortality on the proposed medium voltage internal overhead powerlines are Ludwig’s Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan and to a lesser extent White-backed Vulture and Lappet-faced Vulture.

AVIFAUNAL SENSITIVITIES

The specific avifaunal sensitivities that have been identified at the project site are discussed below.

Very high sensitivity zones

The very high sensitivity zones are listed below. The construction of all infrastructure in these zones should be avoided completely:

- 500m buffer zone around water troughs to prevent the displacement of Sclater's Larks due to disturbance and habitat transformation, and to reduce the risk of turbine collisions for priority species using the water troughs for drinking and bathing. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine.
- Should any priority species nests be discovered during pre-construction monitoring, it will have to be buffered appropriately to prevent displacement of the breeding birds through disturbance, and collisions with turbines.

High sensitivity zones

The high sensitivity zones are listed below. The construction of turbines in these zones should be avoided to eliminate the risk of turbine collisions. Other infrastructure is permitted:

- 2km no-turbine buffer around the seasonal vulture roost on the Aries-Aggeneys 400kV transmission line running through the south of the project site.

Medium sensitivity zones

The medium sensitivity zones are listed below. The construction of turbines in these zones should be restricted to a minimum to reduce the risk of turbine collisions. If restriction is not possible, additional mitigation measures will be required, e.g. increasing cut in speeds or shutdown on demand:

- Highly suitable Red Lark habitat: Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.
- Based on the results of the pre-construction monitoring, a medium risk zone will be delineated where most of the vulture flight activity beyond the 2km turbine exclusion zone is concentrated. If turbines in this medium-risk zone cannot be avoided, pro-active mitigation must be implemented at these turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation. This could include measures such as shutdown on demand during the non-breeding season, a carcass removal programme, and/or other proven measures.

Figure (i) below is a sensitivity map, indicating very high, high sensitivity and medium sensitivity areas identified to date. **This map is subject to refinement based on data to be collected in the field during the pre-construction monitoring.**

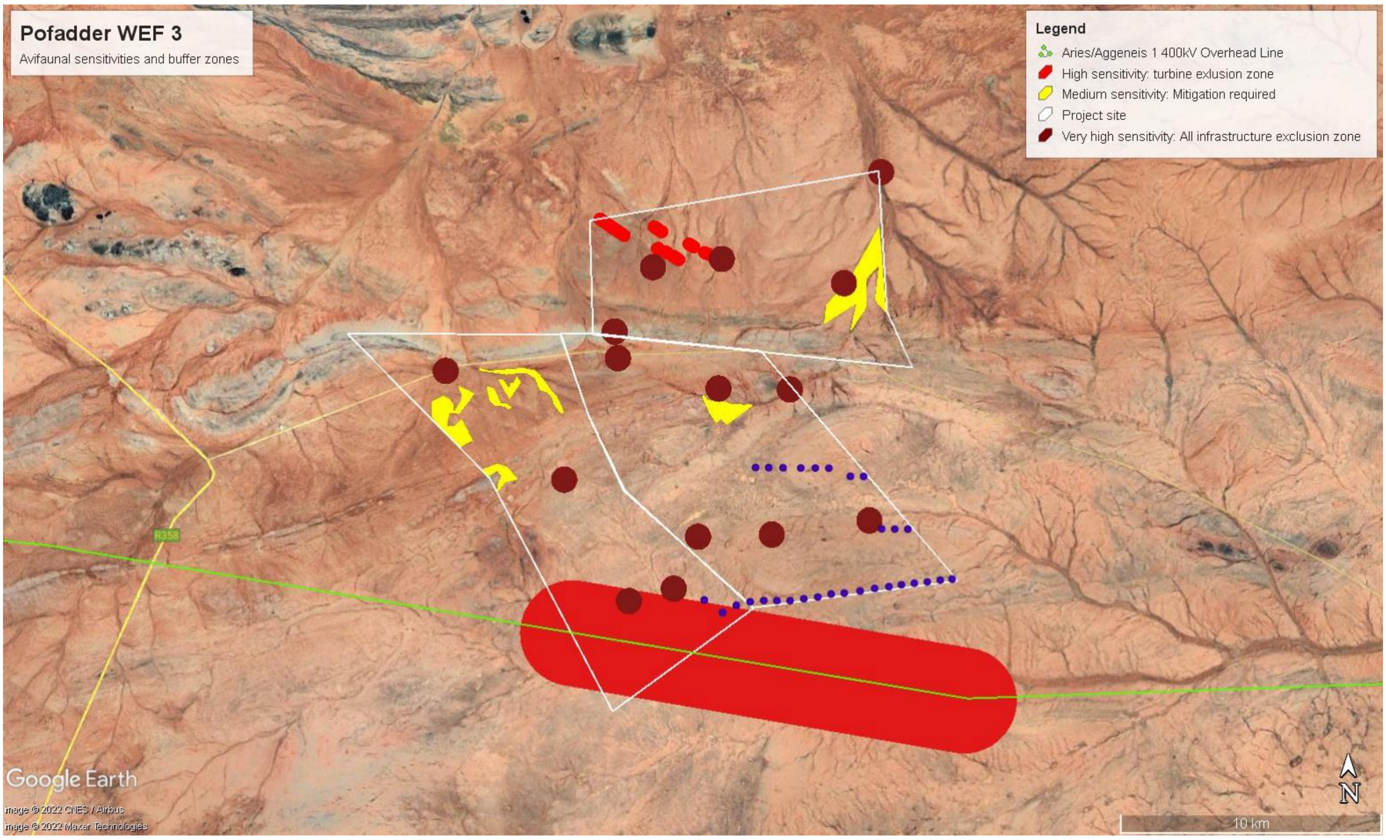


Figure (i): **Avifaunal sensitivities within the project site and Pofadder WEF 3 development area. The purple dots represent the conceptual lay-out of the turbines.**

PRELIMINARY IMPACT ASSESSMENT

A summary of the anticipated impacts associated with the proposed Pofadder WEF 3 development, based on a preliminary assessment of the species and habitat information, is detailed in **Table 3** in the report.

PRELIMINARY CONCLUSIONS

Based on the pre-construction monitoring to date, it is envisaged that the proposed 200MW Pofadder WEF 3 could potentially have a range of pre-mitigation negative impacts on priority avifauna ranging from low to high, all of which could be reduced to acceptable levels with appropriate mitigation. The conclusions and proposed mitigation measures in this report are subject to the completion of the current pre-construction monitoring at the project site. No fatal flaws are expected to be discovered during the remaining investigations.

CONTENTS

DETAILS OF THE SPECIALIST

Chris van Rooyen (Bird Specialist)

Chris has 22 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Bird and GIS Specialist)

Albert has an M. Sc. in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and he is currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Megan Diamond (Bird Specialist)

Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in the environmental sector for 20 years. She has 16 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 140 projects. Megan currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Powerline Network (2013-2015). She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

SPECIALIST DECLARATION

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Savannah Environmental was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Impact Assessment process for the proposed Pofadder Wind Energy Facility 1 project.

Full Name: Chris van Rooyen
Position: Director

1. INTRODUCTION

The applicant Pofadder Wind Energy Facility 1 (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 20km south-east of Pofadder within the Kai !Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Pofadder Wind Energy Facility 1 and Pofadder Wind Energy Facility 3.

A preferred project site with an extent of 24 000ha has been identified as a technically suitable area for the development of the three WEF projects. It is proposed that each WEF will comprise of up to 30 turbines with a combined contracted capacity of up to 200MW per WEF.

The project site comprises the following farm portions:

- The Farm Ganna-Poort 202;
- The Farm Lovedale 201; and
- Portion 3 of the Farm Sand Gat 150.

This report deals with the Pofadder Wind Energy Facility 1 (Pofadder WEF 3).

The Pofadder WEF 3 is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Pofadder WEF 3 under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Pofadder WEF 3 set to inject up to 200MW into the national grid.

The Pofadder WEF 3 development area is proposed to accommodate the following infrastructure, which will enable this WEF to supply a contracted capacity of up to 200MW:

- Up to 30 wind turbines with a maximum hub height of up to 200m;
- A transformer at the base of each turbine;
- Concrete turbine foundations and turbine hardstands;
- Temporary laydown areas which will accommodate the boom erection, storage and assembly area;
- Cabling between the turbines, to be laid underground where practical;
- An on-site substation of up to 1.25ha in extent to facilitate the connection between the wind farm and the electricity grid;
- Access roads to the site and between project components inclusive of stormwater infrastructure. A 12m road corridor may be temporary impacted during construction and rehabilitated to 6m wide post construction.
- Pofadder WEF 3 will have a total road network of about 50 km.
- A temporary concrete batching plant; and
- Operation and Maintenance buildings including a gate house, security building, control centre, offices, warehouses, a workshop and visitors centre.

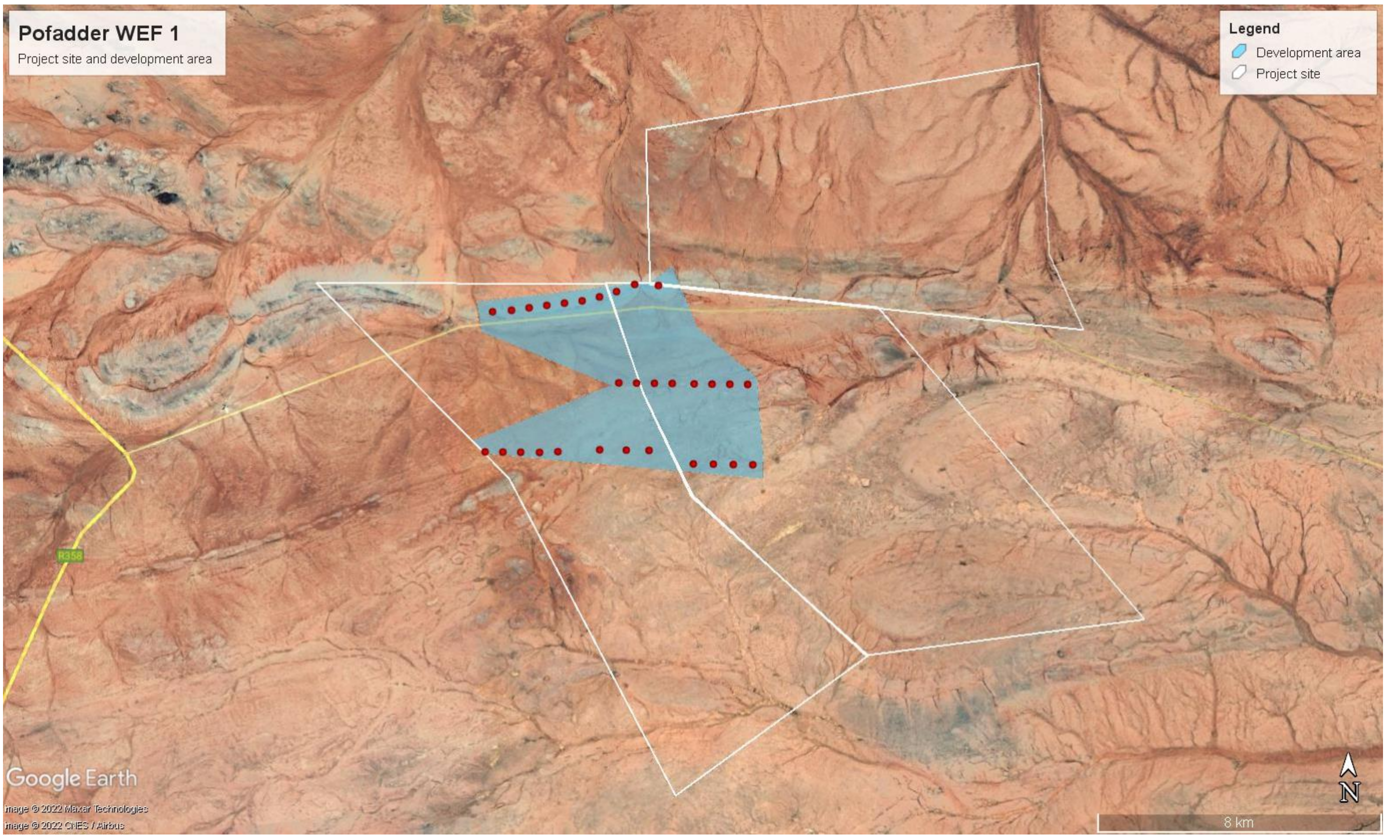


Figure 1: Close-up of proposed Pofadder WEF 3 project site and development area. The red dots represent the conceptual turbine layout.

