AVIFAUNAL WALK-THROUGH REPORT

PROPOSED SUTHERLAND WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE NEAR SUTHERLAND IN THE NORTHERN & WESTERN CAPE PROVINCES

November 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

Chris van Rooyen Consulting was contracted by Nala Environmental to conduct a "walk-through" of the authorised 140MW Sutherland Wind Energy Facility (WEF) site (12/12/20/1782/2/AM6) and associated grid connection infrastructure (14/12/16/3/3/1/2457/AM1, 14/12/16/3/3/1/2458 & ; 14/12/16/3/3/1/2077/AM2) on behalf of Sutherland Wind Farm (Pty) Ltd to identify any avifaunal sensitivities to be considered for the final lay-out of the WEF and associated infrastructure. The Sutherland WEF has been selected as a preferred bidder and is currently finalizing the required layouts and documentation in order to meet financial close requirements. The authorised layout of 39 turbines has been reduced by 12% to 34 turbines, and this lay-out was assessed during the walk-through exercise, with a view to including any required mitigation measures in an updated Environmental Management Programme EMPr. Any additional mitigation measures associated with the authorised grid connection infrastructure has been considered for inclusion in the relevant Generic Environmental Management Programmes.

METHODOLOGY

A four-day site inspection was conducted in late November 2021 and repeated a month later in December 2021 to record all avifaunal sensitivities on, and in the immediate vicinity of the project site, which could influence the lay-out of the turbines. Emphasis was placed on locating nests of priority species, particularly species of conservation concern (SCC), which may be impacted by the proposed WEF. The data gathered during the 12-months monitoring in 2015 -2016, an inspection of the overhead line routes in April 2019 and subsequent nests searches in June and July 2019 were also taken into account. Priority species were defined as species included on the list of priority species of the Avian Wind Farm Sensitivity Map of South Africa compiled by Birdlife South Africa (Retief *et al.* 2012).

RESULTS

Appendix 3 lists the species Van Rooyen *et al*. (2016) recorded during a year of pre-construction monitoring in 2015 -2016. The 78 species that were recorded on and around the project site during the walk-through and nest searches in November and December 2021 are listed in Table 1.

RECOMMENDATIONS

The recommendations below are put forward for inclusion in the Final Environmental Management Programme (EMPr). These recommendations are based on the data gathered during the 12-months monitoring in 2015 -2016, an inspection of the overhead line routes in April 2019, subsequent nests searches in June and July 2019, the walk-through exercises undertaken in November and December 2021, and the Critical Habitat Assessment compiled in September 2022. These recommendations replace the recommendations contained in the original Avian Impact Assessment Report (Jenkins 2011), which are now outdated:

Design phase

- A 3.7km turbine exclusion zone must be implemented around identified Verreaux's Eagle nests, and a 660m turbine exclusion zone along the escarpment (Figure 2).
- A programme of observer-based or automated Shutdown on Demand (SDoD) to reduce potential Verreaux's Eagle turbine collisions must be implemented within the 3.7 – 5.2km medium-risk buffer zone.

- All drainage lines should be buffered as turbine exclusion zones, using the buffer distances recommended by the aquatic and bat specialists.
- All internal 33kV medium voltage cables are to be buried if technically possible.
- Those sections where the 33kV medium voltage cable cannot be trenched due to technical or environmental reasons, but needs to run on overhead poles, the proposed pole designs must be approved by the avifaunal specialist, to ensure that the designs are raptor-friendly.
- Bird flight diverters are to be fitted to all internal overhead lines, as well as all the spans of the proposed 132kV and 400kV overhead lines, according to the applicable Eskom Engineering Instruction.
- The applicant must engage recognised NGO role players in Black Harrier conservation (e.g. the Overberg Renosterveld Conservation Trust), as well as experts in the design and implementation of conservation off-sets (e.g. Conservation Outcomes) to assist them with designing and implementing a strategy for off-setting potential impacts on the breeding pair of Black Harriers (discovered during November 2021) at the project site. This strategy must have as objective the securing of measures in the core Black Harrier breeding areas to ensure a nett gain for the population in in perpetuity. The off-set plan must be implemented before the wind farm commences with operations.
- An 800m all infrastructure exclusion zone must be implemented around the Black Harrier nest to prevent potential disturbance of the breeding pair.
- It is recommended that all turbines within 5km of the Black Harrier nest (-32.622000° 20.887000°) have 2/3 of one blade painted in signal red or black. It is acknowledged that blade painting as a mitigation strategy is still in an experimental phase in South Africa, but research indicates that it has a very good chance of reducing raptor mortality, based on research conducted in Norway (see Simmons *et al*. 2021 (Appendix 5) for an explanation of the science and research behind this mitigation method).

Construction phase

- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible, and in particular to the proposed road network. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of SCC.
- Removal of vegetation must be restricted to a minimum.
- Construction of new roads should only be considered if existing roads cannot be upgraded.
- Construction work on structures 44 - 48 of the proposed Acrux to Koring 132kV grid connection should be timed to fall outside the Verreaux's Eagle breeding season i.e. construction should not take place from April to October.

Operational phase

- Vehicle and pedestrian access to the site should be controlled and restricted to access roads to prevent unnecessary disturbance of SCC.
- Formal monitoring should be resumed once the wind turbines have been constructed, as per the most recent edition (2015) of the best practice guidelines (Jenkins *et al.* 2011). The exact time when post-construction monitoring should commence, will depend on the construction schedule, and will be agreed upon with the site operator once these timelines and a commercial operational date have been finalised.
- As a minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in Year 5, and again every five years thereafter for the operational lifetime of the facility. The exact scope and nature of the post-construction monitoring will be determined on an ongoing basis by the results of the monitoring through a process of adaptive management.
- Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels exceed pre-determined mortality thresholds, which may include measures

such as expanding the SDoD beyond the current zones, selective curtailment of turbines during specific high-risk conditions or any other practical and effective mitigation.

IMPACT STATEMENT

It is recommended that the proposed lay-out is approved subject to the implementation of the mitigation measures as detailed in the updated Environmental Management Programme (EMPr).

DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A WALK-THROUGH REPORT

See Appendix 4 for comprehensive curriculum vitae

Chris van Rooyen (Avifaunal Specialist)
Chris has decades of 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 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 (Avifaunal Specialist)
Albert has a Master of Science degree 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.

Eric Hermann (Field specialist)
Eric is a field biologist with over 10 years of experience in biodiversity research and conservation with knowledge and experience in the quantitative survey methods for estimating abundance of wildlife species, surveying bird and mammal populations with respect to demographics and movements, practical field research, with respect to bird banding and observation, and spreadsheet modelling of animal populations dynamics. Aside from research and field biology, Eric has experience in nature/bird guiding primarily within the context of biodiversity conservation. Eric holds a Masters degree in Conservation Ecology from the University of Stellenbosch.

DECLARATION BY THE SPECIALIST

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

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT AND FINAL LAYOUT FOR THE AUTHORISED 140MW SUTHERLAND WIND ENERGY FACILITY, ASSOCIATED INFRASTRUCTURE (DFFE REF: 12/12/20/1782/2/AM6) AND GRID CONNECTION INFRASTRUCTURE (DFFE REF:, 14/12/16/3/3/1/2457/AM1, 14/12/16/3/3/1/2458 AND 14/12/16/3/3/1/2077/AM2) NORTHERN & WESTERN CAPE PROVINCES

Kindly note the following:

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

Departmental Details

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

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

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

1. SPECIALIST INFORMATION

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

2. DECLARATION BY THE SPECIALIST

I, Christiaan Stephanus van Rooyen, declare that –

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

Signature of the Specialist

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

25 November 2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

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

Signature of the Specialist

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

Name of Company

25 November 2022

Date

SOUTH AFRICAN POLICE SERVICE
PLETTENBERG BAY
2022 -11- 25
PLETTENBERGBAAI
SOUTH AFRICAN POLICE SERVICE

Signature of the Commissioner of Oaths

2022/11/25

Date

1 BACKGROUND

Sutherland Wind Farm (Pty) Ltd received an Environmental Authorisation (EA) (DFFE Ref: 12/12/20/1782/2) dated (22/02/2012), for the development of a 140MW Sutherland Wind Energy Facility (WEF) and associated infrastructure near Sutherland and located within the Komsberg Renewable Energy Development Zone (REDZ) in the Northern and Western Cape Provinces, with further amendments to the EA as stated below:

- Replacement of the first issue EA Reference: 12/12/20/1782/2 issued on 10 November 2016;
- First Amendment - Amendment of Listed activities on the EA Reference: 12/12/20/1782/2/AM1 issued on 25 November 2016;
- Second Amendment – Amendment of turbine specifications & change of technical details of the proposed facility EA Reference: 12/12/20/1782/2/AM2 issued on: 25 August 2017;
- Third Amendment – Change in contact details of the holder of the EA & selected project description changes EA Reference: 12/12/20/1782/2/AM3 issued on 10 March 2020;
- Fourth Amendment - Name correction EA Reference: 12/12/20/1782/2/AM4 issued on 08 June 2020;
- Fifth Amendment – Extension and name change to SPV EA Reference 12/12/20/1782/2/AM5 issued on 20 July 2021;
- Sixth Amendment - Amendment to the co-ordinates of the access road EA Reference: 12/12/20/1782/2/AM6 issued on 06 December 2021.

The project will include (as authorised):

- Up to 34 wind turbines with a height of up to 200m and rotor diameter of up to 200m.
- The wind turbines will be connected to another by means of medium voltage cable.
- An internal gravel road network will be constructed to facilitate movement between turbines on site. These roads will include drainage and cabling.
- A hard standing laydown area of a maximum of 10 000 m^2 will be constructed; and
- A temporary site office will be constructed on site for all contractors, this would be approximately 5000m^2 in size.
- A 10km portion of the existing access road will be upgraded and widened to a width of 7 metres to facilitate abnormal loads to the Sutherland WEF site.

The properties associated with the Sutherland WEF include:

- Portion 1 of Beeren Valley Farm 150;
- Remaining Extent of Beeren Valley Farm 150;
- Portion 1 of Boschmanskloof Farm 9;
- Remaining Extent of Nooitgedacht Farm 148;

The Sutherland Wind Farm (Pty) Ltd also received EAs for a new proposed onsite substation and associated electrical grid infrastructure to support issued on 14 March 2022 for the Sutherland WEF in the Northern Cape Province of South Africa. The EA for the onsite substation has been split into an Independent Power Producer (IPP) Portion EA Reference 14/12/16/3/3/1/2458, Switching Station Portion and 132kV powerline EA Reference 14/12/16/3/3/1/2457.

The infrastructure associated with the IPP Portion of the on-site substation is located on Remaining Extent of Nooitgedacht Farm 148 and includes:

- An IPP portion of the on-site substation (Acrux);
- Laydown area;
- Operation & Maintenance (O&M) Building;

- Fencing of the proposed on-site substation; and
- Battery Energy Storage Infrastructure (BESS).

The infrastructure associated with the Switching Station Portion of the on-site substation and 132kV powerline is located on Remaining Extent of Nooitgedacht Farm 148 (DFFE Ref: 14/12/16/3/3/1/2457/AM1) includes:

- Switching Station portion of the on-site substation:
- Fencing;
- 132kV distribution line from the proposed Sutherland WEF on-site substation to the Koring Main Transmission Substation (MTS) third party substation including tower/pylon infrastructure and foundations;
- Connection to the Koring MTS third party substation; and
- Service road below the powerline.

The Sutherland Wind Farm (Pty) Ltd has also been issued with an EA for Electrical Grid Infrastructure that supports the Sutherland, Sutherland 2 and Rietrug WEF, Northern & Western Cape Provinces (Ref; 14/12/16/3/3/1/2077/AM2) authorised within a 500m grid corridor.

The infrastructure associated with the project includes:

- Koring Main Transmission Substation (MTS) including O&M building and laydown area;
- Fencing of the proposed on-site substation;
- Overhead 132kV powerline from the Sutherland WEF on-site substation to the Koring MTS;
- Overhead 400kV powerline connecting to the proposed 400kV Koring MTS and an existing 400kV Eskom powerline
- Service roads will be constructed below the powerline (jeep tracks)

The properties associated with the Electrical Grid Infrastructure to support the Sutherland WEF includes:

- Remaining extent of Hartebeeste Fontein Farm 147;
- Remaining Extent of Nooitgedacht Farm 148;
- Remaining Extent of Beeren Valley Farm 150;
- Portion 1 of Farm 219;
- Remaining extent of Farm 219;
- Remaining extent of Farm 280;
- Portion 1 of Rheebokkenfontein Farm 4;
- Portion 2 of Rheebokkenfontein Farm 4;
- Portion 2 of De Molen Farm 5;
- Portion 6 of Hamelkraal Farm 16;
- Portion 7 of Hamelkraal Farm 16; and
- Remainder of Spitzkop Farm 20

The Sutherland WEF has been awarded preferred bidder status in round 5 of the Renewable Energy IPP Procurement Programme (REIPPPP) and in order to meet financial close requirements and comply with the requirements of the EAs (as amended), as per conditions 16 and 18 which specifies that the applicant must submit a Final Layout plan and EMPr to DFFE for written approval prior to commencement of the activity.

