AVIFAUNAL IMPACT ASSESSMENT

Paarde Valley PV2 Grid Connection to Vetlaagte Main Transmission Substation (MTS) located near De Aar in the Northern Cape Province

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EXECUTIVE SUMMARY

Chris van Rooyen Consulting has been appointed by Holland & Associates Environmental Consultants, on behalf of Paarde Valley PV2 (Pty) Ltd to undertake an Avifaunal Specialist Study for the proposed construction and operation of a 132kV switching station and a 132kV powerline grid connection. The currently authorised 132kV/220kV grid connection for Paarde Valley PV2 is routed from the Paarde Valley PV2 facility to the De Aar substation. However, due to grid capacity constraints in the Northern Cape, the Paarde Valley PV2 cannot connect to the De Aar substation. As a result, Paarde Valley PV2 (Pty) Ltd wishes to amend the authorised grid connection (realignment and termination point) and create a separate EA for the construction of the 132kV overhead powerline (OHPL) grid connection from the authorised on-site substation at Paarde Valley PV2 to the Vetlaagte Main Transmission Station. The proposed OHPL is approximately 12.7km in length. The project also includes the switching station component of the authorised Paarde Valley PV2 on-site substation, with an approximate footprint area of 100 m x 100m, and a capacity of 132kV, and an access road from the main road to the switching station.

The Paarde Valley PV2 grid connection is located within 10km of De Aar, in the Pixley Ka Seme District Municipality in the Northern Cape Province of South Africa. The proposed development is the subject of this impact assessment report.

PROJECT ALTERNATIVES

A single switching station site with access road corridor and 132kV OHPL alignment are proposed. No substation site and OHPL route alignment alternatives have been provided for assessment. OHPL tower structure (i.e. design/ technology) alternatives are proposed in the form of steel lattice and the standard steel monopole structures respectively. The impact assessment is equal for both and the tables pertain to both technology alternatives.

AVIFAUNA

The SABAP2 data indicates that a total of 171 bird species could potentially occur within the study area and immediate surroundings – Appendix 1 provides a comprehensive list of all the species. Of these, 50 species are classified as priority species (see definition of priority species in section 4) and ten are South African Red List species. Of the priority species, 32 are likely to occur regularly at the study area and immediate surrounding area, with the remaining 18 occurring sporadically.

The site visit produced a combined list of 18 species (Appendix 1 - highlighted in grey), covering both the study area and to a limited extent, the surrounding area. Four priority species were observed along the proposed OHPL alignment, none of which are Red List species. All other observations were of small passerine and game bird species that are common to this area.

POTENTIAL IMPACTS

The following impacts have been identified in the Avifaunal Specialist Assessment.

Construction Phase

- Displacement due to disturbance associated with the construction of the proposed switching station, access road and 132kV OHPL; and
- Displacement due to habitat transformation associated with the construction of the proposed 132kV switching station, access road and to a limited extent the 132kV OHPL.

Operational Phase

- Collisions with the proposed 132kV OHPL;
- Electrocutions on the proposed switching station infrastructure; and
- Electrocution of vultures on the proposed 132kV OHPL infrastructure.

Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the proposed switching station, access road and the 132kV OHPL.

Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the proposed switching station and 132kV OHPL;
- Displacement due to habitat transformation associated with the proposed switching station and to a limited extent the 132kV OHPL;
- Collisions with the proposed 132kV OHPL;
- Electrocutions within the switching station; and
- Electrocution of vultures on the proposed 132kV OHPL infrastructure.

ENVIRONMENTAL SENSITIVITIES

An evaluation of site-based Ecological Importance (SEI) was conducted for each habitat type within the Project Area Of Interest (PAOI), using the criteria described in the Species Environmental Assessment Guideline. At a site-specific level, environmentally sensitive features present within the proposed study area include permanent and ephemeral waterbodies and wetland areas. These areas are delineated as areas of HIGH sensitivity. The construction of the proposed powerline across or within close proximity to the waterbodies will necessitate the marking of the powerline with bird flight diverters to mitigate the collision impact. The large majority of PAOI is comprised of Karoo vegetation, that supports the foraging and breeding needs for the SCC recorded in the study area, particularly Ludwig Bustard *Neotis ludwigii* and Blue Crane *Grus paradiseus*. This habitat type together with the ridges located in the lower reaches of the PAOI area delineated as being of MEDIUM sensitivity and will also necessitate the marking of the powerline with bird flight diverters to mitigate the collision impact. Small pockets of agricultural lands and urban infrastructure are considered to be of LOW sensitivity, requiring no mitigation intervention

MANAGEMENT ACTIONS

The following management actions have been proposed in this assessment:

Planning & Design phase

- It is imperative that the OHPL be constructed with a minimum vertical clearance of 1.8m between the jumper cables and/or insulators and the horizontal earthed component on the lattice or monopole structure.

Construction phase

- Conduct a pre-construction inspection (avifaunal walk-through) as soon as the final switching station layout and 132kV OHPL route alignment, together with its associated pole positions, have been approved to identify species of conservation concern (SCC) that may be breeding within the infrastructure footprints. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding birds during the construction period. This could include measures such as delaying some of the activities until after the breeding season or other measures deemed suitable and practical at the time.
- Bird Flight Diverters must be fitted to the entire OHPL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines)..
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.

- Existing access roads must be used to access the development footprints and the construction of new roads must be kept to a minimum.
- Vegetation clearance should be limited to what is absolutely necessary.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.

Operational phase

- The hardware within the proposed switching station is too complex to warrant any mitigation for electrocution at this stage. It is recommended that quarterly inspections of the onsite substation yard and switching station are conducted to monitor the electrocution mortality. If electrocutions are recorded once operational, site specific mitigation (insulation) be applied reactively. This is an acceptable approach because SCC are unlikely to frequent the switching station infrastructure.
- If installed, electrocution mitigation to be maintained during the operational life span of the switching station.
- Bird flight diverters to be maintained on all sections of powerline during the operational life span of the 132kV powerline

De-commissioning phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Existing access roads must be utilised and the construction of new roads must be kept to a minimum.

IMPACT RATING

The table below indicates the overall impact significance for each phase before and after mitigation, as well as cumulative impacts.

Nature of the Impact	Rating prior to mitigation	Rating post mitigation
*Displacement of priority species due to **disturbance** associated with construction of the proposed development.*	LOW	VERY LOW
*Displacement of priority species due to **habitat transformation** associated with construction of the switching station*	LOW	VERY LOW
*Displacement of priority species due to **habitat transformation** associated with construction of the 132kV OHPL*	VERY LOW	NEGLIGIBLE
*Mortality of priority species due to **collisions** with the 132kV OHPL*	HIGH	MEDIUM
*Mortality of priority species due to **electrocution** within the switching station*	LOW	VERY LOW
*Mortality of priority species due to **electrocution** on the 132kV OHPL*	MEDIUM	NEGLIGIBLE
*Displacement of priority species due to **disturbance** associated with decommissioning of the development*	LOW	VERY LOW

CUMULATIVE IMPACTS

According to the official database of the Department of Forestry, Fisheries and the Environment (DFFE) (2021 Q4), there are at least 51 renewable energy projects, approximately 1273km^2 in area, within a 35km radius around the proposed development. The proposed 132kV OHPL equates to a maximum of 12.7km. There are approximately 16 transmission powerlines and 19 distribution powerlines totalling hundreds of kilometres of existing medium and high voltage lines within the 35km radius around the development project area. An intensive internet search was conducted to source information on the grid connections of the abovementioned projects available within the public domain, but in some instances no information could be obtained. The proposed development will thus increase the total number of existing high voltage lines by a very small percentage. The contribution of the proposed 132kV OHPL to the cumulative impact of all the high voltage lines is thus LOW. However, the combined cumulative impact of the existing and proposed powerlines on avifauna within a 35km radius is considered to be MODERATE.

A total of fifteen substations and switching stations occur within 35km of the proposed development. The cumulative impact of displacement due to disturbance and habitat transformation at the 132kV SwS is considered to be LOW, due to the small size of the switching station footprint and the availability of similar habitat within the 35km radius area. The cumulative impact of potential electrocutions within the switching station yard is also likely to be LOW as it is expected to be a rare event.

NO-GO ALTERNATIVE

The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would maintain the natural habitat which would be beneficial to the avifauna currently occurring there.

CONCLUDING STATEMENT

The expected impacts of the proposed development range from VERY LOW to HIGH significance and negative status pre-mitigation. However, with appropriate mitigation, the post-mitigation significance of the identified impacts could be reduced to MEDIUM and LOW negative. No fatal flaws were discovered in the course of the investigation. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix 4) are strictly implemented.

CONTENTS

DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT

Chris van Rooyen (Avifaunal Specialist)

Chris has 26 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous powerline and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Avifaunal and GIS Specialist) (SACNASP) Prof Natural Scientist (reg. nr 400177/09)

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

Megan Diamond (Avifaunal Specialist)

Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in the environmental sector for 20 years. She has 16 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 180 projects. Megan currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Powerline Network (2013-2015). She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

SPECIALIST DECLARATION

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Holland & Associates Environmental Consultants was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Basic Assessment for the proposed Paarde Valley PV2 grid connection development.

Full Name: Chris van Rooyen
Position: Director

Minimum report requirements listed 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)

HIGH SENSITIVITY RATING FOR TERRESTRIAL ANIMAL SPECIES	
SITE SENSITIVITY VERIFICATION	
The site sensitivity verification must be undertaken by an environmental assessment practitioner or specialist.	Page 8
The site sensitivity verification must be undertaken through the use of: (a) a desk top analysis, using satellite imagery; (b) a preliminary on-site inspection; and (c) any other available and relevant information.	Section 3, Section 6 and Appendix 3
The outcome of the site sensitivity verification must be recorded in the form of a report that: (a) confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.; (b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and (c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.	Appendix 3
SPECIALIST ASSESSMENT & MINIMUM REPORT CONTENT REQUIREMENTS	
Contact details and relevant experience as well as the SACNASP Registration number of the specialist preparing the assessment including a curriculum vitae;	Page 8 & Appendix 5
A signed statement of independence by the specialist;	Page 8
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2 and Section 3
A description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;	Section 3
A description of the mean density of observations/number of sample sites per unit area and the site inspection observations;	Section 7
A description of the assumptions made and any uncertainties or gaps in knowledge or data;	Section 4
details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;	Section 7
the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;	N/A
The location of areas not suitable for development and to be avoided during construction where relevant;	Section 6
a discussion on the cumulative impacts;	Section 9
Impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Section 10 and Appendix 4
A reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and	Section 11
A motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having “low” or “medium” terrestrial animal species sensitivity and were not considered appropriate.	N/A

1 INTRODUCTION

Paarde Valley PV2 (Pty) Ltd (hereafter referred to as the Applicant) proposes the construction of a 132 kV, double circuit, overhead powerline (OHPL) grid connection from the authorised on-site substation and switching station at Paarde Valley PV2 to Vetlaagte Main Transmission Station (MTS) (which is currently undergoing its own EA application process). The OHPL is proposed to be approximately 12.7 km in length and is located in the Strategic Transmission Central Corridor[1]. The final OHPL servitude will be registered as 31 m but during the design development process a corridor of 200 meters is required to allow for minor tower position adjustments. The exact pylon locations will be determined by the outcome of the specialist's investigations, and engineering considerations. On average there will be 4 - 5 towers per km, so that the route will consist of an approximately 40 towers. The teams constructing the OHPL often use cranes and these will fit into an area with a maximum radius of approximately 30 m around the base of each tower, with the final footprint being relatively small. The line will have a capacity of 132kV and will make use of either steel monopole or steel lattice structure in line with Eskom required specifications.

A monopole self-supporting structure has a maximum base of 5 m in diameter above the ground. In some situations the structures have stays. These would fall into the area with a maximum radius of 30 meters, but the stays themselves are hardly exposed at ground level, with only small steel rods protruding from the ground. Lattice towers have a bigger footprint as each has four legs that are a maximum of 15 m apart so that the final footprint would be approximately 15 m x 15 m. The height of either pylon structure will be up to 32 m.

The project will also include the switching station component of the authorised Paarde Valley PV2 on-site substation, with an approximate footprint area of 100 m x 100m, and a feeder bay at the Vetlaagte MTS with a capacity of 132 kV, as this needs to be handed over to Eskom with the grid connection self-build works once constructed.

In summary, the infrastructure associated with the proposed Grid Connection works for the Paarde Valley PV2 project (and to be handed back to Eskom following construction), includes the following:

- A 132kV, double circuit Overhead Power Line (OHPL) from the Switching Station connecting to the proposed Vetlaagte Main Transmission Substation (MTS)
- 132kV Feeder bay at the Vetlaagte MTS
- On-site Switching Station (SwS), adjacent to the authorised IPP 132 kV substation. (approximately 100 m x 100 m combined)

The technical details include:

Overhead Powerline:

- Height of pylons Up to 32m
- Type of poles/ pylons to be used. Double Circuit configuration. The alternatives under consideration and to be assessed include Steel lattice or Monopole structures in line with Eskom required specifications.
- Transmission line capacity 132kV
- OHPL Service Road (to lie within the OHPL servitude)
  - Length of OHPL service road(s) – Twin tracked service road following line route
  - Width of OHPL service road(s) 6 m

Switching Station:

[1]No. 113 of Government Gazette No. 41445 published 16 February 2018

- Footprint of approximately 50 m – 100 m x 100 m adjacent to IPP Substation
- Area occupied by buildings (Control building, relay room, generator, storage warehouse, water tanks, ablutions) +-1.0 Hectares
- Switching Station Access Road (separate access servitude from the nearest public road to the Switching Station yard):
  - Compacted gravel
  - Length of access road: +- 2.34 km
  - Width of access road: 8 m .
- Security fencing height: 2.4 m
- Type of fencing: Eskom palisade fencing + chainlink fencing for temporary works
- Capacity of on-site switching station 132kv

The OHPL and Switching station are required to connect the Paarde Valley PV2 Solar farm to the Eskom National Grid. The route selected follows boundary lines and / or existing OHPL routes so as to limit disruption to current farming activities as much as possible.

The Paarde Valley PV2 grid connection is located within 10km of De Aar, in the Pixley Ka Seme District Municipality in the Northern Cape Province of South Africa (Figure 1). The proposed Paarde Valley PV2 grid connection development is the subject of this impact assessment report.