In order to evacuate the energy generated by the three WEFs to supplement the national grid, Pofadder Grid (Pty) Ltd is proposing two grid connection alternatives which will be **assessed in a separate Integrated Grid Basic Assessment Report:**

- Alternative 1: A ~ 50 km 132kV overhead powerline within a 300m assessment corridor (150m on either side) from the Switching Station on site to the proposed Korana Main Transmission Substation (MTS).
- Alternative 2: A ~ 7 km 132kV overhead powerline within a 300m assessment corridor (150m on either side) from the Switching Station on site to a proposed new 400/132 kV MTS located south of the WEF and adjacent to the Aggeneis – Aries 400kV line. This MTS could serve as a back-up to the planned Korana MTS, in the event that Eskom encounters delays or development issues with that project.

Two additional WEFs are concurrently being considered on the properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Pofadder WEF 1 and Pofadder WEF 2. The EA applications for the three wind farm projects and gridline are being undertaken in parallel as they are co-dependent, i.e. one will not be developed without the other.

2 PROJECT SCOPE

The purpose of the Scoping Report is to determine the main issues and potential impacts of the proposed project/s during the scoping phase at a desktop level based on existing information and field assessments. The terms of reference are as follows:

- Describe the affected environment from an avifaunal perspective.
- Discuss gaps in baseline data and other limitations and describe the expected impacts associated with the wind farm and associated infrastructure.

- Identify potential sensitive environments and receptors that may be impacted on by the proposed wind farm and the types of impacts that are most likely to occur.
- Determine the nature and extent of potential impacts during the construction and operational phases.
- Identify 'No-Go' areas, where applicable.
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.
- Recommend mitigation measures to reduce the impact of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://SABAP 2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 17 pentads some of which intersect and others that are near the development area, henceforth referred to as "the broader area". The decision to include multiple pentads around the development area was influenced by the fact that many of the pentads in the area have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The 17 pentad grid cells are the following: 2910_1935, 2910_1940, 2910_1945, 2915_1915, 2915_1920, 2915_1925, 2915_1930, 2915_1935, 2915_1940, 2915_1945, 2920_1915, 2920_1920, 2920_1925, 2920_1930, 2920_1935, 2920_1940 and 2920_1945 (Figure 3). A total of 29 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 39 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 17 pentads where the development area is located. The SABAP 2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during on-site surveys conducted between 20-25 June 2020, three of four planned preconstruction monitoring surveys conducted to date between 10-17 June 2021, 15-19 October 2021 and 5 – 11 February 2022 respectively, in addition to general knowledge of the area.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- 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 national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho and Swaziland (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 latest (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- An intensive internet search was conducted to source information on the impacts of wind energy facilities on avifauna.
- Satellite imagery (Google Earth © 2021) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the development area relative to National Protected Areas.
- The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa (Solar and Wind SEA) was consulted to determine if the site falls within a Renewable Energy Development Zone (REDZ), and the level of avifaunal sensitivity assigned to the combined footprint of the site (CSIR 2015).
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the development area.
- The following sources were consulted to determine the investigation protocol that is required for the site:

- Protocol for the specialist assessment and minimum report content requirements for environmental impacts om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
  - 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 (Jenkins *et al*. 2015).
- The main source of information on the avifaunal diversity and abundance at the project site and development area is an integrated pre-construction monitoring programme which is currently being implemented at the project site, covering three proposed WEF projects - three of four surveys have been completed to date (Appendix 3).
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).

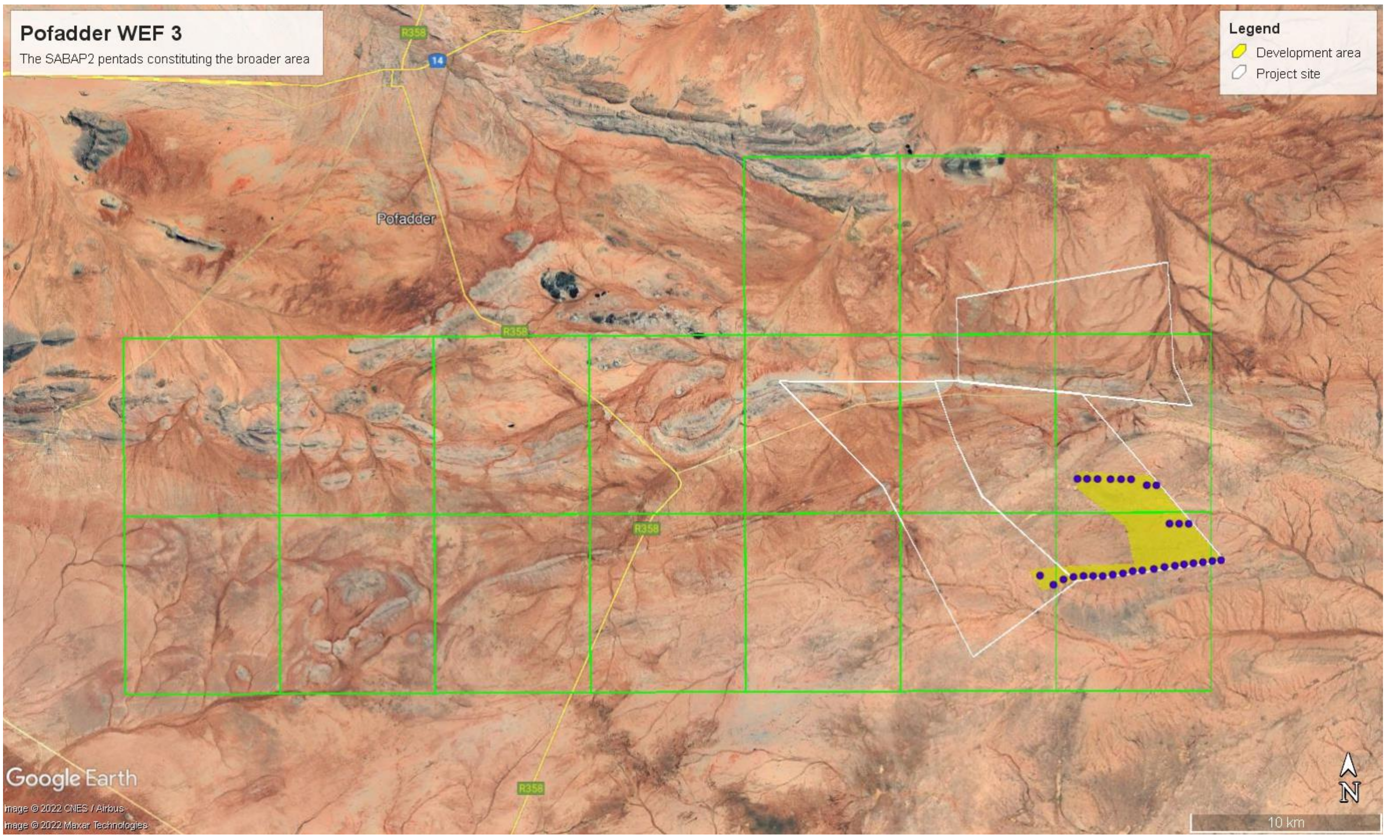


Figure 3: Area covered by the seventeen SABAP 2 pentads (broader area).

4 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 SABAP 2 dataset provides a reasonably accurate snapshot of the avifauna which could occur in the broader areas and at the proposed development area. Little data is available for the pentads within which the development area is located, therefore a broader area was chosen. Because of the relative uniformity of the habitat within the project site and broader area, this approach should still provide accurate estimates of the avifauna within the development area itself. The SABAP 2 data was supplemented with personal observations made during the initial site survey in June 2020, previous field surveys in the broader area, the results of the pre-construction monitoring which is currently being conducted at the project site, and general knowledge of the area.
- Conclusions in this scoping report 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. 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."
- The development area is that identified area (located within the project site) where the Pofadder WEF 3 is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The development area is ~2 425ha in extent.
- While every reasonable effort is made to assess all relevant high-risk features of the development area, the possibility of additional high-risk features being discovered during the final pre-construction monitoring season which is scheduled for March 2022, cannot be ruled out.

5 LEGISLATIVE CONTEXT

5.1 Agreements and conventions

The following agreements and conventions which South Africa is party to (Table 1) and which are relevant to the conservation of avifauna[1] as well as the pieces of legislation applicable to this assessment are described below.

Table 1: Agreements and conventions which are relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and	Global

[1] (BirdLife International (2021) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2021-09-20).

	international cooperation for the conservation and wise use of wetlands and their resources.	
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

5.2 National legislation

5.2.1 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.

5.2.2 The National Environmental Management Act 107 of 1998 (NEMA)

The National Environmental Management Act 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 a number of 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. 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.

5.2.3 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.

5.2.4 The National Environmental Management: Protected Areas Act 57 of 2003

The National Environmental Management: Protected Areas Act (No. 57 of 2003), as amended in 2014, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also provides for the establishment of a national register of all national, provincial and local protected areas that are managed in accordance with national norms and standards; and to endure intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are declared in order to regulate the area as a buffer zone for protection of a special nature reserve, world heritage site or nature reserve; to enable owners of land to take collective action to conserve biodiversity on their land and to seek legal recognition therefor; to protect the area if the area is sensitive to development due to its- (i) biological diversity; (ii) natural characteristics; (iii) scientific, cultural, historical, archaeological or geological value; (iv) scenic and landscape value; or (v) provision of environmental goods and services; to protect a specific ecosystem outside of a special nature reserve, world heritage site or nature reserve; to ensure that the use of natural resources in the area is sustainable. This Act explicitly states that no development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority.

5.2.5 The National Environmental Management Act 107 of 1998 (NEMA) Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and Avifaunal Species

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on terrestrial animal and/or avifaunal species for activities requiring environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for terrestrial animal species. The relevant terrestrial animal species data in the screening tool has been provided by the South African National Biodiversity Institute (SANBI).