Nala Environmental (Pty) Ltd has been commissioned to undertake the Final Layout plan and EMPr associated with the authorised WEF and its authorised grid infrastructure. As per the conditions of the relevant EAs various specialist pre-construction walkthroughs have been undertaken to inform the placement of infrastructure for the Final Layout. Chris van Rooyen Consulting was contracted by Nala Environmental to conduct the final walk-through of the proposed WEF layout and grid infrastructure to identify any avifaunal sensitivities to be considered for the final lay-out of the turbines.

2 METHODOLOGY

A four-day site inspection was conducted in late November 2021 and repeated a month later in December 2021 to record all avifaunal sensitivities on, and in the immediate vicinity of the project site, which could influence the lay-out of the turbines. Emphasis was placed on locating nests of priority species, particularly species of conservation concern (SCC), which may be impacted by the proposed WEF. The data gathered during the 12-months monitoring in 2015 -2016, an inspection of the overhead line routes in April 2019 and subsequent nests searches in June and July 2019 were also taken into account. Priority species were defined as species included on the list of priority species of the Avian Wind Farm Sensitivity Map of South Africa compiled by Birdlife South Africa (Retief *et al.* 2012).

See Figure 1 for the lay-out of the proposed WEF and associated infrastructure, and Figure 2 for the alignment of the proposed 132kV and 400kV overhead lines and the location of the proposed Koring MTS.

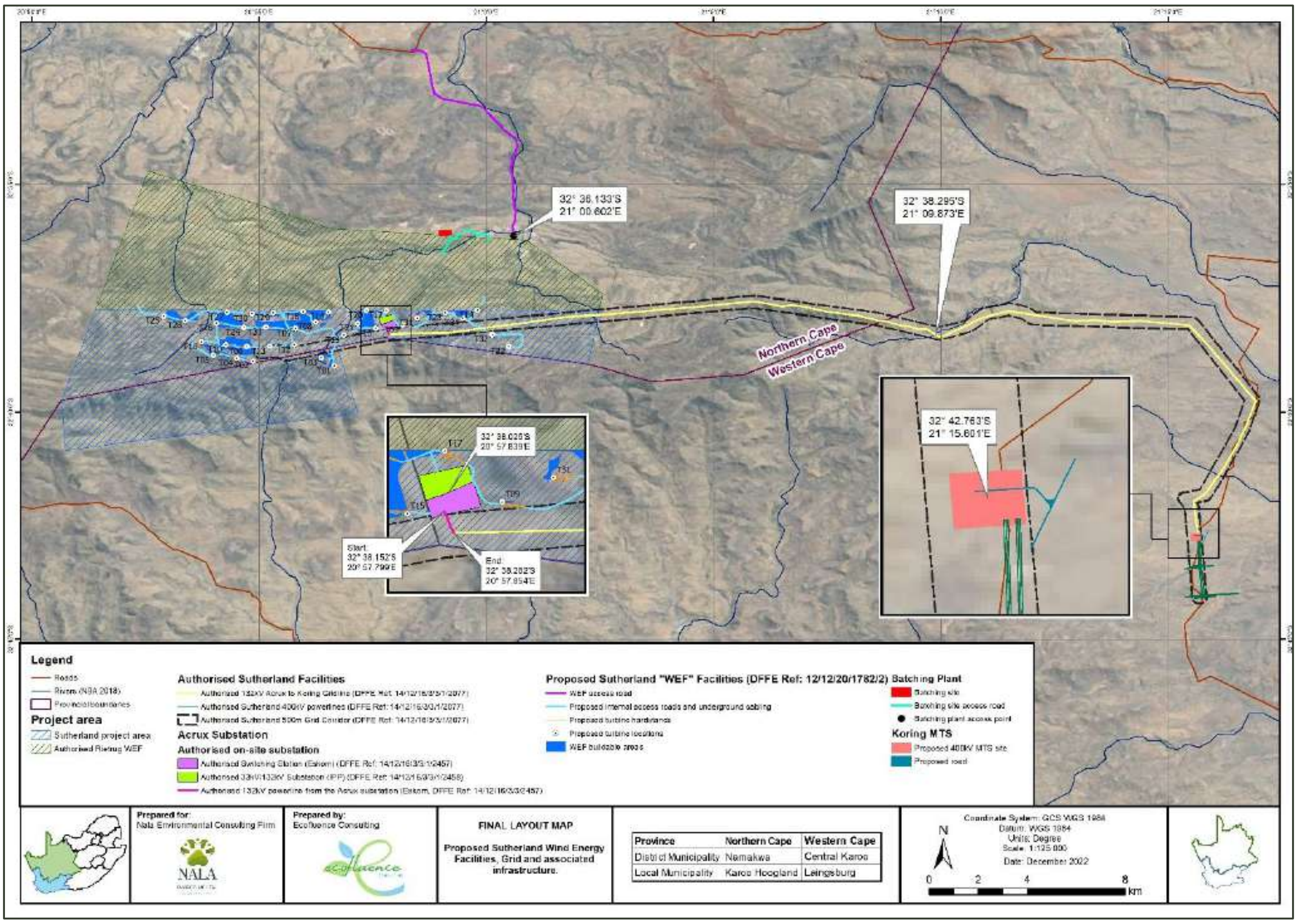

Figure 1: The proposed lay-out of the Sutherland WEF and associated infrastructure.

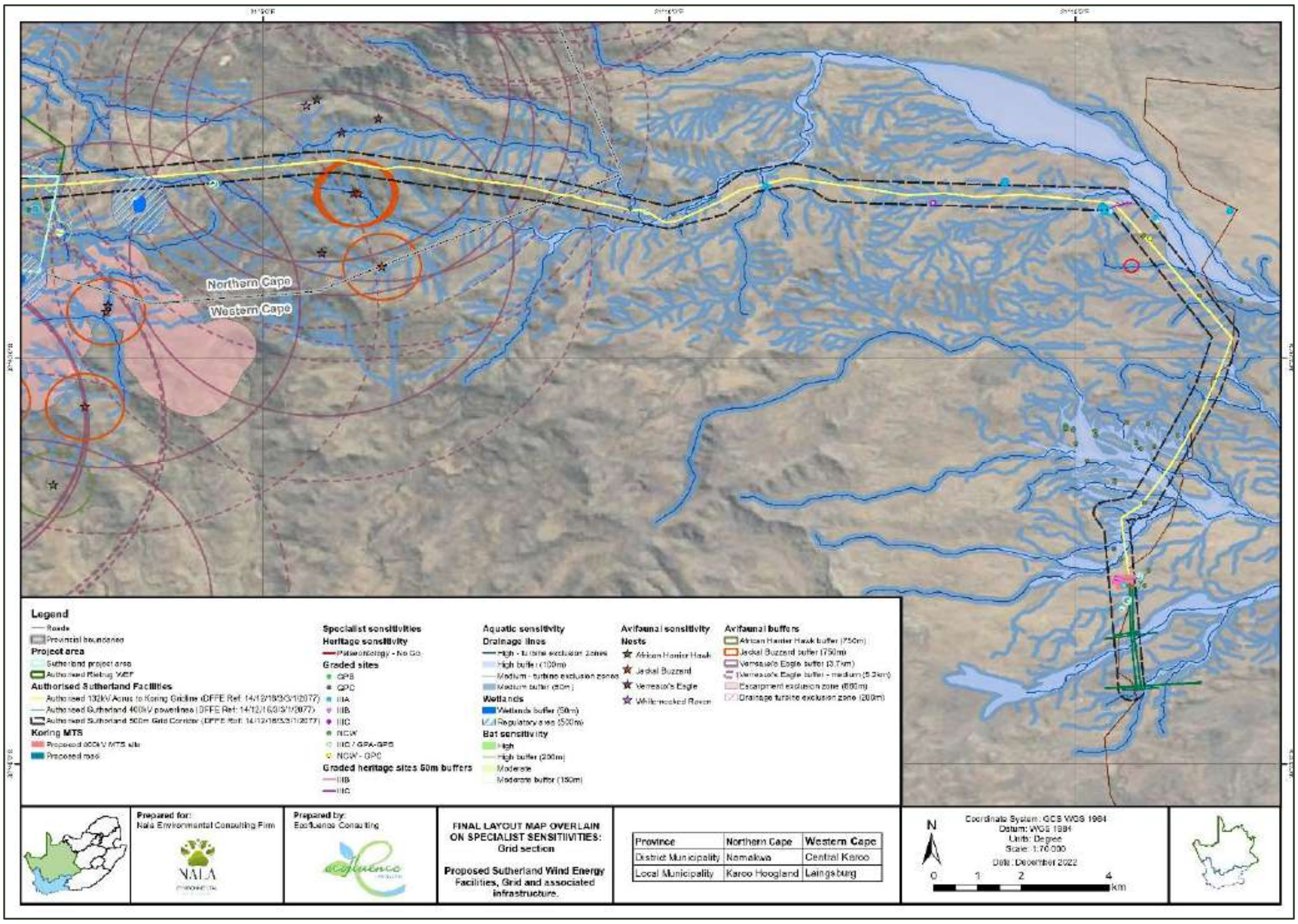

Figure 2: The alignment of the proposed 132kV and 400kV overhead lines and the location of the Koring MTS.

3 RECEIVING ENVIRONMENT

3.1 DFFE National Screening Tool

3.1.1 Avian Wind Theme

The majority of the WEF project site is classified as Medium and Low sensitivity for avifauna from a wind energy perspective. The Medium sensitivity is linked to areas with high topographic relief which is linked to the potential occurrence of cliff nesting species of conservation concern (SCC) such as Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable) Lanner Falcon *Falco biarmicus* (Regionally Vulnerable) and Black Stork *Ciconia nigra* (Regionally Vulnerable). A small section of the project site is classified as medium due to it being within 2km of major wetlands.

3.1.2 Terrestrial Animal Species Theme

The WEF project site, the on-site substation sites, and the associated 132kV overhead line corridors are classified as a mixture of **Medium** and **High** sensitivity for avifauna. The High sensitivity is linked to Southern Black Korhaan *Afrotis afra* (Globally and Regionally Vulnerable), and Verreaux's Eagle. The medium sensitivity is linked to Ludwig's Bustard *Neotis ludwigii* and Verreaux's Eagle. The Koring MTS and the 400kV overhead line corridor are classified as Medium sensitivity, but the classification is not linked to avifauna.

The project WEF site, all the substation sites and overhead line corridors contain confirmed habitat for species of conservation concern (SCC), as defined in the Protocol for the specialist assessment and minimum

report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020), namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near-threatened or Data Deficient. The occurrence of SCC was confirmed during the 12 months pre-construction monitoring in 2015 – 2016, subsequent nests searches in June and July 2019, and site inspections in November and December 2021. Verreaux's Eagle, Black Harrier *Circus maurus* (Globally and Regionally Endangered), Black Stork, Karoo Korhaan *Eupodotis vigorsii* (Regionally Near-threatened), Martial Eagle *Polemaetus bellicosus* (Globally and Regionally Near-threatened), Lanner Falcon, Southern Black Korhaan and Ludwig's Bustard (Globally and Regionally Endangered) were recorded at the WEF project site and immediate environment.
A classification of High sensitivity is suggested for all the project sites and powerline corridors, based on actual conditions recorded on the ground during multiple site surveys between 2016 and 2021.

See Appendix 1 for the DFFE screening reports.

3.2 Bird habitat

The proposed WEF is located at the junction of the Fynbos and Succulent Karoo biomes, and more specifically, at the interface between the Karoo Renosterveld and Rainshadow Valley Karoo bioregions (Mucina & Rutherford 2006). The site is situated on a plateau at an altitude of between 1600 and 1700 meters above sea-level and partially straddles the escarpment of the Klein-Roggeveld and Komsberg mountain ranges. The dominant vegetation type in the proposed WEF project site is Roggeveld Shale Renosterveld (Mucina & Rutherford 2006). This vegetation type occurs on undulating, plateau landscapes with low hills and broad shallow valleys, supporting mainly moderately tall shrublands dominated by renosterbos, with rich geophytic flora in the wetter and rocky habitats. The climate is quite severe, with about 170 mm of rain per annum, falling mostly in winter, with mean winter minimum and summer maximum temperatures of 0˚C and 29˚C respectively (Mucina & Rutherford 2006). There are several artificial impoundments on the plateau as well as a number of natural, flat depressions which hold water after good rains. There are also a number of drainage lines traversing the plateau with associated wetland areas. The principal land-use is sheep farming. The dominant vegetation type on the plains below the plateau where the proposed Koring MTS and associated overhead lines will be located is Gamka Karoo which consists of dwarf spiny shrubland dominated by Karoo dwarf shrubs (e.g. *Chrysocoma ciliata, Eriocephalus ericoides*) with rare low trees (e.g. *Euclea undulata*). Dense stands of drought-resistant grasses (*Stipagrostis, Aristida*) cover (especially after abundant rains) broad sandy bottomlands (Mucina & Rutherford 2006). Stands of alien trees, mostly Eucalyptus, are present at dwellings.