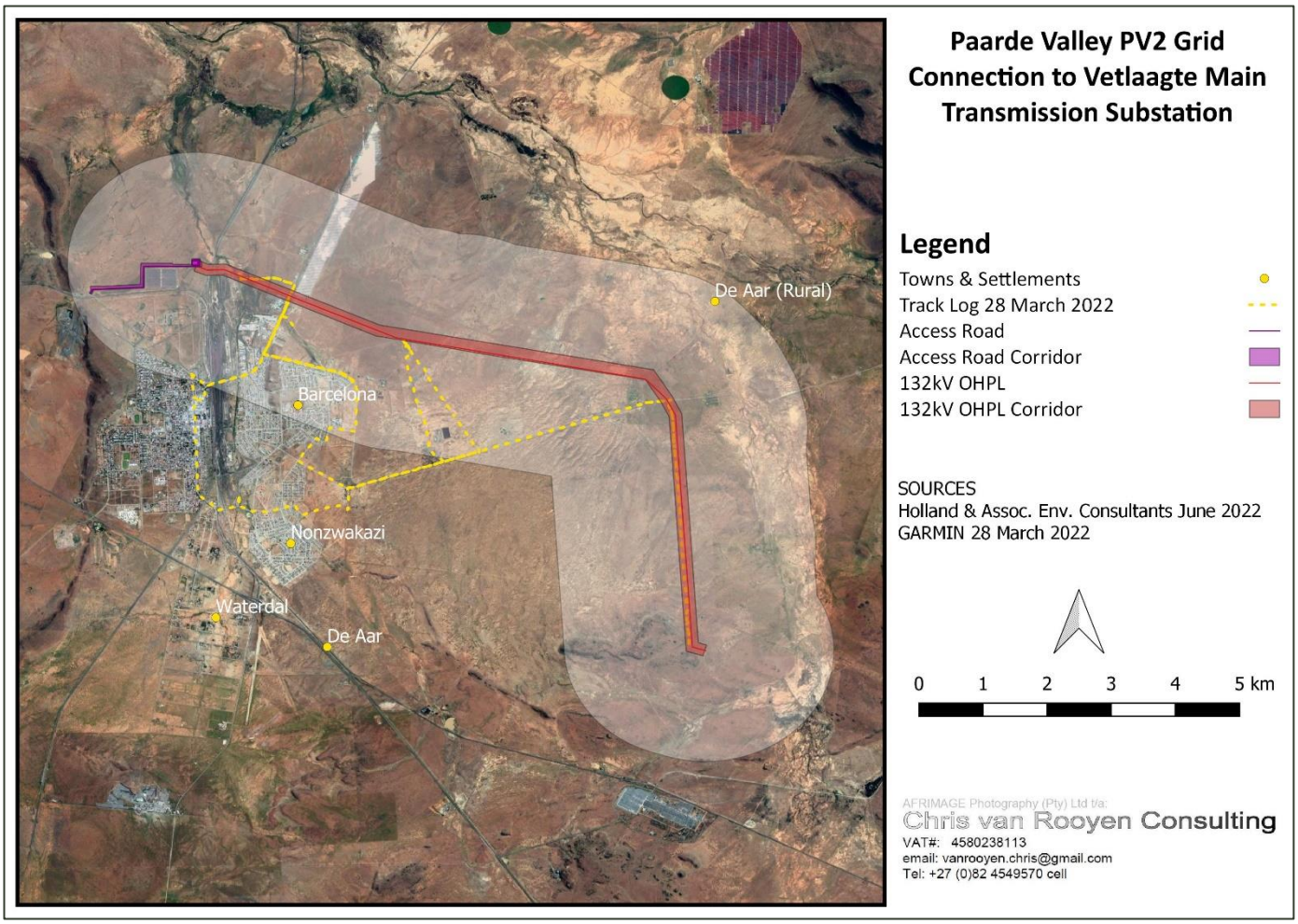


Figure 1: Locality map indicating the location of the proposed development within the study area near De Aar, Northern Cape Province.

1.1 Project alternatives

A single SwS site, access road and 132kV OHPL alignment are proposed. No SwS site, access road and OHPL route alignment alternatives have been provided for assessment. OHPL tower structure (i.e. design/technology) alternatives are proposed in the form of steel lattice and the standard steel monopole structures respectively. The impact assessment is equal for both and the tables pertain to both technology alternatives.

2 PROJECT SCOPE

The terms of reference for this assessment report are as follows:

- Conduct a site sensitivity verification (Appendix 3) through the use of a desk top analysis of primary species occurrence data emanating from a single season (austral summer) site survey, conducted at the SwS site and along the OHPL alignment in addition to secondary avifaunal data sets (detailed below);
- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts associated with the proposed development;
- Perform an assessment of the potential impacts; and
- Recommend mitigation measures to reduce the significance of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5" × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of six pentads some of which intersect and others that are near the study area. The decision to include multiple pentads around the study area was influenced by the fact that the pentads within which the proposed development is located have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The six pentad grid cells are the following: 3035_2355, 3035_2400, 3035_2405, 3040_2355, 3040_2400 and 3040_2405 (Figure 2). A total of 28 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 41 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the six pentads within which the study area is located. The SABAP2 data is regarded as a reliable reflection of the avifauna which occurs in the area and is supplemented with data collected during the site visit and extensive general knowledge of the area.
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015), and the latest authoritative summary of southern African bird biology (Hockey et al. 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the study area relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the Northern Cape Province .
- The Department of Forest Fisheries and Environment National Screening Tool was used to determine the assigned avian sensitivity of the study area (February, 2022).

- Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
- Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
- Primary avifaunal diversity and abundance data collected during a single season, one-day site visit conducted on 28 March 2022. Data was collected by means of incidental counts (Figure 1).

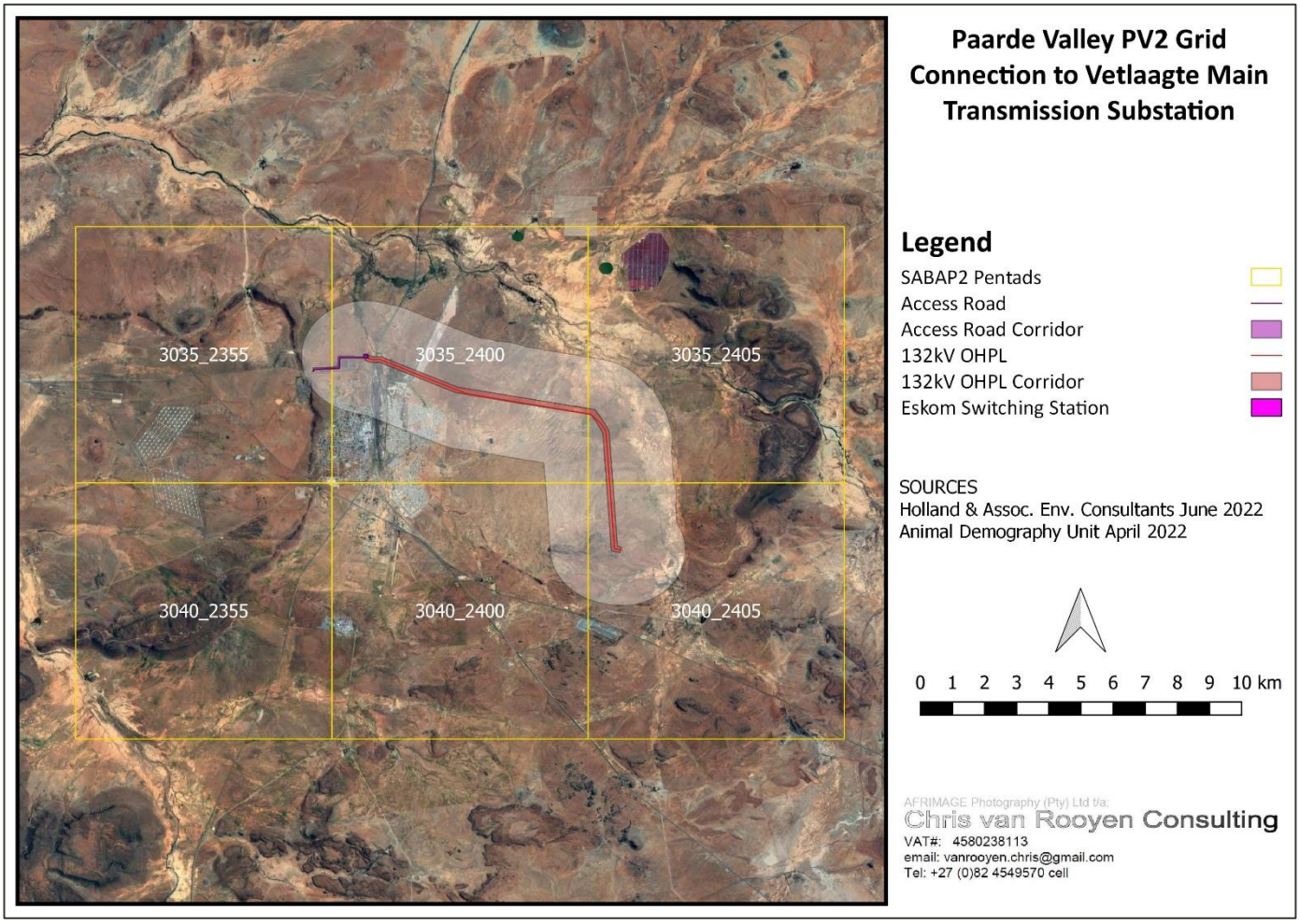


Figure 2: Location of the six South African Bird Atlas Project 2 (SABAP2) pentad grid cells that were considered for the proposed development.

4 ASSUMPTIONS AND LIMITATIONS

This study assumed that the sources of information used in this report are reliable. In this respect, the following must be noted:

The focus of this assessment is primarily on the potential impacts of the proposed development on priority species. Priority species are defined as those species which could potentially be impacted by powerline collisions or electrocutions, based on specific morphological and/or behavioural characteristics. These include both Species of Conservation Concern (SCC) as defined by the *Species Environmental Assessment Guideline: Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa (2020)* i.e. those species listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened and Data Deficient, as well as certain other species.

- The assessment of impacts is based on the baseline environment as it currently exists in the study area.

- Cumulative impacts include all wind energy facility (WEF) and SEF (PV) projects, grid connections and existing transmission and distribution powerline for which information could be sourced in the public domain, within a 35km radius that currently have open applications or have been approved by the Competent Authority as per the 2021 Q4 database from the DFFE.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The primary Project Area Of Interest (PAOI) was defined as a 2km zone around the proposed 132kV switching station and 132kV powerline grid connection.

5 LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[2].

Table 1: Agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna.

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

[2] (BirdLife International (2021) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2021-08-27).

5.2 National legislation

5.2.1 Constitution of the Republic of South Africa, 1996

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

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

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

  (i) prevent pollution and ecological degradation;

  (ii) promote conservation; and

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

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

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species was published on 30 October 2020. This protocol applies also for the assessment of impacts caused by powerlines on avifauna.

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

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

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

The National Environmental Management: Protected Areas Act (No. 57 of 2003), as amended in 2014, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also provides for the establishment of a national register of all national,

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

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

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

5.3 Provincial Legislation

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

5.4 Species Assessment Guidelines

The *Species Environmental Assessment Guideline* provides background and context to the assessment and minimum reporting criteria contained within the Terrestrial Animal and Plant Species Protocols; as well as to provide guidance on sampling and data collection methodologies for the different taxonomic groups that are represented in the respective protocols. This guideline is intended for specialist studies undertaken for activities that have triggered a listed and specified activity in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as identified by the EIA Regulations, 2014 (as amended) and Listing Notices 1-3

6 BASELINE ASSESSMENT

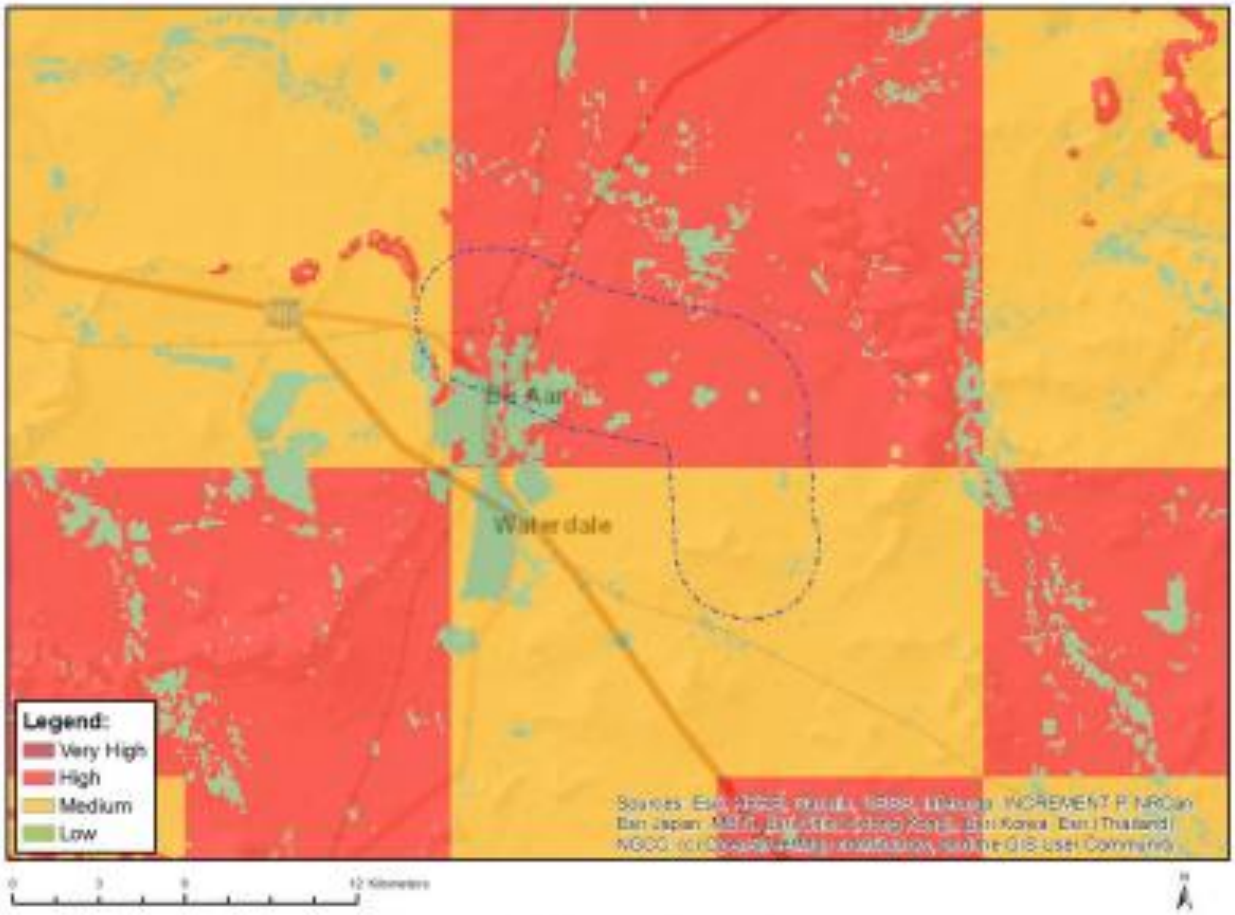
6.1 DFFE National Screening Tool (April 2022)

The project site and immediate environment is classified as **MEDIUM and HIGH** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. These classifications are linked to the potential occurrence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable). In addition, the study area contains confirmed habitat for 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). Although the occurrence of the SCC could not be confirmed during the site visit to the study area, the authors have conducted several assessments and research projects in the secondary PAOI and have previously observed both Ludwig's Bustard *N. ludwigii* and Verreaux's Eagle *A. verreauxii* in identical habitats, in addition to Martial Eagle *Polemaetus bellicosus* and Tawny Eagle *Aquila rapax*. Based on these observations, the classification of **HIGH** sensitivity for avifauna in the screening tool is therefore confirmed (Figure 3).

6.2 Protected Areas

The most northerly section of the De Aar Nature Reserve (Figure 4) intersects with a very small portion of the study area, but not within the area proposed to be developed. No information could be obtained on the De Aar Nature Reserve, but it is assumed that the composition and abundance of avifauna in the reserve will be similar to the surrounding area.

