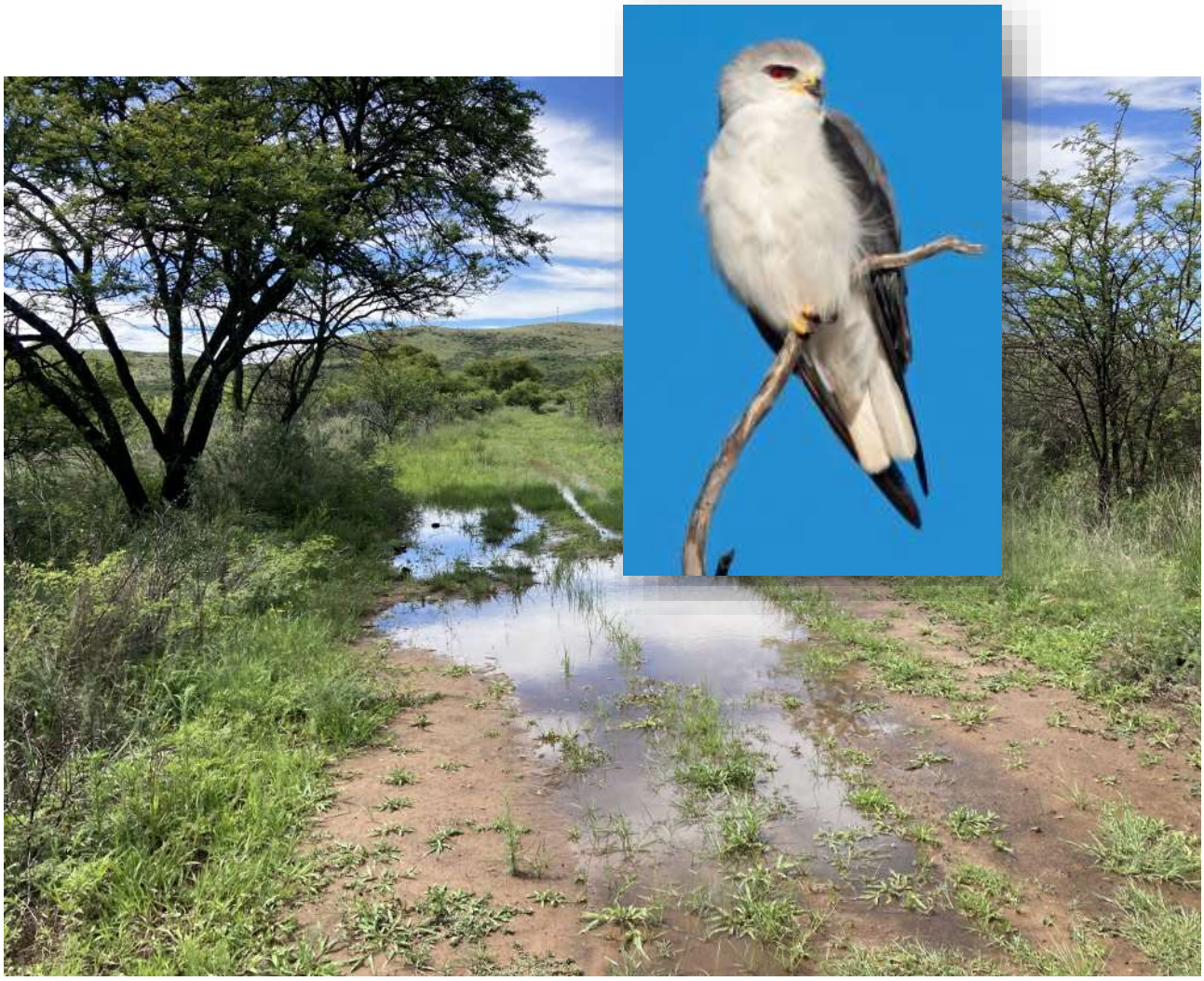
# AVIFAUNAL COMPLIANCE STATEMENT

## ROAN 1 PV Facility and Associated Infrastructure near Hartbeesfontein, North-West Province



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## EXECUTIVE SUMMARY

The Applicant, AMDA Mike (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility known as Roan 1 located on Farm 337 and 338 approximately 3km south of Hartbeesfontein in the North-West Province.

The project is situated within a Renewable Energy Development Zone (REDZ) known as the Klerksdorp REDZ (REDZ10). The solar PV facility will comprise of arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 100 MW. The project is situated within the City of Matlosana local Municipality within the Dr Kenneth Kaunda District Municipality of the North-West Province of South Africa.

An additional 100 MW PV facility known as Roan 2 is concurrently being assessed through a separate Basic Assessment process.

A total of 268 species could potentially occur within the broader where the project is located (see Appendix B). Of these, 97 are classified as priority species. Of the 97 priority species, 38 have a medium to high probability of occurring in the development area. Of the 38 priority species with a medium to high probability of occurrence, 14 were recorded during site surveys.

**All the species of conservation concern (SSC) recorded in the broader area by SABAP2 (Lanner Falcon, Secretarybird, Verreaux's Eagle), except one (Yellow-billed Stork), have a full protocol reporting rates of less than 1%, indicating vagrant status in the area**. **Yellow-billed Stork has a reporting rate of 1.74%, which is also very low**.

### POTENTIAL IMPACTS

The potential impacts identified in the course of the study are:

- Construction Phase

Displacement due to disturbance and habitat transformation associated with the construction of the solar PV plant and associated infrastructure.

- Operational Phase

Collisions with the solar panels
Entrapment in perimeter fences
Electrocutions in the onsite substations
Collisions with the 132kV grid connection

- Decommissioning Phase

Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure.

### ENVIRONMENTAL SENSITIVITIES

The following environmental sensitivities were identified at the proposed Roan 1 PV facility:

- Pans, dams and water reservoirs (waterbodies): Very High sensitivity (Solar panel exclusion zone)

Included are areas within 100m of waterbodies (including artificial waterbodies) and wetlands. Wetlands and waterbodies are crucially important for priority avifauna, particularly waterbirds, and many non-priority species. It is therefore important to leave open space for birds to access and leave the waterbodies unhindered. No solar panels should be constructed in these areas, and other infrastructure should be limited to what is absolutely essential.

- Rivers and wetlands: Very High sensitivity (Solar panel exclusion zone):

Included are areas within 100m of rivers and wetlands. These areas are important for priority avifauna and many non-priority species. It is important to leave open space for birds to access and leave the riverine areas and wetlands unhindered. No solar panels should be constructed in these areas, and other infrastructure should be limited to what is absolutely essential.

The table below provides a summarised assessment of the impact ratings.

| Environmental parameter | Issues | Significance rating prior to mitigation | Significance rating post mitigation |
|---|---|---|---|
| Avifauna | *Displacement of priority species due to disturbance and habitat destruction associated with construction of the PV plant and associated infrastructure.* | High | High |
| | *Mortality of priority species due to collisions with solar panels* | Very low | Very low |
| | *Entrapment of birds in the perimeter fence* | Medium | Low |
| | *Mortality of priority species due to electrocution in the onsite substations* | Low | Low |
| | *Mortality of priority species due to collisions with the 132kV OHL* | Medium | Low |
| | *Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.* | Medium | Medium |

**MANAGEMENT ACTIONS**

The following management actions have been proposed in this assessment:

**Construction phase**

- 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.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the botanical specialist must be strictly enforced.
- A 100m solar panel exclusion zone must be maintained around sensitive areas i.e. rivers, pans, dams, water reservoirs and wetlands.

**Operational phase**

- Increasing the spacing on the fence between at least the top two wires (to a minimum of 30cm) and ensuring they are correctly tensioned will reduce the snaring risk.
- If possible, a single perimeter fence should be used.
- Substation: Due to the complicated design of the substation hardware, pro-active mitigation is not a practical option. Instead, the situation must be monitored, and should electrocutions of priority species be recorded, reactive mitigation could be applied in the form of insulation of live components.
- The whole grid connection needs to be marked with Eskom approved bird flight diverters. The bird flight diverters should be installed on the full span length on the earthwire (according to Eskom guidelines - five

metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

**De-commissioning phase**

- Decommissioning 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.

**REASONED OPINION**

The study area and immediate environment is classified as Low to Medium sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. The medium sensitivity classification is not linked to avifauna. The project site contains marginal 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. The absence of SCC at the Roan 1 PV development area was confirmed during the site surveys. Based on these criteria, the development area is correctly classified as Low sensitivity for avifauna. No fatal flaws were discovered during the investigations. 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 C) are strictly implemented.

**IMPACT STATEMENT**

It is 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 C) are strictly implemented.

**DECLARATION OF INDEPENDENCE**

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 we were appointed as specialist consultants in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with the Environmental Impact Assessment for the Roan 1 PV Site.