See Appendix 2 for images of the habitat at the project sites and overhead line corridors.

4 RESULTS AND CONCLUSIONS

4.1 Avifauna

Appendix 3 lists the species Van Rooyen *et al*. (2016) recorded during a year of pre-construction monitoring in 2015 -2016 at the WEF site. Table 1 lists the wind priority species that have been recorded at the WEF project site and immediate environment during the walk-through exercises in November and December 2021.

Table 1: Avifauna recorded during surveys at the WEF project site and immediate environment in November and December 2021. SCC are shaded.

Species	Taxonomic name	Global Red Data status IUCN	Regional Red Data status SA
African Pipit	*Anthus cinnamomeus*		

Species	Taxonomic name	Global Red Data status IUCN	Regional Red Data status SA
African Red-eyed Bulbul	*Pycnonotus nigricans*		
African Rock Pipit	*Anthus crenatus*	LC	NT
Alpine Swift	*Tachymarptis melba*		
Barn Swallow	*Hirundo rustica*		
Black Harrier	*Circus maurus*	EN	EN
Black-eared Sparrow-Lark	*Eremopterix australis*		
Black-headed Canary	*Serinus alario*		
Blacksmith Lapwing	*Vanellus armatus*		
Bokmakierie	*Telophorus zeylonus*		
Cape Bunting	*Emberiza capensis*		
Cape Clapper Lark	*Mirafra apiata*		
Cape Eagle-Owl	*Bubo capensis*		
Cape Penduline Tit	*Anthoscopus minutus*		
Cape Sparrow	*Passer melanurus*		
Cape Turtle Dove	*Streptopelia capicola*		
Cape Wagtail	*Motacilla capensis*		
Capped Wheatear	*Oenanthe pileata*		
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*		
Common Starling	*Sturnus vulgaris*		
Common Waxbill	*Estrilda astrild*		
Crowned Lapwing	*Vanellus coronatus*		
Egyptian Goose	*Alopochen aegyptiaca*		
Fairy Flycatcher	*Stenostira scita*		
Familiar Chat	*Oenanthe familiaris*		
Greater Kestrel	*Falco rupicoloides*		
Greater Striped Swallow	*Cecropis cucullata*		
Grey Tit	*Melaniparus afer*		
Grey-backed Cisticola	*Cisticola subruficapilla*		
Grey-winged Francolin	*Scleroptila afra*		
Ground Woodpecker	*Geocolaptes olivaceus*		
Hadeda	*Bostrychia hagedash*		
House Sparrow	*Passer domesticus*		
Jackal Buzzard	*Buteo rufofuscus*		
Karoo Chat	*Emarginata schlegelii*		
Karoo Eremomela	*Eremomela gregalis*		
Karoo Korhaan	*Eupodotis vigorsii*		
Karoo Lark	*Calendulauda albescens*		
Karoo Long-billed Lark	*Certhilauda subcoronata*		
Karoo Prinia	*Prinia maculosa*		
Karoo Scrub Robin	*Cercotrichas coryphoeus*		
Large-billed Lark	*Galerida magnirostris*		
Lark-like Bunting	*Emberiza impetuani*		
Layard's Tit-Babbler	*Sylvia layardi*		
Little Swift	*Apus affinis*		
Long-billed Crombec	*Sylvietta rufescens*		
Ludwig's Bustard	*Neotis ludwigii*	EN	EN
Malachite Sunbird	*Nectarinia famosa*		
Mountain Wheatear	*Myrmecocichla monticola*		
Namaqua Dove	*Oena capensis*		
Namaqua Sandgrouse	*Pterocles namaqua*		
Nicholson's Pipit	*Anthus nicholsoni*		
Pale Chanting Goshawk	*Melierax canorus*		
Pale-winged Starling	*Onychognathus nabouroup*		

Species	Taxonomic name	Global Red Data status IUCN	Regional Red Data status SA
Pied Crow	*Corvus albus*		
Pied Starling	*Lamprotornis bicolor*		
Red-capped Lark	*Calandrella cinerea*		
Red-winged Starling	*Onychognathus morio*		
Rock Dove	*Columba livia*		
Rock Kestrel	*Falco rupicolus*		
Rock Martin	*Ptyonoprogne fuligula*		
Ruff	*Calidris pugnax*		
Rufous-eared Warbler	*Malcorus pectoralis*		
Sickle-winged Chat	*Emarginata sinuata*		
South African Shelduck	*Tadorna cana*		
Southern Fiscal	*Lanius collaris*		
Southern Masked Weaver	*Ploceus velatus*		
Speckled Pigeon	*Columba guinea*		
Spike-heeled Lark	*Chersomanes albofasciata*		
Unidentified	*Unidentified*		
Verreaux's Eagle	*Aquila verreauxii*	VU	LC
White-backed Mousebird	*Colius colius*		
White-necked Raven	*Corvus albicollis*		
White-rumped Swift	*Apus caffer*		
White-throated Canary	*Crithagra albogularis*		
White-throated Swallow	*Hirundo albigularis*		
Yellow Canary	*Crithagra flaviventris*		
Yellow-bellied Eremomela	*Eremomela icteropygialis*		

4.2 Nests

The nests of SCC that were recorded during the site surveys to date are discussed below.

4.2.1 Verreaux's Eagle

- The latest version of the BLSA Verreaux's Eagle (VE) guidelines (Ralston-Patton & Murgatroyd 2021) require that all Verreaux's Eagle nests are buffered regardless of whether the nest is active at the time of the monitoring (i.e. containing an egg of nestling), because the nest is an indication of an occupied territory, or a vacant territory which could be occupied in future.
- The VE guidelines recommend the application of the VERA model in addition to the conventional monitoring, to determine high risk areas that need to be avoided by wind turbines.
- Alternatively, should VERA not be applied, the VE guidelines recommend that a minimum 3.7km **high risk** turbine exclusion zone should be placed around all nests where no turbines should be located. In addition, all turbines in the area >3.7km up to 5.2km should be regarded as **medium-risk** and relocated if possible. Should relocation not be feasible, these turbines should be subject to pro-active mitigation in the form of a proven mitigation method such as Shutdown on Demand (SDoD), using either biomonitors or an automated system such as IdentiFlight.
- In addition, the Verreaux's Eagle guidelines require all areas of high risk such as ridges where high flight activity can be expected, to be designated as a **high-risk** turbine exclusion zones.

- A total of ten Verreaux's Eagle nests have been recorded on the escarpment edge within 5.2km of the proposed turbine layout[1].
- High risk: The applicant adjusted the turbine layout to accommodate a 3.7km turbine exclusion zone as required by the latest edition (2021) of the Verreaux's Eagle guidelines. In addition, a turbine exclusion zone of 660m along the escarpment was also implemented.
- Medium-risk: Turbines to be subject to mitigation such as Shutdown on Demand (SDoD), using either biomonitors or an automated system such a IdentiFlight within the 3.7 – 5.2km zone around the VE nests.
- There is one VE nest which is situated less than 1km from the proposed grid (closest distance 640m = see below). 1km is the recommended no-disturbance buffer in the VE guidelines. The poles that are implicated are 44 – 48. However, it is obvious that there are technical constrains in this instance, because shifting the line 1km south would result in the line moving over the escarpment. It is therefore recommended that construction work on structures 44 - 48 of the proposed Acrux to Koring 132kV grid connection should be timed fall outside the Verreaux's Eagle breeding season i.e. construction should not take place from April to October.

See Figure 6 for a consolidated map of recommended buffer zones, including the Verreaux's Eagle buffer zones.

4.2.2 Black Harrier

During the walk-through exercise in November/December 2021 the nest of a pair of Black Harriers were discovered in a drainage line close to the project site. This was a surprise finding, for the following reasons:

- The DFFE screening tool, which is based on the habitat suitability models (HSM) developed by BirdLife SA, does not mention the species. The breeding HSM for Black Harrier classifies the project site and surrounding habitat as unsuitable for the species (see Figures 4 and 5).
- Black Harrier received a site-specific collision risk rating of 0 during the pre-construction monitoring which was performed in 2015 – 2016, due to low flight activity. The recorded Black Harrier flight activity amounted to 10 minutes and 11 seconds, all below rotor height, during 420 hours of vantage point watches at nine vantage points, i.e. 2.5% of the total flight time recorded for priority species (6 hours, 45 minutes and 56 seconds).
- A desktop-based Critical Habitat Assessment was conducted for the entire Sutherland buildable area using the guidelines for Critical Habitat determination in Guidance Note 6 of Performance Standard 6 (PS 6) of the International Finance Corporation (SLR 2022). A list of all potentially occurring threatened, restricted-range and migratory / congregatory species, including Black Harrier, was compiled based on the detailed literature review. These species were assessed against the quantitative thresholds in PS 6 for criteria 1, 2 and 3. It was concluded that the project site does not fulfil the criteria for classification as Critical Habitat for Black Harrier.

The Black Harrier guidelines require a buffer of 3 – 5km around a Black Harrier nest. If this were to be applied, it will constitute a fatal flaw for the project. The applicant has diligently applied all the required buffer zones to date, including those which were published after the original authorisation. In this instance, given the marginal suitability of the habitat at the project site, a more effective mitigation strategy to buffering an isolated nest, would be to secure land off site in the core Black Harrier breeding habitat, which is constantly under pressure due to the threat of habitat transformation as a result of agricultural activity. The aim of the off-set

[1] A circular area with a radius of 5.2km around an active nest covers approximately 84% of the space used by the breeding pair. According to Murgatroyd et al. 2021, there is a low risk of turbine collisions beyond 5.2km from an active nest.

will be to preserve core breeding habitat for a number of pairs in perpetuity. In this way the species would ultimately benefit more in the long term than through the buffering an isolated nest in marginal / unsuitable breeding habitat. This is especially important because there is a real possibility that the birds might not breed in the exact same locality again for several years (Garcia – Heras *et al*. 2019), given the marginal nature of the habitat, which would make the buffering of the nest a relatively ineffective exercise.

In a study of the breeding biology of the species, Garcia - Heras *et al.* 2016 postulated that due to climatic variability in interior mountain regions, conditions may not be suitable for breeding in some years, whereas in the core breeding areas in coastal regions, environmental conditions are more stable throughout the harrier breeding season. Thus, the more stable weather conditions and the associated availability of their preferred rodent prey base for breeding (Garcia-Heras *et al.* 2019) in the core coastal breeding habitat within and among years may mean that it is overall a safer choice for Black Harriers to breed there than in the interior mountain regions. It therefore makes more sense to direct conservation efforts there. It must be stressed that this is an exceptional situation and therefore justifies a deviation from the normal mitigation hierarchy.

An 800m all infrastructure exclusion zone is however recommended around the nest as a pre-cautionary measure against displacement / disturbance of the breeding pair during the construction phase.

Figure 3: The location of the Black Harrier nest discovered during nest searches in November 2021. The map also shows the project site buffered by 5km (white polygon) against the backdrop of the BirdLife SA Black Harrier habitat suitability model. The model does not indicate any suitable breeding habitat within 5km of the project site. The closest patch of suitable habitat (classified as lower suitability) is an isolated patch 12.5km away from the closest planned turbine (red arrow).