5.3 Provincial Legislation

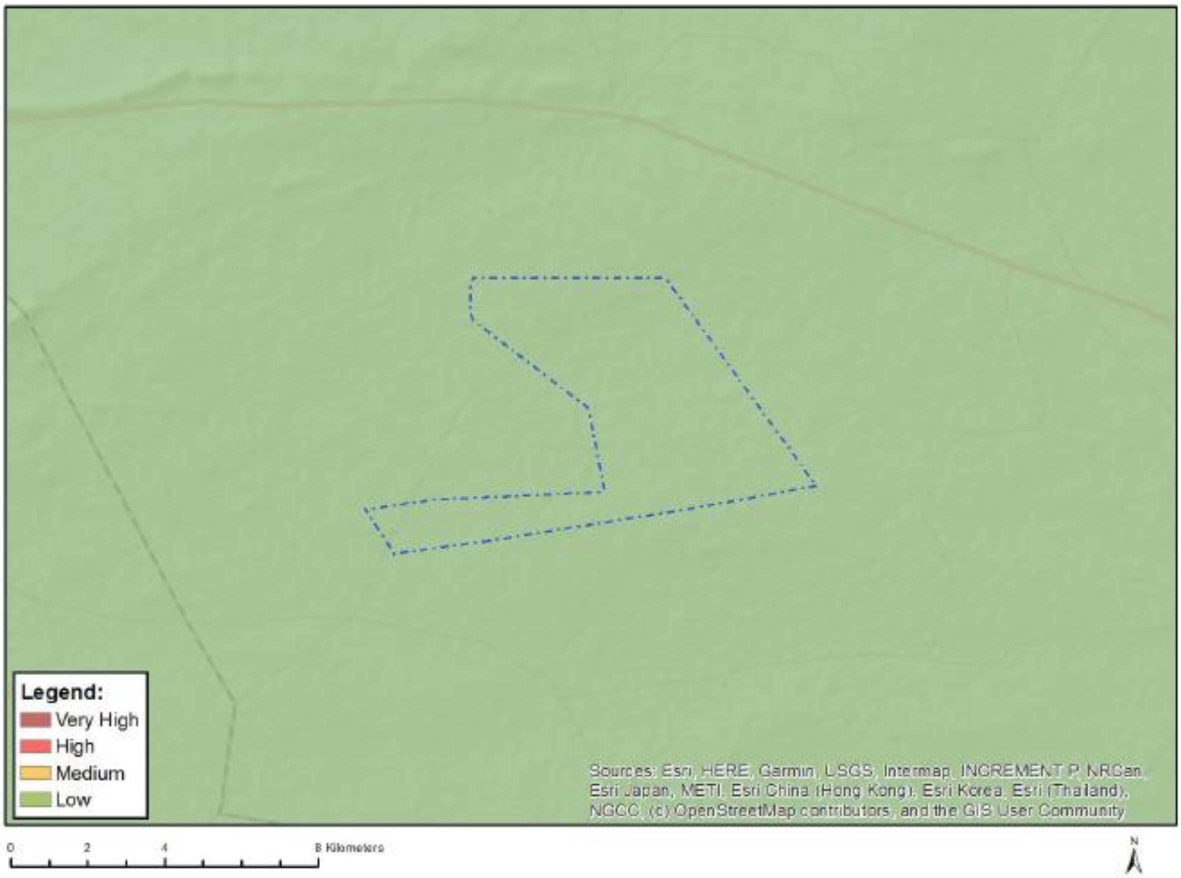
The current legislation applicable to the conservation of fauna and flora in the Northern Cape is the Northern Cape Nature Conservation Act No 9 of 2009. It provides for the sustainable utilisation of wild animals, aquatic biota and plants; the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; describes offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; provides for the issuing of permits and other authorisations; and provides for matters connected therewith.

6 BASELINE ASSESSMENT

6.1 DFFE National Screening Tool

According to the DFFE national screening tool, the habitat within the development area is classified as low sensitivity for birds from a wind development perspective (see Figure 2). This classification is not considered accurate as far as the proposed Pofadder WEF 3 is concerned, based on the habitat and species observations made during the field surveys to date. The classification should be **high sensitivity** according to the definition of High Sensitivity in the regulations, based on the presence of species of conservation concern (SCC) recorded during onsite surveys thus far, namely Ludwig's Bustard (SA status: Endangered). Furthermore the development area contains habitat for other SCCs which could potentially occur, namely Martial Eagle (SA status: Endangered), Lanner Falcon (SA status: Vulnerable), White-backed Vulture (SA status: Endangered), Lappet-faced Vulture (SA status: Endangered).

MAP OF RELATIVE AVIAN (WIND) THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Area Outside Sensitivities

Figure 2: DFFE Screening tool classification for the project site and development area.

6.2 Renewable Energy Development Zones (REDZ)

Renewable Energy Development Zones (REDZ) are defined as geographical areas where wind and solar photovoltaic power development can occur in concentrated areas. These areas support the responsible implementation of the Integrated Resource Plan (IRP 2019) through the creation of priority areas for renewable energy investment (CSIR, 2019). In order to provide a streamlined impact assessment process, proactive and robust Strategic Environmental Assessments (SEA) were completed for each of the REDZ, resulting in the identification of various environmental sensitivities within each of the zones. This ensures that the appropriate mitigation hierarchy is being followed to mitigate for any potential impacts.

The development area is not located in a REDZ and is therefore undergoing a full Environmental Impact Assessment (EIA) process.

6.3 Protected Areas

The project site and proposed development area do not fall within a formally protected area (Figure 3). The proposed wind energy facility is not expected to impact on the avifauna in the closest protected area, namely the Gamsberg Nature Reserve due to the distance from the nearest planned turbines (see Figure 3).

6.4 Important Bird Areas

An Important Bird Area (IBA), the Mattheus-Gat Conservation Area SA034 (Barnes 1998, Marnewick *et al.* 2015) (Figure 3) is situated approximately 12km north of the development area. This IBA is one of a few sites protecting both the globally threatened Red Lark, which inhabits the red sand dunes and sandy plains with a mixed grassy dwarf shrub cover, and the near-threatened Sclater's Lark, which occurs erratically on gravel plains. A Verreaux's Eagle nest is located just inside the border of the development area in the IBA, approximately 20km from the closest planned turbine.

The proposed wind energy facility is not expected to impact on the avifauna in the Mattheus-Gat Conservation Area due to the distance from the nearest planned turbines.

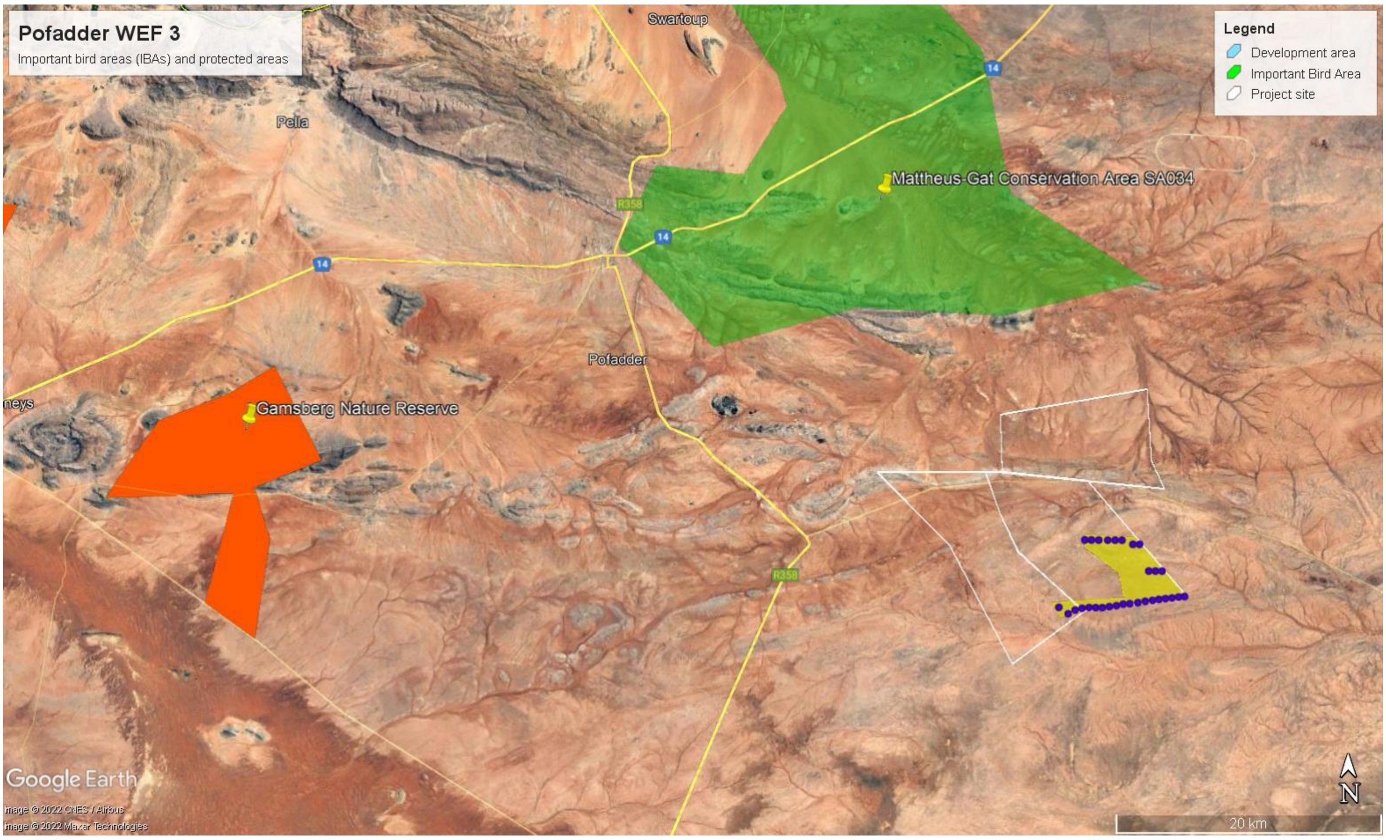


Figure 3: Regional map detailing the location of the proposed Pofadder WEF 3 in relation to Protected Areas and Important Bird Areas.

6.5 Biomes and vegetation types

The habitat in the project site is highly homogenous and consists of extensive sandy and gravel plains with low shrub and grass. Mucina & Rutherford (2006) classify the vegetation as Bushmanland Arid Grassland, which occurs on extensive to irregular plains on a slightly sloping plateau, sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semidesert 'steppe'. In places low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina

& Rutherford 2006). The southern half of the project site constitute mostly gravel plains, while the northern half of the project site constitutes mostly sandy plains. There are also extensive bare patches in places, which are devoid of vegetation. The land is used for sheep farming.

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data. Using this classification system, the natural vegetation in the project site is classified as Nama Karoo. Nama Karoo is dominated by low shrubs and grasses; peak rainfall occurs in summer from December to May. Trees, e.g. *Vachellia karroo* are mainly restricted to ephemeral watercourses, but in the project site, due to the extreme aridity, the ephemeral watercourses contain mostly small, stunted trees and shrubs (Harrison *et al.* 1997).

The Pofadder area is extremely arid with cold winters and hot summers, with temperatures ranging between 33˚C in January (summer) and 2˚C in July (winter), and average rainfall happens mostly between December and April and averages about 120mm per year, which makes for a fairly arid climate (Figure 4).