_____

Full Name: Chris van Rooyen

Title / 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)** | |
|---|---|
| Contact details and relevant experience as well as the SACNASP Registration number of the specialist preparing the assessment including a curriculum vitae; | Appendix A |
| A signed statement of independence by the specialist; | Page 6 |
| 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 |
| 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 2 |
| A description of the mean density of observations/number of sample sites per unit area and the site inspection observations; | Section 5 |
| A description of the assumptions made and any uncertainties or gaps in knowledge or data; | Section 2 |
| The location of areas not suitable for development and to be avoided during construction where relevant; | Section 5 |
| Impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr); | Section 9 and Appendix C |
| 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. | Section 5 |

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**List of Abbreviations**

| | |
|---|---|
| BA | Basic Assessment |
| BGIS | Biodiversity Geographic Information System |
| BLSA | BirdLife South Africa |
| DFFE | Department of Forestry, Fisheries and the Environment |
| EIA | Environmental Impact Assessment |
| EMPr | Environmental Management Programme |
| IBA | Important Bird Area |
| IKA | Index of Kilometric Abundance |
| IUCN | International Union for Conservation of Nature |
| NEMA | National Environmental Management Act (Act 107 of 1998, as amended) |
| OHL | Overhead Line |
| PV | Photovoltaic |
| REDZs | Renewable Energy Development Zones |
| SABAP 1 | South African Bird Atlas 1 |
| SABAP 2 | South African Bird Atlas 2 |
| SACNASP | South African Council for Natural and Scientific Professions |
| SANBI | South African Biodiversity Institute |
| SAPAD | South Africa Protected Areas Database |

**Glossary**

| **Definitions** | |
|---|---|
| Project site | The area covered by the proposed Roan 1 and Roan 2 PV cluster. |
| Broader area | A consolidated data set for the pentads where the project site is located. |
| Development area | The development footprint containing the Roan 1 PV solar arrays and associated infrastructure. |
| Priority species | • South African Red Data species.<br>• South African endemics and near-endemics.<br>• Raptors<br>• Waterbirds |

# 1 INTRODUCTION

The Applicant, AMDA Mike (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility known as Roan 1 located on Farm 337 approximately 3km south of Hartbeesfontein in the North-West Province.

The project is situated within a Renewable Energy Development Zone (REDZ) known as the Klerksdorp REDZ (REDZ10). The solar PV facility will comprise of arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 100 MW. The project is situated within the City of Matlosana local Municipality within the Dr Kenneth Kaunda District Municipality of the North-West Province of South Africa.

An additional 100 MW PV facility known as Roan 2 is concurrently being assessed through a separate Basic Assessment process.

A development footprint of approximately 250ha is being assessed as part of this Basic Assessment Report (BAR) and the infrastructure associated with the 100 MW PV facility includes:

- PV modules and mounting structures;
- Inverters and transformers;
- Cabling;
- Battery Energy Storage System (BESS);
- Site and internal access roads (up to 8 m wide);
- Auxiliary buildings (33 kV switch room, gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Perimeter fencing and security infrastructure;
- Rainwater tanks;
- Temporary and permanent laydown areas;
- Facility substation.
- Grid connection solution, including:
    - On Site facility substation
    - On Site Eskom Switching Station
    - An up to 132kV overhead powerline from the on site switching station to the Existing Eskom Roan Substation.

Additional associated infrastructure will also be required for the grid connection solution, including access roads, feeder bays (inclusive of line bays, busbars, bus section and protection equipment), a fibre and optical ground wire (OPGW) layout, insulation and assembly structures.

A grid connection corridor of approximately 300 m wide is being assessed to allow for the optimisation of the grid connection and associated infrastructure., The grid connection infrastructure will be developed within the 300m wide grid connection corridor, which will allow for the avoidance of identified environmental sensitivities. The grid corridor will connect the PV project to the Eskom Roan Substation. The gridline servitude, once registered, will be 31m in width.

## 1.1 Scope, Purpose and Objectives of this Compliance Statement

The purpose of the statement is to assess the potential impacts of the Roan 1 PV Solar Facility, as well as all associated infrastructure, on avifauna, and to recommend measures, if any, for the mitigation of identified impacts.

## 1.2 Terms of Reference

The terms of reference for the Compliance Statement are as follows:

- Describe the affected environment from an avifaunal perspective.

- Discuss gaps in baseline data and other limitations.
- Describe the methodology that was used for the field surveys.
- Compare the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjust if necessary.
- Provide an overview of all applicable legislation.
- Provide an overview of assessment methodology.
- Identify and assess the potential impacts of the proposed development on avifauna.
- Provide sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
- Conclude with an impact statement.

See Figure 1 for the area covered by the proposed Roan 1 PV facility.

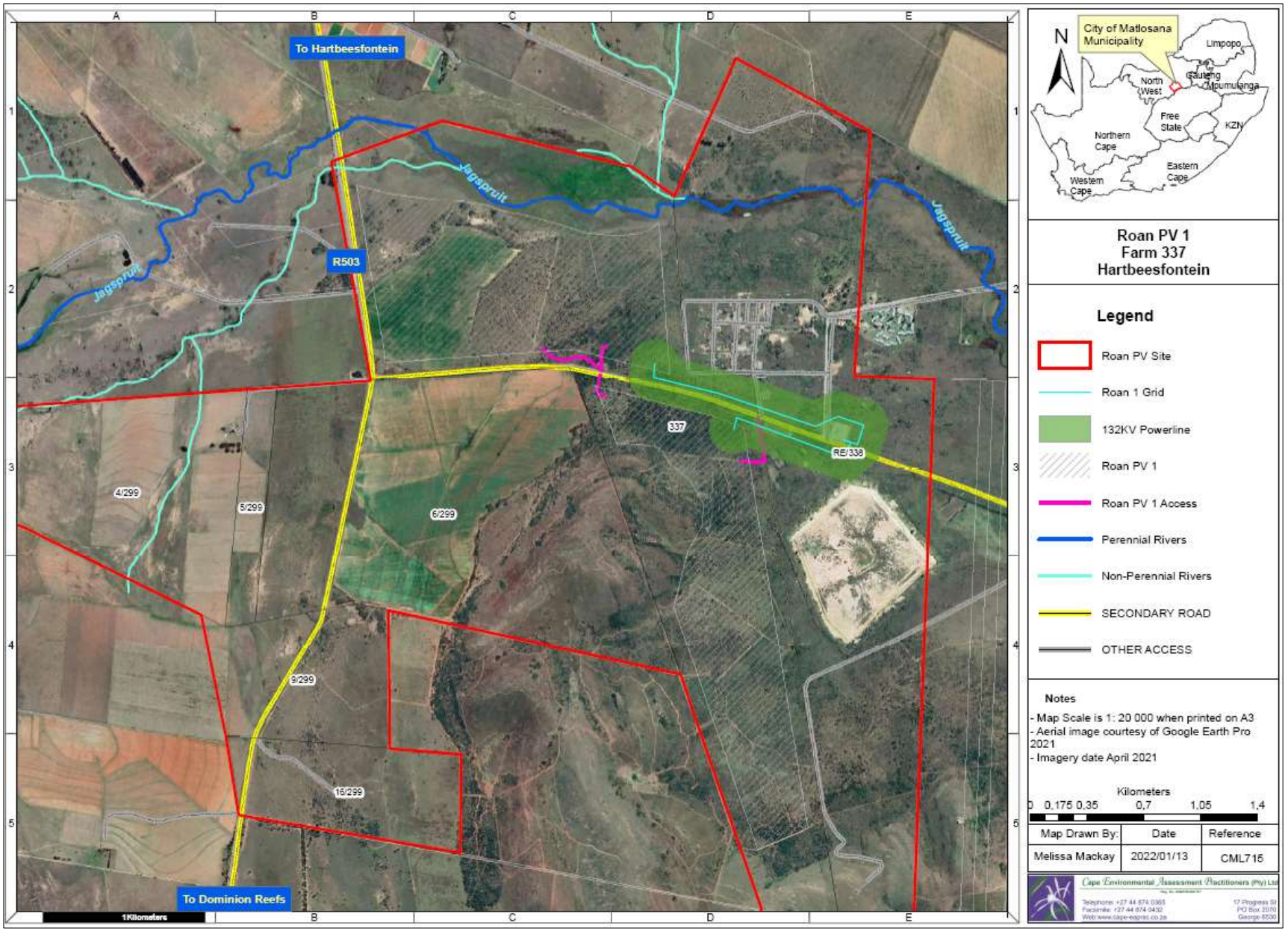



**Figure 1: Map of the proposed Roan 1 PV facility.**

## 2 APPROACH AND METHODOLOGY

The below approach was followed to conduct this study:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town (ADU 2021), to ascertain which species occurs within the broader area i.e., within a block consisting of 4 pentad grid cells within which the proposed project is situated. 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 date, a total of 172 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 45 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2021) was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the proposed development area.
- An on-site survey conducted on 23 December 2021 for purposes of Site Sensitivity Verification. The project site was inspected with a 4x4 vehicle and on foot.
- An additional on-site survey was conducted from 31 January – 2 February 2022 at the project site, based on the best practice guidelines for avifaunal impact studies for solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al.* 2017). Monitoring was conducted in the following manner:
    - Two drive transects of 4.29 km and 6.1 km respectively were identified in the project site and counted three times over a period of 3 days. One observer driving slowly recorded all birds on both sides of the transect. The observer stopped at regular intervals and moved a distance away from the vehicle to listen to bird calls and to scan the environment with binoculars.
    - The following variables were recorded:
        - Species;
        - Number of birds;
        - Date;
        - Start time and end time;
        - Estimated distance from transect (m);
        - Wind direction;
        - Wind strength (estimated Beaufort scale 1 - 7);
        - Weather (sunny; cloudy; partly cloudy; rain; mist);
        - Temperature (cold; mild; warm; hot);
        - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying- foraging; flying-commute; foraging on the ground.
    - All incidental sightings of priority species were recorded.
    - Two focal points of bird activity, namely farm dams, were also monitored during the course of the three day monitoring period.