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-Neotis ludwigii
High	Aves-Aquila verreauxii
Low	Low sensitivity
Medium	Aves-Neotis ludwigii

Figure 3: The National Web-Based Environmental Screening Tool map of the three PV project sites, indicating sensitivities for the Terrestrial Animal Species theme. The High and Medium sensitivity classifications are linked to Ludwig's Bustard *Neotis ludwigii* and Verreaux's Eagle *Aquila verreauxii*.

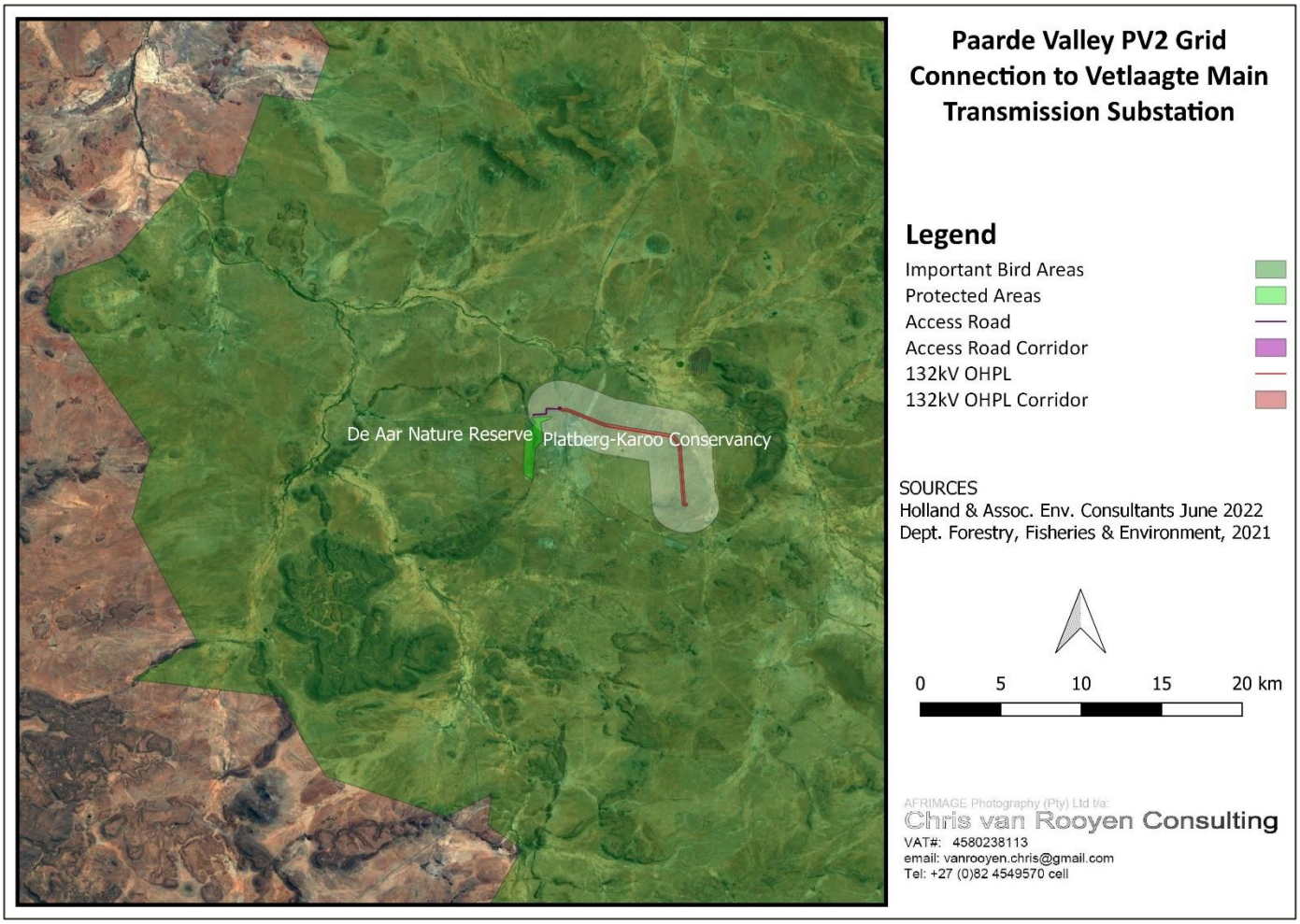


Figure 4: Regional map detailing the location of the proposed development in relation to Important Bird Areas (IBAs) and Protected Areas.

6.3 Important Bird Areas

The project area falls within the Platberg-Karoo Conservancy IBA SA037 (Figure 4). The landscape consists of extensive flat to gently undulating plains that are broken by dolerite hills and flat-topped inselbergs. The ephemeral Brak River flows in an arc from south-east to north-west, eventually feeding into the Orange River basin. Other ephemeral rivers include the Hondeblaf, Seekoei, Elandsfontein and Ongers rivers with a network of tributaries. This IBA contributes significantly to the conservation of large terrestrial birds and raptors. These include Blue Crane *Grus paradiseus*, Ludwig's Bustard *N. ludwigii*, Kori Bustard *Ardeotis kori,* Blue Korhaan *Eupodotis caerulescens*, Black Stork *Ciconia nigra*, Secretarybird *Sagittarius serpentarius*, Martial Eagle *P. bellicosus*, Verreauxs' Eagle *A. verreauxii* and Tawny Eagle *A. rapax.*

A total of 289 bird species are known to occur here. In summer, close to 10% of the global population of Lesser Kestrel *Falco naumanni* congregate and roost in this IBA. Amur Falcons *Falco amurensis* are also abundant and forage and roost with Lesser Kestrels *F. naumanni* . This IBA is seasonally important for White Stork *Ciconia ciconia*, and Coordinated Avifaunal Roadcounts indicate high numbers of this species during outbreaks of brown locusts *Locustana pardalina* and armoured ground crickets *Acanthoplus discoidalis*. The IBA also supports the following biome-restricted species: Karoo Lark *Calendulauda albescens*, Karoo Long-billed Lark *Certhilauda subcoronata,* Karoo Chat *Cercomela schlegelii*, Tractrac Chat *Cercomela tractrac*, Sickle-winged Chat *Cercomela sinuata,* Namaqua Warbler *Phragmacia substriata*, Layard's Tit-Babbler *Sylvia layardi*, Pale-winged Starling *Onychognathus nabouroup* and Black-headed Canary *Serinus alario.*

With the exception of Namaqua Warbler *P. substriata* and Tractrac Chat *C. tractrac*, each of the remaining aforementioned species have been observed in the study area. It is therefore likely that the impacts, associated with the construction and operation of the proposed development, will negatively affect these species if the necessary avoidance and mitigation measures are not implemented.

6.4 Biomes and vegetation types

The study area, within which the proposed development is located within the Nama Karoo biome (Mucina & Rutherford 2006). Two vegetation types are found in the study area, the dominant one being Eastern Upper Karoo, which is found on the plains and Upper Karoo Hardeveld occurring on the ridges (Mucina & Rutherford 2006). Eastern Upper Karoo is dominated by dwarf *mycrophyllus* shrubs, with white grasses of the genera *Aristida* and *Eragrostis*. On the steep slopes, mountain ridges and koppies, Upper Karoo Hardeveld is found which is characterised by dwarf Karoo scrub with drought tolerant grasses of genera such as *Aristida*, *Eragrostis* and *Stipagrostis* (Mucina & Rutherford 2006). The study area contains several large earth dams.

Temperatures at De Aar range between a mean daily maximum of 31˚C in January (summer) and 15.1˚C in July (winter), and rainfall happens mostly between October and April and averages about 211mm per year, which makes for a fairly arid climate (meteoblue.com). Winters are very dry. The land is used for sheep and game farming.

Whilst the distribution and abundance of the bird species in the development area are typical of the broad vegetation type, it is also necessary to examine bird habitats in more detail as it may influence the distribution and behaviour of priority species. These are discussed in more detail below. The priority species most likely associated with the various bird habitat features are listed in Table 2.

6.5 Bird habitats

6.5.1 Nama Karoo

The vegetation at the development area consists of Karoo shrub vegetation, punctuated by rugged relief. Although not remarkably rich in species or endemism, the flora and fauna of the region are remarkably adapted to the region's climatic extremes. The major threats to biodiversity are posed by pastoralism, exotic plants, mining and agriculture. Trees and taller woody shrubs are restricted mostly to watercourses and include *Acacia karroo, Diospyros lycioides, Grewia robusta, Rhus lancea,* and *Tamarix usneoides* (Palmer and Hoffman 1997). This habitat type will typically support Secretarybird *S. serpentarius*, Ludwig's Bustard *N. ludwigii*, Common Buzzard *Buteo buteo*, Jackal Buzzard *Buteo rufofuscus*, Blue Crane *G. paradiseus*, Booted Eagle *Hieraaetus pennatus*, Martial Eagle *P. bellicosus*, Tawny Eagle *A. rapax*, Amur Falcon *F. amurensis*, Lanner Falcon *F. biarmicus*, Pale Chanting Goshawk *Melierax canorus*, African Harrier-Hawk *Polyboroides typus*, Greater Kestrel *F. rupicoloides*, Lesser Kestrel *F. naumanni*, Blue Korhaan *Eupodotis caerulescens*, Northern Black Korhaan *Afrotis afraoides*, White Stork *C.ciconia* and Cape Vulture *Gyps coprotheres.*

6.5.2 Surface water

The study area contains sources of both permanent (i.e. water troughs) and ephemeral (i.e. dams) surface waterbodies. When filled with water, the dams typically attract flocks of Blue Crane *G. paradiseus* and Greater Flamingo *Phoenicopterus roseus,* Secretarybird *S. serpentarius*, Booted Eagle *H. pennatus*, Martial Eagle *P. bellicosus*, Tawny Eagle *A. rapax*, Verreaux's Eagle *A. verreauxii* , Lanner Falcon *F. biarmicus*, Gabar Goshawk *Micronisus gabar*, Pale Chanting Goshawk *M. canorus*, Helmeted Guineafowl *Numida meleagris*, African Harrier-Hawk *P. typus*, Black Stork *Ciconia nigra*, White Stork *C.ciconia*, Cape Vulture *G. coprotheres*, various waterfowl, ibis, heron and goose species that utilise this habitat type in which to roost and forage.

6.5.3 Wetlands

Wetlands are characterized by slow flowing seasonal water (or permanently wet) and tall emergent vegetation (rooted or floating) and provide habitat for many water birds. The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands worldwide, with many having already been destroyed. There is an example of localized wetland within the study area, a drainage line associated with the Brak river, which lies approximately north of the proposed study area. This wetland area is heavily polluted and is unlikely to attract sensitive species such as Blue Crane *G. paradiseus*, Black Stork *C. nigra* and White Stork *C.ciconia* (Young 2003) that are usually attracted to habitats like this. Various common species i.e. korhaan, ibis, herons and geese may utilise this wetland for their foraging needs.

6.5.4 Rocky ridges

The study area contains exposed rocky ridges at the most southern portion of the proposed 132kV OHPL alignment, that are likely to support the foraging needs of Verreaux's Eagle *A. verreauxii* .

6.5.5 Agricultural lands

Relevant to this project, cultivation is limited to a few agricultural lands within the primary PAOI, surrounding the proposed 132kV OHPL alignment. Arable or cultivated land represents a significant feeding area for many bird species in any landscape, but perhaps more so in arid environments. The opening up of the soil surface, and land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the crop or pasture plants cultivated are often eaten by birds, or attract insects which are in turn eaten by birds. Ludwig's Bustard *N. ludwigii*, Common Buzzard *B. buteo*, Blue Crane *G. paradiseus*, Amur Falcon *F. amurensis*, Lanner Falcon *F. biarmicus*, Lesser Kestrel *F. naumanni*, Rock Kestrel *Falco rupicolus*, Egyptian Goose *Alopochen aegyptiaca*, Spur-winged Goose *Plectropterus gambensis*, Helmeted Guineafowl *N. meleagris* and Hadeda Ibis *Bostrychia hagedash* are likely to frequent this microhabitat. Although the cultivated lands are not located within the proposed powerline corridor, we must account for the potential movement birds across the powerline alignment, as and when food resources become available within the cultivated areas, thereby increasing the risk of collision with the overhead powerline conductors and/or earthwires.

6.5.6 Alien trees

The development area is largely devoid of trees, except for alien trees which have been planted in homestead areas. Although stands of *Eucalyptus* are strictly speaking invader species, they have become important refuges for certain species of raptors, particularly Amur Falcon *F. amurensis*, a Palearctic migrant, which will commonly roost in small stands of *Eucalyptus* in suburbs of small towns. Relevant to this project Amur Falcon *F. amurensis*, Lanner Falcon *F. biarmicus*, Lesser Kestrel *F. naumanni*, Greater Kestrel *F. rupicoloides*, Tawny Eagle *A. rapax* and Martial Eagle *P. bellicosus* may utilise this habitat type occasionally.

6.5.7 High voltage lines

Thirteen existing high voltage transmission powerlines have been constructed within the study area, two of which run parallel to parts of the proposed development, both of which occur within the 200m OHPL corridor. Transmission lines are an important breeding substrate for raptors in the Karoo, due to the lack of large trees (Jenkins *et al.* 2013).

See Appendix 2 for photographic record of habitat features in the study area, within which the proposed development occurs, and the immediate surroundings.

7 AVIFAUNA IN THE STUDY AREA

7.1 South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 171 bird species could potentially occur within the study area and secondary PAOIs – Appendix 1 provides a comprehensive list of all the species. Of these, 50 species are classified as priority species (see definition of priority species in section 4) and ten are South African Red List species. Of the priority species, 32 are likely to occur regularly at the study area and immediate surrounding area, with the remaining 18 occurring sporadically.

Table 2 below lists all the priority species and the possible impact on the respective species by the proposed development. The following abbreviations and acronyms are used:

- EN = Endangered
- VU = Vulnerable
- NT = Near threatened
- H = High
- M = Medium
- L = Low

Table 2: Priority powerline species potentially occurring within the study area and immediate surroundings.