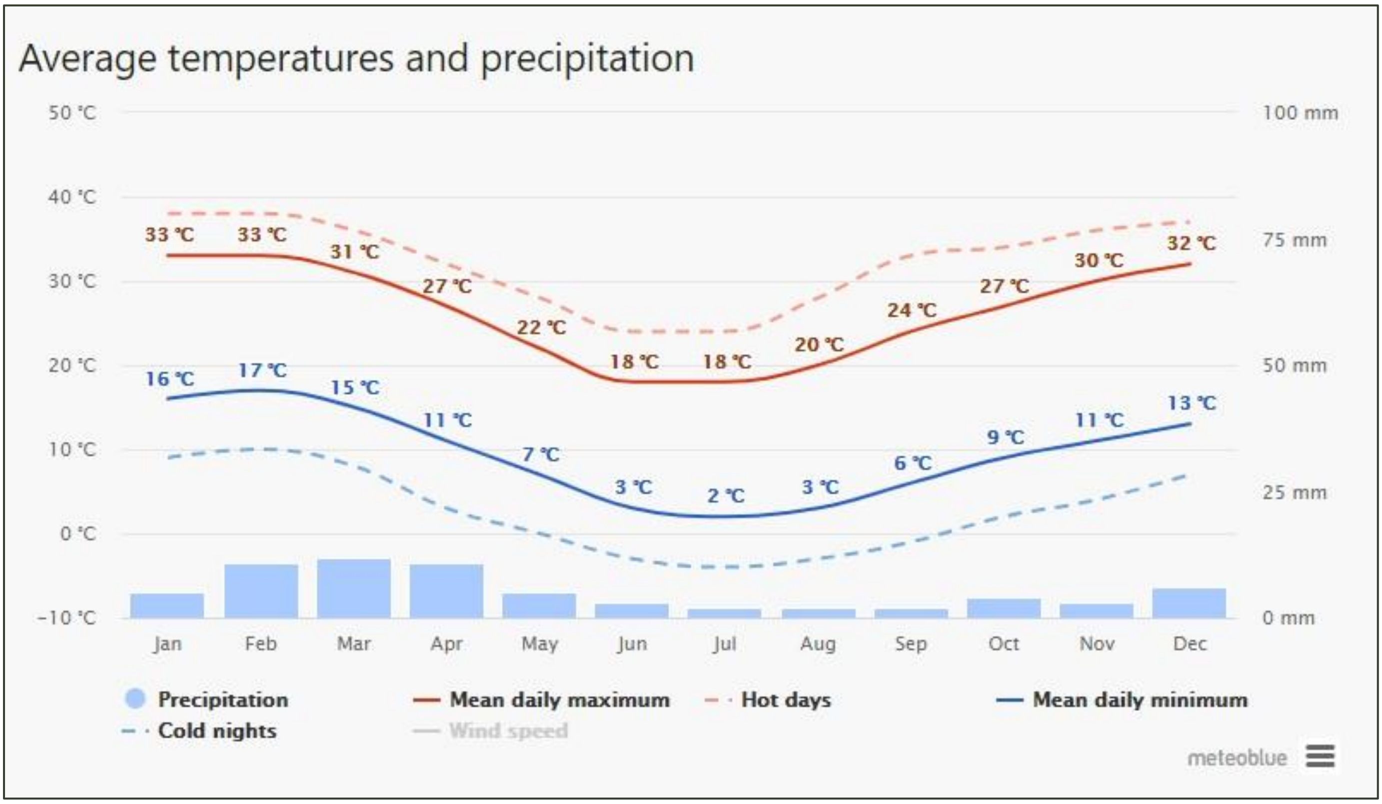


Figure 4: The average precipitation and temperature in Pofadder, based on 30 years of data. The "mean daily maximum" (solid red line) shows the maximum temperature of an average day for every month for Pofadder. Likewise, "mean daily minimum" (solid blue line) shows the average minimum temperature (meteoblue.com).

Whilst the distribution and abundance of the bird species in the project site are typical of the broad vegetation type, it is also necessary to examine bird habitats in more detail as it may influence the distribution and behaviour of priority species. The project site is situated on a wide plain. The only topographically significant features in the area are a few low, boulder strewn ridges in the north of the project site. The only longer term surface water at the project site consists of a couple of dams and boreholes with reservoirs. Drainage lines flow only briefly after good rains. These habitats are discussed in more detail below. The priority species most likely associated with the various bird habitat features are listed in Table 2.

6.6 Bird habitat

6.6.1 Nama Karoo

The vegetation at the project site consists of Karoo shrub vegetation, punctuated by rugged relief. Although not remarkably rich in species or endemism, the flora and fauna of the region are remarkably adapted to the region's climatic extremes.

6.6.2 Surface water

Surface water is of specific importance to avifauna in this arid study area. The project site contains many boreholes**.** Boreholes with open water troughs are important sources of surface water, as they are the only permanent source of drinking water for birds at the project site.

6.6.3 Trees

The project site is generally devoid of trees, except for isolated clumps of trees at homesteads and boreholes, where a mixture of alien and indigenous trees is growing. The trees could attract a variety of bird species for purposes of nesting and roosting.

6.6.4 High voltage lines

High voltage lines are an important potential roosting and breeding substrate for large raptors in the broader area. The Aries – Aggeneys 400kV high voltage line, built on self-supporting lattice structures, runs approximately 1.6km from the closest planned turbine position. There are three Martial Eagle nests on the afore-mentioned line in the broader area, but none on the project site. The nearest nest is approximately 23km from the closest planned turbine.

Appendix 2 provides a photographic record of habitat features in the development area and immediate surroundings.

7 AVIFAUNA IN THE PROJECT SITE

7.1 South African Bird Atlas Project 2

The SABAP 2 data indicates that a total of 96 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 18 species are classified as priority species (see definition of priority species in section 4) and 11 of these are South African Red List species. Based on the SABAP 2 reporting rates of the species, the habitat at the development area and the species recorded thus far at the site during the surveys, we estimate that 15 of the priority species occurring in the broader area, have a medium to high chance of occurring regularly in the development area (see Table 2 below).

Table 2 below lists all the priority species that are likely to occur regularly and the possible impact on the respective species by the proposed wind farm. Acronyms: NT = Near threatened VU = Vulnerable EN = Endangered CR = Critically Endangered.

Table 2: Priority species potentially occurring at the Pofadder WEF 3 development area

		SABAP 2 reporting rates		Status				Habitat						Potential impact				
Species	**Taxonomic name**	**SABAP 2 Reporting rate full protocol**	**SABAP 2 Reporting rate ad hoc protocol**	**Red Data Global (IUCN 2021.3)**	**Red Data Regional Taylor *et al.* 2015)**	**Probability of regular occurrence**	**Recorded during monitoring**	**Arid grassland and shrub on sand**	**Arid grassland on gravel plains**	**Surface water: water troughs**	**Ridges**	**Alien trees**	**High voltage lines**	**Collisions: Turbines**	**Displacement: Disturbance**	**Displacement: Habitat transformation**	**Collisions: MV Powerlines**	**Electrocutions: MV Powerlines**
Black Stork	*Ciconia nigra*	2.86	0.00	LC	VU	Low				x	x	x		x			x	
Black-chested Snake-eagle	*Circaetus pectoralis*	2.86	0.00			Low		x	x	x		x	x	x				
Greater Kestrel	*Falco rupicoloides*	40.00	3.23			High	x	x	x			x	x	x	x			x
Jackal Buzzard	*Buteo rufofuscus*	2.86	0.00			Low	x			x	x	x	x	x				x
Karoo Korhaan	*Eupodotis vigorsii*	68.57	22.58	LC	NT	High	x	x	x					x	x	x	x	
Ludwig's Bustard	*Neotis ludwigii*	48.57	12.90	EN	EN	High	x	x	x					x	x	x	x	
Kori Bustard	*Ardeotis kori*	5.71	0.00	NT	NT	Medium	x	x	x					x	x		x	
Martial Eagle	*Polemaetus bellicosus*	11.43	0.00	VU	EN	Medium		x	x	x	x	x	x	x	x			x
Northern Black Korhaan	*Afrotis afraoides*	45.71	0.00			High	x	x	x					x	x	x	x	
Red Lark	*Calendulauda burra*	42.86	0.00	VU	VU	High	x	x						x	x	x		
Sclater's Lark	*Spizocorys sclateri*	51.43	19.35	NT	NT	High	x		x	x				x	x	x		
Pale Chanting Goshawk	*Melierax canorus*	68.57	9.68			High	x	x	x	x		x	x	x	x			x
Spotted Eagle-owl	*Bubo africanus*	20.00	9.68			High	x	x	x		x	x		x	x		x	x
Verreaux's Eagle	*Aquila verreauxii*	5.71	3.23	LC	VU	High	x			x	x		x	x	x			x
White-backed Vulture	*Gyps africanus*	2.86	0.00	CR	CR	Medium	x	x	x	x	x	x	x	x	x		x	x
Burchell's Courser	*Cursorius rufus*	11.43	3.23	LC	VU	High		x	x	x	x	x	x	x				
Double-banded Courser	*Rhinoptilus africanus*	42.86	9.68			High	x				x			x	x			
Lappet-faced Vulture	*Torgos tracheliotis*	0	0	EN	EN	Medium	x	x	x	x	x	x	x	x	x		x	x

8 IMPACT ASSESSMENT

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 medium voltage overhead lines
- Mortality due to collisions with the medium voltage overhead lines

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 development site 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.

8.1 Collision mortality on wind turbines[2]

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 infrastructure, such as powerlines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.*

[2] 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.

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.

<u>Species-specific factors</u>

- Morphological features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as powerlines 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 Pofadder WEF 3 was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that regularly occurring priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Lappet-faced Vulture and White-backed Vulture, 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 powerline 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 potentially regularly occurring priority species at the proposed Pofadder WEF 3 have high resolution vision areas found in the lateral fields of view, rather than frontally, i.e. Lappet-faced Vulture, White-backed Vulture and Ludwig's Bustard. 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. To date no migratory priority species have been recorded within the project site and Pofadder WEF 3 development area, however Booted Eagle may occur and will behave much the same as the resident birds once they arrive in the area. The same is valid for local nomads such as the Ludwig's Bustard, Lappet-faced Vulture and White-backed Vulture, which are likely only present during certain months of the year, i.e. between January and May. According to several landowners, vultures have recently (2020) been observed at carcasses for the first time in several decades, with numbers ranging from a few birds to over a hundred. During the third survey in February 2022, 42 White-backed Vultures and Lappet-faced Vultures were recorded roosting on the Aries – Aggeneys 400kV line just south of the southern border of the project site, although flight activity over the development area itself was not recorded. 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 powerlines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with powerlines, as some species appear to be vulnerable to collisions with powerlines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to powerline 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, very few bustard collisions with wind turbines have been reported to date, all 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 Pofadder WEF 3 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 project site, Ludwig Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan are included in this category. Occasional long-distance fliers generally behave as terrestrial species but can and do undertake long distance flights on occasion (Shaw 2013). Species in this category are 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 and vultures. Based on the time spent potentially flying at rotor height, soaring species are likely to be at greater risk of collision. Specific behaviour of some species might put them at risk of collision, e.g. display flights of Red Lark and Northern Black Korhaan may place them within the rotor swept zone, resulting in mortalities (Ralston-Paton & Camagu 2019). Vultures taking off and arriving at carcasses could also be at risk of turbine collisions.

- 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 Pofadder WEF 3 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. White-backed Vultures and Lappet-faced Vulture Vultures descending to carcasses may also be at risk as they will be concentrating on the carcass and not the turbines. Complete macro-avoidance of the wind farm is unlikely for any of the priority species likely to occur within the project site.

- 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 within the proposed Pofadder WEF 3 development area will fluctuate depending on the season of the year, and possibly in response to rainfall e.g. Ludwig's Bustard. White-backed and Lappet-faced Vulture are probably only present at the project site in numbers between January and May, when collision with the turbines may occur. However, it is not clear at this stage whether the occurrence of White-backed Vulture and Lappet-faced Vulture in the first quarter of 2022 (during the third preconstruction monitoring survey) is an extraordinary event, or whether it signals the start of a regular pattern in the non-breeding season. However, anecdotal evidence is accumulating that vultures are expanding deeper into the Northern Cape and roosting on high voltage lines.

<u>Site-specific factors</u>

- 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 project site does not contain many landscape features as the majority of it is situated on a vast, slightly undulating plain. The most significant landscape features from a turbine collision risk perspective are the Aries – Aggeneys 400kV high voltage line, low ridges (not present in the Pofadder WED 1 development area), and the multitude of drinking troughs. The powerline might serve as a regular roosting substrate for White-backed Vulture and Lappet-faced Vulture as well as a roosting substrate for large raptors, including Martial Eagle. The powerline is situated 1.7km from the closest planned turbine. The water troughs will attract many birds, including Red List species such as Martial Eagle, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture and Sclater's Lark.