See Figure 2 below for the extent of the broader area.


**Figure 2: Area covered by the broader area (4 x pentad grid cells).**

See Figure 3 for the location of drive transects and focal points.

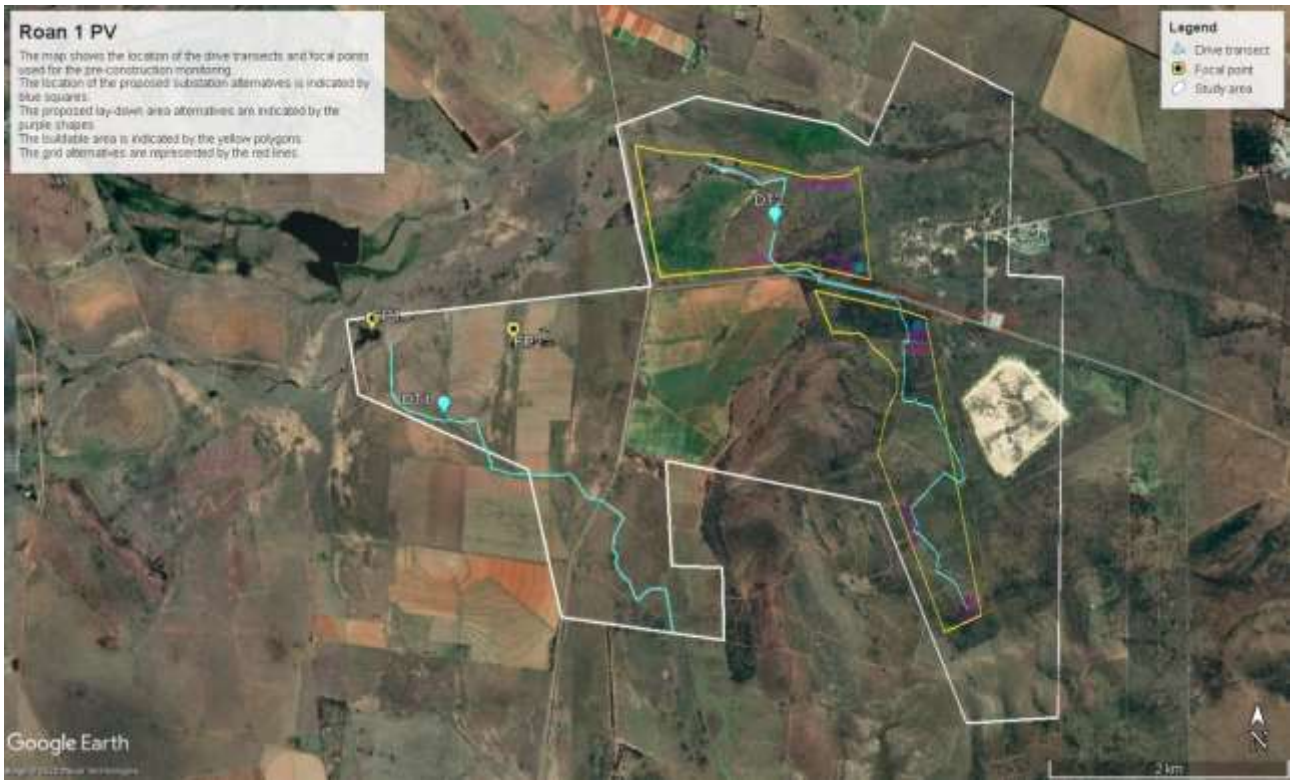



**Figure 3: The location of the drive transects relative to the proposed Roan 1 PV site.**

## 2.1 Information Sources

The following data sources were used to compile this report:

| Data / Information | Source | Date | Type | Description |
|---|---|---|---|---|
| South African Protected Areas Database (SAPAD) | Department of Forestry, Fisheries and the Environment (DFFE) | 2021, Q3 | Spatial | Spatial delineation of protected areas in South Africa. Updated quarterly |
| Atlas of Southern African Birds 1 (SABAP1) | University of Cape Town | 1987-1991 | Spatial, reference | SABAP1, which took place from 1987-1991. |
| South African Bird Atlas Project 2 (SABAP2) | University of Cape Town | February 202 | Spatial, database | SABAP2 is the follow-up project to the SABAP1. The second bird atlas project started on 1 July 2007 and is still growing. The project aims to map the distribution and relative abundance of birds in southern Africa. |
| National Vegetation Map | South African National Biodiversity Institute (SANBI) (BGIS) | 2018 | Spatial | The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map and sample the vegetation of South Africa, Lesotho and Swaziland. |
| Red Data Book of Birds of South Africa, Lesotho and Swaziland | BirdLife South Africa | 2015 | Reference | The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between BirdLife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI. |
| IUCN Red List of Threatened Species (2021.3) | IUCN | 2021. 1 | Online reference source | Established in 1964, the International Union for Conservation of Nature's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species. |
| Important Bird and Biodiversity Areas of South Africa | BirdLife South Africa | 2015 | Reference work | Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified nationally through multi-stakeholder processes using globally standardised, |

| Data / Information | Source | Date | Type | Description |
|---|---|---|---|---|
| | | | | quantitative and scientifically agreed criteria. |
| Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa | Department of Environmental Affairs, 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch. | 2015 | SEA | The SEA identifies areas where large scale wind and solar PV energy facilities can be developed in terms of Strategic Infrastructure Project (SIP) 8 and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs). |
| The National Screening Tool | Department of Forestry, Fisheries and the Environment | February 2022 | Spatial | The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity. |

## 2.2 Assumptions, Knowledge Gaps and Limitations

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

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town (ADU 2021), to ascertain which species occurs within the broader area i.e., within a block consisting of 4 pentad grid cells within which the proposed project is situated. 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 date, a total of 172 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 45 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The focus of the study was primarily on the potential impacts of the proposed solar PV facility on priority species.
- Priority species were defined as follows:
  - South African Red Data species.
  - South African endemics and near-endemics.
  - Raptors
  - Waterbirds
- Only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser *et al.* 2019) currently exists. Some reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists at the study area.
- Conclusions drawn in this study are based on experience of the specialist on the species found on site 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 **broader area** is defined as the area encompassed by the pentads where the project is located (see Figure 2 above). The **project site** is defined as the combined area (land parcels) where the proposed Roan 1 and Roan 2 PV facilities will be located. The **development area** is the where the Roan 1 development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

# 3 LEGISLATIVE AND PERMIT REQUIREMENTS

## 3.1 Legislative Framework

There is no legislation pertaining specifically to the impact of solar facilities and associated electrical grid infrastructure on avifauna. There are best practice guidelines available which were compiled under the auspices of BLSA i.e. Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017. *Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa*. This guideline has been considered in this assessment.

### *3.1.1 Agreements and conventions*

International agreements and conventions are described in this section.

**Table 1: International 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 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.<br><br>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 three main objectives:<br>• The conservation of biological diversity;<br>• The sustainable use of the components of biological diversity; and<br>• 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 UNEP, 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 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 | The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action | Global |

| Convention name | Description | Geographic scope |
|---|---|---|
| Importance, Ramsar, 1971 | and international cooperation for the conservation and wise use of wetlands and their resources. | |
| Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia | The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate. | Regional |

### *3.1.2 National legislation*

#### 3.1.2.1 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.

#### 3.1.2.2 The National Environmental Management Act NEMA (Act 107 of 1998, as amended)

The 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 (via the promulgation of the EIA Regulations (2014, as amended), which may significantly affect the environment, may be performed only after an EIA or BA has been undertaken and environmental authorisation has been obtained from the relevant competent authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020 is applicable in the case of solar PV developments.

#### 3.1.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 and the Threatened or Protected Species Regulations, February 2007

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act (Act 10 of 2004, as amended) 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 (as noted in Table 5 above). The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

*3.1.3 Provincial legislation*

3.1.3.1 North-West Biodiversity Management Act, No 4 of 2016

The Act provides for the management and conservation of the North West Province's biophysical environment and protected areas within the framework of the National Environmental Management Act, 1998 (Act No 107 of 1998) including the protection of species and ecological- systems that warrant provincial protection.