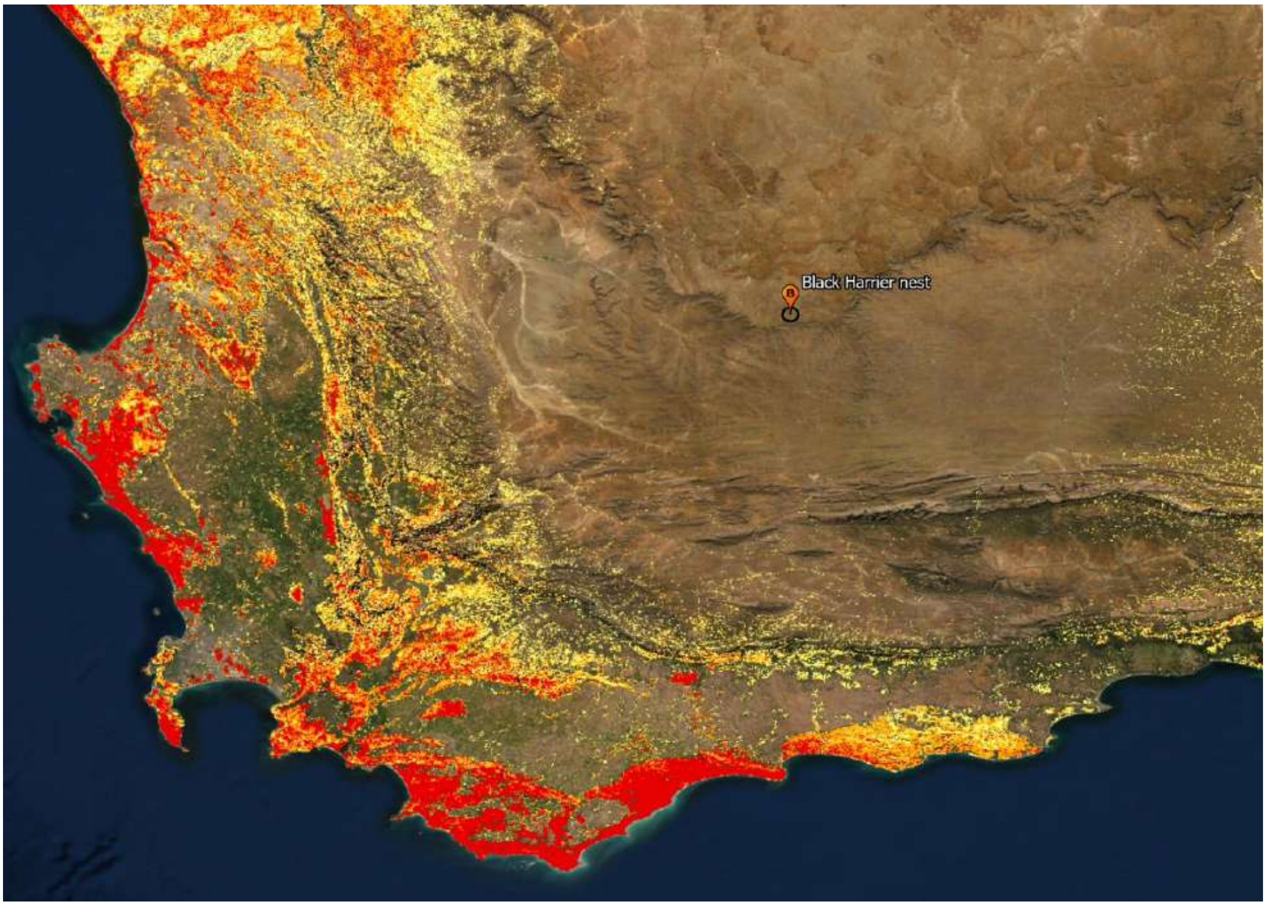

Figure 4: The location of the Black Harrier nest in relation to the Black Harrier habitat suitability model for the wider area, indicating suitable habitat for breeding. The shading from yellow to red indicates an increase in breeding habitat suitability. The rest is classified as marginal / unsuitable habitat.

See Figure 6 for a consolidated map of recommended buffer zones, including the Black Harrier buffer zone.

4.3 Other sensitivities

Surface water (drainage lines and dams) is crucially important for priority avifauna including all SCC in this dry climate. It is important to leave open space with no obstructions for birds to access and leave the surface water area unhindered. It is therefore required to exclude turbines around these sources of surface water. The avifaunal turbine exclusion zones were derived from the buffer zones proposed by the aquatic and bat specialists, as these were assessed to equally effective for the avifauna.

See Figure 6 for a consolidated map of recommended buffer zones, including the surface water buffer zones.

5 RECOMMENDATIONS

The recommendations below are put forward for inclusion in the Final Environmental Management Programme (EMPr) for the wind energy facility. These recommendations are based on the data gathered during the 12-months monitoring in 2015 - 2016, powerline route investigations in April 2019, subsequent nests searches in June and July 2019, the walk-through exercises undertaken in November and December 2021 and the Critical Habitat Assessment compiled in September 2022. These recommendations replace the recommendations contained in the original Avian Impact Assessment Report (Jenkins 2011), which are now outdated:

5.1 Design phase

- A 3.7km turbine exclusion zone must be implemented around identified Verreaux's Eagle nests, and a 660m turbine exclusion zone along the escarpment (Figure 2).
- A programme of observer-based or automated Shutdown on Demand (SDoD) to reduce potential Verreaux's Eagle turbine collisions must be implemented within the 3.7 – 5.2km medium-risk buffer zone.
- All drainage lines and dams should be buffered as turbine exclusion zones, using the buffer distances recommended by the aquatic and bat specialists.
- All internal 33kV medium voltage cables are to be buried if technically possible.
- Those sections where the 33kV medium voltage cable cannot be trenched due to technical or environmental reasons, but needs to run on overhead poles, the proposed pole designs must be approved by the avifaunal specialist, to ensure that the designs are raptor-friendly.
- Bird flight diverters are to be fitted to all internal overhead lines, as well as all the spans of the proposed 132kV and 400kV overhead lines, according to the applicable Eskom Engineering Instruction.
- The applicant must engage recognised NGO role players in Black Harrier conservation (e.g. the Overberg Renosterveld Conservation Trust), as well as experts in the design and implementation of conservation off-sets (e.g. Conservation Outcomes) to assist them with designing and implementing a strategy for off-setting potential impacts on the breeding pair of Black Harriers (discovered during November 2021) at the project site. This strategy must have as objective the securing of measures in the core Black Harrier breeding areas to ensure a nett gain for the population in in perpetuity. The off-set plan must be implemented before the wind farm commences with operations.
- An 800m all infrastructure exclusion zone must be implemented around the Black Harrier nest to prevent potential disturbance of the breeding pair.
- It is recommended that all turbines within 5km of the Black Harrier nest (-32.622000° 20.887000°) have 2/3 of one blade painted in signal red or black. It is acknowledged that blade painting as a mitigation strategy is still in an experimental phase in South Africa, but research indicates that it has a very good chance of reducing raptor mortality, based on research conducted in Norway (see Simmons *et al*. 2021 (Appendix 5) for an explanation of the science and research behind this mitigation method).

5.2 Construction phase

- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible, and in particular to the proposed road network. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of SCC.
- Removal of vegetation must be restricted to a minimum.
- Construction of new roads should only be considered if existing roads cannot be upgraded.
- Construction work on structures 44 - 48 of the proposed Acrux to Koring 132kV grid connection should be timed fall outside the Verreaux's Eagle breeding season i.e. construction should not take place from April to October.

5.3 Operational phase

- Vehicle and pedestrian access to the site should be controlled and restricted to access roads to prevent unnecessary disturbance of SCC.
- Formal monitoring should be resumed once the turbines have been constructed, as per the most recent edition (2015) of the best practice guidelines (Jenkins *et al.* 2011). The exact time when post-

construction monitoring should commence, will depend on the construction schedule, and will be agreed upon with the site operator once these timelines and a commercial operational date have been finalised.

- As a minimum, post-construction monitoring should be undertaken for the first two years of operation, and then repeated again in Year 5, and again every five years thereafter for the operational lifetime of the facility. The exact scope and nature of the post-construction monitoring will be determined on an ongoing basis by the results of the monitoring through a process of adaptive management.
- Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels exceed pre-determined mortality thresholds, which may include measures such as expanding the SDoD beyond the current zones, selective curtailment of turbines during specific high-risk conditions or any other practical and effective mitigation.

6 IMPACT STATEMENT

It is recommended that the lay-out is approved, subject to the implementation of the mitigation measures as detailed in the updated Environmental Management Programme (EMPr) for the wind energy facility and Generic EMPrs for the grid connection infrastructure.

7 REFERENCES

- Garcia-Heras M-S, Arroyo B, Mougeot F, Amar A, Simmons RE (2016) Does timing of breeding matter less where the grass is greener? Seasonal declines in breeding performance differ between regions in an endangered endemic raptor. Nature Conservation 15: 23–45. doi: 10.3897/natureconservation.15.9800
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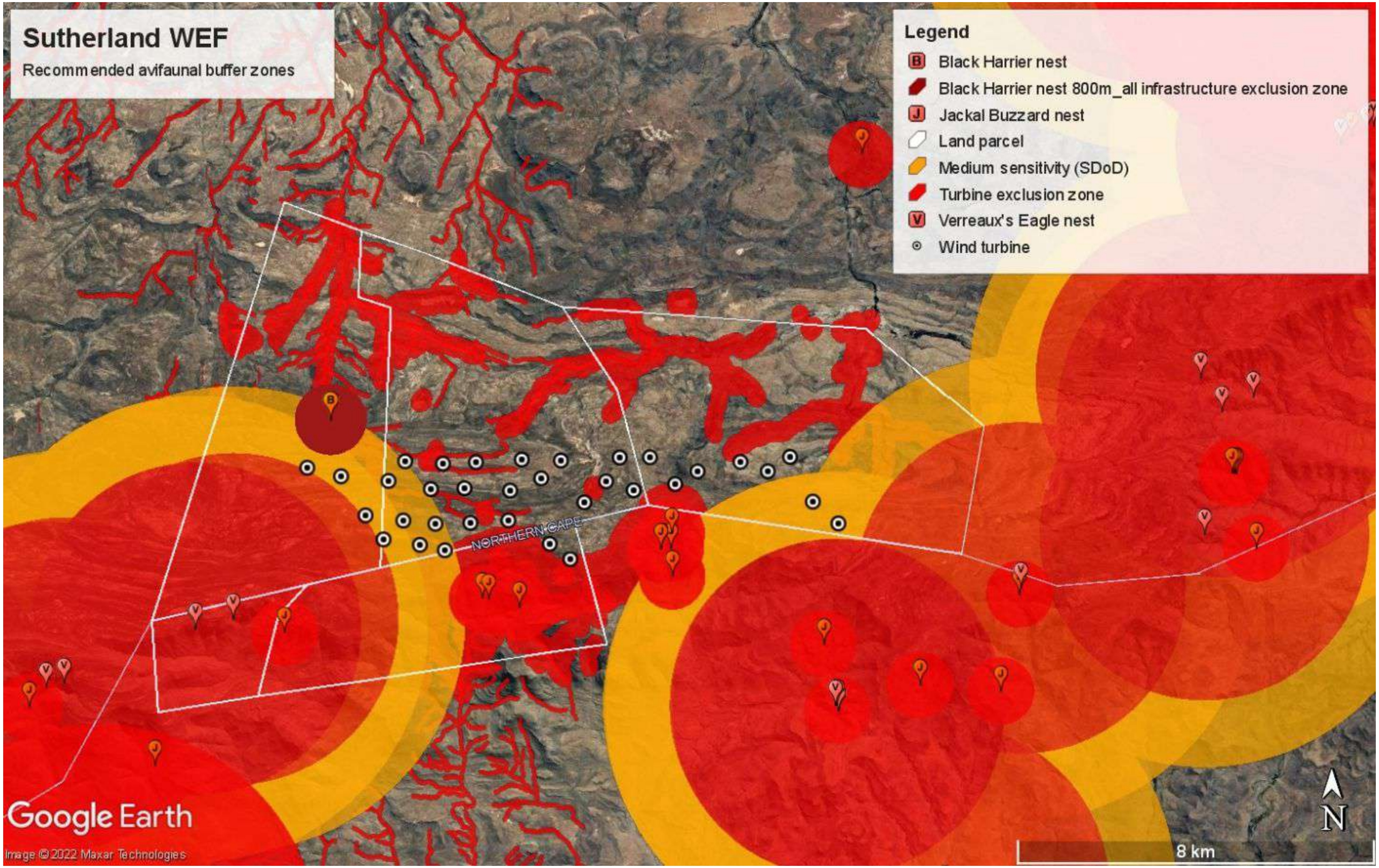
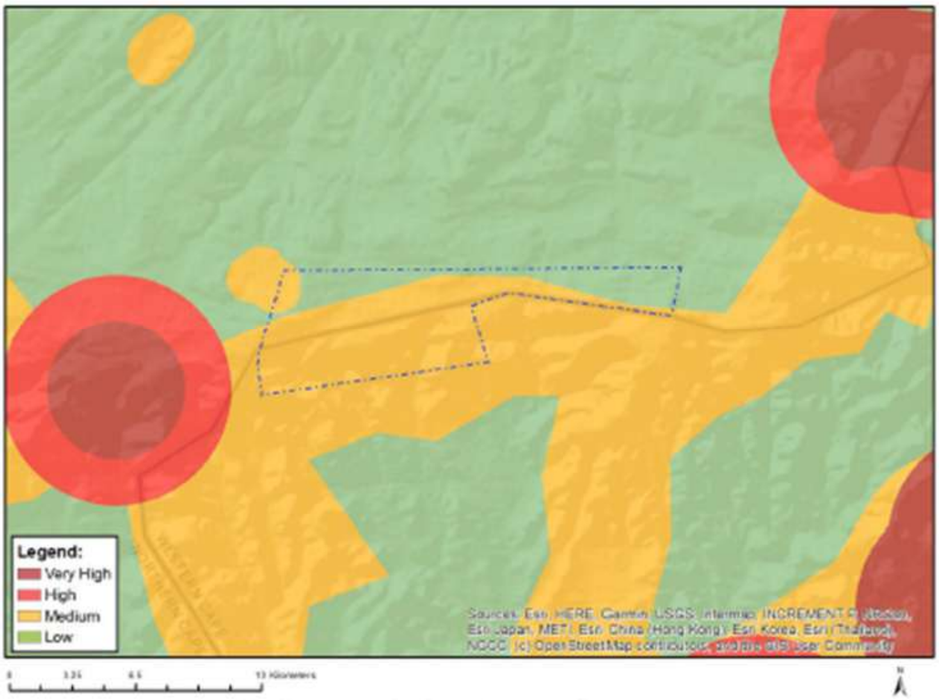