Name		SABAP2 reporting rate		Status					Habitat							Impacts				
Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional	Powerline priority	Recorded during surveys	Likelihood of occurrence	Karoo	Alien trees	Dams and water troughs	Wetlands	Agriculture	HV lines	Ridges	Electrocution Substation	Electrocution HV	Powerline - Collision	Displacement - Disturbance	Displacement - Habitat transformation
Hamerkop	*Scopus umbretta*	3,6	0,0	-	-	x		L			x	x				x		x		
Secretarybird	*Sagittarius serpentarius*	3,6	5,0	EN	VU	x		L	x		x							x		x
Ludwig's Bustard	*Neotis ludwigii*	14,3	2,5	EN	EN	x		H	x				x					x	x	x
Common Buzzard	*Buteo buteo*	7,1	0,0	-	-	x		M	x	x	x		x	x		x				x
Jackal Buzzard	*Buteo rufofuscus*	32,1	7,5	-	-	x		H	x	x	x			x	x	x			x	x
Red-knobbed Coot	*Fulica cristata*	10,7	0,0	-	-	x		M			x							x		
White-breasted Cormorant	*Phalacrocorax lucidus*	3,6	0,0	-	-	x		L			x							x		
Blue Crane	*Grus paradisea*	21,4	0,0	VU	NT	x		H	x		x	x	x					x		x
Cape Crow	*Corvus capensis*	3,6	2,5	-	-	x		L	x	x				x		x			x	x
Pied Crow	*Corvus albus*	78,6	47,5	-	-	x	x	H	x	x				x		x			x	x
African Black Duck	*Anas sparsa*	3,6	0,0	-	-	x		L			x	x						x		
White-faced Whistling Duck	*Dendrocygna viduata*	3,6	0,0	-	-	x		L			x	x						x		
Yellow-billed Duck	*Anas undulata*	17,9	2,5	-	-	x		M			x	x						x		
Booted Eagle	*Hieraaetus pennatus*	10,7	2,5	-	-	x		M	x	x	x			x	x	x				x
Martial Eagle	*Polemaetus bellicosus*	3,6	0,0	EN	EN	x		L	x	x	x			x		x			x	x
Tawny Eagle	*Aquila rapax*	3,6	2,5	VU	EN	x		L	x	x	x			x		x			x	x
Verreaux's Eagle	*Aquila verreauxii*	17,9	12,5	-	VU	x		L		x	x			x	x	x		x		
Spotted Eagle-Owl	*Bubo africanus*	3,6	0,0	-	-	x		M	x	x				x	x	x		x		x
Little Egret	*Egretta garzetta*	3,6	0,0	-	-	x		L			x	x						x		
Western Cattle Egret	*Bubulcus ibis*	3,6	0,0	-	-	x		L		x	x	x				x		x		
Amur Falcon	*Falco amurensis*	10,7	7,5	-	-	x		M	x	x			x	x		x				x
Lanner Falcon	*Falco biarmicus*	7,1	0,0	-	VU	x		M	x	x	x		x	x	x	x			x	x
Greater Flamingo	*Phoenicopterus roseus*	10,7	0,0	-	NT	x		L			x							x		
Egyptian Goose	*Alopochen aegyptiaca*	46,4	7,5	-	-	x		H			x	x	x			x		x		
Spur-winged Goose	*Plectropterus gambensis*	28,6	2,5	-	-	x		H			x	x	x					x		
Gabar Goshawk	*Micronisus gabar*	3,6	0,0	-	-	x		L		x	x									
Pale Chanting Goshawk	*Melierax canorus*	50,0	20,0	-	-	x		H	x	x	x			x		x				x
Little Grebe	*Tachybaptus ruficollis*	3,6	0,0	-	-	x		L			x	x						x		
Helmeted Guineafowl	*Numida meleagris*	42,9	5,0	-	-	x		H	x	x	x		x	x		x				x

Name		SABAP2 reporting rate		Status					Habitat							Impacts				
Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional	Powerline priority	Recorded during surveys	Likelihood of occurrence	Karoo	Alien trees	Dams and water troughs	Wetlands	Agriculture	HV lines	Ridges	Electrocution Substation	Electrocution HV	Powerline - Collision	Displacement - Disturbance	Displacement - Habitat transformation
African Harrier-Hawk	*Polyboroides typus*	3,6	5,0	-	-	x		L	x	x	x					x				x
Black-headed Heron	*Ardea melanocephala*	10,7	0,0	-	-	x		M	x	x	x	x		x		x		x		x
Grey Heron	*Ardea cinerea*	14,3	0,0	-	-	x		M		x	x	x						x		
African Sacred Ibis	*Threskiornis aethiopicus*	39,3	2,5	-	-	x	x	H		x	x	x				x		x		
Glossy Ibis	*Plegadis falcinellus*	21,4	0,0	-	-	x		M				x						x		
Hadada Ibis	*Bostrychia hagedash*	53,6	0,0	-	-	x	x	H		x	x	x	x	x		x		x		
Greater Kestrel	*Falco rupicoloides*	10,7	10,0	-	-	x	x	M	x	x				x		x			x	x
Lesser Kestrel	*Falco naumanni*	67,9	10,0	-	-	x		H	x	x			x	x		x				x
Rock Kestrel	*Falco rupicolus*	32,1	17,5	-	-	x		H	x	x			x	x	x	x			x	x
Black-winged Kite	*Elanus caeruleus*	7,1	0,0	-	-	x		M	x	x				x		x				x
Blue Korhaan	*Eupodotis caerulescens*	10,7	0,0	NT	LC	x		M	x									x	x	x
Northern Black Korhaan	*Afrotis afraoides*	71,4	10,0	-	-	x		H	x									x	x	x
Common Moorhen	*Gallinula chloropus*	17,9	0,0	-	-	x		M			x	x								
White-necked Raven	*Corvus albicollis*	14,3	7,5	-	-	x		M	x	x				x	x	x				x
South African Shelduck	*Tadorna cana*	25,0	5,0	-	-	x		H			x	x						x		
Cape Shoveler	*Spatula smithii*	3,6	0,0	-	-	x		L			x	x						x		
Black Stork	*Ciconia nigra*	7,1	0,0	-	VU	x		M		x	x	x		x		x		x		
White Stork	*Ciconia ciconia*	3,6	0,0	-	-	x		L	x	x	x	x		x				x		x
Cape Teal	*Anas capensis*	10,7	0,0	-	-	x		M			x	x						x		
Red-billed Teal	*Anas erythrorhyncha*	14,3	0,0	-	-	x		M			x	x						x		
Cape Vulture	*Gyps coprotheres*	3,6	0,0	EN	EN	x		L	x	x	x			x	x		x	x		x

7.2 Co-ordinated Avifaunal Road count Data

Cranes, bustards, storks and other large birds that spend most of their time on the ground, need wide, open spaces and are certainly not restricted to protected areas. Agricultural habitats are used extensively for feeding, roosting and breeding, often because no natural, pristine habitats are available, and sometimes because the agricultural habitats are especially attractive to birds. The Coordinated Avifaunal Roadcounts (CAR) project monitors the populations of 36 species of large terrestrial birds in agricultural habitats, in addition to gamebirds, raptors and corvids along 350 fixed routes covering over 19 000km (http://car.adu.org.za/). Although CAR road counts do not give an absolute count of all the individuals in a population, they do provide a measure of relative abundance in a particular area. A single CAR route (NK131) intersects the proposed powerline, along the R48 provincial road (Figure 5). Five surveys were conducted along this route between 1996 and 1998, with each survey producing observations of a single species. Species abundance along this route is also low with less than five individuals recorded during each survey. Species recorded include Kori Bustard *A. kori*, Ludwig's Bustard *N. ludwigii*, Karoo Korhaan *Eupodotis vigorsii* and Black-headed Heron *Ardea melanocephala*.

7.3 Co-ordinated Waterbird Count Data

A Co-ordinated Waterbird Count (CWAC) site is any body of water, other than the oceans, which supports a significant number (set at approximately 500 individual waterbirds, irrespective of the number of species) of birds which use the site for feeding, and/or breeding and roosting (Harrison et al, 2004). This definition includes natural pans, vleis, marshes, lakes, rivers, as well as a range of manmade impoundments (i.e. sewage works). The presence of a CWAC site within the study area is an indication of a large number of waterbird species occurring there and the overall sensitivity of the area.

There are no CWAC sites located within the study area. The closest CWAC site (De Aar Sewage Works) is located within a 35km radius of the proposed development study area (Figure 5). Greater Flamingo (n=4) is the only Red List species that has been recorded at this CWAC location. Species recorded in relatively larger numbers include Red-knobbed Coot *Fulica cristata*, Yellow-billed Duck *Anas undulata*, Spur-winged Goose *P. gambensis*, Hadeda Ibis *B. hagedash*, Blacksmith Lapwing *Vanellus armatus*, Black-winged Stilt *Himantopus himantopus* and Cape Teal *Anas capensis*.

While this CWAC site may provide an indication of the waterbird species that could be supported by similar natural and artificial impoundments located along the proposed development, this site will not have a significant impact on the sensitivity rating for the proposed development. However, with the exception of Blacksmith Lapwing, the remaining species are considered priority species that are susceptible to collisions with powerline infrastructure.

7.4 On-site surveys

A single late summer survey was conducted on 28 March 2021 within the study area. In order to describe the avifaunal community present, a concerted effort was made to observe the various species in all of the primary habitats that were available within the proposed development study area.

The site visit produced a combined list of 18 species (Appendix 1 - highlighted in grey), covering both the study area and to a limited extent, the surrounding area. Four priority species were observed along the proposed powerline alignment, none of which are Red List species. All other observations were of small passerine and game bird species that are common to this area. Each of the aforementioned species has the potential to be displaced by the proposed development as a result of habitat transformation and disturbance. However, these species have persisted despite existing disturbance i.e., pastoral, industrial, residential activities and vehicle disturbance within the study area. This resilience, coupled with the fact that similar habitat is available throughout the broader area, means that the displacement impact will not be of regional or national significance. In addition, no raptor nests or other possible Red List breeding sites were noted during the site survey.

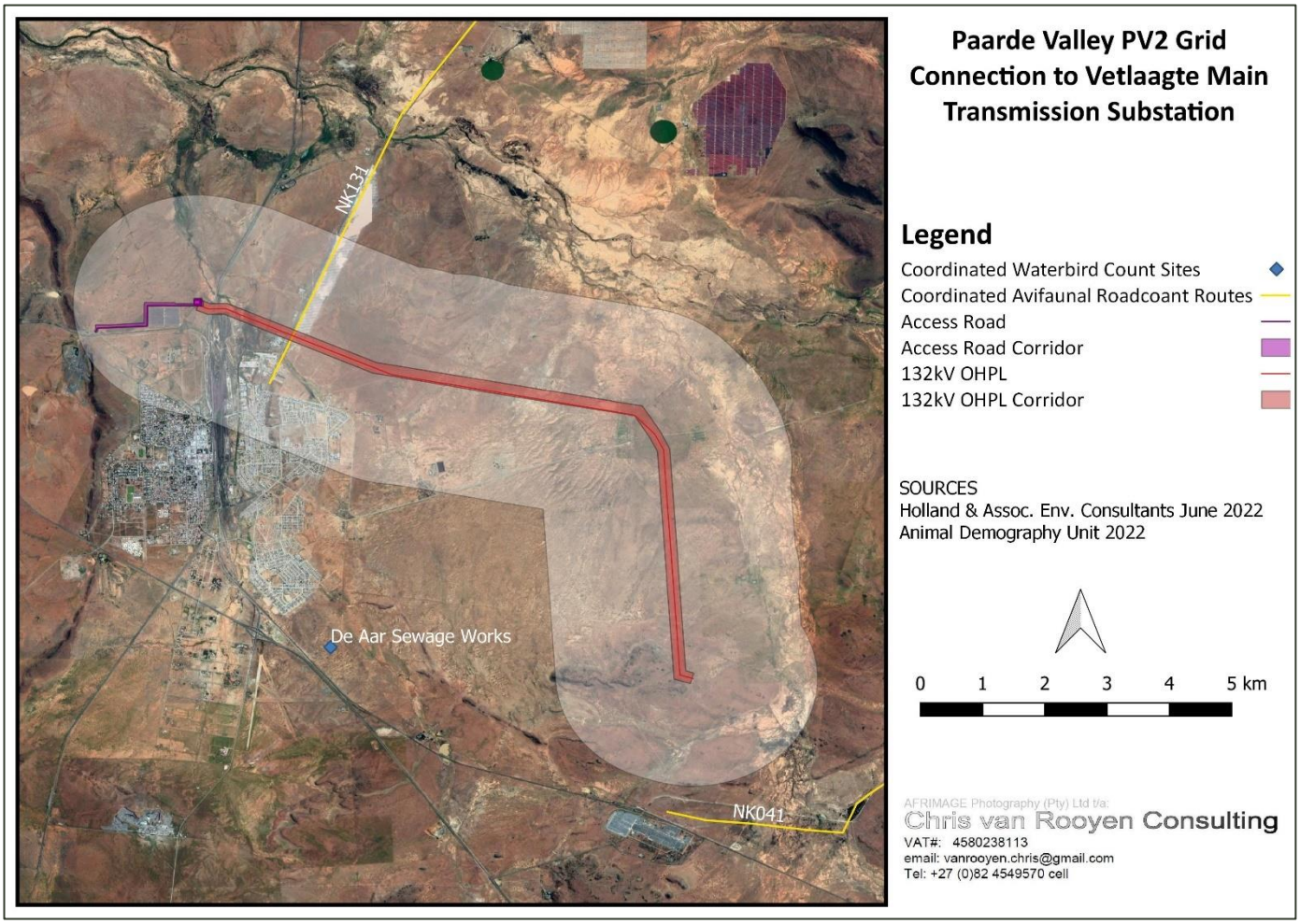


Figure 5: Regional map detailing the location of the proposed development in relation to Coordinated Avifaunal Roadcount (CAR) routes and Coordinated Waterbird Count (CWAC) sites

8 IMPACT ASSESSMENT

8.1 General

Negative impacts on avifauna by electricity infrastructure generally take two (2) main forms, namely electrocution and collisions (Ledger & Annegarn, 1981; Ledger 1983; Ledger, 1984; Hobbs and Ledger, 1986a; Hobbs & Ledger, 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn, 1996; Kruger & Van Rooyen, 1998; Van Rooyen, 1998; Kruger, 1999; Van Rooyen, 1999; Van Rooyen, 2000; Van Rooyen, 2004; Jenkins *et al*., 2010). Displacement due to habitat destruction and disturbance associated with the construction of the electricity infrastructure and other associated infrastructure is another impact that could potentially impact on avifauna.

The following potential impacts have been identified:

8.1.1 Construction Phase

- Displacement due to disturbance associated with the construction of the proposed switching station and 132kV powerline; and
- Displacement due to habitat transformation associated with the construction of the proposed 132kV switching station and to a limited extent the 132kV powerline;

8.1.2 Operational Phase

- Collisions with the proposed 132kV powerline;
- Electrocutions on the proposed switching station infrastructure; and
- Electrocution of vultures on the proposed 132kV powerline infrastructure.

8.1.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the proposed switching station, and the 132kV powerline.

8.1.4 Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the proposed switching station and 132kV powerline;
- Displacement due to habitat transformation associated with the proposed switching station and to a limited extent the 132kV powerline;
- Collisions with the proposed 132kV powerline;
- Electrocutions within the switching station; and
- Electrocution of vultures on the proposed 132kV powerline infrastructure.

8.2 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. Relevant to the proposed 132kV OHPL, the significance of the electrocution impact on the majority of priority species will be low. The only priority species capable of bridging the clearance distances of the proposed powerline infrastructure is the Cape Vulture recorded in the study area, due to their size and gregarious nature. SABAP data suggests that the species is unlikely to occur regularly in the study area, a premise that is supported by no observations being made during the site visit to the study area. However, pastoral activities feature prevalently, so their sporadic occurrence cannot be ruled out. The only envisaged high risk scenario would be when a carcass becomes available within a few hundred metres of the proposed powerline, attracting vultures which may cluster on a few towers. Both technological alternatives i.e. the steel lattice and standard steel monopole tower structures pose an electrocution risk to this SCC. The only mitigation option is the construction of the double circuit OHPL using a minimum clearance of 1.8m between the jumpers and/or insulators and the horizontal earthed component on the lattice/monopole structure. The configuration of the insulators and the clearance distances between the live and earthed components on this structure can comfortably accommodate a perching vulture thereby eliminating the electrocution risk. Additional mitigation in the form of insulating sleeves on *jumpers* present on strain poles and terminal poles is also recommended (if suitable insulation material is readily available), alternatively all *jumpers* must be suspended below the crossarms.