# 4 BASELINE ENVIRONMENTAL DESCRIPTION

## 4.1 General Description

*4.1.1 Important Bird Areas (IBAs)*

The Barberspan and Leeupan IBA SA026 is the closest IBA and is located approximately 86km north-west of the site. The proposed development is not expected to have any impact on the avifauna in this IBA due to the distance from the development.

*4.1.2 Protected Areas*

The site does not form part of a formally protected area. The closest protected area is the Bosworth Private Nature Reserve which is located approximately 21km away at its closest point. The proposed development is not expected to have any impact on the avifauna in this nature reserve due to the distance from the development.

*4.1.3 The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa*

The site falls within the Klerksdorp REDZ10 Renewable Energy Zone (REDZ).

*4.1.4 Bird Habitat*

The study area is situated approximately 18.5 km north-west of the town of Klerksdorp, and 5 km south of the town of Hartbeesfontein the North-West Province. It is located in the Grassland Biome, in the Dry Highveld Grassland Bioregion and is situated in area that is made up of a mixture of grassland and thorny woodland. The habitat is quite variable and consists of fallow fields (recovering grassland), natural grassland, shrub- and woodland, some wetland and pans, and some agricultural and industrial activities. Mucina & Rutherford (2006) classifies the area as mixture between Vaal-Vet Sandy Grassland (an Endangered vegetation type) and Klerksdorp Thornveld.

There is a riparian zone, the Jagspruit River and its floodplain and wetlands, in the north of the study area. The is also a scattering of artificial wetlands, pans, and round cement dams. The eastern half of the study area, where the proposed Roan 1 development area is located, consists mainly of woodland and scattered grassland interspersed with some industrial and agricultural activities.

The Klerksdorp area has a semi-arid climate (according to the Köppen-Geiger climate classification), with warm to hot summers and cool, dry winters. The average annual precipitation is 482 mm, with most of the rainfall occurring during summer. It should be noted that images from the field survey were created in the rainy season (i.e., summer).

The following distinct habitat features are present in or in the immediate vicinity of the development area:

- Grassland
- Woodland
- Rivers and Wetlands
- Pans and Dams
- Agriculture
- Industrial

#### 4.1.4.1 Grassland

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data (Harrison *et al.* 1997).

Grassland is dominated by grasses, with geophytes and herbs also well represented. Grasslands are maintained by a combination of relatively high summer rainfall, frequent fires, frost, and grazing, which prevent the presence of shrubs and trees (Harrison *et al.* 1997).

The following priority species with a medium to high likelihood of occurrence could potentially use the grassland in the development area:

- African Sacred Ibis
- Amur Falcon
- Black-headed Heron
- Blacksmith Lapwing
- Black-winged Kite
- Cloud Cisticola
- Common Buzzard
- Lesser Kestrel
- Pied Starling
- South African Cliff Swallow
- Western Barn Owl
- Western Cattle Egret

#### 4.1.4.2 Woodland

The dominant habitat in the development area is mainly woodland and thornveld. Woodlands can be important nesting areas for avian species. The woodland areas consist of mainly fine-leaved, semi-deciduous Vachellia-dominated habitat.

The following priority species with a medium to high likelihood of occurrence could potentially use the woodland in the development area:

- Black-winged Kite
- Common Buzzard
- Fiscal Flycatcher
- Karoo Thrush
- Western Barn Owl

#### 4.1.4.3 Rivers and wetlands

Rivers and wetlands are important habitats, especially for priority species. There are a number of wetlands scattered across the study area. These provide habitat for waterfowl, waders and reedbed dwellers such as rails and crakes. There is riparian zone, the Jagspruit River, and its floodplain and wetlands, bordering on the development area in the north.

The following priority species with a medium to high likelihood of occurrence could potentially use the riverine habitat and wetlands in close proximity the development area:

- Fiscal Flycatcher
- Glossy Ibis
- Great Crested Grebe
- Grey Heron
- Kittlitz's Plover
- Little Egret
- Little Grebe
- Little Stint
- Marsh Sandpiper
- Red-billed Teal
- Red-knobbed Coot
- Reed Cormorant
- Ruff
- South African Cliff Swallow
- South African Shelduck
- Southern Pochard
- Spur-winged Goose
- Three-banded Plover
- Western Cattle Egret
- Whiskered Tern
- White-breasted Cormorant
- White-faced Whistling Duck
- Wood Sandpiper
- Yellow-billed Duck

#### 4.1.4.4 Pans, dams and water reservoirs

Surface water is of importance to avifauna in this semi-arid area. The study area contains a few small seasonal pans and some artificial impoundments (ground dams and water reservoirs) which provide habitat for waterbirds. Some of these are located in (water reservoirs) or near (pans) the development area.

The following priority species with a high or medium likelihood of occurrence could use pans and dams in the development area:

- African Sacred Ibis
- African Spoonbill
- Red-knobbed Coot
- Blacksmith Lapwing
- Black-winged Stilt
- Cape Shoveler
- Cape Teal

- Egyptian Goose
- Grey Heron
- Little Grebe
- Common Buzzard
- Kittlitz's Plover
- Little Stint
- Marsh Sandpiper
- Red-billed Teal
- Reed Cormorant
- South African Shelduck
- Southern Pochard
- Spur-winged Goose
- Three-banded Plover
- Whiskered Tern
- White-breasted Cormorant
- White-faced Whistling Duck
- Wood Sandpiper
- Yellow-billed Duck

#### 4.1.4.5 Agriculture

There is some agricultural activity within the development area. The fields are mainly used for grazing. Certain bird species have adapted to, and some even thrive, in agricultural habitats.

The following species with a high or medium likelihood of occurrence could use agricultural lands in the development area:

- African Sacred Ibis
- Amur Falcon
- Blacksmith Lapwing
- Egyptian Goose
- Black-winged Kite
- Common Buzzard
- Lesser Kestrel
- Pied Starling
- Spur-winged Goose
- Western Cattle Egret
- Western Barn Owl

#### 4.1.4.6 Industrial

There are some industrial developments and heavily transformed habitats bordering the development area. Remnants of old mining quarries, extraction pits and stockpiles are present in the study area as well as an electrical substation. There are also some areas with alien trees and residential homes.

The following priority species with a high or medium likelihood of occurrence could use industrial habitat (including alien trees) on occasion:

- Amur Falcon
- Black-headed Heron
- Black-winged Kite
- Common Buzzard
- Fiscal Flycatcher

- Lesser Kestrel
- Karoo Thrush
- Western Barn Owl

### *4.1.5 Avifauna*

#### 4.1.5.1 Southern African Bird Atlas 2

A total of 268 species could potentially occur within the broader where the project is located (see Appendix B). Of these, 97 are classified as priority species. Of the 97 priority species, 38 have a medium to high probability of occurring in the development area. Of the 38 priority species with a medium to high probability of occurrence, 14 were recorded during site surveys.

**All the species of conservation concern (SSC) recorded in the broader area by SABAP2 (Lanner Falcon, Secretarybird, Verreaux's Eagle), except one (Yellow-billed Stork), have a full protocol reporting rates of less than 1%, indicating vagrant status in the area**. **Yellow-billed Stork has a reporting rate of 1.74%, which is also very low**.

**No SSC was recorded at the Roan 1 development area during surveys[1].**

The probability of a priority species occurring regularly in the study area is indicated in Table 2.

Table 2 below lists all the priority species and the possible impact on the respective species by the proposed Roan 1 PV facility and associated infrastructure.

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

[1] A Martial Eagle was recorded in the project site, in the Roan 2 development area.