Figure 5: The recommended avifaunal buffer zones

APPENDIX 1: DFFE SCREENING REPORTS

Project name: 140MW Sutherland Wind Energy Facility, Northern and Western Cape Provinces

MAP OF RELATIVE AVIAN (WIND) THEME SENSITIVITY



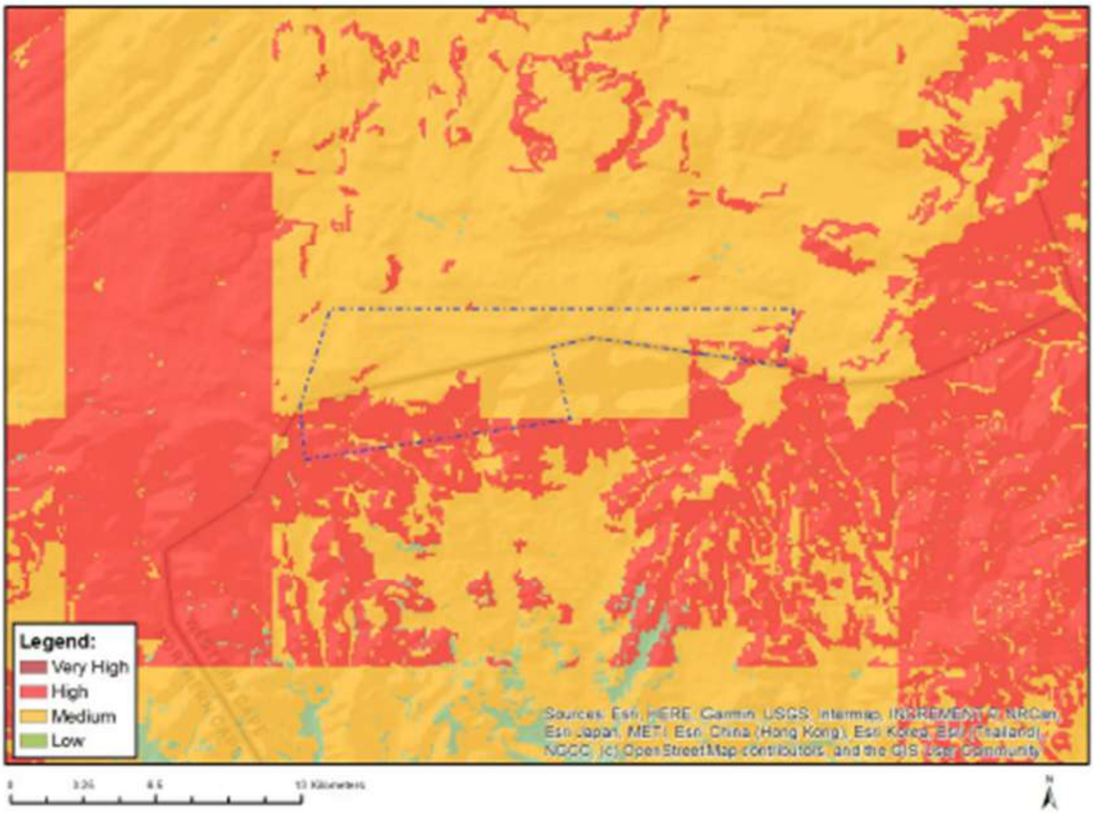
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Area Outside Sensitivities
Medium	only areas with high topographic relief
Medium	within 2 km of major wetlands

Project name: 140MW Sutherland Wind Energy Facility, Northern and Western Cape Provinces

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

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

Project name: 132kV Powerline associated with the Eskom portion of the Acrux on-site substation, Northern Cape Province

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

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

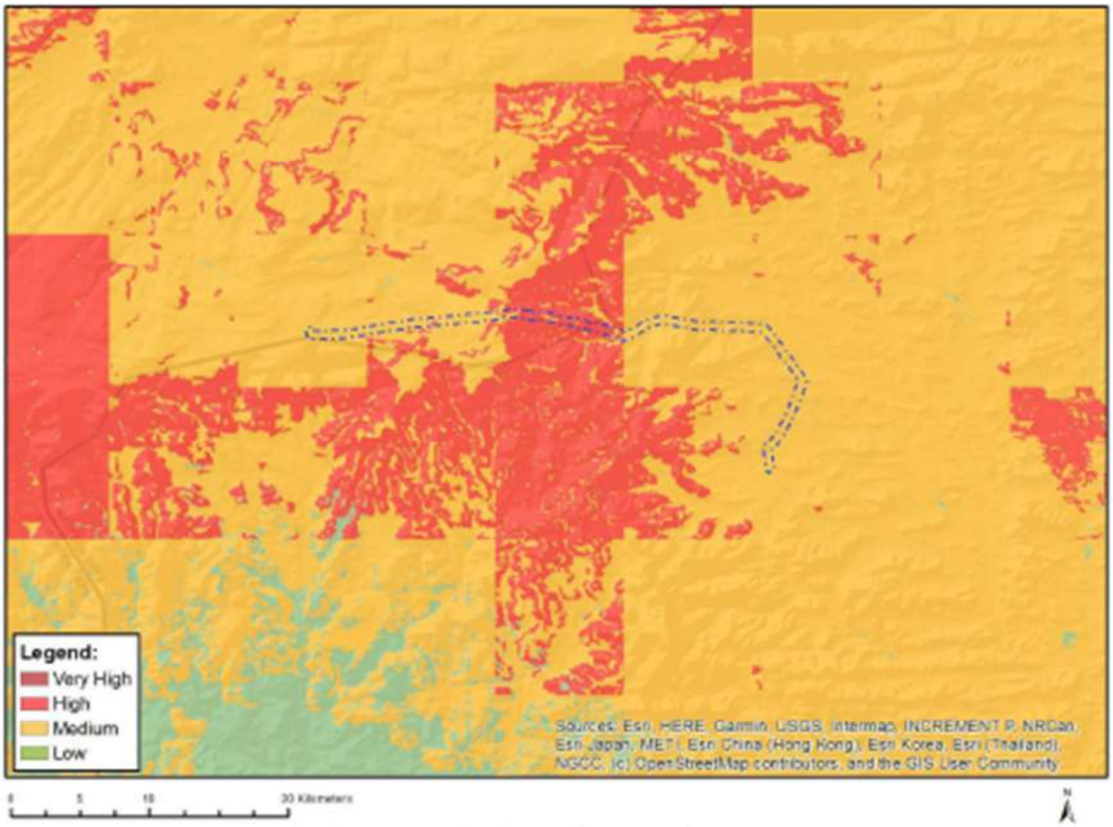
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Neotis ludwigii
Medium	Reptilia-Chersobius boulengeri

Project name: 132kV Powerline to support the Sutherland and Rietrug Wind Energy Facilities, Northern and Western Cape Provinces

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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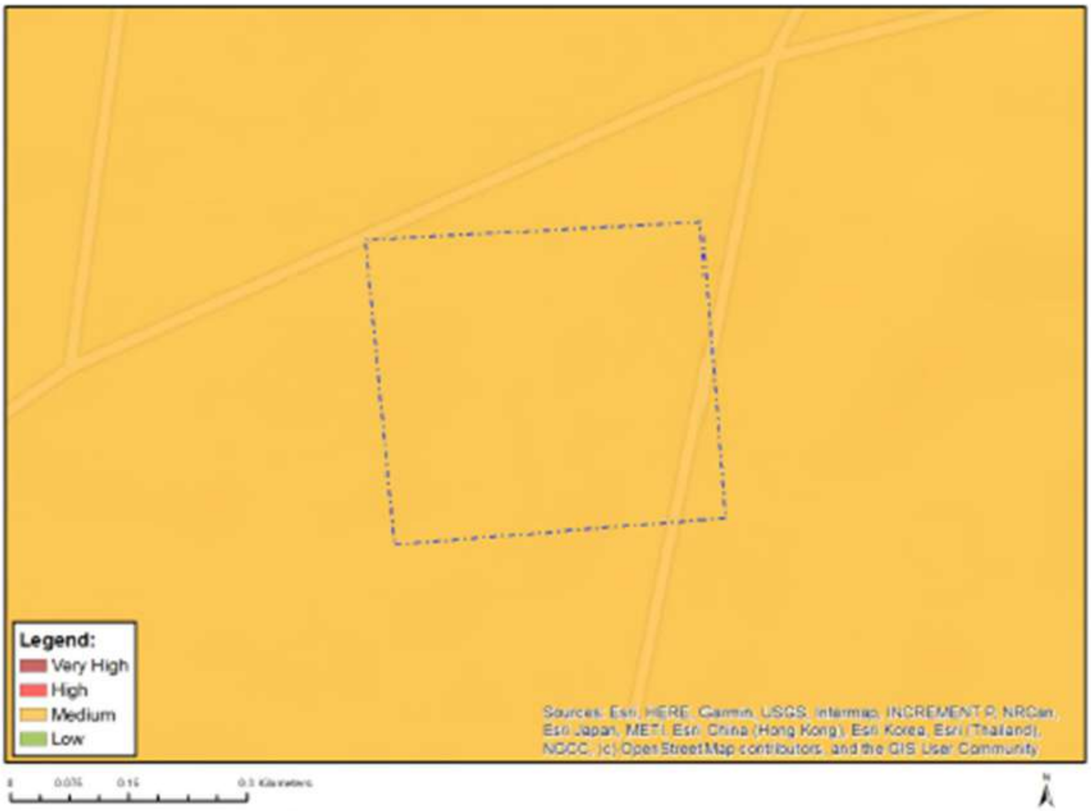
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Aquila verreauxii
Medium	Aves-Neotis ludwigii
Medium	Aves-Aquila verreauxii
Medium	Mammalia-Bunolagus monticularis
Medium	Reptilia-Chersobius boulengeri

Project name: 400kV Koring MTS associated with Sutherland and Rietrug WEF Electrical Grid Infrastructure, Western Cape Province

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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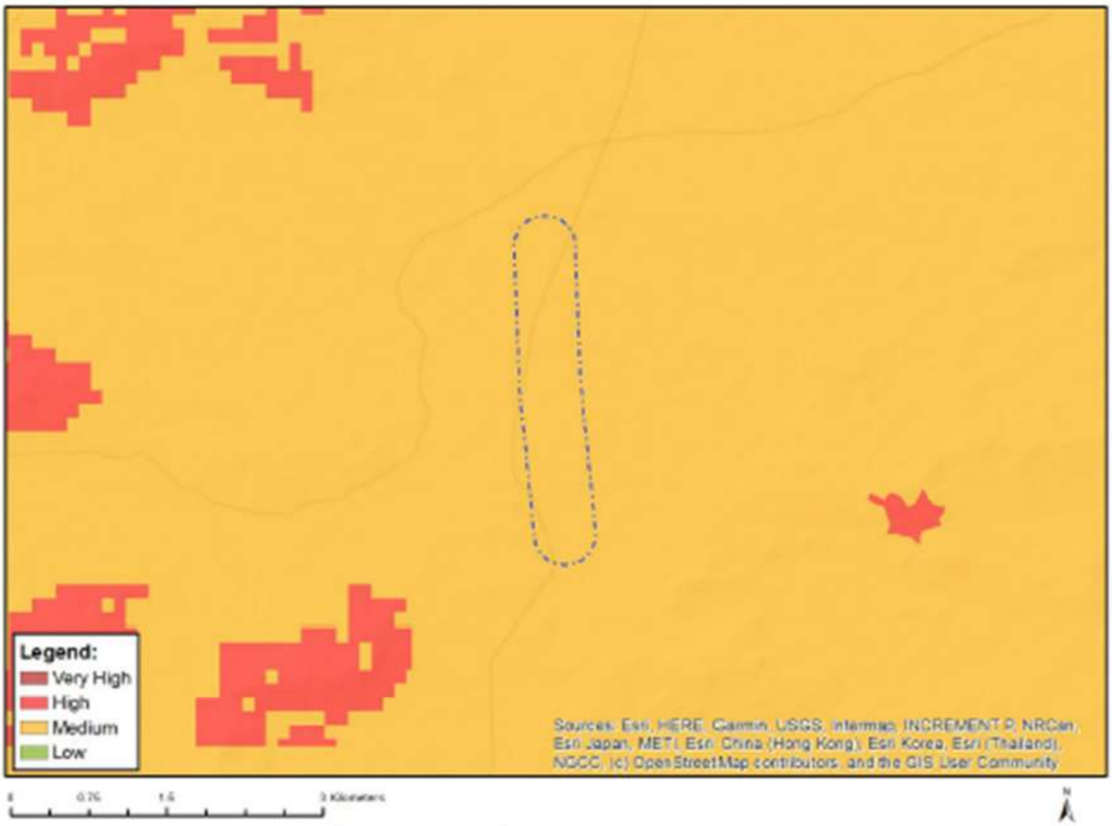
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Reptilia-Chersobius boulengeri