Electrocutions within the proposed switching station, contained within the on-site PV substation are possible, however the likelihood of this impact on the more sensitive Red List priority species is remote, as these species are unlikely to regularly utilise the infrastructure within the switching station for perching or roosting. Species that are more vulnerable to this impact are medium-sized raptors, corvids, owls and certain species of waterbirds. The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

132kV powerline:

- Cape Vulture

132kV switching station:

- African Harrier-Hawk
- African Sacred Ibis
- Amur Falcon
- Black Stork
- Black-headed Heron
- Black-winged Kite
- Booted Eagle

- Cape Crow
- Common Buzzard
- Egyptian Goose
- Greater Kestrel
- Hamerkop
- Hadeda Ibis
- Helmeted Guineafowl
- Jackal Buzzard
- Lanner Falcon
- Lesser Kestrel
- Martial Eagle
- Pale Chanting Goshawk
- Pied Crow
- Rock Kestrel
- Spotted Eagle-Owl
- Tawny Eagle
- Verreaux's Eagle
- Western Cattle Egret
- White-necked Raven

8.3 Collisions

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

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

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

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

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

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

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

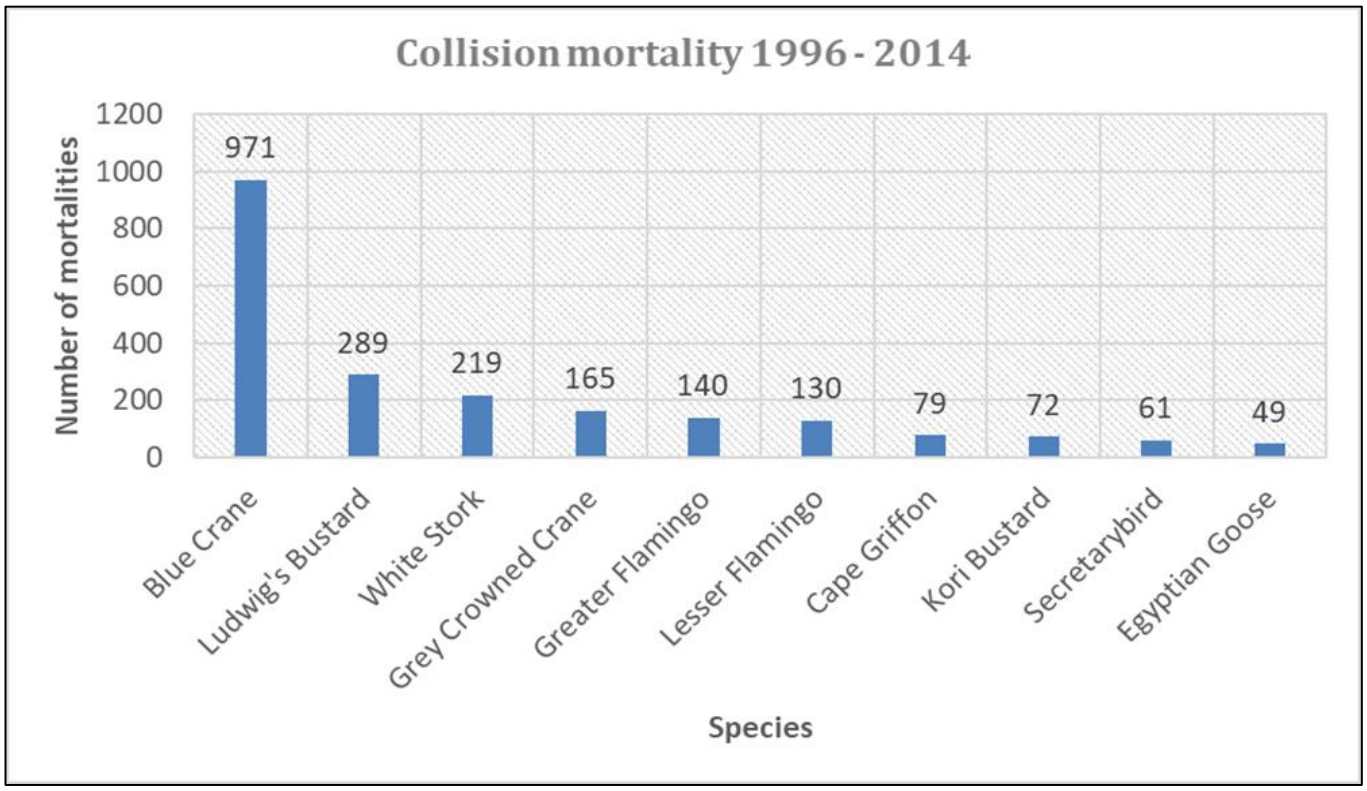


Figure 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and powerline configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as powerlines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some

species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with powerlines i.e. Kori Bustards *A. kori*, Blue Cranes *G. paradisea* and White Storks *C. ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and powerlines. These findings have applicability to species outside of these families especially raptors (A*ccipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to powerline collisions.

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

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

The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

- African Black Duck
- African Sacred Ibis
- Black Stork
- Black-headed Heron
- Blue Crane
- Blue Korhaan
- Cape Shoveler

- Cape Teal
- Cape Vulture
- Egyptian Goose
- Glossy Ibis
- Greater Flamingo
- Grey Heron
- Hadeda Ibis
- Hamerkop
- Helmeted Guineafowl
- Little Egret
- Little Grebe
- Ludwig's Bustard
- Northern Black Korhaan
- Red-billed Teal
- Red-knobbed Coot
- Secretarybird
- South African Shelduck
- Spotted Eagle-Owl
- Spur-winged Goose
- Verreaux's Eagle
- Western Cattle Egret
- White-breasted Cormorant
- White-faced Whistling Duck
- White Stork
- Yellow-billed Duck

8.4 Displacement due to habitat destruction and disturbance

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

- Site clearance and preparation;
- Excavations for infrastructure;
- Construction of the infrastructure (i.e. the 132kV switching station, access road and 132kV OHPL); and
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site.

These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed switching station and the 132kV OHPL through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the central collector substation is unavoidable. In the case of the 132kV OHPL, the direct habitat transformation is limited to the pole footprints and the narrow access road/track under the powerline. The habitat in the study area is highly uniform from a bird impact perspective. The loss of habitat a relatively small quantity of the habitat for priority species due to direct habitat transformation associated with the construction of the proposed 132kV OHPL is likely to be fairly minimal.

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle. Terrestrial

species and raptors potentially breeding on the existing powerline infrastructure within the PAOI are most likely to be affected by displacement due to disturbance.

The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

- African Harrier-Hawk
- Amur Falcon
- Black-headed Heron
- Black-winged Kite
- Blue Crane
- Blue Korhaan
- Booted Eagle
- Cape Crow
- Cape Vulture
- Common Buzzard
- Greater Kestrel
- Helmeted Guineafowl
- Jackal Buzzard
- Lanner Falcon
- Lesser Kestrel
- Ludwig's Bustard
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk
- Pied Crow
- Rock Kestrel
- Secretarybird
- Spotted Eagle-Owl
- Tawny Eagle
- White-necked Raven
- White Stork

9 IMPACT RATING

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

9.1 Determination of Significance of Impacts

For each impact, the **nature** (positive/negative), **extent** (spatial scale), **magnitude/intensity** (intensity scale), **duration** (time scale), **consequence** (calculated numerically) and **probability** of occurrence is ranked and described. These criteria would be used to ascertain the **significance** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The tables below show the rankings of these variables, and defines each of the rating categories.

Table 3: Assessment criteria for the evaluation of impacts

CRITERIA	RANK	DESCRIPTION
Nature	**Positive (+)**	The environment will be positively affected.
	Negative (-)	The environment will be negatively affected.
Extent or spatial influence of impact	**National (4)**	Beyond provincial boundaries, but within national boundaries.
	Regional (3)	Beyond a 10 km radius of the proposed activities, but within provincial boundaries.
	Local (2)	Within a 10 km radius of the proposed activities.
	Site specific (1)	On site or within 100 m of the proposed activities.
	Zero (0)	Zero extent.
Magnitude/ intensity of impact (at the indicated spatial scale)	**High (3)**	Natural and/ or social functions and/ or processes are *severely* altered.
	Medium (2)	Natural and/ or social functions and/ or processes are *notably* altered.
	Low (1)	Natural and/ or social functions and/ or processes are *slightly* altered.
	Zero (0)	Natural and/ or social functions and/ or processes remain *unaltered.*
Duration of impact	**Long Term (3)**	More than 10 years, but impact ceases after the operational phase.
	Medium Term (2)	Between 3 – 10 years.
	Short Term (1)	Construction period (up to 3 years).
	None (0)	Zero duration.
Consequence (Nature x (Extent + Magnitude/ Intensity + Duration))	**Extremely beneficial/detrimental (10 – 11) (+/-)**	The impact is *extremely* beneficial/ detrimental.
	Highly beneficial/detrimental (8 – 9) (+/-)	The impact is *highly* beneficial/ detrimental.
	Moderately beneficial/detrimental (6 – 7) (+/-)	The impact is *moderately* beneficial/ detrimental.
	Slightly beneficial/detrimental (4 – 5) (+/-)	The impact is *slightly* beneficial/ detrimental.
	Negligibly beneficial/detrimental (1 – 3) (+/-)	The impact is *negligibly* beneficial/ detrimental.
	Zero consequence (0) (+/-)	The impact has zero consequence.
Probability of occurrence	**Definite (4)**	Estimated at a greater than 95% chance of the impact occurring.
	Probable (3)	Estimated 50 – 95% chance of the impact occurring.
	Possible (2)	Estimated 6 – 49% chance of the impact occurring.
	Unlikely (1)	Estimated less than 5% chance of the impact occurring.
	None (0)	Estimated no chance of impact occurring.

The **significance** of an impact is derived by taking into account the **consequence** (nature of the impact and its extent, magnitude/intensity and duration) of the impact and the **probability** of this impact occurring through the use of the following formula:

Significance Score = Consequence x Probability

The means of arriving at a significance rating is explained in the table below:

Table 4: Definition of significance ratings

SIGNIFICANCE SCORE	SIGNIFICANCE RATINGS	
32 – 40	**High (+)**	**High (-)**
25 – 31	**Medium (+)**	**Medium (-)**
19 – 24	**Low (+)**	**Low (-)**
10 – 18	**Very-Low (+)**	**Very-Low (-)**
1 – 9	**Negligible**	

Once the significance of an impact has been determined, the **confidence** in the assessment of the impact, as well as the degree of **reversibility** of the impact and **irreplaceable loss of resources** would be determined using the rating systems outlined in Table 5,6 and 7 respectively. Lastly, the **cumulative impact** is ranked and described as outlined in Table 8.

Table 5: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
High	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Medium	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Low	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 6: Degree of reversibility

REVERSABILITY OF IMPACT	CRITERIA
High	High potential for reversibility.
Medium	Medium potential for reversibility.
Low	Low potential for reversibility.
Zero	Zero potential for reversibility.

Table 7: Degree of irreplaceability

IRREPLACEABLE LOSS OF RESOURCES	CRITERIA
High	Definite loss of irreplaceable resources.
Medium	Medium potential for loss of irreplaceable resources.
Low	Low potential for loss of irreplaceable resources.
Zero	Zero potential for loss of irreplaceable resources.

Table 8: Cumulative Impact on the environment

CUMULATIVE IMPACTS	CRITERIA
High	The activity is one of *several* similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the geographical, physical, biological, social, economic and cultural aspects of the environment.
Medium	The activity is one of a *few* similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the geographical, physical, biological, social, economic and cultural aspects of the environment.
Low	The activity is localised and might have a negligible cumulative impact.
Zero	No cumulative impact on the environment.

9.2 Impact Assessment

The impact assessments are summarised in the Tables 9-15 below.

9.2.1 Construction Phase

Table 9: Displacement due to disturbance impact assessment

IMPACT *Displacement of priority species due to* ***disturbance*** *associated with construction of the proposed development using either technology alternative (i.e. steel lattice or standard steel monopole tower structures)*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative-	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Extent	Local	Local	
Magnitude	Medium	Medium	
Duration	Short	Short	
Consequence	Slightly detrimental	Slightly detrimental	
Significance	**Low**	**Very Low**	
Probability	Probable	Possible	
Confidence	High	High	
Reversibility	Medium	High	
Irreplaceable loss of resources?	Low	Low	
Cumulative Impact	Medium	Low	
Degree to which the impact can be avoided	Low. The impact will occur regardless of mitigation.		
Degree to which the impact can be managed	Low.		
Degree to which the impact can be mitigated	Low. There will still be a high potential for disturbance, regardless of mitigation.		

Table 10: Displacement due to habitat transformation impact assessment (switching station)

IMPACT *Displacement of priority species due to* ***habitat transformation*** *associated with construction of the switching station*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative -	Neutral. The no-go alternative will result in the current status quo being maintained within
Extent	Site Specific	Site Specific	

Magnitude	Medium	Low	the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Duration	Long	Long	
Consequence	Moderately detrimental	Slightly detrimental	
Significance	**Low**	**Very Low**	
Probability	**Definite**	**Probable**	
Confidence	High	High	
Reversibility	Low	Medium	
Irreplaceable loss of resources?	Medium	Low	
Cumulative Impact	Medium	Medium	
Degree to which the impact can be avoided	Low. The construction of the switching station will result in the complete transformation of the footprint.		
Degree to which the impact can be managed	Low		
Degree to which the impact can be mitigated	Low		

Table 11: Displacement due to habitat transformation impact assessment (132kV powerline)

IMPACT *Displacement of priority species due to* ***habitat transformation*** *associated with construction of the 132kV OHPL using either technology alternative (i.e. steel lattice or standard steel monopole tower structures)*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative -	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Extent	Site Specific 1	Site Specific 1	
Magnitude	Low 1	Low 1	
Duration	Medium 2	Medium 2	
Consequence	Slightly detrimental	Slightly detrimental	
Significance	**Very Low**	**Negligible**	
Probability	Probable 3	Possible 2	
Confidence	High	High	
Reversibility	Medium	Medium	
Irreplaceable loss of resources?	Low	Low	
Cumulative Impact	Medium	Medium	
Degree to which the impact can be avoided	High. Very little vegetation clearance will be required for the powerline.		
Degree to which the impact can be managed	Medium		
Degree to which the impact can be mitigated	Medium		

9.2.2 Operational Phase

Table 12: Mortality due to collision impact assessment

IMPACT *Mortality of priority species due to* ***collisions*** *with the 132kV OHPL using either technology alternative (i.e. steel lattice or standard steel monopole tower structures)*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative -	

Extent	Regional	Regional	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Magnitude	High	Medium	
Duration	Long	Medium	
Consequence	Highly detrimental	Moderately detrimental	
Significance	**High**	**Medium**	
Probability	Definite	Probable	
Confidence	High	High	
Reversibility	Medium	Medium	
Irreplaceable loss of resources?	High	Medium	
Cumulative Impact	High	Medium	
Degree to which the impact can be avoided	Low. The impact will almost definitely happen in the course of the lifetime of the powerline.		
Degree to which the impact can be managed	Medium		
Degree to which the impact can be mitigated	Medium. The marking of powerlines is very effective for most large terrestrial species, but not for the bustard family.		