**Table 2: Priority species occurring in the broader area with a medium to high likelihood of regular occurrence in the development area.**

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status | Likelihood of regular occurrence | Grassland (natural and recovering) | Woodland | Rivers and wetlands | Pans, dams, water reservoirs | Agriculture | Industrial (incl alien trees) | Solar priority | Recorded during monitoring | Solar - Collisions with solar panels | Solar - Displacement: Disturbance | Solar - Displacement: Habitat transformation | Solar - Entanglement in fences | Powerline - Electrocution Substations | HV Powerline - Collision |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| African Sacred Ibis | *Threskiornis aethiopicus* | 19.77 | 6.67 | LC | - | M | x | | x | x | x | | x | | | | | | | x |
| African Spoonbill | *Platalea alba* | 15.70 | 0.00 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Amur Falcon | *Falco amurensis* | 8.72 | 0.00 | LC | - | M | x | | | | x | x | x | x | x | | x | | x | |
| Black-headed Heron | *Ardea melanocephala* | 23.84 | 4.44 | LC | - | M | x | | x | | | x | x | | | | x | x | x | x |
| Blacksmith Lapwing | *Vanellus armatus* | 88.37 | 15.56 | LC | - | H | x | | x | x | x | | x | x | | | x | | x | x |
| Black-winged Kite | *Elanus caeruleus* | 36.63 | 8.89 | LC | - | H | x | x | | | x | x | x | x | | x | x | | x | |
| Black-winged Stilt | *Himantopus himantopus* | 42.44 | 2.22 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Cape Shoveler | *Spatula smithii* | 29.65 | 4.44 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Cape Teal | *Anas capensis* | 13.95 | 0.00 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Cloud Cisticola | *Cisticola textrix* | 11.63 | 0.00 | LC | - | M | x | | | | | | x | x | x | x | x | | | |
| Common Buzzard | *Buteo buteo* | 5.23 | 2.22 | LC | - | M | x | x | | x | x | x | x | x | | | x | | x | |
| Egyptian Goose | *Alopochen aegyptiaca* | 76.16 | 13.33 | LC | - | H | | | x | x | x | | x | | x | | | | x | x |
| Fiscal Flycatcher | *Melaenornis silens* | 63.95 | 4.44 | LC | - | H | | x | | | | x | x | x | | x | | | | |
| Glossy Ibis | *Plegadis falcinellus* | 27.33 | 8.89 | LC | - | M | | | x | | | | x | | | | | | | x |
| Grey Heron | *Ardea cinerea* | 29.65 | 11.11 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Karoo Thrush | *Turdus smithi* | 30.23 | 6.67 | LC | - | M | | x | | | | x | x | | | x | x | | | |
| Kittlitz's Plover | *Charadrius pecuarius* | 26.16 | 0.00 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Lesser Kestrel | *Falco naumanni* | 7.56 | 2.22 | LC | - | M | x | | | | x | x | x | x | x | | x | | x | |
| Little Grebe | *Tachybaptus ruficollis* | 43.60 | 4.44 | LC | - | M | | | | x | | | x | x | x | | | | | x |
| Little Stint | *Calidris minuta* | 24.42 | 2.22 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Marsh Sandpiper | *Tringa stagnatilis* | 15.70 | 4.44 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Pied Starling | *Lamprotornis bicolor* | 34.88 | 4.44 | LC | - | H | x | | | | x | | x | x | x | | x | | | |
| Red-billed Teal | *Anas erythrorhyncha* | 45.93 | 8.89 | LC | - | H | | | x | x | | | x | x | x | | | | | x |
| Red-knobbed Coot | *Fulica cristata* | 75.00 | 13.33 | LC | - | M | | | | x | | | x | | x | | | | | x |
| Reed Cormorant | *Microcarbo africanus* | 32.56 | 6.67 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Ruff | *Calidris pugnax* | 23.26 | 0.00 | LC | - | M | | | x | | | | x | | x | | | | | |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status | Likelihood of regular occurrence | Grassland (natural and recovering) | Woodland | Rivers and wetlands | Pans, dams, water reservoirs | Agriculture | Industrial (incl alien trees) | Solar priority | Recorded during monitoring | Solar - Collisions with solar panels | Solar - Displacement: Disturbance | Solar - Displacement: Habitat transformation | Solar - Entanglement in fences | Powerline - Electrocution MV Substation | HV Powerline - Collision HV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South African Cliff Swallow | *Petrochelidon spilodera* | 48.26 | 11.11 | LC | - | H | x | | | | | | x | x | x | | x | | | |
| South African Shelduck | *Tadorna cana* | 59.88 | 4.44 | LC | - | H | | | x | x | | | x | | x | | | | | x |
| Southern Pochard | *Netta erythrophthalma* | 24.42 | 6.67 | LC | - | M | | | x | x | | | x | x | x | | | | | x |
| Spur-winged Goose | *Plectropterus gambensis* | 22.67 | 0.00 | LC | - | M | | | x | x | x | | x | x | x | | | | | x |
| Three-banded Plover | *Charadrius tricollaris* | 44.19 | 6.67 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Western Barn Owl | *Tyto alba* | 5.81 | 2.22 | LC | - | M | x | x | | | x | x | x | | x | | x | x | | |
| Western Cattle Egret | *Bubulcus ibis* | 65.70 | 8.89 | LC | - | H | x | | x | | x | | x | | x | | | | x | |
| Whiskered Tern | *Chlidonias hybrida* | 25.58 | 2.22 | LC | - | M | | | x | x | | | x | | x | | | | | |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 19.19 | 2.22 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| White-faced Whistling Duck | *Dendrocygna viduata* | 15.70 | 4.44 | LC | - | M | | | x | x | | | x | | x | | | | | x |
| Wood Sandpiper | *Tringa glareola* | 20.93 | 4.44 | LC | - | M | | | x | x | | | x | | x | | | | | |
| Yellow-billed Duck | *Anas undulata* | 70.35 | 13.33 | LC | - | M | | | x | x | | | x | x | x | | | | | x |

4.1.5.2 Pre-construction surveys

As noted above, surveys were conducted from 31 January – 2 February 2022 at the project site, during the high (wet) season. Surveys were conducted according to a Regime 1 site (low sensitivity) as defined in the best practice guidelines for avifaunal impact studies at solar developments, compiled by BLSA in 2017 (Jenkins *et al.* 2017).[2]

The abundance of priority species (Index of Kilometric Abundance i.e. birds/km = IKA) recorded during the drive transects in the project site is displayed in Figure 4 below.

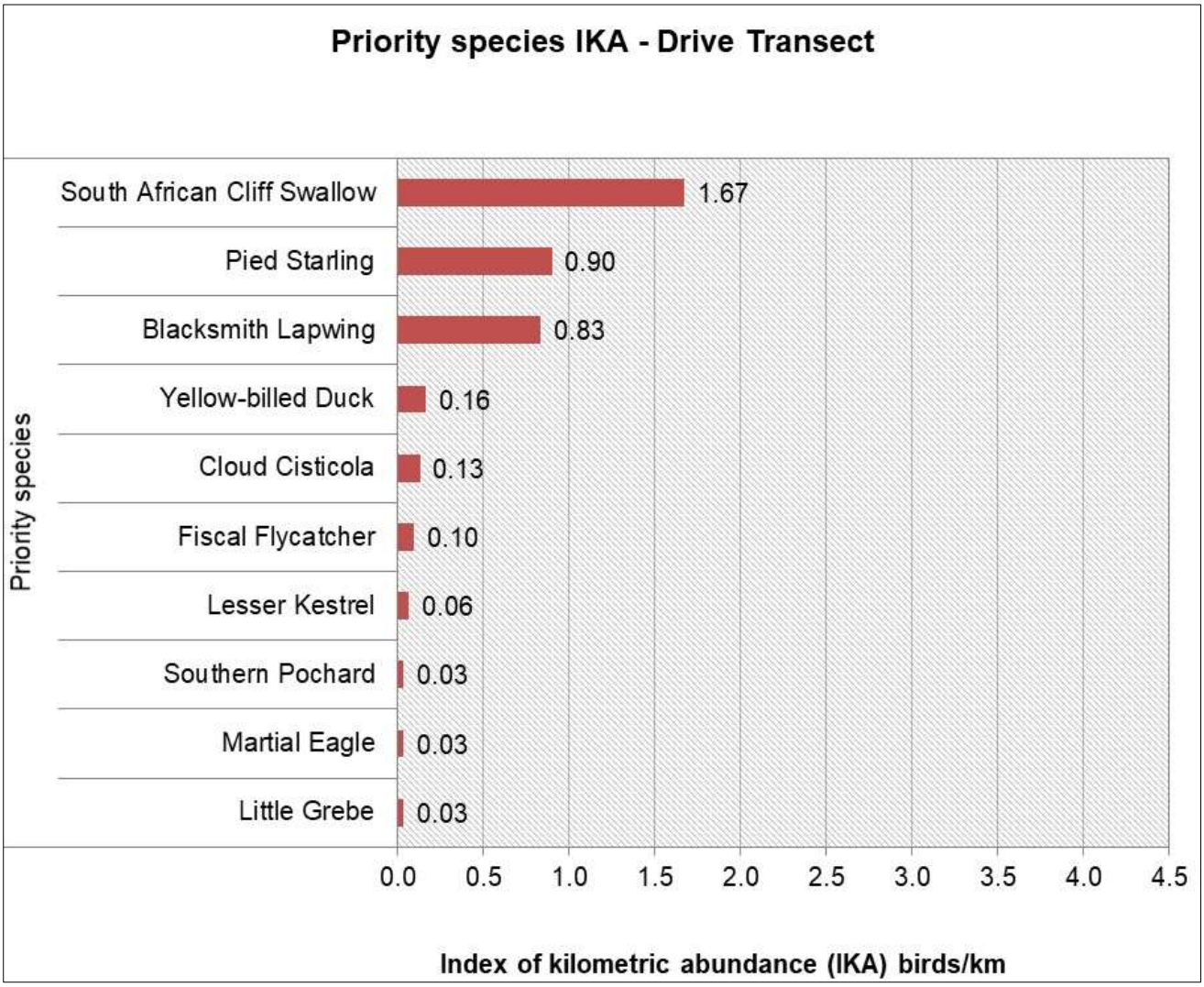



**Figure 4: The abundance of priority species recorded during transect counts in the project site.**

[2] It should be noted that the sensitivity criteria in the best practice guidelines for avifaunal impact studies for solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al*. 2017) differs from the sensitivity criteria in Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species which was published in October 2020.