Project name: 400kV Powerline associated with the Sutherland and Rietrug WEFs Electrical Grid Infrastructure, Western Cape Province

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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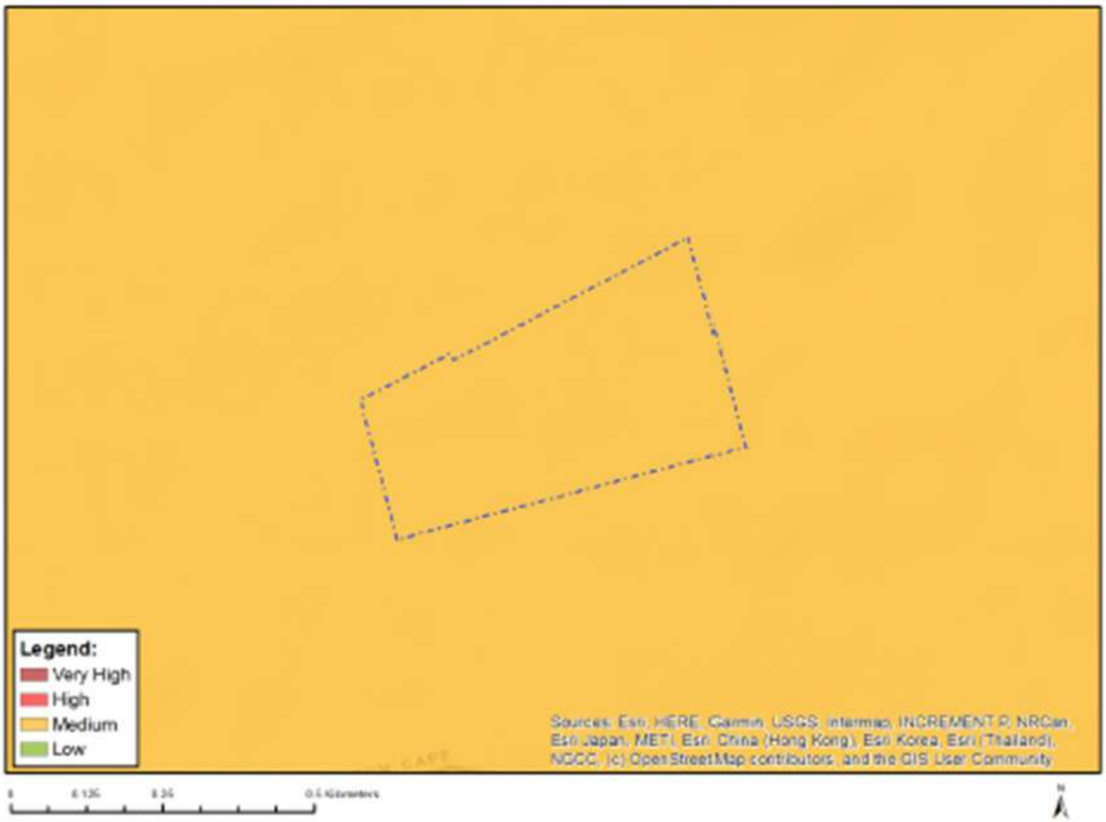
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Reptilia-Chersobius boulengeri

Project name: Eskom portion of the 33/132kV Acruc on-site substation, Northern Cape Province

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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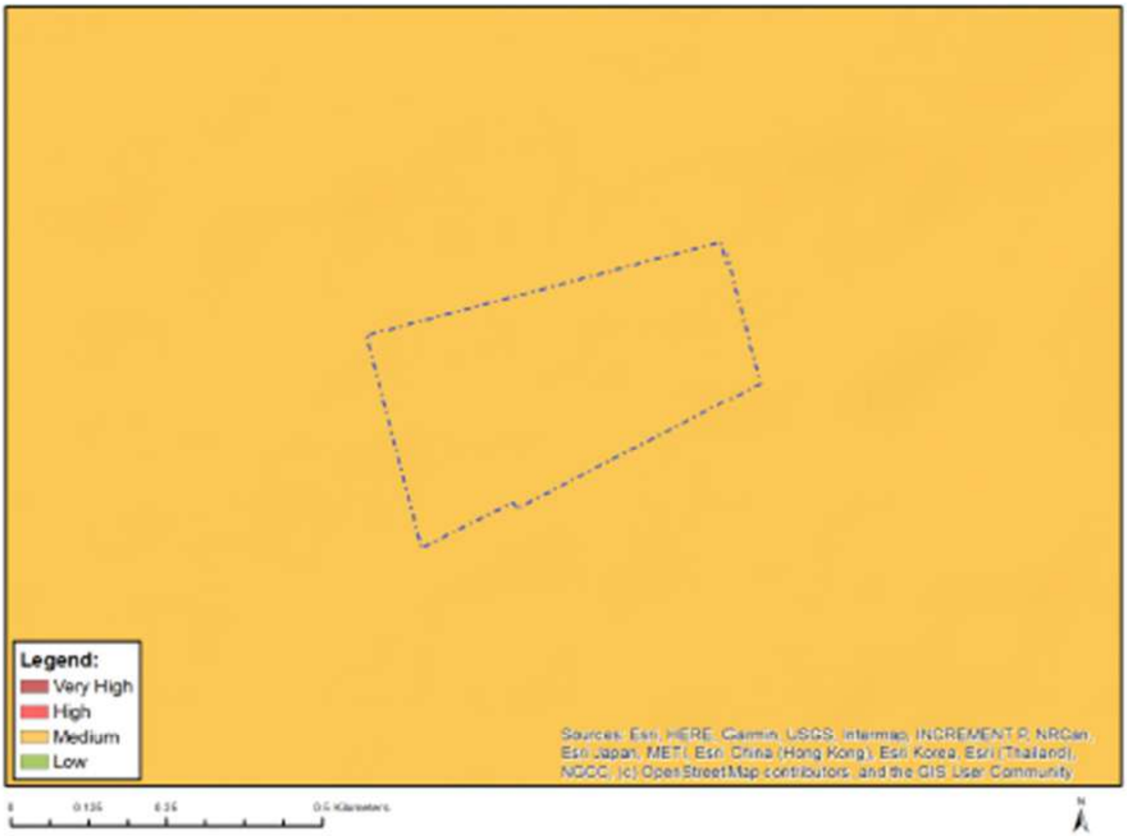
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Neotis ludwigii
Medium	Reptilia-Chersobius boulengeri

Project name: IPP portion of the 33kV/132kV Acrux on-site susbstation, Northern Cape Province

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Neotis ludwigii
Medium	Reptilia-Chersobius boulengeri

APPENDIX 2: BIRD HABITAT

Figure 1: Typical Roggeveld Shale Renosterveld vegetation on the plateau above the Komsberg mountains at the WEF project site.

Figure 2: A drainage line on the plateau at the WEF project site

Figure 3: South-facing cliffs along the escarpment at the WEF project site.

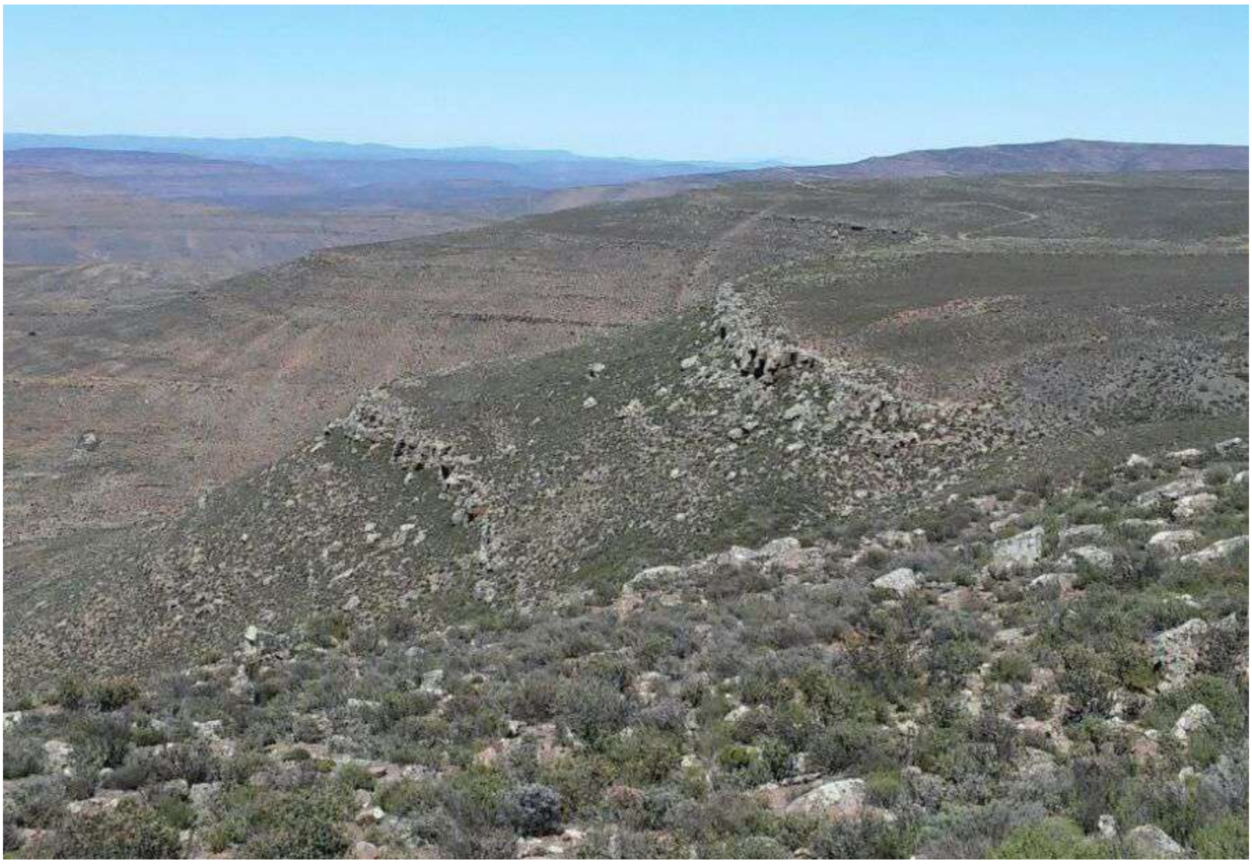

Figure 4: The edge of the escarpment, showing the vegetation and exposed ridge lines at the WEF project site.

Figure 5: A example Gamka Karoo at the site of the proposed Koring MTS.

Figure 6: An ephemeral waterbody near the proposed 400kV line.