Table 13: Mortality due to electrocution impact assessment (switching station)

IMPACT *Mortality of priority species due to electrocution on the switching station infrastructure*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative -	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Extent	Regional	Local	
Magnitude	Low	Low	
Duration	Long	Medium	
Consequence	Moderately detrimental	Slightly detrimental	
Significance	**Low**	**Very Low**	
Probability	Probable	Possible	
Confidence	High	High	
Reversibility	Medium	High	
Irreplaceable loss of resources?	High	Low	
Cumulative Impact	Low	Low	
Degree to which the impact can be avoided	Low. Pro-active insulation is not a practical option.		
Degree to which the impact can be managed	High		
Degree to which the impact can be mitigated	High		

Table 14: Mortality due to electrocution impact assessment (132kV powerline)

IMPACT *Mortality of priority species due to electrocution on the 132kV OHPL infrastructure using either technology alternative (i.e. steel lattice or standard steel monopole tower structures)*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative -	

Extent	Regional	Regional	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Magnitude	High	High	
Duration	Long	Long	
Consequence	Highly detrimental	Highly detrimental	
Significance	**Medium**	**Negligible**	
Probability	Probable	Unlikely	
Confidence	High	High	
Reversibility	Low	High	
Irreplaceable loss of resources?	High	Low	
Cumulative Impact	High	Low	
Degree to which the impact can be avoided	High. Construction of the double circuit OHPL using a minimum clearance distance of 1.8m between the jumpers and/or insulators and the horizontal earthed component on the lattice/monopole structure should practically eliminate the risk of electrocutions.		
Degree to which the impact can be managed	High		
Degree to which the impact can be mitigated	High.		

9.2.3 Decommissioning Phase

Table 15: Displacement due to disturbance impact assessment

IMPACT *Displacement of priority species due to* ***disturbance*** *associated with decommissioning of the development*			
	Without mitigation	**With mitigation**	**No Go**
Nature	Negative -	Negative-	Neutral. The no-go alternative will result in the current status quo being maintained within the proposed development area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.
Extent	Local	Local	
Magnitude	Medium	Medium	
Duration	Short	Short	
Consequence	Slightly detrimental	Slightly detrimental	
Significance	**Low**	**Very Low**	
Probability	Probable	Possible	
Confidence	High	High	
Reversibility	Medium	High	
Irreplaceable loss of resources?	Low	Low	
Cumulative Impact	Medium	Low	
Degree to which the impact can be avoided	Low. The impact will occur regardless of mitigation.		
Degree to which the impact can be managed	Medium		
Degree to which the impact can be mitigated	Medium		

9.3 Cumulative impacts

“Cumulative Impact”, in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities .

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section addresses whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment
- Unacceptable increase in impact

According to the official database of DFFE, there are at least 51 renewable energy projects, approximately 1273km^2 in area, within a 35km radius around the proposed development as at the fourth quarter (Q4) of 2021 (Figure 7).

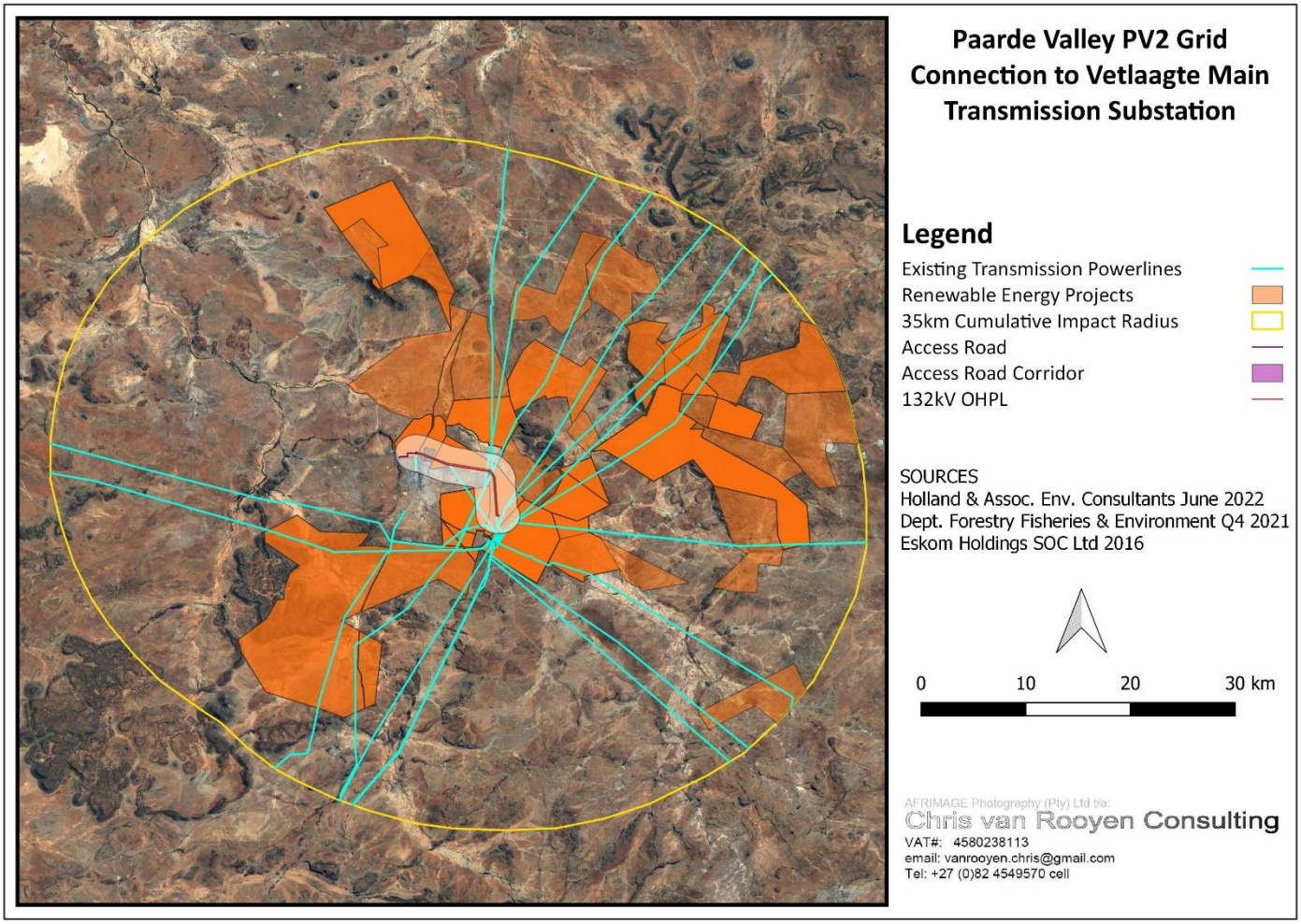


Figure 7: Renewable energy applications and existing high voltage powerlines within 35km of the proposed development

The proposed 132kV OHPL equates to a maximum of 12.7km. There are approximately 16 transmission powerlines and 19 distribution powerlines totalling hundreds of kilometres of existing medium and high voltage lines within the 35km radius around the proposed development project area. An intensive internet search was conducted to source information on the grid connections of the abovementioned projects available within the public domain, but in some instances no information could be obtained. The proposed development will thus increase the total number of existing high voltage lines by a very small percentage. The contribution of the proposed 132kV OHPL to the cumulative impact of all the high voltage lines is thus LOW. However, the combined cumulative impact of the existing and proposed powerlines on avifauna within a 35km radius is considered to be MODERATE to HIGH.

A total of fifteen substations and switching stations have been constructed within 35km of the proposed project. The cumulative impact of displacement due to disturbance and habitat transformation at the 132kV SwS is considered to be LOW, due to the small size of the switching station footprint and the availability of similar habitat within the 35km radius area. The cumulative impact of potential electrocutions within the switching station yard is also likely to be LOW as it is expected to be a rare event.

9.4 Site-based Ecological Importance (SEI)

An evaluation of site-based Ecological Importance (SEI) was conducted for each habitat type within the PAOI, using the criteria described in the *Species Environmental Assessment Guideline* (Table 16). At a site-specific level, environmentally sensitive features present within the proposed study area include permanent and ephemeral waterbodies and wetland areas. These areas are delineated as areas of **HIGH** sensitivity. The construction of the proposed powerline across or within close proximity to the waterbodies will necessitate the marking of the powerline with bird flight diverters to mitigate the collision impact. The large majority of PAOI is comprised of Karoo vegetation, that supports the foraging and breeding needs for the SCC recorded in the study area, particularly Ludwig Bustard and Blue Crane. This habitat type together with the ridges located in the lower reaches of the PAOI area delineated as being of **MEDIUM** sensitivity and will also necessitate the marking of the powerline with bird flight diverters to mitigate the collision impact. Small pockets of agricultural lands and urban infrastructure are considered to be of **LOW** sensitivity, requiring no mitigation intervention (Figure 8).

Table 16: Site-based Ecological Importance assessment

Habitat Type	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site-based Ecological Importance
Nama Karoo (including High Voltage lines)	High - Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2.	High - Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.	High	High - SCCs have a high likelihood of returning to the site once the disturbance or impact has been removed.	Medium - Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Alien Trees	Medium - highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals.	Low - Small (> 1 ha but < 5 ha) area.	Low	Medium - SCCs have a moderate likelihood of returning to the site once the disturbance or impact has been removed.	Low - Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Dams/Water troughs/ Wetlands	High - Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2.	Medium - Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.	High	Medium - SCCs have a moderate likelihood of returning to the site once the disturbance or impact has been removed.	High - Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable.
Urban and agriculture	Medium - highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals.	Low - Several minor and major current negative ecological impacts.	Low	Medium - SCCs have a moderate likelihood of returning to the site once the disturbance or impact has been removed.	Low - Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Ridges	High - Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2.	High - Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.	High	High - SCCs have a high likelihood of returning to the site once the disturbance or impact has been removed.	Medium - Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.

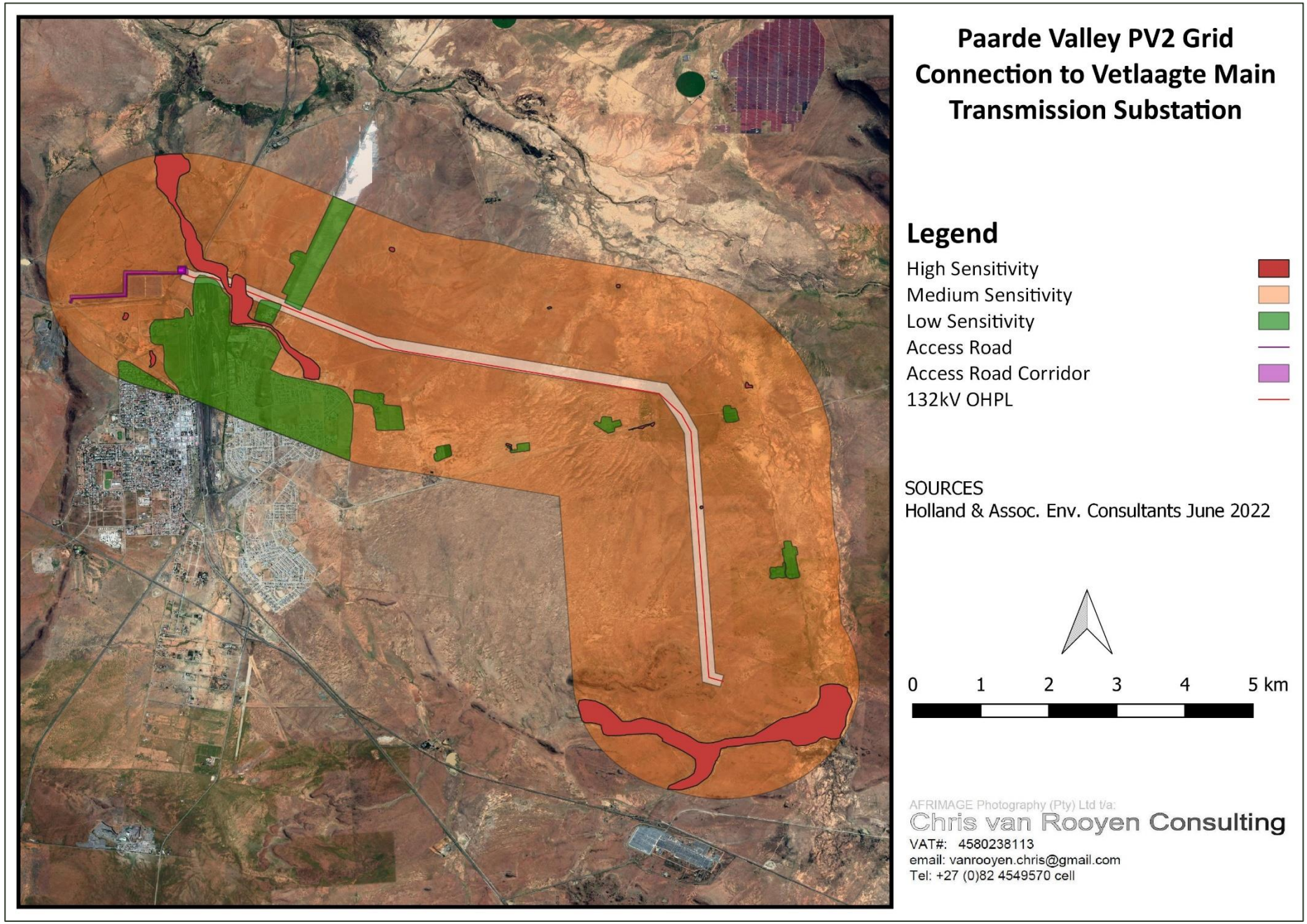


Figure 8: Site-based Ecological Importance delineating areas of high, medium and low sensitivity

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

Refer to Appendix 4 for a description of the key mitigation and monitoring recommendations for each applicable impact identified for all phases of the project.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

11.1 Statement and Reasoned Opinion

The expected impacts of the proposed development range from VERY LOW to HIGH significance and negative status pre-mitigation. However, with appropriate mitigation, the post-mitigation significance of the identified impacts should be reduced to MEDIUM and LOW negative (see Table 3 above). No fatal flaws were discovered in the course of the investigation. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix 4) are strictly implemented.

11.2 EA Condition Recommendations

The proposed mitigation measures are detailed in the EMPr (Appendix 4).