- 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 potential areas of high flight activity that have been identified are the low ridges in the north of the project site (not present in the Pofadder WED 1 development area), and the vulture roost on the Aries – Aggeneys 400kV powerline.

The pair of Verreaux's Eagles which are breeding in Mattheus-Gat IBA might forage along the ridges, as they most likely fall within the core range of the pair, and a juvenile Verreaux's Eagle was also recorded perched on a ridge. However, it is unlikely that the species will regularly forage in the development areas where the turbines are planned, due to the absence of ridges.

The high voltage powerline to the south of the project site is a focal point for vulture flight activity. No vultures were recorded during surveys in June and October 2021, all the flight activity was recorded during the third survey in February 2022. Indications are that this could a regular pattern, based on experiences at other proposed wind farms in the Northern Cape. The passage rate during the February 2022 survey was 0.3 birds/hour, or just under 4 birds per day. This points to a regular occurrence of vultures, but only during a specific time period, namely the non-breeding season from January to May, with an expected peak in February-March. All the flight activity that has been recorded to date was within 2km of the powerline roost, coming no closer than about 500m from a planned turbine position.

- 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 reason for the influx of Lappet-faced Vultures and White-backed Vulture into the broader area during the first two quarters of 2020 (as reported by landowners) and during the third pre-construction monitoring survey at the project site in 2021, is not immediately clear, but it might be related to the availability of food.

Rock Hyrax were observed on the ridges in the project site, which could attract Verreaux's Eagle, including non-breeding floaters and juveniles, but these are not located near the WEF 3 development area.

- Summary

The proposed Pofadder WEF 3 could potentially pose a collision risk to several priority species which could occur regularly at the project site. Species exposed to this risk are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan - although bustards generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Verreaux's Eagle, Greater Kestrel, Lappet-faced Vulture and White-backed Vulture are most at risk of all the priority species likely to occur regularly at the project site.

In summary, the following regularly occurring priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture (non-breeding season), Lappet-faced Vulture (non-breeding season) Burchell's Courser, Double-banded Courser, Red Lark and Sclater's Lark.

8.2 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.[3] 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

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

birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15– 53%, with Common Buzzard Buteo buteo, Hen Harrier Circus cyaneus, Golden Plover Pluvialis apricaria, Snipe Gallinago gallinago, Curlew Numenius arquata and Wheatear Oenanthe oenanthe most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse Lagopus lagopus scoticus, Snipe Gallinago gallinago and Curlew Numenius arquata breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark Alauda arvensis and Stonechat Saxicola torquata increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

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. Species that are likely to be most impacted are ground-nesting species and some species of raptors. If any priority nests are discovered habitat during pre-construction monitoring, it will have to be buffered appropriately to prevent displacement of the breeding birds. Based on likely occurrence in the development area, priority species that could be temporary displaced, either partially or completely, due to disturbance during the construction phase are Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Burchell’s Courser, Double-banded Courser, Red Lark and Sclater’s Lark.

8.3 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 development site (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. powerlines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under powerlines, 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 powerlines 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 powerlines 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).

The network of roads is likely to result in some habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan and possibly also on smaller passerines such as the Red Listed Sclater's Lark or Red Lark. The extent of this potential impact will depend on the density of the proposed turbine lay-out and associated road infrastructure, although it is not expected that any priority species will be permanently displaced from the development area.

8.4 Electrocution on the 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.

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Raptors and vultures could use these poles as perches. As far as the medium voltage powerlines are concerned, the potential electrocution risk to raptors could be eliminated by using a bird-friendly pole design. Species most at risk of electrocution on the medium voltage network are Greater Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, Lappet-faced Vulture and White-backed Vulture.

8.5 Collisions with the medium voltage network

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). From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to powerline collisions in South Africa (Figure 6).

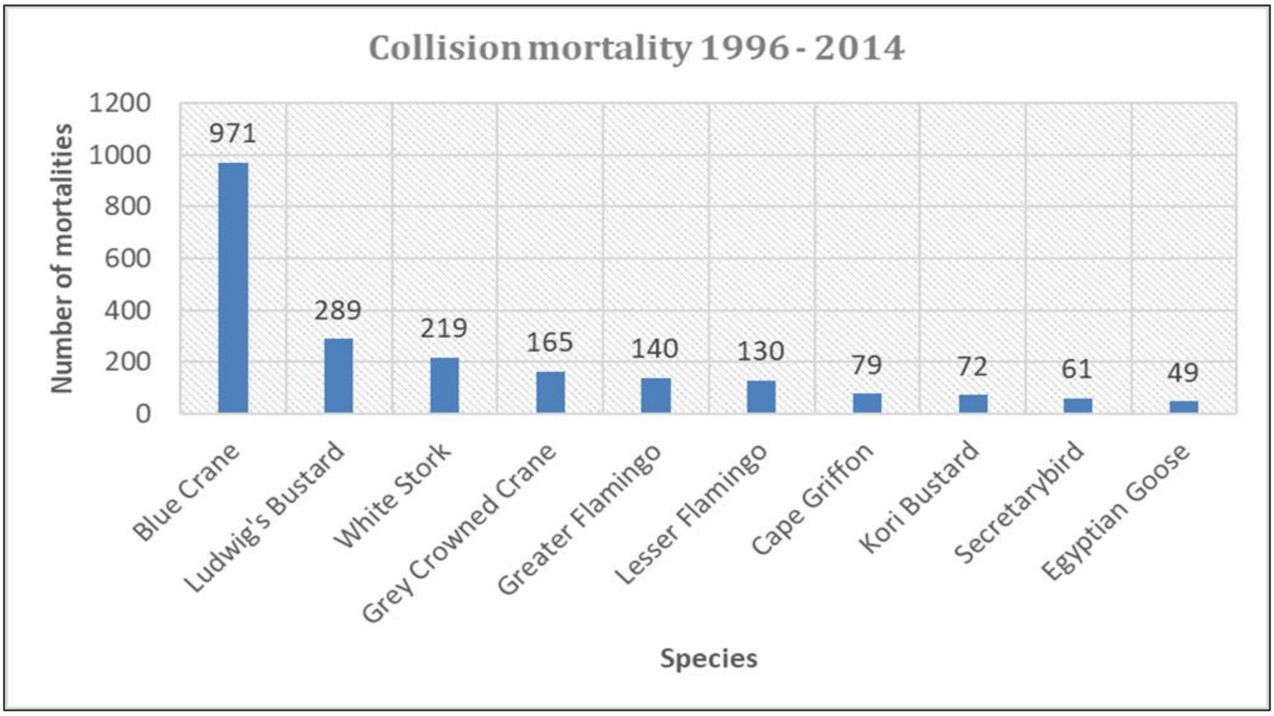


Figure 5: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

Powerline 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 one 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 powerlines (Shaw 2013).

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 powerline 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).

Likely priority species candidates for collision mortality on the proposed medium voltage internal overhead powerlines are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan and to a lesser extent White-backed Vulture and Lappet-faced Vulture.

9 AVIFAUNAL SENSITIVTY ZONES

The specific avifaunal sensitivities that have been identified at the project site are discussed below.

9.1. Very high sensitivity zones

The very high sensitivity zones are listed below. The construction of all infrastructure in these zones should be avoided completely:

- 500m buffer zone around water troughs to prevent the displacement of Sclater's Larks due to disturbance and habitat transformation, and to reduce the risk of turbine collisions for priority species using the water troughs for drinking and bathing. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine.
- Should any priority species nests be discovered during pre-construction monitoring, it will have to be buffered appropriately to prevent displacement of the breeding birds through disturbance, and collisions with turbines.

9.2. High sensitivity zones

The high sensitivity zones are listed below. The construction of turbines in these zones should be avoided to eliminate the risk of turbine collisions. Other infrastructure is permitted:

- 2km no-turbine buffer around the vulture roost on the Aries – Aggeneys 400kV powerline.

9.3. Medium sensitivity zones

The medium sensitivity zones are listed below. The construction of turbines in these zones should be restricted to a minimum to reduce the risk of turbine collisions. If restriction is not possible, additional mitigation measures will be required, e.g. increasing cut in speeds or shutdown on demand:

- Highly suitable Red Lark habitat: Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.
- Based on the results of the pre-construction monitoring, a medium risk zone will be delineated where most of the vulture flight activity beyond the 2km turbine exclusion zone is concentrated. If turbines in this medium-risk zone cannot be avoided, pro-active mitigation must be implemented at these turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation. This could include measures such as shutdown on demand during the non-breeding season and/or other proven measures.

Figure 7 below is a sensitivity map, indicating very high, high sensitivity and medium sensitivity areas identified to date. **This map is subject to refinement based on data to be collected in the field during the pre-construction monitoring.**

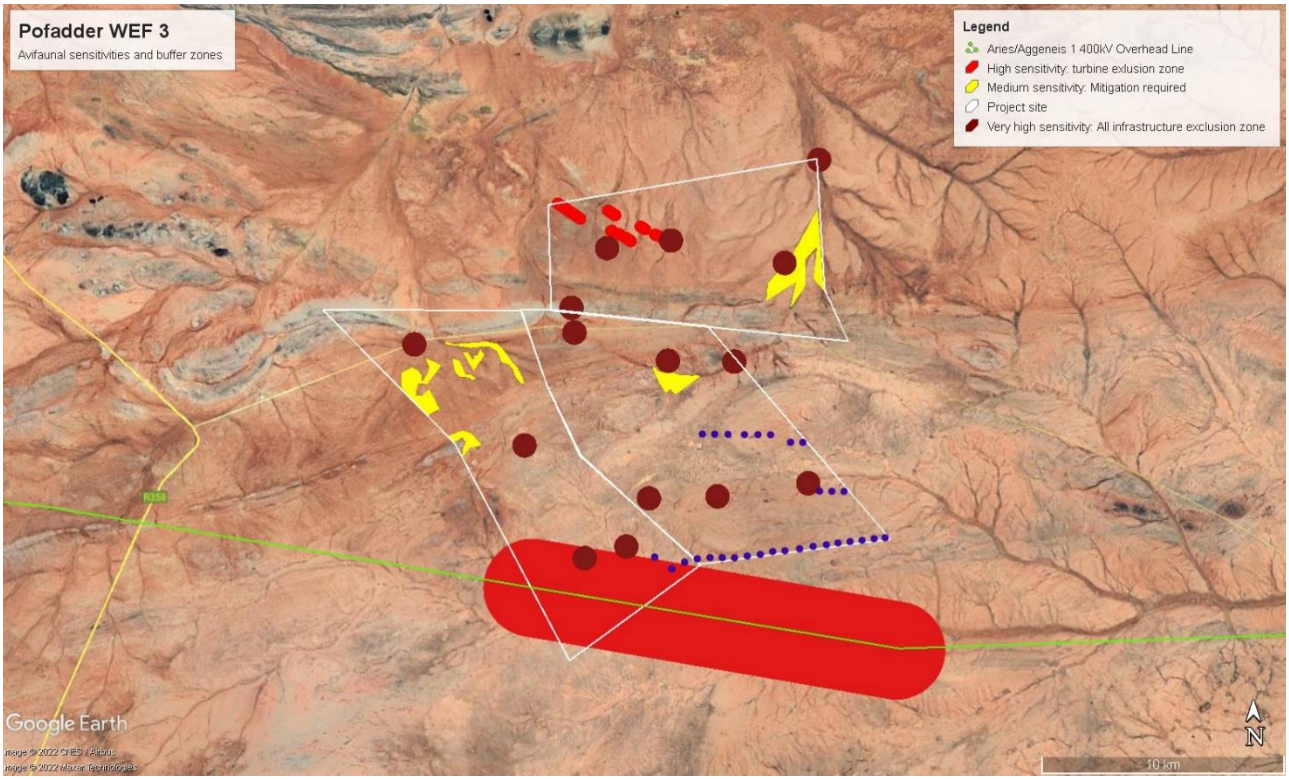


Figure 6: Avifaunal sensitivities at the within the project site and Pofadder WEF 3 development area

10 PRELIMINARY IMPACT ASSESSMNET

A summary of the anticipated impacts associated with the proposed Pofadder WEF 3 development, based on a preliminary assessment of the species and habitat information, is detailed in the table below.