Table 3 lists the priority species which were recorded as incidental records in the project site.

**Table 3: Priority species which were recorded as incidental records in the project site.**

| Species | Sci name | Total |
|---|---|---|
| Amur Falcon | *Falco amurensis* | 1 |
| Black-winged Kite | *Elanus caeruleus* | 1 |
| Common Buzzard | *Buteo buteo* | 2 |
| Lesser Kestrel | *Falco naumanni* | 2 |
| Spur-winged Goose | *Plectropterus gambensis* | 1 |

The overall abundance of priority species at the project site was moderate, with an average of 3.95 birds/km recorded during drive transect counts.

See Figure 5 for the location of priority species recorded during the surveys.

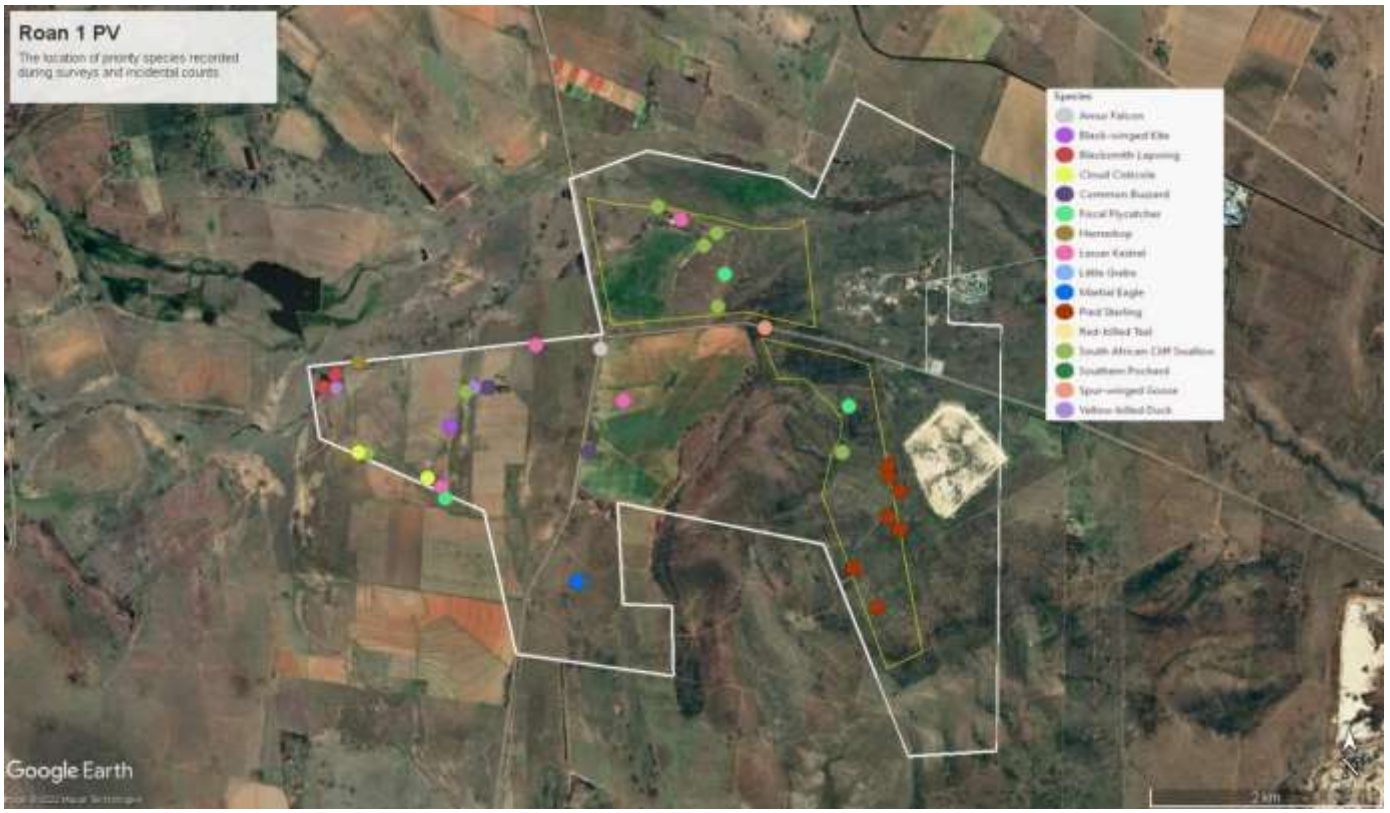



**Figure 5: Priority species recorded during surveys.**

## 5 IDENTIFICATION OF ENVIRONMENTAL SENSITIVITIES

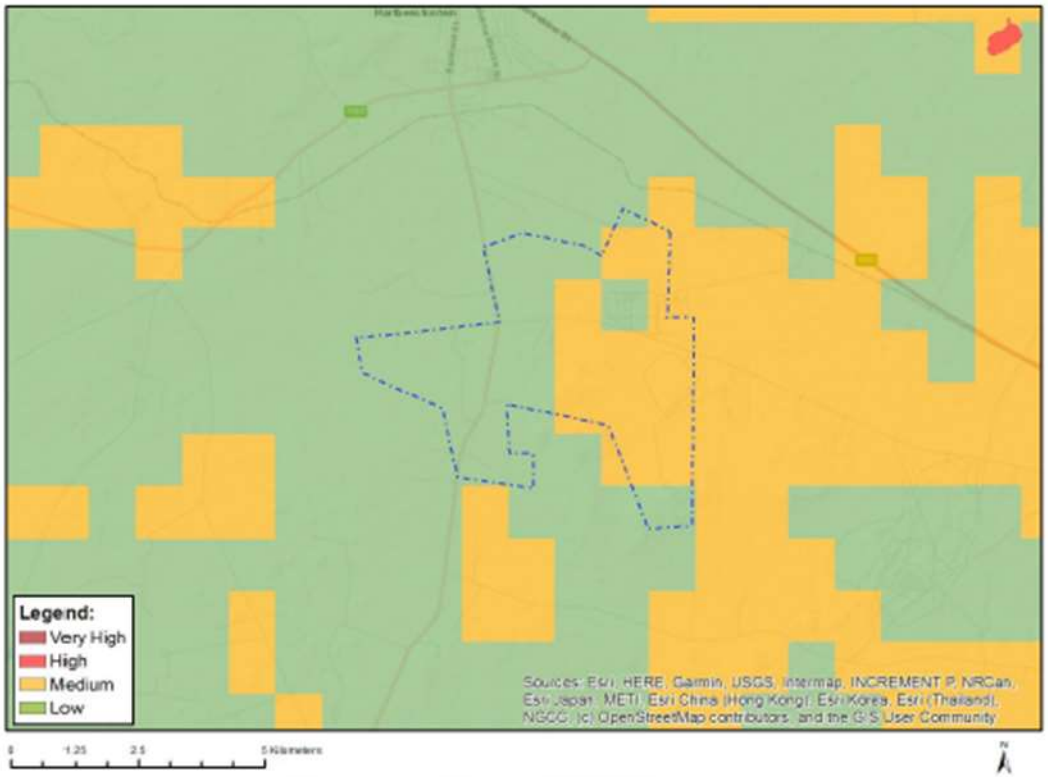
### 5.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

The study area and immediate environment is classified as **Low** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme[3] (see Figure 6). The medium sensitivity classification is not linked to avifauna. The project site contains marginal 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,

[3] Note that the Avian theme for PV in the Screening Tool is incorrect, as it displays the sensitivities for bats, and not birds.

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. The virtual absence of SCC was confirmed during the project site surveys. Based on these criteria, the study area is correctly classified as **Low** sensitivity for avifauna. See Appendix E for the Site Sensitivity Report.

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) |
|---|---|
| Low | Low sensitivity |
| Medium | Mammalia-Crocidura maquassiensis |
| Medium | Mammalia-Hydrictis maculicollis |

**Figure 6: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Terrestrial Animal Species theme. The medium sensitivity is not related to avifauna.**

## 5.2 Specialist Sensitivity Analysis and Verification

The following environmental sensitivities were identified at the proposed Roan 1 PV facility:

### *5.2.1 Pans, dams and water reservoirs (waterbodies): Very High sensitivity (Solar panel exclusion zone)*

Included are areas within 100m of waterbodies and wetlands. Wetlands and waterbodies are crucially important for priority avifauna, particularly waterbirds, and many non-priority species. It is therefore important to leave open space for birds to access and leave the waterbodies unhindered. No solar panels should be constructed in these areas, and other infrastructure should be limited to what is absolutely essential.