APPENDIX 3: SPECIES LIST PRE-CONSTRUCTION MONITORING 2015 – 2016

Priority Species	**Scientific Name**	**Turbine**	**Control**	**VP**	**Ctrl VP**	**Incidental**	
Black Harrier	*Circus maurus*	*		*		*	
Black Stork	*Ciconia nigra*					*	
Black-chested Snake-Eagle	*Circaetus pectoralis*		*	*	*	*	
Booted Eagle	*Aquila pennatus*	*		*		*	
Cape Eagle-Owl	*Bubo capensis*					*	
Greater Flamingo	*Phoenicopterus ruber*		*				
Grey-winged Francolin	*Scleroptila africanus*	*	*			*	
Jackal Buzzard	*Buteo rufofuscus*	*	*	*	*	*	
Karoo Korhaan	*Eupodotis vigorsii*	*		*		*	
Lanner Falcon	*Falco biarmicus*		*	*			
Ludwig's Bustard	*Neotis ludwigii*	*		*		*	
Martial Eagle	*Polemaetus bellicosus*		*	*		*	
Peregrine Falcon	*Falco peregrinus*			*			
Sclater's Lark	*Spizocorys sclateri*		*				
Southern Black Korhaan	*Afrotis afra*					*	
Southern Pale Chanting Goshawk	*Melierax canorus*	*	*	*		*	
Spotted Eagle-Owl	*Bubo africanus*					*	
Steppe Buzzard	*Buteo vulpinus*	*		*			
Verreaux's Eagle	*Aquila verreauxii*		*	*	*	*	
19	**Total:**	**8**	**9**	**12**	**3**	**14**	
Non-Priority Species		**Turbine**	**Control**	**VP**	**Ctrl VP**	**Incidental**	**Focal points**
African Black Duck	*Anas sparsa*	*					
African Pipit	*Anthus cinnamomeus*	*	*				
Barn Swallow	*Hirundo rustica*	*	*				
Black-eared Sparrowlark	*Eremopterix australis*	*					
Black-headed Canary	*Serinus alario*	*	*				
Black-headed Heron	*Ardea melanocephala*	*	*				
Blacksmith Lapwing	*Vanellus armatus*	*	*				*
Bokmakierie	*Telophorus zeylonus*	*	*				
Cape Bulbul	*Pycnonotus capensis*	*					
Cape Bunting	*Emberiza capensis*	*	*				
Cape Clapper Lark	*Mirafra apiata*	*	*				
Cape Crow	*Corvus capensis*	*					
Cape Penduline-Tit	*Anthoscopus minutus*	*	*				
Cape Shoveler	*Anas smithii*		*				
Cape Sparrow	*Passer melanurus*	*	*				
Cape Spurfowl	*Pternistis capensis*	*	*				
Cape Teal	*Anas capensis*		*				
Cape Turtle-Dove	*Streptopelia capicola*	*	*				
Cape Wagtail	*Motacilla capensis*	*	*				*
Capped Wheatear	*Oenanthe pileata*	*	*				
Cinnamon-breasted Bunting	*Emberiza tahapisi*	*					
Common Fiscal	*Lanius collaris*	*	*				
Common Greenshank	*Tringa nebularia*						*
Common Starling	*Sturnus vulgaris*		*				
Common Swift	*Apus apus*	*	*				
Common Waxbill	*Estrilda astrild*	*					
Crowned Lapwing	*Vanellus coronatus*	*	*				
Dusky Sunbird	*Cinnyris fuscus*	*					
Egyptian Goose	*Alopochen aegyptiaca*	*	*				*
European Roller	*Coracias garrulus*		*				
Fairy Flycatcher	*Stenostira scita*	*	*				
Familiar Chat	*Cercomela familiaris*	*	*				
Glossy Ibis	*Plegadis falcinellus*		*				
Greater Striped Swallow	*Hirundo cucullata*	*	*				
Grey Heron	*Ardea cinerea*						*
Grey Tit	*Parus afer*	*	*				

Grey-backed Cisticola	*Cisticola subruficapilla*	*	*				
Ground Woodpecker	*Geocolaptes olivaceus*	*					
Hadeda Ibis	*Bostrychia hagedash*	*	*				
Helmeted Guineafowl	*Numida meleagris*	*					
Horus Swift	*Apus horus*	*					
Common House-martin	*Delichon urbicum*		*				
House Sparrow	*Passer domesticus*	*					
Karoo Chat	*Cercomela schlegelii*		*				
Karoo Eremomela	*Eremomela gregalis*	*	*				
Karoo Lark	*Calendulauda albescens*	*	*				
Karoo Long-billed Lark	*Certhilauda subcoronata*	*	*				
Karoo Prinia	*Prinia maculosa*	*	*				
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	*	*				
Kittlitz's Plover	*Charadrius pecuarius*	*	*				*
Large-billed Lark	*Galerida magnirostris*	*	*				
Lark-like Bunting	*Emberiza impetuani*	*	*				
Layard's Tit-Babbler	*Parisoma layardi*	*	*				
Levaillant's Cisticola	*Cisticola tinniens*	*					
Little Stint	*Calidris minuta*						*
Little Swift	*Apus affinis*	*	*				
Long-billed Crombec	*Sylvietta rufescens*	*					
Malachite Sunbird	*Nectarinia famosa*	*					
Mountain Wheatear	*Oenanthe monticola*	*	*				
Namaqua Sandgrouse	*Pterocles namaqua*	*	*				
Pied Crow	*Corvus albus*	*	*				
Pied Starling	*Spreo bicolor*	*	*				
Red-billed Teal	*Anas erythrorhyncha*		*				
Red-capped Lark	*Calandrella cinerea*	*	*				
Red-eyed Dove	*Streptopelia semitorquata*	*	*				
Red-winged Starling	*Onychognathus morio*	*					
Rock Kestrel	*Falco rupicolus*	*	*				
Rock Martin	*Hirundo fuligula*	*	*				
Rufous-eared Warbler	*Malcorus pectoralis*	*	*				
Sickle-winged Chat	*Cercomela sinuata*	*	*				
South African Shelduck	*Tadorna cana*	*	*				*
Southern Double-collared Sunbird	*Cinnyris chalybeus*	*					
Southern Masked-Weaver	*Ploceus velatus*	*					
Speckled Pigeon	*Columba guinea*	*	*				
Spike-heeled Lark	*Chersomanes albofasciata*	*	*				
Spur-winged Goose	*Plectropterus gambensis*		*				*
Three-banded Plover	*Charadrius tricollaris*	*	*				*
White-necked Raven	*Corvus albicollis*	*	*				
White-rumped Swift	*Apus caffer*	*	*				
White-throated Canary	*Crithagra albogularis*	*	*				
Wood Sandpiper	*Tringa glareola*						*
Yellow Canary	*Crithagra flaviventris*	*	*				
Yellow-bellied Eremomela	*Eremomela icteropygialis*	*	*				
Yellow-billed Duck	*Anas undulata*		*				*
84	**Total:**	**70**	**63**				**12**
Grand Total		**78**	**72**	**12**	**3**	**14**	**12**

APPENDIX 4: CURRICULUM VITAE

Expertise of Specialist

Curriculum vitae: Chris van Rooyen

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

Key Experience

Chris van Rooyen has 26 years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

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

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. PhezukomEmaya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Sutherland Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Facility (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)

50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Sutherland, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Veld Solar One Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia
15. Dayson Klip PV Facility near Upington, Northern Cape
16. Geelkop PV Facility near Upington, Northern Cape

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV

53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
117. Matla-Glockner 400kV
118. Delmas North 44kV
119. Houwhoek 11kV Refurbishment
120. Clau-Clau 132kV
121. Ngwedi-Silwerkrans 134kV
122. Nieuwehoop 400kV walk-through
123. Booysendal 132kV Switching Station
124. Tarlton 132kV
125. Medupi - Witkop 400kV walk-through
126. Germiston Industries Substation
127. Sekgame 132kV
128. Botswana – South Africa 400kV Transfrontier Interconnector
129. Syferkuil – Rampheri 132kV
130. Queens Substation and associated 132kV powerlines
131. Oranjemond 400kV Transmission line
132. Aries – Helios – Juno walk-down

133. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
134. Transnet

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

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

Professional affiliations

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

Chris van Rooyen
30 November 2022

Expertise of Specialist

Curriculum vitae: Albert Froneman (Pr.Sci.Nat Registration no: 400177/09)

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

Key Qualifications

Albert Froneman (Pr.Sci.Nat) has more than 24 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Key Project Experience

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

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oysterbay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskopvlakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Utrecht Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
28. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
29. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
30. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
31. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
32. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
33. Kwagga Wind Energy Facility, Sutherland, 12-months pre-construction monitoring (ABO)
34. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assesment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality

12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports
19. Avifaunal Impact Scoping & EIA Study - Renosterberg Wind Farm and Solar PV site
20. Bird Impact Assessment Study - Proposed 60 year Ash Disposal Facility near to the Kusile Power Station
21. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
22. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
23. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
24. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
25. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
26. Avifaunal Specialist Study – Rooikat Hydro Electric Dam – Hope Town, Northern Cape
27. The Stewards Pan Reclamation Project – Bird Impact Assessment study
28. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Origstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA – GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map production
37. City of Tswane – New bulkfeeder pipeline projects x3 Map production
38. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
39. ESKOM Geluk Rural Powerline GIS & Mapping
40. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
41. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
42. ESKOM Lephalale CNC – GIS Specialist & Mapping
43. ESKOM Marken CNC – GIS Specialist & Mapping
44. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
45. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping

Professional affiliations

South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.

Signature of the Specialist

Albert Froneman
30 November 2022

APPENDIX 5: BLADE PAINTING AS MITIAGTION STRATEGY

Coloured-blade mitigation at Africa's wind farms to reduce eagle deaths: implementation, challenges and solutions

Robert E Simmons *FitzPatrick Institute, Department of Biological Sciences, University of Cape Town, Rondebosch 7701, South Africa* Rob.Simmons@uct.ac.za

Marlei Martins *Birds & Bats Unlimited, 8 Sunhill Estate, Capri, 7975, South Africa* Marlei@bushbaby@gmail.com

Roel May *Norwegian Institute for Nature Research, P.O. Box 5685 Torgarden, 7485 Trondheim, Norway* roel.may@nina.no

Introduction

The recent publication of the ground-breaking experimental study of black-blade mitigation at an operational wind farms in Norway (May et al. 2020) has opened up a new and exciting method that could reduce avian fatalities at wind farms in other, more biologically diverse area of the world where renewable energies are being rolled out. This contribution :

- Explains what black/coloured-blade mitigation is
- Outlines the theory behind the black-blade mitigation
- Outlines the field test of the idea
- Summarises the challenges for rolling it out in Africa
- Assesses what it could mean for reducing raptor fatalities in Africa

Figure 1: The single black-blade in the process of being painted in situ, at the Smøla Wind Farm. Painting white blades black after they are erected is more expensive than producing them at source.

Rationale

Research around the world has shown that avian populations are declining due to climate change effects arising from increasing temperature and decreased rainfall in arid areas (www.ipcc.ch/, Thomas et al. 2004, Simmons et al. 2004, Phipps et al. 2017). In the USA, non-renewable fossil fuel energy sources are estimated to kill ~14.5 million birds annually, whereas green wind energy kills about 234 000 birds per year (Sovacool 2013, Loss et al. 2013). That is a 62-fold difference and a powerful environmental argument in support of renewable energy for our future needs. But while wind farms have many positive effects, they also pose some environmental challenges, particularly where wind farms are poorly positioned (on migration corridors for example Smallwood references).

In Africa two data sets on avian fatalities indicate that an average of 2.0 bird (adjusted) fatalities occur per MW per year in South Africa (Perold et al. 2020), and at one farm 1 raptor per month is killed of which 17% are breeding red data raptors (Simmons and Martins 2018). With about 2294 MW already being produced by 27 operational farms here in 2019 (energy.org.za), the cumulative impacts of South African wind farms alone are in excess of 4500 birds annually. If about 36% (>1600 birds per annum) are predicted to be raptors (Ralston-Paton et al. 2017) and about 17% (Simmons and Martins 2018) are known to be red data species, then an estimated 280 red data raptors are likely to be killed per year in South Africa in 2020. Since taller and longer-bladed turbines kill significantly more birds (Loss et al. 2013) and bats (Barclay et al. 2007) then Africa's threatened birds face increasing risks.

The need for urgent mitigations to reduce these costs is at a premium. Enter the coloured-blade mitigation.

What is coloured-blade mitigation?

This is a new mitigation technique in which one of the three white blades on a wind turbine are painted black (figure 1). About two thirds of the blade to the tip is painted this way. This is designed to increase visibility and decrease avian impacts (May et al. 2020). Since Civil Aviation in South Africa does not allow black but does allow "Signal Red" we propose that this is used in experiments here in South Africa. The amount of paint required can also be reduced by using the two-strip patterning shown in the experiments of McIsaac (see below).

Why black-blade mitigation?

Several innovative mitigation measures have recently been proposed for wind farms (flashing UV lights, automated shut-down-on demand, habitat management: May et al. 2017) and in a few cases have reduced collisions. However, developers are reticent to implement these.

The idea for **Black-blade mitigation** arose from work by Hodos (2003) who argued that a bird's retina views moving objects differently at different distances and as the bird gets close to a fast-moving object, the retinal image is moving so fast that the birds' brain can no longer process it. This was dubbed "motion smear" and means that birds approaching a fast-moving object no longer see it, with disastrous consequences. He suggested that a single coloured-blade may break up the motion smear. This is supported by recent work from Sweden (Potier et al. 2018) who show that raptors, despite their very high visual acuity, have very poor contrast abilities (poorer than humans). So, a coloured blade may be even better than a black one. So, a light (white) blade against a bright background is unlikely to be seen. But a black or coloured one is.