Table 3: Summarised scoping level assessment of the anticipated impacts

Impact	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	Exclusion zones	Additional mitigation measures
CONSTRUCTION: Displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.	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. Relative to this assessment, species which fall in this category are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Burchell's Courser, Double-banded Courser, Spotted Eagle-Owl, Sclater's Lark and Red Lark. Some raptors might also be affected, e.g. 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.	Local	High	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to disturbance. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • Very high sensitivity: If any priority nests are discovered in this habitat during pre-construction monitoring, these will require appropriate no-disturbance buffers.	• Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible.
CONSTRUCTION: Displacement of priority species due to habitat transformation associated with construction of the wind turbines and associated infrastructure.	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, Kori Bustard, Northern Black Korhaan and Karoo Korhaan. Red Lark and Sclater's Lark could also potentially be impacted. However, given the expected 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 development site. The building infrastructure and substations will all be	Local	Low	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to habitat transformation. Alternatively, water troughs could be relocated to maintain a minimum	• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the biodiversity specialist, including rehabilitation, must be strictly implemented.

	situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the physical footprint. In summary, the following species are likely to be most affected by habitat transformation: Karoo Korhaan, Northern Black Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark and Red Lark.			distance of 500m from the closest turbine.	• Placement of turbines in highly suitable Red Lark habitat to be avoided where possible.
Impact	**Nature of Impact**	**Extent of Impact**	Significance (pre-mitigation)	**Exclusion zones**	**Additional mitigation measures**
OPERATION: Mortality of priority species due to collisions with wind turbines.	The proposed WEF will pose a potential collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan - although bustards generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Booted Eagle, Verreaux's Eagle, Greater Kestrel, Lappet-faced Vulture and White-backed Vulture are most at risk of all the priority species likely to occur regularly at the project site. Red Larks could also potentially be at risk during display flights. In summary, the following priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture, Burchell's Courser, Double-banded Courser, Red Lark and Sclater's Lark.	Local	High	• Very high sensitivity: All surface water (water troughs) must be buffered by 500m (all infrastructure) to prevent turbine collisions of priority species attracted to the water. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • High sensitivity: A 2km no - turbine buffer zone must be implemented around vulture roost on the HV line running to the south of the development area.	• A procedure for the prompt removal of carcasses within the development area must be implemented to prevent vultures from being attracted to the area where they could be at risk of collision with the turbines. • Based on the results of the pre-construction monitoring, a medium risk zone will be delineated where most of the vulture flight activity beyond the 2km turbine exclusion zone is concentrated. If turbines in this medium-risk zone cannot be avoided, pro-active mitigation must be implemented at these turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation. This could include measures such as shutdown on demand during the non-breeding season, a carcass removal

					programme, and/or other proven measures. • All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and packed down so as to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food for the Verreaux's Eagles). • 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. • • If estimated annual 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 mitigation measures. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased

					to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.

Impact	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	Exclusion zones	Additional mitigation measures
OPERATION: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	The medium voltage powerlines could potentially pose an electrocution risk to several priority species which may occur regularly in the development area . Species at risk are White-backed Vulture, Lappet-faced Vulture, Verreaux's Eagle, Pale Chanting Goshawk, Greater Kestrel and Spotted Eagle-Owl.	Regional	High	No avifaunal exclusion zones were determined necessary for the mitigation of this anticipated impact.	A raptor-friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.
During operation: Mortality of priority species due to collisions with the medium voltage internal reticulation network	Priority species which most at risk of collisions with the medium voltage powerlines are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan and to a lesser extent White-backed Vultures and Lappet-faced Vultures.	Regional	High	No avifaunal exclusion zones were determined necessary for the mitigation of this anticipated impact.	All medium high voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.

11 EIA PHASE

11.1 Plan of study

The following are proposed for the EIA Phase:

- The implementation of four avifaunal surveys, utilising transects, vantage point watches, focal points and incidental counts, to inform the assessment of the potential impacts of the planned infrastructure within the development footprint (Appendix 3)[4]. The monitoring protocol is guided by the following:
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
  - 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 (Jenkins *et al.* 2015).
- The avifaunal specialists report will be structured around the following terms of reference:
  - Description of the affected environment from an avifaunal perspective.
  - Discussion of gaps in baseline data and other limitations.
  - Description of the methodology that was used for the field surveys.
  - Comparison of the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjustment if necessary.
  - Provision of an overview of all applicable legislation.
  - Provision of an overview of assessment methodology.
  - Identification and assessment of the potential impacts of the proposed development on avifauna including cumulative impacts.
  - Provision of sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
  - Conclusion with an impact statement whether the wind energy facility is fatally flawed or may be authorised.

11.2 Environmental Management Programme

For each anticipated impact, management recommendations for the design, construction, and operational phase (where appropriate) will be drafted for inclusion in the project EMPr.

12 PRELIMINARY CONCLUSIONS

Based on the pre-construction monitoring to date, it is envisaged that the proposed 200MW Pofadder WEF 3 could potentially have a range of pre-mitigation negative impacts on priority avifauna ranging from low to high, all of which could be reduced to acceptable levels with appropriate mitigation. The conclusions and proposed mitigation measures are subject to the completion of the current pre-construction monitoring at the project site. No fatal flaws are expected to be discovered during the remaining investigations.

[4] This is currently ongoing with three of the four surveys having been completed to date.

13 REFERENCES

- ALONSO, J. A. AND ALONSO, J. C. 1999 Collision of birds with overhead transmission lines in Spain. Pp. 57–82 in Ferrer, M. and Janss, G. F. E., eds. Birds and power lines: Collision, electrocution and breeding. Madrid, Spain: Quercus.Google Scholar
- Altamont Pass Avian Monitoring Team. 2008. Bird Fatality Study at Altamont Pass Wind Resource Area October 2005 – September 2007. Draft Report prepared for the Almeda County Scientific Review Committee.
- ANIMAL DEMOGRAPHY UNIT. 2021. The southern African Bird Atlas Project 2. University of Cape Town. http://SABAP 2.adu.org.za.
- AVIAN POWER LINE INTERACTION COMMITTEE (APLIC). 2012. Mitigating Bird Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute. Washington D.C.
- BARRIENTOS R, PONCE C, PALACIN C, MARTÍN CA, MARTÍN B, *ET AL.* 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. PLoS ONE 7(3): e32569. Doi:10.1371/journal.pone.0032569.
- BARRIENTOS, R., ALONSO, J.C., PONCE, C., PALACÍN, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.
- BARRIOS, L. & RODRÍGUEZ, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology. Volume 41. Issue 1. Pp72-81.
- BEAULAURIER, D.L. 1981. Mitigation of bird collisions with transmission lines. Bonneville Power Administration. U.S. Dept. of Energy.
- BERNARDINO, J., BEVANGER, K., BARRIENTOS, R., DWYER, J.F. MARQUES, A.T., MARTINS, R.C., SHAW, J.M., SILVA, J.P., MOREIRA, F. 2018. Bird collisions with power lines: State of the art and priority areas for research. https://doi.org/10.1016/j.biocon.2018.02.029. Biological Conservation 222 (2018) 1 – 13.
- CARETTE, M., ZAPATA-SANCHEZ, J.A., BENITEZ, R.J., LOBON, M. & DONAZAR, J.A. (In press) Large scale risk-assessment of wind farms on population viability of a globally endangered long-lived raptor. Biol. Cons. (2009), doi: 10.1016/j.biocon.2009.07.027.
- CSIR. 2015. The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa.
- DE LUCAS, M., JANSS, G.F.E., WHITFIELD, D.P. & FERRER, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45, 1695 – 1703.
- DREWITT, A.L. & LANGSTON, R.H.W. 2006. Assessing the impacts of wind farms on birds. Ibis 148, 29-42.
- ENDANGERED WILDLIFE TRUST. 2014. Central incident register for powerline incidents. Unpublished data.
- ERICKSON, W. P., G. D. JOHNSON, AND D. P. YOUNG, JR. 2005. A summary and comparison of bird mortality form anthropogenic causes with an emphasis on collisions. U.S. Department of Agriculture Forest Service General Technical Report PSW-GTR-191, Albany, California, USA.
- ERICKSON, W. P., G. D. JOHNSON, M. D. STRICKLAND, D. P. YOUNG, JR., K. J. SERNKA, AND R. E. GOOD. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, c/o RESOLVE, Washington, D.C., USA.
- EVERAERT, J., DEVOS, K. & KUIJKEN, E. 2001. Windturbines en vogels in Vlaanderen: Voorlopige Onderzoeksresultaten En Buitenlandse Bevindingen [Wind Turbines and Birds in Flanders (Belgium): Preliminary Study Results in a European Context]. Instituut Voor Natuurbehoud. Report R.2002.03. Brussels B.76pp. Brussels, Belgium: Institut voor Natuurbehoud.

- EWEA 2003. Wind Energy – The Facts. Volume 4: Environment. The European Wind Energy Association (EWEA), and the European Commission's Directorate General for Transport and Energy (DG TREN). Pp182-184. (www.ewea.org/documents/)
- FARFÁN M.A., VARGAS J.M., DUARTE J. AND REAL R. (2009). What is the impact of wind farms on birds? A case study in southern Spain. Biodiversity Conservation. 18:3743-3758.
- FERRER, M., DE LUCAS, M., JANSS, G.F.E., CASADO, E., MUNOZ, A.R., BECHARD, M.J., CALABUIG,C.P. 2012. Weak relationship between risk assessment studies and recorded mortality on wind farms. Journal of Applied Ecology. 49. P38-46.
- FOX, A.D., DESHOLM, M., KAHLERT, J., CHRISTENSEN, T.K. & KRAG PETERSEN, I.B. 2006. Information needs to support environmental impact assessments of the effects of European marine offshore wind farms on birds. In Wind, Fire and Water: Renewable Energy and Birds. Ibis 148 (Suppl. 1): 129–144.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- HOBBS, J.C.A. & LEDGER J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. Proceedings of the Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986.
- HOBBS, J.C.A. & LEDGER J.A. 1986b. Power lines, Birdlife and the Golden Mean. Fauna and Flora, 44:23-27.
- HOCKEY, P.A.R., DEAN, W.R.J, AND RYAN, P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- HÖTKER, H., THOMSEN, K.-M. & H. JEROMIN. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats – facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut I NABU, Bergenhusen.
- HOWELL, J.A. & DIDONATO, J.E. 1991. Assessment of avian use and mortality related to wind turbine operations: Altamont Pass, Alameda and Contra Costa Counties, California, September 1988 Through August 1989. Final report prepared for Kenentech Windpower.
- HUNT, W.G. 2001. Continuing studies of golden eagles at Altamont Pass. Proceedings of the National Avian-Wind Power Planning Meeting IV.
- HUNT, W.G., JACKMAN, R.E., HUNT, T.L., DRISCOLL, D.E. & CULP, L. 1999. A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Population Trend Analysis 1994–97. Report to National Renewable Energy Laboratory, Subcontract XAT-6-16459–01. Santa Cruz: University of California.
- JENKINS A R; VAN ROOYEN C S; SMALLIE J J; ANDERSON M D & SMIT H A. 2015. 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.
- JENKINS, A. & SMALLIE, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? Africa Birds and Birding. Vol 14, No 2.
- JENKINS, A., DE GOEDE, J.H. & VAN ROOYEN, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildife Trust.
- JENKINS, A.R., DE GOEDE, J.H., SEBELE, L. & DIAMOND, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International 23: 232-246.