### *5.2.2 Rivers and wetlands: Very High sensitivity (Solar panel exclusion zone)*

Included are areas within 100m of rivers and wetlands. These areas are important for priority avifauna and many non-priority species. It is important to leave open space for birds to access and leave the riverine areas and wetlands unhindered. No solar panels should be constructed in these areas, and other infrastructure should be limited to what is absolutely essential.

See Figure 7 for avifaunal solar panel no-go buffers at the site.

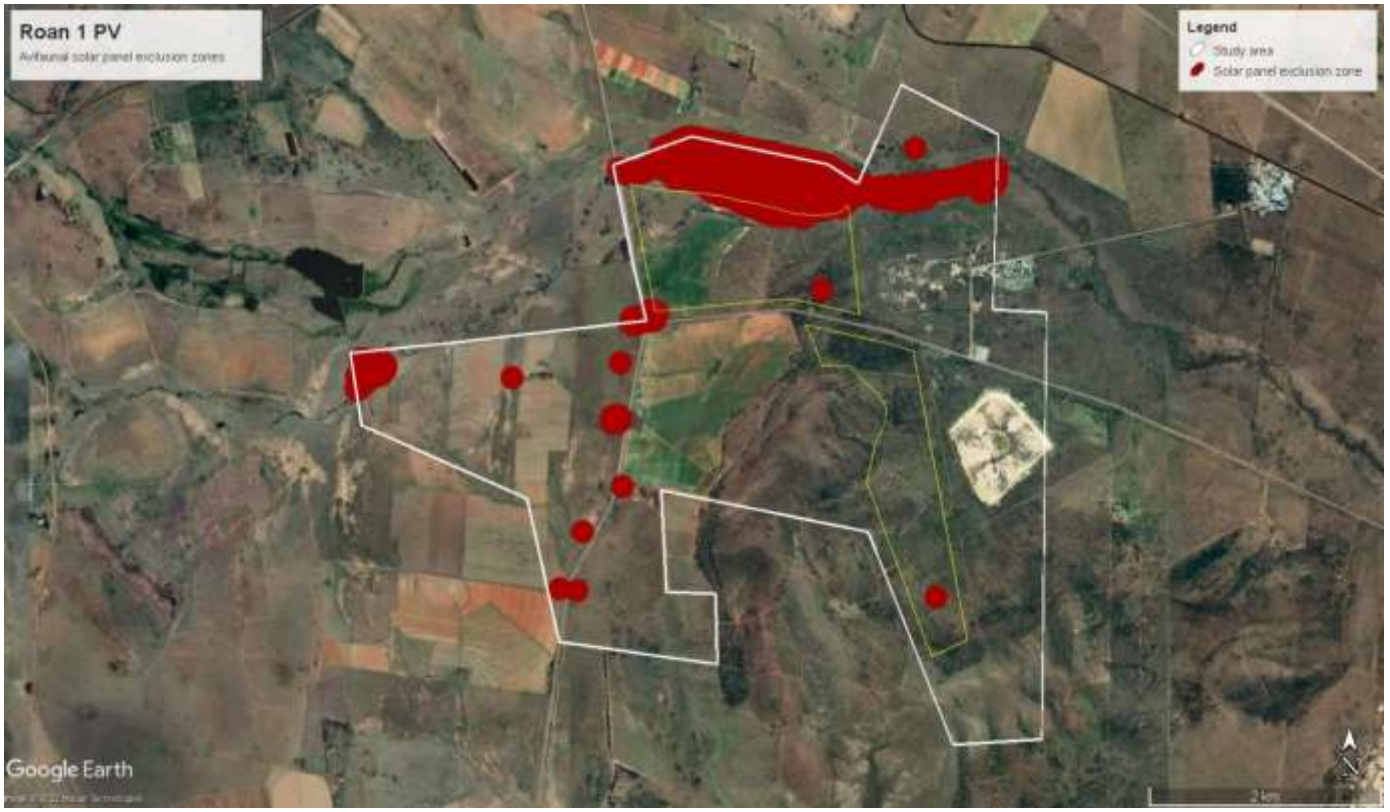



**Figure 7: Avifaunal solar panel no-go buffer zones at the site.**

## 6 ISSUES, RISKS AND IMPACTS

### 6.1 Identification of Potential Impacts/Risks

The potential impacts identified in the course of the study are:

### *6.1.1 Construction Phase*

- Displacement due to disturbance and habitat transformation associated with the construction of the solar PV plant and associated infrastructure.

### *6.1.2 Operational Phase*

- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the onsite substations
- Collisions with the 132kV grid connection

### *6.1.3 Decommissioning Phase*

- Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure.

# 7 IMPACT ASSESSMENT

## 7.1 Introduction

Increasingly, human-induced climate change is recognized as a fundamental driver of biological processes and patterns. Historic climate change is known to have caused shifts in the geographic ranges of many plants and animals, and future climate change is expected to result in even greater redistributions of species (National Audubon Society 2015). In 2006, the World Wide Fund for Nature (WWF) Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth & Mallon, 2006). The report found that:

- Climate change now affects bird species' behaviour, ranges and population dynamics;
- Some bird species are already experiencing strong negative impacts from climate change; and
- In future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers of bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72%, depending on the region, climate scenario and potential for birds to shift to new habitat.

Using statistical models based on the North American Breeding Bird Survey and Audubon Christmas Bird Count datasets, the National Audubon Society assessed geographic range shifts through the end of the century for 588 North American bird species during both the summer and winter seasons under a range of future climate change scenarios (National Audubon Society 2015). Their analysis showed the following:

- 314 of 588 species modelled (53%) lose more than half of their current geographic range in all three modelled scenarios.
- For 126 species, loss occurs without accompanying range expansion.
- For 188 species, loss is coupled with the potential to colonize new areas.

Climate sensitivity is an important piece of information to incorporate into conservation planning and adaptive management strategies. The persistence of many birds will depend on their ability to colonize climatically suitable areas outside of current ranges and management actions that target climate change adaptation.

South Africa is among the world's top 10 developing countries required to significantly reduce their carbon emissions (Seymore *et al.* 2014), and the introduction of low-carbon technologies into the country's compliment of power generation will greatly assist with achieving this important objective (Walwyn & Brent 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri 2009; Munzhedi & Sebitosi*.* 2009), it is clear that solar power generation should feature

prominently in future efforts to convert to a more sustainable energy mix in order to combat climate change, also from an avifaunal impact perspective. However, while the expansion of solar power generation is undoubtedly a positive development for avifauna in the longer term in that it will help reduce the effect of climate change and thus habitat transformation, it must also be acknowledged that renewable energy facilities, including solar PV facilities, in themselves have some potential for negative impacts on avifauna.

A literature review reveals a scarcity of published, scientifically examined information regarding large-scale PV plants and birds. The reason for this is mainly that large-scale PV plants are a relatively recent phenomenon. The main source of information for these types of impacts are from compliance reports and a few government-sponsored studies relating to recently constructed solar plants in the south-west United States. In South Africa, only one published scientific study has been completed on the impacts of PV plants in a South African context (Visser *et al*. 2019).

## 7.2 Impacts associated with PV plants and associated infrastructure

### *7.2.1 Impact trauma (collisions)*

This impact refers to collision-related fatality i.e. fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al.* 1986; Hernandez *et al.* 2014; Kagan *et al.* 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injured state.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space (Loss *et al.* 2014). Although very few cases have been reported it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna.

An extremely rare but potentially related problem is the so-called “lake effect” i.e. it seems possible that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014)[4]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility in California (44%) may support the “lake effect” hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). Kosciuch *et al.* (2020) analysed the results from fatality monitoring studies at 10 photovoltaic solar facilities across 13 site years in the Sonoran and Mojave Deserts Bird Conservation Region in California and Nevada in the USA. They found no evidence of mass mortality related to the lake effect despite the occurrence of water water-obligate birds, which rely on water for take-off and landing, occurring at 90% (9/10) of site-years in the Sonoran and Mojave Deserts Bird Conservation Region. However, until such time that enough scientific evidence has been collected to discount the “lake effect” hypothesis completely, it must be considered as a potential source of impacts.

[4] This could either result in birds colliding directly with the solar panels or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g. grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feather spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

Walston *et al.* (2015) conducted a comprehensive review of avian fatality data from large scale solar facilities (all technology types) in the USA. Collision as cause of death (19 birds) ranked second at Desert Sunlight PV plant and California Valley Solar Ranch (CVSR) PV plant, after unknown causes. Cause of death could not be determined for over 50% of the fatality observations and many carcasses included in these analyses consisted only of feather spots (feathers concentrated together in a small area) or partial carcasses, thus making determination of cause of death difficult. It is anticipated that some unknown fatalities were caused by predation or some other factor unrelated to the solar project. However, they found that the lack of systematic data collection and standardization was a major impediment in establishing the actual extent and causes of fatalities across all projects.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility (28°17′53″S, 23°21′56″E) which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser *et al.* 2019). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser *et al.* 2019).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. However, it is clear from this limited literature survey that the lack of systematic and standardised data collection is a major problem in the assessment of the causes and extent of avian mortality at all types of solar facilities, regardless of the technology employed (Kosciuch *et al.* 2020). Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely based on professional opinion.