What is the evidence that it works?

Black-blade mitigation was field-tested by May et al. (2020) at the Smøla wind farm in 2013 in Norway over 3.5 years. On Smøla, White-tailed Eagles *Haliaeetus albicilla* are being killed at a very high rate by collision with the turbine blades. Four turbines were painted with a single black-painted blade in summer 2013. The black-painted turbines killed (i) 71% fewer total birds and (ii) 100% fewer eagles relative to unpainted blades.

Even more exciting in 2020 still no eagles have been killed at the coloured-blade turbines since 2013. In other words, no more eagles were killed in the 11-year experiment (starting 7.5 years before painting (2006-2013) and in situ 3.5 years after painting (2013-2016) (May et al.

2020). This despite 45-50 territorial pairs present on the island of Smøla (Dahl et al. 2012). The white-bladed turbines, however, are still killing birds at an average of 6 eagles per year (B. Iuell in litt.).

We see little reason why coloured blade – in the form of **Signal-red**, approved by Civil Aviation, would not work as well. This is because raptors see well in the colour spectrum (i.e. with the cones in the retina as opposed to the rods which see in black and white).

What are the visual impacts?

Discussions with wind farm managers in South Africa and Kenya suggest that visual effects are among the possible negative perceptions. We, therefore, requested the Smøla managers to supply us with images and videos of the turning blades to determine the effects.

Figure 1: The black-blade set up on a cloudy day in Norway is shown left. The black-blade (far turbine) is little different to the shadow cast by the all-white blades in the foreground © Bjorn Iuell.

The effect can be seen in the video kindly provided by Arild Soleim at www.birds-and-bats.com/specialist-studies. This shows little to no visual flicker or intrusion on the landscape from a single coloured-blade, and this concern is largely negated for all but the most sensitive human observer. It also has the effect of making the blade appear slower as one follows the black blade itself.

We argue that the benefits (no eagles killed) far outweigh the costs (initial costs to produce the coloured-blades). And once the blades are installed there will be no further costs as there are with competing mitigations (DT bird, or observer-operated shut-downs).

Black blade and Civil Aviation – white blades are not the most conspicuous

South African Civil Aviation state that white is "to provide the maximum daytime conspicuousness" However this statement was tested by McIsaac (2003) and he found that white is NOT the most conspicuous colour for either a moving blade or a stationary one

Embedded in the experiments undertaken by McIsaac's (2003) on kestrels is this very revealing graphic showing how human observers perceive the same patterns (including pure white).

Raptor Acuity and Wind-Turbine Blade Conspicuity

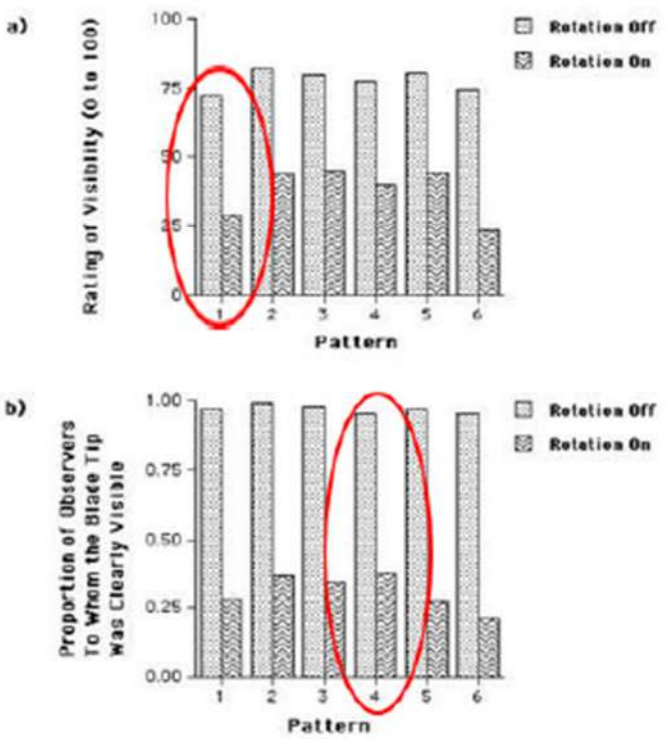

FIGURE 10. Human-perceived blade-pattern conspicuity: two-factor interactions of pattern and rotation. *These diagrams show the relationship between blade-pattern conspicuity and the effects of rotation. Illustrations of the blade patterns are presented in Fig. 9. Both blade pattern and rotation significantly affected conspicuity. Two ratings of pattern conspicuity are presented, a) full-blade visibility ratings, b) blade-tip visibility ratings.*

- **The pure white blade [pattern 1] was perceived as <u>less visible</u> by human observers than 5 of the other 6 patterns used whether the blades were spinning or not (top graph)**
- The <u>tip</u> of the pure white blade [pattern 1] was also perceived as less visible by human observers than 4 of the other 6 patterns used whether the blades were spinning or not (bottom graph)
- Like the Kestrels being tested, human observers saw patterned blades (patterns 2,3,4,5,6) better than pure white [pattern 1].

So, the CAA assumption that white is the most conspicuous colour for humans is not supported by experimentation with either raptorial birds or humans.

Patterned blades are better for both humans and raptors.

It is very important the South African Civil Aviation Authority is aware of these findings. Why? Because their guiding documents on painting of tall structures (**139.01.30 OBSTACLE LIMITATIONS AND MARKINGS OUTSIDE AERODROME OR HELIPORT (effective 1 August 2012)**) makes the following statement under section in **1.14. Wind turbine generators (Windfarms)**

- (4) Windfarm Markings (page 12 of 16)
  Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness. The colours grey, blue and darker shades of white should be avoided altogether. If such colours have been used, the wind turbines shall be supplemented with daytime lighting, as required.

While this assumption that "bright white" would be most obvious to pilots and others, the experiments of McIsaac (2001) indicate that this is a false assumption. The pure white blade performed very poorly in the experiments of McIsaac (2001) and the patterned blade (No. 4 below) performed best of all.

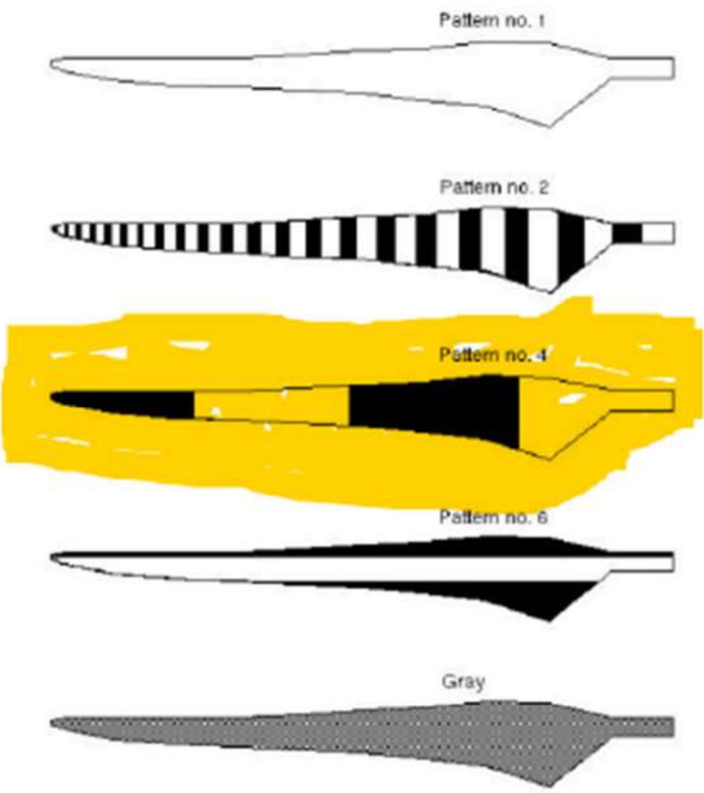

FIGURE 12. Kestrel-perceived blade-pattern conspicuity: stimulus blade patterns. *Depicted are the four black-and-white test patterns and the gray control pattern that were used to determine pattern conspicuity as perceived by a kestrel.*

Can it be applied in an African setting?

Given that eagles and raptors the world over probably see the landscape in similar ways there is a high probability that African eagles will see coloured-blades similarly well. Recent research on other raptors shows that despite their high visual acuity they see contrast more poorly than do humans (Potier, Milbus & Kelber 2019). This nicely explains why raptors take no avoiding action and are struck by white blades in the first place, and second why painting a blade black (increasing the contrast) increases the avoidance of those blades by eagles.

It also breaks up the "motion smear" researched by Hodos (2003) because he predicted a single black or coloured blade would increase the ability of birds to see movement in a set of fast-moving blade (the same effect can be seen by pilots of prop-driven planes, where one blade is painted differently). In an African setting the same can be seen on farmers' metal windmills where a blade is missing or painted on the rapidly spinning blades. Both increase the visual contrast and effect of movement.

The coloured-blade mitigation has yet to be rolled out in Africa – where it is urgently needed, given that we have over 100 species of raptors – more than any other continent (Clark and Davies 2018). Red blade tips have, however, already been used at the Ysterfontein Wind farm in the Western Cape, setting a precedent for their use elsewhere in South Africa.

Figure 2: Red-tipped turbine-blades on turbines at the Ysterfontein wind farm north west of Clanwilliam in the Western Cape (S 32° 9'23.42" E 18°49'7.10"). While these mitigations are not used in the correct single-blade configuration used by the Norwegians, they set a precedent for turbine blades to be red-painted in South Africa © RE Simmons

We have been informed that this mitigation is indeed being rolled out at the Kobe wind farm site in Japan. And there are plans for testing it in the Netherlands (Arjen Schultinga of Innogy, to Iuell Bjorn, Senior Environmental Advisor at Smøla Wind farm.)

This suggests that General Electric Renewables (GE), a manufacture of wind turbine blades, are already in the market for coloured blades. Attempts to engage with GE Renewables through the internet have proven unsuccessful despite contact with officials there.

We as avian specialist recommend the coloured-blade version of the black blade mitigation because (i) it is likely to be seen even more clearly by raptors than black, (ii) South African Civil Aviation (Lizell Stroh) in correspondence with Birdlife SA and Birds & Bats Unlimited have suggested that "signal red" would be preferable to black as it already used for marking structures such as towers, and is approved by them and (iii) the red paint may heat up less than a black blade in an African environment.

Four more aspects to consider from experience at the Smøla wind farm:

(i) It will cost a fraction to paint while the rotor blades are still on the ground instead of installed at the hub. At Smøla the painting was done with the blades up on the tower in situ and proved quite costly. The cost of painting one blade (with the crane lift and specialised personnel) was K55,000 ($5900). For all four blades and all fees and disbursements included over 2 weeks (due mainly to inclement weather) the total cost was c. K750 000 ($79 000). This would have been negligible had the blades been painted on the ground or come pre-painted (B. Iuell pers comm).

(ii) Although not an issue at Smøla, potentially a black blade may increase the blade temperature with potential consequences for blade quality and operation. We noticed that the temperature in the turbine tower at ground level with a painted tower base was high in summer (Stokke et al. 2020); there the surface area is large and more localized, and, of course, is not moving. No such effect was noticed for the black-painted turbine blades and there was no effect of any imbalance of the blades from differential heating of the black blade.

(iii) Smøla wind farm was not allowed to paint turbines which were constructed in the second construction stage due to insurance issues. Thus, guarantees with the blade manufacturers must be secured before the painting takes places – and preferably come pre-manufactured with a blade already painted red or black.

(iv) Each blade weighed 9 tonnes and the blade were painted with Carboline Windmastic TopCoat HSX. Two coats were applied and weighed approximately 60 kg. This is about 0.66% the weight of the blade and no mechanical effects were apparent. On inspection of the paint there was no wear or cracking apparent (B Iuell pers comm).

It is for influential players such as those in the South African Wind Energy Association and other wind farm developers, their governing bodies and avian conservation organisations to lobby the main players such as General Electric and Siemens to roll out this form of mitigation to reduce to a minimum the thousands of raptors deaths likely in future years. Without black or coloured blades on Africa's turbines we will continue to see the high fatality rates already apparent at some wind farms in South Africa (Simmons and Martins 2018, Perold et al. 2020).

With black-blade mitigation now shown to be highly effective in reducing eagle deaths in Norway, there is a great incentive for wind farm developers elsewhere to enact the coloured blade mitigation to reduce raptor deaths, particularly since it has no operational costs once installed.

Acknowledgments

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Figure 3: A 4-year old Martial Eagle, struck by a white-bladed turbine, plummets to the earth at an Eastern Cape wind farm. Deaths like this could be reduced or avoided with black/coloured blade mitigation . © RE Simmons

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