- JENKINS, A.R., SMALLIE, J.J. & DIAMOND, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.
- JOHNSON, G.D., STRICKLAND, M.D., ERICKSON, W.P. & YOUNG, D.P. 2007. Use of data to develop mitigation measures for wind power impact on birds. In: De Lucas, M., Janss, G.F.E., & Ferrer, M eds: Birds and Wind Farms Risk Assessment and Mitigation. Quercus, Madrid.
- JOHNSON, G.D., STRICKLAND, M.D., ERICKSON, W.P., SHEPERD, M.F. & SHEPERD D. A. 2000. Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a four-year study. Technical Report prepared for Northern States Power Company, Minneapolis, MN 262pp.
- KESKIN, G., DURMUS, S., ŐZELMAS, Ű AND KARAKAYA, M. 2019. Effects of wing loading on take-off and turning performance which is a decisive factor in the selection of resting location of the Great Bustard (*Otis tarda*). Biological Diversity and Conservation 12(3):28-32. DOI: 10.5505/biodicon.2019.69875
- KOOPS, F.B.J. & DE JONG, J. 1982. Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. Electrotechniek 60 (12): 641 – 646.
- Kruckenberg, H. & Jaene, J. 1999. Zum Einfluss eines Windparks auf die Verteilung weidender Bläßgänse I Rheiderland (Landkreis Leer, Niedersachsen). Natur Landsch. 74: 420–427.
- KRUGER, R. & VAN ROOYEN, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: The Molopo Case Study. Proceedings of the 5th World Conference on Birds of Prey and Owls. August 4-8,1998. Midrand, South Africa.
- KRUGER, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. Bloemfontein (South Africa): University of the Orange Free State. (M. Phil. Mini-thesis)
- LANGGEMACH, T. 2008. Memorandum of Understanding for the Middle-European population of the Great Bustard, German National Report 2008. Landesumweltamt Brandenburg (Brandenburg State Office for Environment).
- LANGSTON, R.H.W. & PULLAN, J.D. 2003. Wind farms and birds: an analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues. Report written by Birdlife International on behalf of the Bern Convention. Council Europe Report T-PVS/Inf
- LARSEN, J.K. & MADSEN, J. 2000. Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*40nswer brachyrhynchus*): A landscape perspective. Landscape Ecol. 15: 755–764.
- LEDDY, K.L., HIGGINS, K.F., NAUGLE, D.E., 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 11, 100–104.
- LEDGER, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Eskom Test and Research Division. (Technical Note TRR/N83/005).
- LEDGER, J.A. & ANNEGARN H.J. 1981. Electrocution Hazards to the Cape Vulture (Gyps coprotheres) in South Africa. Biological Conservation 20:15-24.
- LEDGER, J.A. 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. The Certificated Engineer, 57:92-95.
- LEDGER, J.A., J.C.A. HOBBS & SMITH T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. Proceedings of the International Workshop on Avian Interactions with Utility Structures. Miami (Florida), Sept. 13-15, 1992. Electric Power Research Institute.
- MADDERS, M & WHITFIELD, D.P. Upland raptors and the assessment of wind farm impacts. 2006. Ibis. Volume 148, Issue Supplement s1. Pp 43-56.
- MARNEWICK M.S., RETIEF, E.F., THERON, N.T., WRIGHT, D.R., & ANDERSON, T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
- MARTIN, G., SHAW, J., SMALLIE J. & DIAMOND, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.

- MUCINA. L. & RUTHERFORD, M.C. (EDS) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- ORLOFF, S. & FLANNERY, A. 1992. Wind turbine effects on avian activity, habitat use and mortality in Altamont Pass and Solano County Wind Resource Areas, 1989–91. California. Energy Commission.
- PEARCE-HIGGINS J.W, STEPHEN L, LANGSTON R.H.W, BAINBRIDGE, I.P.& R BULLMAN. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 2009, 46, 1323–1331
- PEARCE-HIGGINS, J.W., STEPHEN, L., DOUSE, A., & LANGSTON, R.H.W. Greater impacts on bird populations during construction than subsequent operation: result of multi-site and multi-species analysis. Journal of Applied Ecology 2012, 49, 396-394.
- PEDERSEN, M.B. & POULSEN, E. 1991. Impact of a 90 m/2MW wind turbine on birds. Avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Danske Vildtunderogelser Haefte 47. Rønde, Denmark: Danmarks Miljøundersøgelser.
- PEROLD V, RALSTON-PATON S & RYAN P (2020): On a collision course? The large diversity of birds killed by wind turbines in South Africa, Ostrich, DOI: 10.2989/00306525.2020.1770889
- RAAB, R., JULIUS, E., SPAKOVSZKY, P. & NAGY, S. 2009. Guidelines for best practice on mitigating impacts of infrastructure development and afforestation on the Great Bustard. Prepared for the Memorandum of Understanding on the conservation and management of the Middle-European population of the Great Bustard under the Convention on Migratory species (CMS). Birdlife International. European Dvision.
- RAAB, R., SPAKOVSZKY, P., JULIUS, E., SCHÜTZ, C. & SCHULZE, C. 2010. Effects of powerlines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International. Birdlife International.
- RALSTON-PATTON S. 2017. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa, March 2017
- RALSTON-PATTON, M & CAMAGU, N. 2019. Birds & Renewable Energy Update for 2019. Birds and Renewable Energy Forum, 10 October 2019. BirdLife South Africa.
- RETIEF E.F., DIAMOND M, ANDERSON M.D., SMIT, H.A., JENKINS, A & M. BROOKS. 2012. Avian Wind Farm Sensitivity Map. Birdlife South Africa http://www.birdlife.org.za/conservation/birds-and-wind-energy/windmap.
- SCOTTISH NATURAL HERITAGE (2005, revised 2010) Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance. SNH, Battleby.
- SCOTTISH NATURAL HERITAGE. 2010. Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. SNH Avoidance Rate Information & Guidance Note.
- SHAW, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.
- SHAW, J.M., PRETORIUS, M.D., GIBBONS, B., MOHALE, O., VISAGIE, R., LEEUWNER, J.L.& RYAN, P.G. 2017. The effectiveness of line markers in reducing power line collisions of large terrestrial birds at De Aar, Northern Cape. Eskom Research, Testing and Development. Research Report. RES/RR/17/1939422.
- SMALLWOOD, K. S. (2013), Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin, 37: 19–33. Doi: 10.1002/wsb.260.
- SABAP 2. South African Bird Atlas Project 2. http://SABAP 2.adu.org.za.
- SPORER, M.K., DWYER, J.F., GERBER, B.D, HARNESS, R.E, PANDEY, A.K. 2013. Marking Power Lines to Reduce Avian Collisions Near the Audubon National Wildlife Refuge, North Dakota. Wildlife Society Bulletin 37(4):796–804; 2013; DOI: 10.1002/wsb.329

- STEWART, G.B., COLES, C.F. & PULLIN, A.S. 2004. Effects of Wind Turbines on Bird Abundance. Systematic Review no. 4. Birmingham, UK: Centre for Evidence-based Conservation.
- STEWART, G.B., PULLIN, A.S. & COLES, C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation. 34, 1-11.
- TAYLOR, M.R., PEACOCK F, & WANLESS R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- TAYLOR, M.R., PEACOCK F, & WANLESS R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- THELANDER, C.G., SMALLWOOD, K.S. & RUGGE, L. 2003. Bird Risk Behaviours and Fatalities at the Altamont Pass Wind Resource Area. Report to the National Renewable Energy Laboratory, Colorado.
- UGORETZ, S. 2001. Avian mortalities at tall structures. In: Proceedings of the National Avian Wind Power Planning Meeting IV pp. 165-166. National Wind Coordinating Committee. Washington DC.
- VAN ROOYEN, C.S. & LEDGER, J.A. 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230, in Ferrer, M. & G.F.M. Janns. (eds.). Birds and Power lines. Quercus, Madrid (Spain). Pp 238.
- VAN ROOYEN, C.S. & TAYLOR, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina.
- VAN ROOYEN, C.S. 1998. Raptor mortality on power lines in South Africa. Proceedings of the 5th World Conference on Birds of Prey and Owls. Midrand (South Africa), Aug.4 – 8, 1998.
- VAN ROOYEN, C.S. 1999. An overview of the Eskom-EWT Strategic Partnership in South Africa. EPRI Workshop on Avian Interactions with Utility Structures Charleston (South Carolina), Dec. 2-3 1999.
- Van Rooyen, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In: The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.
- VAN ROOYEN, C.S. 2007. Eskom-EWT Strategic Partnership: Progress Report April-September 2007. Endangered Wildlife Trust, Johannesburg.
- VAN ROOYEN, C.S. VOSLOO, H.F. & R.E. HARNESS. 2002. Eliminating bird streamers as a cause of faulting on transmission lines in South Africa. Proceedings of the IEEE 46th Rural Electric Power Conference. Colorado Springs (Colorado), May. 2002.
- VERDOORN, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV power lines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. Proceedings of the 2nd International Conference on Raptors: Urbino (Italy), Oct. 2-5, 1996.