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE STUDY AREA AND SURROUNDINGS

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional
Acacia Pied Barbet	*Tricholaema leucomelas*	42,9	10,0	-	-
African Black Duck	*Anas sparsa*	3,6	0,0	-	-
African Black Swift	*Apus barbatus*	3,6	0,0	-	-
African Harrier-Hawk	*Polyboroides typus*	3,6	5,0	-	-
African Hoopoe	*Upupa africana*	21,4	0,0	-	-
African Pipit	*Anthus cinnamomeus*	42,9	12,5	-	-
African Red-eyed Bulbul	*Pycnonotus nigricans*	46,4	10,0	-	-
African Reed Warbler	*Acrocephalus baeticatus*	17,9	5,0	-	-
African Rock Pipit	*Anthus crenatus*	25,0	15,0	NT	NT
African Sacred Ibis	*Threskiornis aethiopicus*	39,3	2,5	-	-
African Stonechat	*Saxicola torquatus*	25,0	2,5	-	-
Alpine Swift	*Tachymarptis melba*	10,7	5,0	-	-
Amur Falcon	*Falco amurensis*	10,7	7,5	-	-
Ant-eating Chat	*Myrmecocichla formicivora*	60,7	20,0	-	-
Barn Swallow	*Hirundo rustica*	60,7	17,5	-	-
Black Crake	*Zapornia flavirostra*	3,6	0,0	-	-
Black Stork	*Ciconia nigra*	7,1	0,0	-	VU
Black-chested Prinia	*Prinia flavicans*	10,7	5,0	-	-
Black-headed Canary	*Serinus alario*	10,7	7,5	-	-
Black-headed Heron	*Ardea melanocephala*	10,7	0,0	-	-
Blacksmith Lapwing	*Vanellus armatus*	42,9	7,5	-	-
Black-throated Canary	*Crithagra atrogularis*	25,0	5,0	-	-
Black-winged Kite	*Elanus caeruleus*	7,1	0,0	-	-
Black-winged Stilt	*Himantopus himantopus*	25,0	10,0	-	-
Blue Crane	*Grus paradisea*	21,4	0,0	VU	NT
Blue Korhaan	*Eupodotis caerulescens*	10,7	0,0	NT	LC
Bokmakierie	*Telophorus zeylonus*	60,7	7,5	-	-
Booted Eagle	*Hieraaetus pennatus*	10,7	2,5	-	-
Bradfield's Swift	*Apus bradfieldi*	3,6	0,0	-	-
Brown-throated Martin	*Riparia paludicola*	7,1	0,0	-	-
Buffy Pipit	*Anthus vaalensis*	3,6	0,0	-	-
Cape Bunting	*Emberiza capensis*	35,7	20,0	-	-
Cape Crow	*Corvus capensis*	3,6	2,5	-	-
Cape Robin-Chat	*Cossypha caffra*	35,7	0,0	-	-
Cape Shoveler	*Spatula smithii*	3,6	0,0	-	-
Cape Sparrow	*Passer melanurus*	82,1	20,0	-	-
Cape Starling	*Lamprotornis nitens*	7,1	2,5	-	-
Cape Teal	*Anas capensis*	10,7	0,0	-	-
Cape Turtle Dove	*Streptopelia capicola*	57,1	12,5	-	-
Cape Vulture	*Gyps coprotheres*	3,6	0,0	EN	EN
Cape Wagtail	*Motacilla capensis*	39,3	2,5	-	-
Cape Weaver	*Ploceus capensis*	0,0	2,5	-	-
Cape White-eye	*Zosterops virens*	14,3	0,0	-	-

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional
Capped Wheatear	*Oenanthe pileata*	39,3	7,5	-	-
Chat Flycatcher	*Melaenornis infuscatus*	28,6	12,5	-	-
Chestnut-vented Warbler	*Curruca subcoerulea*	3,6	0,0	-	-
Cinnamon-breasted Bunting	*Emberiza tahapisi*	0,0	2,5	-	-
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*	14,3	2,5	-	-
Common Buzzard	*Buteo buteo*	7,1	0,0	-	-
Common Greenshank	*Tringa nebularia*	10,7	0,0	-	-
Common Moorhen	*Gallinula chloropus*	17,9	0,0	-	-
Common Ostrich	*Struthio camelus*	7,1	0,0	-	-
Common Quail	*Coturnix coturnix*	0,0	2,5	-	-
Common Ringed Plover	*Charadrius hiaticula*	0,0	2,5	-	-
Common Sandpiper	*Actitis hypoleucos*	0,0	2,5	-	-
Common Starling	*Sturnus vulgaris*	17,9	0,0	-	-
Common Swift	*Apus apus*	10,7	0,0	-	-
Common Waxbill	*Estrilda astrild*	14,3	0,0	-	-
Crowned Lapwing	*Vanellus coronatus*	17,9	0,0	-	-
Curlew Sandpiper	*Calidris ferruginea*	3,6	0,0	NT	LC
Desert Cisticola	*Cisticola aridulus*	39,3	5,0	-	-
Diederik Cuckoo	*Chrysococcyx caprius*	21,4	2,5	-	-
Double-banded Courser	*Rhinoptilus africanus*	3,6	2,5	-	-
Dusky Sunbird	*Cinnyris fuscus*	7,1	0,0	-	-
Eastern Clapper Lark	*Mirafra fasciolata*	50,0	10,0	-	-
Egyptian Goose	*Alopochen aegyptiaca*	46,4	7,5	-	-
European Bee-eater	*Merops apiaster*	39,3	7,5	-	-
Fairy Flycatcher	*Stenostira scita*	14,3	2,5	-	-
Familiar Chat	*Oenanthe familiaris*	64,3	22,5	-	-
Fiscal Flycatcher	*Melaenornis silens*	14,3	2,5	-	-
Gabar Goshawk	*Micronisus gabar*	3,6	0,0	-	-
Glossy Ibis	*Plegadis falcinellus*	21,4	0,0	-	-
Greater Flamingo	*Phoenicopterus roseus*	10,7	0,0	-	NT
Greater Kestrel	*Falco rupicoloides*	10,7	10,0	-	-
Greater Striped Swallow	*Cecropis cucullata*	39,3	7,5	-	-
Grey Heron	*Ardea cinerea*	14,3	0,0	-	-
Grey Tit	*Melaniparus afer*	17,9	2,5	-	-
Grey-backed Cisticola	*Cisticola subruficapilla*	42,9	10,0	-	-
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	14,3	0,0	-	-
Grey-headed Gull	*Chroicocephalus cirrocephalus*	3,6	0,0	-	-
Grey-winged Francolin	*Scleroptila afra*	3,6	12,5	-	-
Hadada Ibis	*Bostrychia hagedash*	53,6	0,0	-	-
Hamerkop	*Scopus umbretta*	3,6	0,0	-	-
Helmeted Guineafowl	*Numida meleagris*	42,9	5,0	-	-
House Sparrow	*Passer domesticus*	32,1	10,0	-	-
Jackal Buzzard	*Buteo rufofuscus*	32,1	7,5	-	-
Karoo Chat	*Emarginata schlegelii*	7,1	2,5	-	-

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional
Karoo Lark	*Calendulauda albescens*	7,1	0,0	-	-
Karoo Long-billed Lark	*Certhilauda subcoronata*	32,1	22,5	-	-
Karoo Prinia	*Prinia maculosa*	17,9	7,5	-	-
Karoo Scrub Robin	*Cercotrichas coryphoeus*	71,4	25,0	-	-
Karoo Thrush	*Turdus smithi*	32,1	2,5	-	-
Kittlitz's Plover	*Charadrius pecuarius*	7,1	0,0	-	-
Lanner Falcon	*Falco biarmicus*	7,1	0,0	-	VU
Large-billed Lark	*Galerida magnirostris*	25,0	17,5	-	-
Lark-like Bunting	*Emberiza impetuani*	39,3	25,0	-	-
Laughing Dove	*Spilopelia senegalensis*	60,7	7,5	-	-
Layard's Warbler	*Curruca layardi*	35,7	10,0	-	-
Lesser Kestrel	*Falco naumanni*	67,9	10,0	-	-
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	14,3	0,0	-	-
Levaillant's Cisticola	*Cisticola tinniens*	7,1	5,0	-	-
Little Egret	*Egretta garzetta*	3,6	0,0	-	-
Little Grebe	*Tachybaptus ruficollis*	3,6	0,0	-	-
Little Stint	*Calidris minuta*	7,1	0,0	-	-
Little Swift	*Apus affinis*	64,3	15,0	-	-
Long-billed Crombec	*Sylvietta rufescens*	3,6	2,5	-	-
Long-billed Pipit	*Anthus similis*	7,1	0,0	-	-
Ludwig's Bustard	*Neotis ludwigii*	14,3	2,5	EN	EN
Malachite Kingfisher	*Corythornis cristatus*	3,6	0,0	-	-
Martial Eagle	*Polemaetus bellicosus*	3,6	0,0	EN	EN
Mountain Wheatear	*Myrmecocichla monticola*	35,7	27,5	-	-
Namaqua Dove	*Oena capensis*	10,7	2,5	-	-
Namaqua Sandgrouse	*Pterocles namaqua*	7,1	0,0	-	-
Nicholson's Pipit	*Anthus nicholsoni*	14,3	2,5	-	-
Northern Black Korhaan	*Afrotis afraoides*	71,4	10,0	-	-
Orange River White-eye	*Zosterops pallidus*	14,3	2,5	-	-
Pale Chanting Goshawk	*Melierax canorus*	50,0	20,0	-	-
Pale-winged Starling	*Onychognathus nabouroup*	28,6	7,5	-	-
Pied Avocet	*Recurvirostra avosetta*	14,3	2,5	-	-
Pied Crow	*Corvus albus*	78,6	47,5	-	-
Pied Starling	*Lamprotornis bicolor*	39,3	7,5	-	-
Pin-tailed Whydah	*Vidua macroura*	10,7	0,0	-	-
Pririt Batis	*Batis pririt*	3,6	0,0	-	-
Quailfinch	*Ortygospiza atricollis*	0,0	2,5	-	-
Red-billed Quelea	*Quelea quelea*	21,4	2,5	-	-
Red-billed Teal	*Anas erythrorhyncha*	14,3	0,0	-	-
Red-eyed Dove	*Streptopelia semitorquata*	28,6	2,5	-	-
Red-faced Mousebird	*Urocolius indicus*	17,9	5,0	-	-
Red-headed Finch	*Amadina erythrocephala*	21,4	2,5	-	-
Red-knobbed Coot	*Fulica cristata*	10,7	0,0	-	-
Red-winged Starling	*Onychognathus morio*	3,6	0,0	-	-

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List Global	Red List Regional
Rock Dove	*Columba livia*	10,7	0,0	-	-
Rock Kestrel	*Falco rupicolus*	32,1	17,5	-	-
Rock Martin	*Ptyonoprogne fuligula*	32,1	17,5	-	-
Ruff	*Calidris pugnax*	10,7	0,0	-	-
Rufous-eared Warbler	*Malcorus pectoralis*	64,3	20,0	-	-
Sabota Lark	*Calendulauda sabota*	46,4	7,5	-	-
Secretarybird	*Sagittarius serpentarius*	3,6	5,0	EN	VU
Short-toed Rock Thrush	*Monticola brevipes*	21,4	12,5	-	-
Sickle-winged Chat	*Emarginata sinuata*	7,1	12,5	-	-
South African Cliff Swallow	*Petrochelidon spilodera*	35,7	0,0	-	-
South African Shelduck	*Tadorna cana*	25,0	5,0	-	-
Southern Fiscal	*Lanius collaris*	71,4	5,0	-	-
Southern Grey-headed Sparrow	*Passer diffusus*	10,7	2,5	-	-
Southern Masked Weaver	*Ploceus velatus*	64,3	10,0	-	-
Southern Red Bishop	*Euplectes orix*	50,0	5,0	-	-
Speckled Pigeon	*Columba guinea*	46,4	12,5	-	-
Spike-heeled Lark	*Chersomanes albofasciata*	39,3	7,5	-	-
Spotted Eagle-Owl	*Bubo africanus*	3,6	0,0	-	-
Spotted Flycatcher	*Muscicapa striata*	10,7	0,0	-	-
Spotted Thick-knee	*Burhinus capensis*	7,1	0,0	-	-
Spur-winged Goose	*Plectropterus gambensis*	28,6	2,5	-	-
Tawny Eagle	*Aquila rapax*	3,6	2,5	VU	EN
Three-banded Plover	*Charadrius tricollaris*	35,7	7,5	-	-
Verreaux's Eagle	*Aquila verreauxii*	17,9	12,5	-	VU
Wattled Starling	*Creatophora cinerea*	7,1	7,5	-	-
Western Cattle Egret	*Bubulcus ibis*	3,6	0,0	-	-
White Stork	*Ciconia ciconia*	3,6	0,0	-	-
White-backed Mousebird	*Colius colius*	46,4	0,0	-	-
White-breasted Cormorant	*Phalacrocorax lucidus*	3,6	0,0	-	-
White-browed Sparrow-Weaver	*Plocepasser mahali*	7,1	0,0	-	-
White-faced Whistling Duck	*Dendrocygna viduata*	3,6	0,0	-	-
White-necked Raven	*Corvus albicollis*	14,3	7,5	-	-
White-rumped Swift	*Apus caffer*	35,7	5,0	-	-
White-throated Canary	*Crithagra albogularis*	50,0	22,5	-	-
White-throated Swallow	*Hirundo albigularis*	21,4	2,5	-	-
Wood Sandpiper	*Tringa glareola*	3,6	2,5	-	-
Yellow Canary	*Crithagra flaviventris*	10,7	10,0	-	-
Yellow-bellied Eremomela	*Eremomela icteropygialis*	32,1	5,0	-	-
Yellow-billed Duck	*Anas undulata*	17,9	2,5	-	-
Zitting Cisticola	*Cisticola juncidis*	35,7	0,0	-	-

APPENDIX 2: HABITAT WITHIN THE STUDY AREA

Figure 1: Typical Nama Karoo habitat which comprises the vast majority of the study area.

Figure 2: A tributary of the ephemeral Brak River (wetland area - degraded)

Figure 3: An example of a large dam within the broader 2km study area

Figure 4: Surface water associated with a borehole and water trough within the broader 2km study area

Figure 5: Rocky ridges and inselbergs adjacent to the powerline alignment

Figure 6: An example of small stands of alien trees associated with homesteads observed within the study area

Figure 7: Existing HV powerlines within the study area

APPENDIX 3: SITE SENSITIVITY VERIFICATION

CONTENTS

1. INTRODUCTION

Environmental Authorisation (EA) for 150MW Paarde Valley PV2 was granted by the Department of Forestry, Fisheries and the Environment (DFFE) on 7 September 2012. The authorised project includes the construction of a PV solar energy facility (SEF) to generate approximately 75–150MW, as well as 132kV/220kV overhead transmission lines and associated infrastructure (access roads, water supply infrastructure, stormwater infrastructure, internal access roads, buildings and fencing).

The currently authorised 132kV/220kV grid connection for Paarde Valley PV2 is routed from the Paarde Valley PV2 facility to the De Aar substation. However, due to grid capacity constraints in the Northern Cape, the Paarde Valley PV2 cannot connect to the De Aar substation. As a result, Paarde Valley PV2 (Pty) Ltd wishes to amend the authorised grid connection (realignment and termination point) and create a separate EA for the construction of the 132kV double circuit overhead powerline (OHPL) grid connection from the authorised on-site substation and switching station (SwS) at Paarde Valley PV2 to Vetlaagte Main Transmission Station (MTS), which is currently undergoing its own EA application process. The proposed OHPL is approximately 12.7km in length, located within the Strategic Transmission Central Corridor, following boundary lines and/or existing powerline alignments so as to limit disruption to current farming activities as much as possible. The project also includes the 132kV SwS component of the authorised Paarde Valley PV2 on-site substation, with an approximate footprint area of 100 m x 100m, a feeder bay at the Vetlaagte MTS and an 8m wide SwS gravel access road, approximately 2.34km in length. The Paarde Valley PV2 grid connection is located within 10km of De Aar, in the Pixley Ka Seme District Municipality in the Northern Cape Province of South Africa (Figure 1).

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations [4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended], various aspects of the proposed developments may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. In accordance with GN 320 and GN 1150 (20 March 2020)[3] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool). Chris van Rooyen, in association with Albert Froneman, as avifaunal specialists, have been commissioned to verify the sensitivity of the project sites under these specialist protocols. The scope of this report is for the proposed development.