APPENDIX 1: SABAP 2 SPECIES LIST FOR THE BROADER AREA

Species name	Scientific name	Full Protocol Report Rate	Ad hoc Protocol Report Rate	Red List Global Status	Red List Regional Status
Acacia Pied Barbet	Tricholaema leucomelas	51,4286	16,129		
African Pipit	Anthus cinnamomeus	2,8571	0		
African Red-eyed Bulbul	Pycnonotus nigricans	17,1429	3,2258		
Ant-eating Chat	Myrmecocichla formicivora	57,1429	16,129		
Ashy Tit	Melaniparus cinerascens	2,8571	0		
Barn Swallow	Hirundo rustica	14,2857	0		
Black Stork	Ciconia nigra	2,8571	0		VU
Black-chested Prinia	Prinia flavicans	40	9,6774		
Black-chested Snake Eagle	Circaetus pectoralis	2,8571	0		
Black-eared Sparrow-Lark	Eremopterix australis	20	9,6774		
Black-headed Canary	Serinus alario	17,1429	3,2258		
Blacksmith Lapwing	Vanellus armatus	8,5714	3,2258		
Black-winged Stilt	Himantopus himantopus	2,8571	6,4516		
Bokmakierie	Telophorus zeylonus	31,4286	3,2258		
Burchell's Courser	Cursorius rufus	11,4286	3,2258		VU
Cape Bunting	Emberiza capensis	20	0		
Cape Penduline Tit	Anthoscopus minutus	11,4286	6,4516		
Cape Robin-Chat	Cossypha caffra	2,8571	0		
Cape Sparrow	Passer melanurus	68,5714	16,129		
Cape Turtle Dove	Streptopelia capicola	37,1429	6,4516		
Cape Wagtail	Motacilla capensis	5,7143	0		
Capped Wheatear	Oenanthe pileata	20	9,6774		
Chat Flycatcher	Melaenornis infuscatus	65,7143	16,129		
Chestnut-vented Warbler	Curruca subcoerulea	5,7143	0		
Common Greenshank	Tringa nebularia	2,8571	0		
Desert Cisticola	Cisticola aridulus	2,8571	0		
Double-banded Courser	Rhinoptilus africanus	42,8571	9,6774		
Dusky Sunbird	Cinnyris fuscus	45,7143	9,6774		
Egyptian Goose	Alopochen aegyptiaca	2,8571	6,4516		
Fairy Flycatcher	Stenostira scita	5,7143	0		
Familiar Chat	Oenanthe familiaris	28,5714	3,2258		
Fawn-colored Lark	Calendulauda africanoides	8,5714	0		
Greater Kestrel	Falco rupicoloides	40	3,2258		
Greater Striped Swallow	Cecropis cucullata	2,8571	0		
Grey Tit	Melaniparus afer	2,8571	0		
Grey-backed Cisticola	Cisticola subruficapilla	28,5714	9,6774		
Grey-backed Sparrow-Lark	Eremopterix verticalis	37,1429	6,4516		
House Sparrow	Passer domesticus	17,1429	0		
Jackal Buzzard	Buteo rufofuscus	2,8571	0		
Karoo Chat	Emarginata schlegelii	57,1429	22,5806		
Karoo Eremomela	Eremomela gregalis	2,8571	0		
Karoo Korhaan	Eupodotis vigorsii	68,5714	22,5806		NT
Karoo Long-billed Lark	Certhilauda subcoronata	60	12,9032		
Karoo Scrub Robin	Cercotrichas coryphoeus	42,8571	6,4516		
Karoo Thrush	Turdus smithi	14,2857	0		
Kori Bustard	Ardeotis kori	5,7143	0	NT	NT
Large-billed Lark	Galerida magnirostris	25,7143	3,2258		

Species name	Scientific name	Full Protocol Report Rate	Ad hoc Protocol Report Rate	Red List Global Status	Red List Regional Status
Lark-like Bunting	*Emberiza impetuani*	74,2857	16,129		
Laughing Dove	*Spilopelia senegalensis*	22,8571	0		
Layard's Warbler	*Curruca layardi*	5,7143	3,2258		
Little Grebe	*Tachybaptus ruficollis*	0	3,2258		
Little Swift	*Apus affinis*	8,5714	0		
Long-billed Crombec	*Sylvietta rufescens*	20	0		
Ludwig's Bustard	*Neotis ludwigii*	48,5714	12,9032	EN	EN
Martial Eagle	*Polemaetus bellicosus*	11,4286	0	EN	EN
Mountain Wheatear	*Myrmecocichla monticola*	20	6,4516		
Namaqua Dove	*Oena capensis*	48,5714	9,6774		
Namaqua Sandgrouse	*Pterocles namaqua*	74,2857	19,3548		
Northern Black Korhaan	*Afrotis afraoides*	45,7143	0		
Pale Chanting Goshawk	*Melierax canorus*	68,5714	9,6774		
Pale-winged Starling	*Onychognathus nabouroup*	22,8571	6,4516		
Pied Avocet	*Recurvirostra avosetta*	2,8571	3,2258		
Pied Crow	*Corvus albus*	65,7143	16,129		
Pririt Batis	*Batis pririt*	5,7143	0		
Pygmy Falcon	*Polihierax semitorquatus*	5,7143	3,2258		
Red Lark	*Calendulauda burra*	42,8571	0	VU	VU
Red-capped Lark	*Calandrella cinerea*	20	0		
Red-faced Mousebird	*Urocolius indicus*	17,1429	3,2258		
Red-headed Finch	*Amadina erythrocephala*	2,8571	0		
Rock Kestrel	*Falco rupicolus*	11,4286	0		
Rock Martin	*Ptyonoprogne fuligula*	60	9,6774		
Rufous-eared Warbler	*Malcorus pectoralis*	65,7143	16,129		
Sabota Lark	*Calendulauda sabota*	34,2857	12,9032		
Scaly-feathered Weaver	*Sporopipes squamifrons*	5,7143	6,4516		
Sclater's Lark	*Spizocorys sclateri*	51,4286	19,3548	NT	NT
Sociable Weaver	*Philetairus socius*	60	12,9032		
South African Shelduck	*Tadorna cana*	0	3,2258		
Southern Fiscal	*Lanius collaris*	45,7143	0		
Southern Grey-headed Sparrow	*Passer diffusus*	2,8571	0		
Southern Masked Weaver	*Ploceus velatus*	22,8571	0		
Speckled Pigeon	*Columba guinea*	65,7143	19,3548		
Spike-heeled Lark	*Chersomanes albofasciata*	85,7143	38,7097		
Spotted Eagle-Owl	*Bubo africanus*	20	9,6774		
Spotted Thick-knee	*Burhinus capensis*	11,4286	0		
Stark's Lark	*Spizocorys starki*	42,8571	29,0323		
Three-banded Plover	*Charadrius tricollaris*	0	6,4516		
Tractrac Chat	*Emarginata tractrac*	51,4286	16,129		
Verreaux's Eagle	*Aquila verreauxii*	5,7143	3,2258		VU
White-backed Mousebird	*Colius colius*	17,1429	3,2258		
White-backed Vulture	*Gyps africanus*	2,8571	0	CR	CR
Lappet-faced Vulture	*Torgos tracheliotis*				
White-browed Sparrow-Weaver	*Plocepasser mahali*	2,8571	0		
White-rumped Swift	*Apus caffer*	2,8571	0		
White-throated Canary	*Crithagra albogularis*	45,7143	9,6774		
Yellow Canary	*Crithagra flaviventris*	48,5714	9,6774		
Yellow-bellied Eremomela	*Eremomela icteropygialis*	37,1429	9,6774		

APPENDIX 2: HABITAT FEATURES WITHIN THE PROJECT SITE

Figure 1: Arid grassland and scrub on sandy plains in the development area

Figure 2: Arid grassland on gravel plains in the development area.

Figure 4: A typical water trough in the project site.

Figure 5: The Aries – Aggeneys 400kV high voltage line that bisects a section of the project site in the south which is used by vultures as a roost in the non-breeding season.

APPENDIX 3: PRE-CONSTRUCTION MONITORING

Monitoring at the project site is conducted in the following manner:

- One drive transects were identified totalling 13.7 on the project site and one drive transect in the control site with a total length of 10.8km.
- Two monitors travelling slowly (± 10km/h) in a vehicle record 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, 11 walk transects of 1km each were identified on the development site and 2 transects of on the control site. The PV transects are 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 and solar farm activities.

- Eleven vantage points (VPs) were identified from which the majority of the proposed turbine area can be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables are recorded for each flight:
  - Species
  - Number of birds
  - Date
  - Start time and end time
  - Wind direction
  - Wind strength (estimated Beaufort scale 1-7)
  - Weather (sunny; cloudy; partly cloudy; rain; mist)
  - Temperature (cold; mild; warm; hot)
  - Flight altitude (high i.e. above rotor height; medium i.e. rotor height; low i.e. below rotor height)
  - Flight mode (soar; flap; glide; kite; hover) and
  - Flight time (in 15 second intervals).

The objective of vantage point counts is 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.

No focal points of bird activity have been identified to date at the site. The closest Martial Eagle nest is located on Tower 166 of the Aggeneis – Aries 1 400kV line, approximately 23km west from the closest planned turbine position. The closest Verreaux's Eagle nest is located approximately 13km north of the closest planned turbine position. However, the presence of White-backed Vultures and Lappet-faced Vultures on the Aries – Aggeneys 400kV line is being monitored.

Figure 1 below indicates the location of the transects, vantage points and focal points where monitoring is taking place.

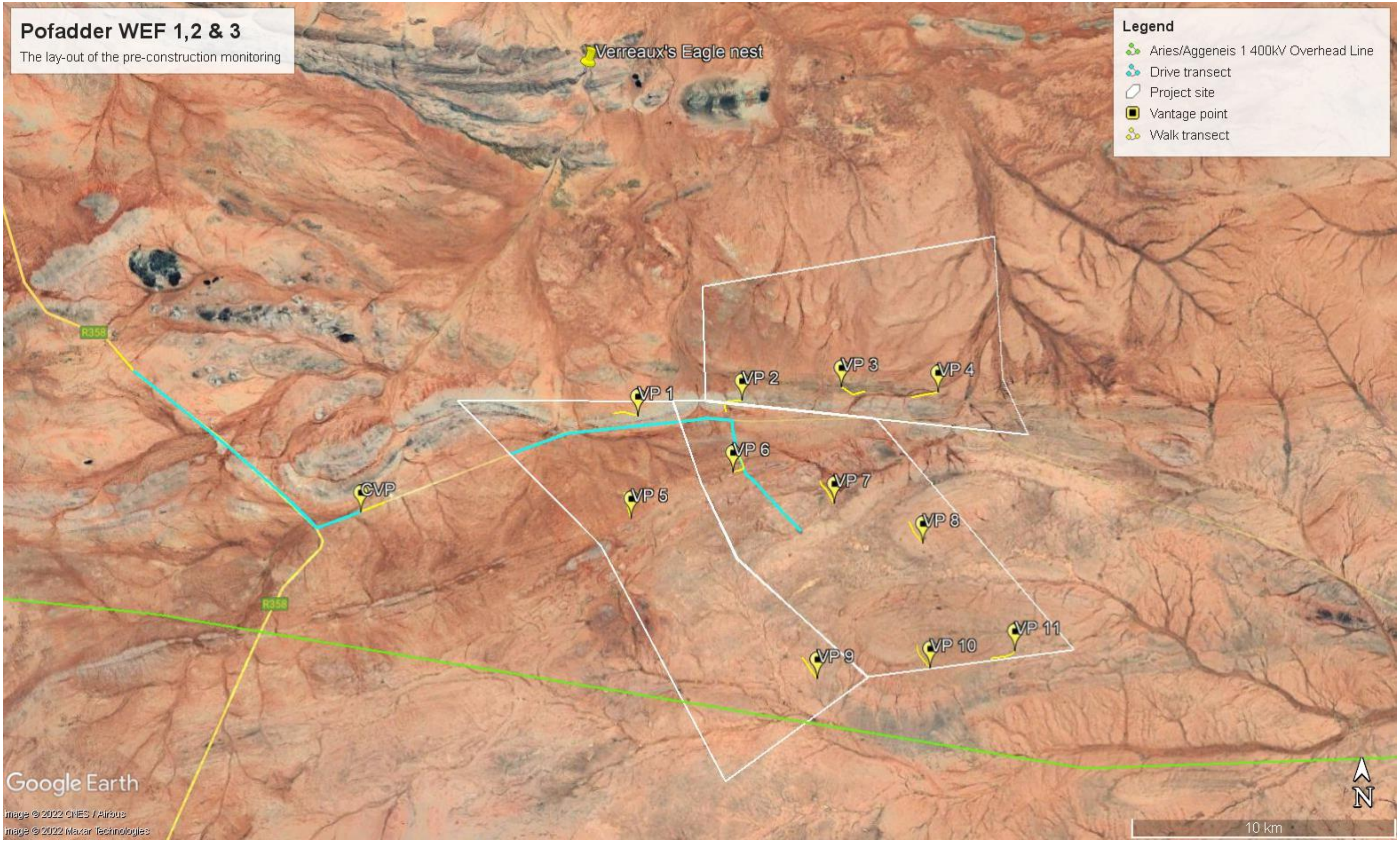


Figure 1: Area where monitoring is taking place, with position of Vantage Points, Drive transects and Walk transects in the project site.