[3] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

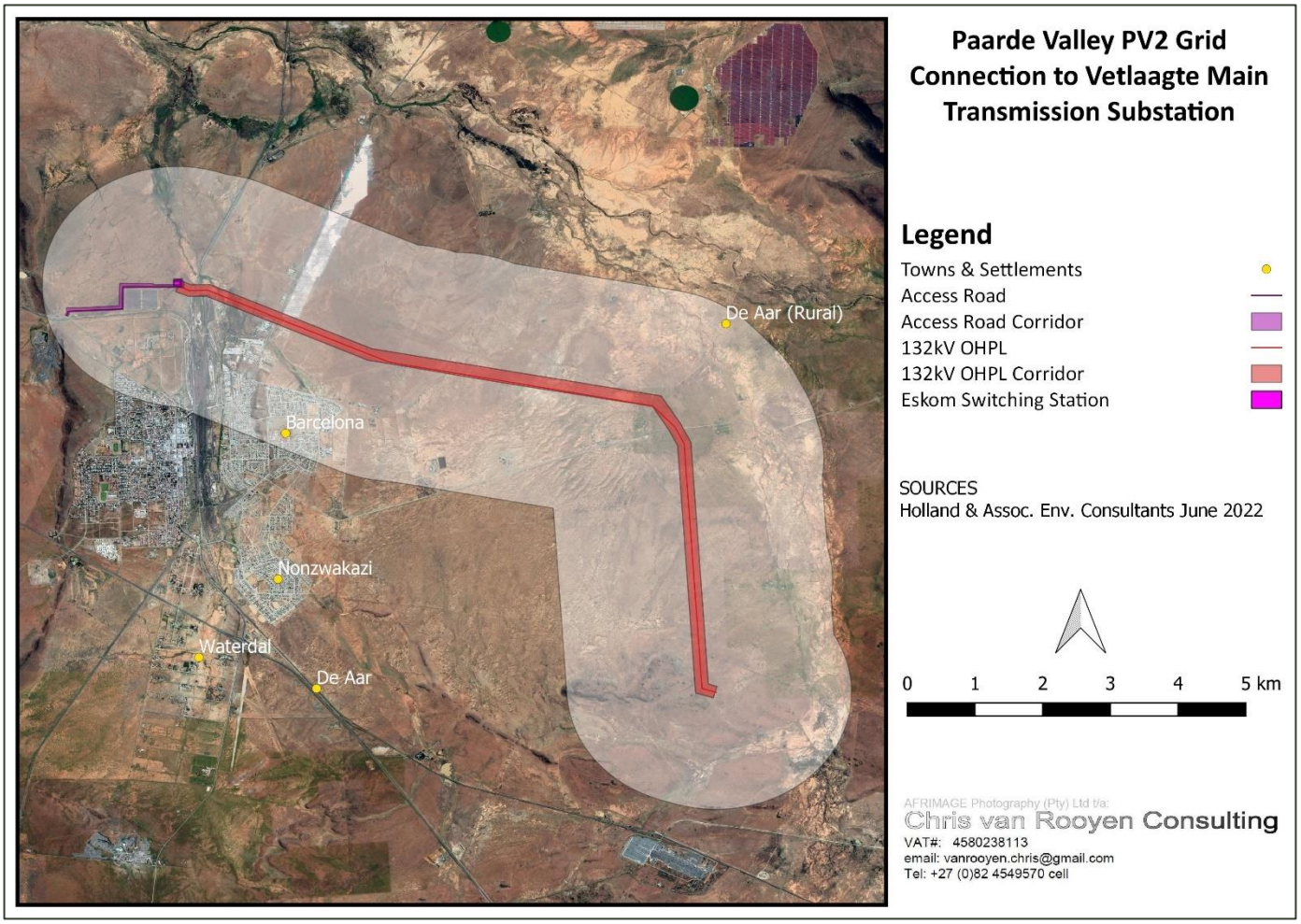

Figure 1: Locality map indicating the location of the proposed development within the study area near De Aar, Northern Cape Province.

2. SITE SENSITIVITY VERIFICATION METHODOLOGY

The following information sources were consulted to compile this report:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of six pentads some of which intersect and others that are near the study area. The decision to include multiple pentads around the study area was influenced by the fact that the pentads within which the proposed development is located have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The six pentad grid cells are the following: 3035_2355, 3035_2400, 3035_2405, 3040_2355, 3040_2400 and 3040_2405 (Figure 2). A total of 28 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 41 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the six pentads within which the study area is located. The SABAP2 data is regarded as a reliable reflection of the avifauna which occurs in the area and is supplemented with data collected during the site visit and extensive general knowledge of the area.
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015), and the latest authoritative summary of southern African bird biology (Hockey et al. 2005).

- The global threatened status of all priority species was determined by consulting the latest (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the study area relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the Northern Cape Province .
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the study area (February, 2022).
- Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
- Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
- Primary avifaunal diversity and abundance data collected during a single season, one-day site visit conducted on 28 March 2022. Data was collected by means of incidental counts.

3. OUTCOME OF SITE SENSITIVITY VERIFICATION

The project site and immediate environment is classified as **MEDIUM and HIGH** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 2). These classifications are linked to the potential occurrence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable). The study area contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable.

4. CONCLUSION

Although the occurrence of the SCC could not be confirmed during the site visit to the study area, the authors have conducted several assessments and research projects in broader area and have previously observed both Ludwig's Bustard and Verreaux's Eagle in identical habitats in the broader area, in addition to Martial Eagle *Polemaetus bellicosus* and Tawny Eagle *Aquila rapax*. Based on these observations, the classification of **HIGH** sensitivity for avifauna in the screening tool is therefore confirmed.

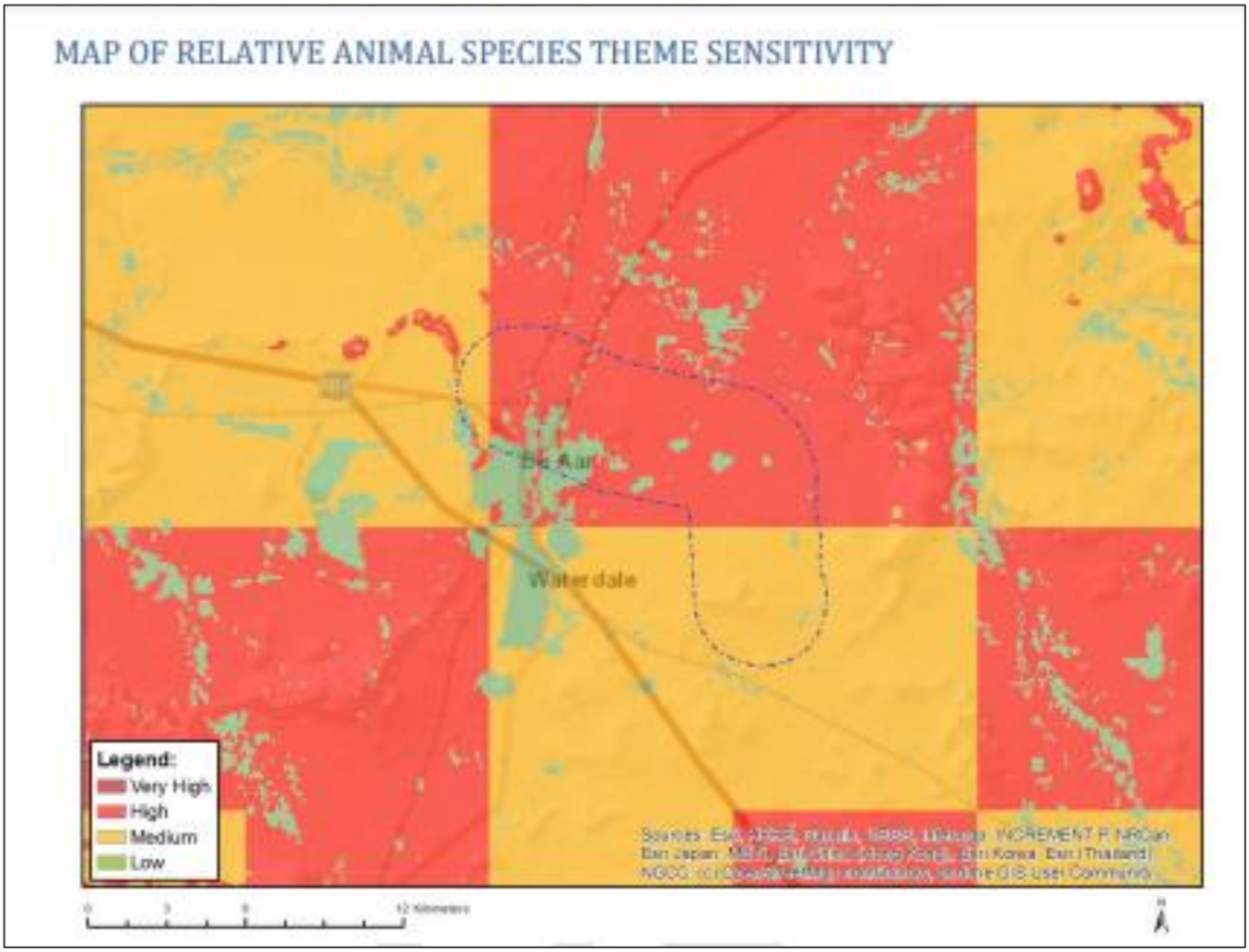

Figure 2: the classification of the study area in the DFFE online screening tool.

APPENDIX 4: ENVIRONMENTAL MANAGEMENT PROGRAMME

Impact management outcome: *e.g. Potential impact on avifauna of the proposed infrastructure*

Impact Management Actions	**Implementation**			**Monitoring**		
	Responsible person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Design Phase						
– *Use of bird-friendly structure to minimize electrocution mortality of avifauna.*	*Project Manager*	*Construction of the double circuit OHPL using a minimum clearance distance of 1.8m between the jumpers and/or insulators and the horizontal earthed component on the lattice/monopole structure.*	*Design phase*	*Project manager*	*Once-off during design phase*	*Written approval of the powerline design by the avifaunal specialist.*
Construction phase						
– *Minimize the noise and movement associated with the construction activities at the development footprint to reduce the risk of displacement of avifauna.*	*Project manager/ECO*	*Conduct a pre-construction inspection (avifaunal walk-through) of the final switching station layout and powerline alignment to identify priority species that may be breeding within the final footprint. If a SSC nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimizing the potential disturbance to the breeding birds during the construction period. This could include measures such as delaying some of the activities until after the breeding season.* *A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following:*	*Construction phase*	*Project manager/ECO*	*1. Once-off at least one month before construction starts* *2. On a daily basis* *3. Weekly* *4. Weekly* *5. Weekly* *6. Weekly*	*ECO records and audit reports*

		1. No off-road driving; *2. Maximum use of existing roads, where possible;* *3. Measures to control noise and dust according to latest best practice;* *4. Restricted access to the rest of the property;* *5. Strict application of all recommendations in the biodiversity specialist report pertaining to the limitation of the footprint.* *6. Inclusion of operational measures to be followed with Environmental Awareness Training.*				
– *Mark the entire length of the overhead powerline with Eskom approved Bird Flight Diverters (BFDs) to reduce collision mortality of avifauna.*	*Project manager/ECO*	*Bird Flight Diverters must be fitted to the entire OHPL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).*	*Construction phase*	*Project manager/ECO*	*1. Once-off when the earthwires are strung*	*ECO records and audit reports*
Operational Phase						
– *Minimize the total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance within the switching station and powerline servitude*	*EA holder/SHE officer*	*1. Appointment of rehabilitation specialist to develop Habitat Rehabilitation Plan (HRP).* *2. Site inspections to monitor progress of HRP.* *3. Adaptive management to ensure HRP goals are met.*	*Operational phase*	*EA holder/SHE officer*	*1. Once-off* *2. Once a year* *3. As required*	*SHE audit reports*
– *Minimize the risk of avifaunal electrocution mortality in the switching station*	*EA holder/SHE officer*	*1. Monitor the electrocution mortality within the switching station* *2. Apply mitigation if electrocution affects SCC.*	*Operational phase*	*EA holder/SHE officer and avifaunal specialist*	*1. Quarterly inspections by avifaunal specialist*	*EA holder/SHE officer*
Decommissioning Phase						
– *Minimize the noise and movement associated with the dismantling activities at the development footprint*	*Project manager/ECO*	*1. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.*	*Construction phase*	*Project manager/ECO*	*1. Daily* *2. Weekly* *3. Weekly* *4. Weekly*	*ECO records and audit reports*

to reduce the risk of displacement of avifauna.		2. *Ensure that decommissioning personnel are made aware of the impacts relating to off-road driving.* 3. *Access roads must be demarcated clearly. Undertake site inspections to verify.* 4. *Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.* 5. *Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.*				

APPENDIX 5: CURRICILUM VITAE

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	20 years
SACNASP Reg Nr:	:	Registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science

Key Qualifications

Albert Froneman **(**Pr.Sci.Nat) has more than 18 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, Beaufort West, 12-months pre-construction monitoring (ABO)
34. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre- construction monitoring (ABO). Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
35. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
36. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
37. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
38. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
39. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
40. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
41. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
42. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
43. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
44. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
45. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
46. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
47. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
48. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
49. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

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.

Curriculum vitae: Chris van Rooyen

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

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.

Key Experience

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

Key Project Experience

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

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

43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).
54. Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
55. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
56. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
57. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
58. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
59. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
67. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).
70. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 24 months operational phase monitoring (Mainstream).
71. Great Karoo Wind Energy Facility, Richmond, Northern Cape, 12 months pre-construction monitoring, African Green Ventures.
72. Ezelsjacht Wind Energy Facility, De Doorns, Western Cape, 12-months pre-construction monitoring Mainstream Renewable Power.
73. Canopus Wind Energy Facility, Laingsburg, Western Cape, 12-months pre-construction monitoring WKN Windcurrent.
74. Kangnas Wind Energy Facility, Aggeneys, Northern Cape, 24-months operational monitoring, Mainstream Renewable Power.
75. Taaibosch Wind Energy Facility, Lime Acres, Northern Cape, 12-months pre-construction monitoring, Enertrag SA
76. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
77. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
78. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
79. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
80. Kappa Solar PV facility, Touwsrivier, Western Cape, pre-construction monitoring (Veroniva)
81. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
82. Pofadder Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
83. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
84. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
85. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).
86. Iphiko Wind Energy facilities, Laingsburg, Western Cape, screening and pre- construction monitoring (G7 Energies)
87. Kangnas Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
88. Perdekraal East Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
89. Aberdeen 1, 2 & Aberdeen Kudu (3&4) Wind Energy Facilities, Eastern Cape, 12- month pre-construction monitoring (Atlantic Renewable Energy Partners)
90. Loxton / Beaufort West Wind Energy Facilities, Northern Cape, 12-month pre- construction monitoring (Genesis Eco-Energy Developments)
91. Ermelo & Volksrust Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape

12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia
15. Dayson Klip PV Facility near Upington, Northern Cape
16. Geelkop PV Facility near Upington, Northern Cape
17. Oya PV Facility, Ceres, Western Cape
18. Vrede and Rondawel PV Facilities, Free State
19. Kolkies & Sadawa PV Facilities, Western Cape
20. Leeuwbosch PV1 and 2 and Wildebeeskuil PV1 and 2 Facilities, North-West
21. Kenhardt PV 3,4 and 5, Northern Cape
22. Wittewal PV, Grootfontein PV and Hoekdoornen PV Facilities, Touws River, Western Cape
23. Aardvark Solar PV facility, Copperton, Northern Cape, 12-month pre-construction monitoring (ABO)
24. Bestwood Solar PV facility, Kathu, Northern Cape, pre-construction monitoring (AMDA)
25. Boundary Solar PV facility, Kimberley, Northern Cape, Site sensitivity verification
26. Rinkhals PV 1 – 6 Solar PV Facility, Kimberley, 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
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV

129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

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

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek N17 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.