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small, ground-dwelling birds which forage between the solar panels, and a variety of waterbirds which may be potentially at risk due to the "lake effect".

See Table 2 for list of priority species which could potentially be affected by this impact.

### *7.2.2 Entrapment in perimeter fences*

Visser *et al.* 2019 recorded a fence-line fatality (Orange River Francolin *Scleroptila gutturalis*) resulting from the bird being trapped between the inner and outer perimeter fence of the facility. This was further supported by observations of large-bodied birds unable to escape from between the two fences (e.g. Red-crested Korhaan *Lophotis ruficrista*) (Visser *et al.* 2019). Considering that one would expect the birds to be able to take off in the lengthwise direction (parallel to the fences), it seems possible that the birds panicked when they were approached by observers and thus flew into the fence. Another potential problem is birds, particularly owls, that get stuck between the strands of barbed wire fences.

It is not foreseen that entrapment in perimeter fences will be a significant impact for priority species at the PV facility.

See Table 2 for list of priority species which could potentially be affected by this impact.

### *7.2.3 Displacement due to disturbance and habitat transformation associated with the construction and operation of the solar PV facilities.*

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. These processes have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the semi-desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are *typically* associated with the construction and operation of solar facilities and could have direct impacts on avifauna (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and

- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through disturbance and transformation of habitat, which could result in temporary or permanent displacement.

In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale.

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (2019) gathered bird transect data at the 180 hectares, 96MW Jasper PV solar facility in the Northern Cape, representing the solar development, boundary, and untransformed landscape. The study found both bird density and diversity per unit area was higher in the boundary and untransformed landscape, however, the extent therefore was not considered to be statistically significant. This indicates that the PV facility matrix is permeable to most species. However, key environmental features, including available habitat and vegetation quality are most likely the overriding factors influencing species' occurrence and their relative density within the development footprint. The most significant finding of Visser *et al.* (2019) was that the distribution of birds in the landscape changed, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns were detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, were favoured by its development (Visser *et al.* 2019).

As far as disturbance is concerned, it is likely that all the avifauna, including all the priority species, will be temporarily displaced in the footprint area of the proposed project, either completely or more likely partially (reduced densities) during the construction phase, due to the disturbance associated with the construction activities. This is likely to affect breeding residents most.

As far as displacement, either completely or partially (reduced densities) due to habitat loss and transformation is concerned, it is highly likely that the same pattern of reduced avifaunal densities, perhaps more so for shrubland species than grassland species, as explained above, will manifest itself at the proposed project. In addition, raptors and terrestrial species could also be impacted.

See Table 2 for list of priority species which could potentially be affected by this impact.

### *7.2.4 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 design of the electrical hardware. There could be an electrocution risk to certain species, mostly raptors, but also some waterbirds, in the onsite substations, but it is unlikely to be a regular occurrence for any of the priority species.

See Table 2 for list of priority species which could potentially be affected by this impact.

### *7.2.5 Collisions*

Collisions are the biggest threat posed by high voltage lines to birds in southern Africa (van Rooyen, 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and

to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (van Rooyen, 2004).

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 8 below).

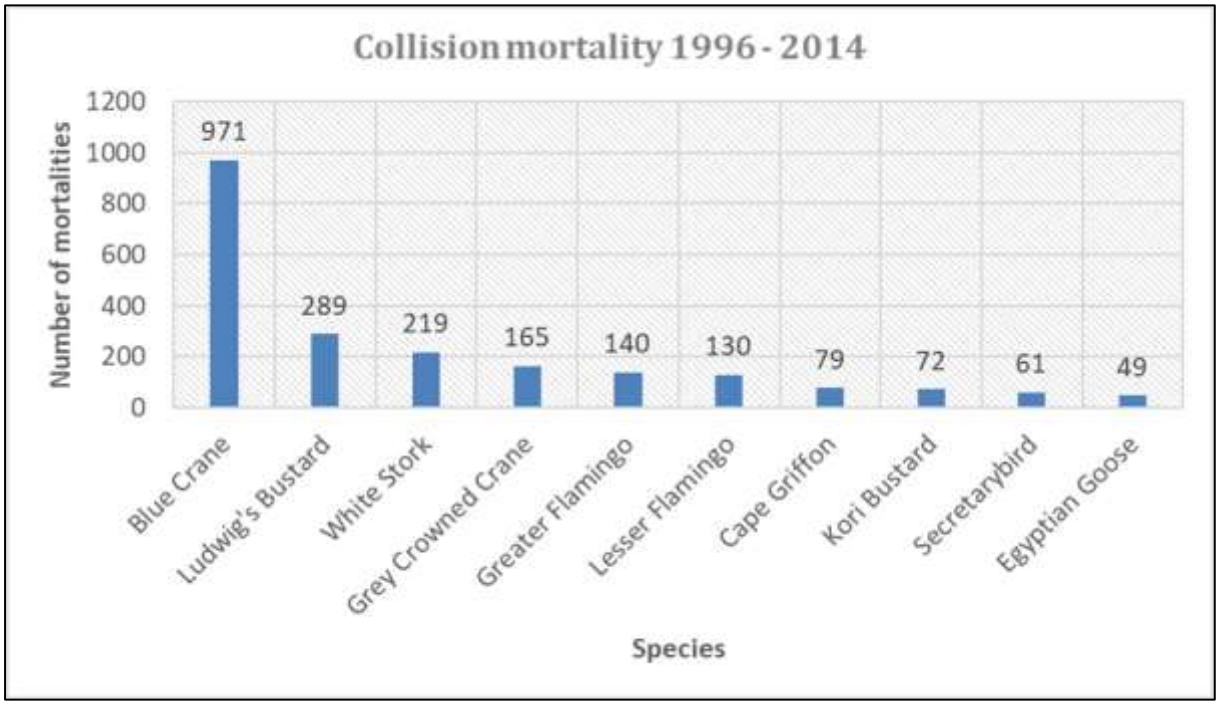



**Figure 8: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)**

There are many 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). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes *Anthropoides paradiseus*, 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 (*Neotis ludwigii*). 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.* 2018).

See Table 2 for list of priority species which could potentially be affected by this impact.

### 7.3 No-go option

The no-go option will result in no additional impacts on avifauna and will result in the ecological status quo being maintained, which will be to the advantage of the avifauna. However, no fatal flaws were identified during the investigations.

## 8 IMPACT RATING METHODOLOGY

See Appendix D for the explanation of the impact criteria.

## 9 IMPACT RATING METHODOLOGY

Then tables below summarise the potential impacts on avifauna of the proposed Roan 1 PV project.

### 9.1 Construction Phase

| Displacement of priority species due to disturbance and habitat transformation associated with construction of the PV plant and associated infrastructure | | |
|---|---|---|
| CRITERIA | WITHOUT MITIGATION | WITH MITIGATION |
| **Intensity** | High | High |
| **Duration** | Long term | Long term |
| **Extent** | Local | Local |
| **Consequence** | High | High |
| **Probability** | Definite | Probable |
| **Significance** | **High** | **High** |
| **Status** | Negative | Negative |
| **Confidence** | Medium | Medium |
| | | |
| Degree to which impact can be reversed | Low | |
| Degree to which impact may cause irreplaceable loss of resources | High | |
| Degree to which impact can be mitigated | Low | |
| PROPOSED MITIGATION | | |
| • Construction activity should be restricted to the immediate footprint of the infrastructure.<br>• Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.<br>• Measures to control noise and dust should be applied according to current best practice in the industry.<br>• Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• The mitigation measures proposed by the botanical specialist must be strictly enforced.<br>• A 100m solar panel exclusion zone must be maintained around sensitive areas i.e. rivers, pans, dams, water reservoirs and wetlands. | | |

### 9.2 Operational Phase

| Mortality of priority species due to collisions with the solar panels | | |
|---|---|---|
| **CRITERIA** | **WITHOUT MITIGATION** | **WITH MITIGATION** |
| **Intensity** | Low | Low |
| **Duration** | Long term | Long term |
| **Extent** | Local | Local |
| **Consequence** | Low | Low |
| **Probability** | Possible | Possible |
| **Significance** | **Very low** | **Very low** |
| **Status** | Negative | Negative |
| **Confidence** | Medium | Medium |
| | | |
| Degree to which impact can be reversed | Irreversible | |
| Degree to which impact may cause irreplaceable loss of resources | Low | |
| Degree to which impact can be mitigated | Low | |
| PROPOSED MITIGATION | | |
| • A 100m solar panel exclusion zone must be maintained around sensitive areas i.e. rivers, pans, dams, water reservoirs and wetlands. | | |

| Entrapment of birds in the perimeter fence | | |
|---|---|---|
| **CRITERIA** | **WITHOUT MITIGATION** | **WITH MITIGATION** |
| **Intensity** | Medium | Medium |
| **Duration** | Long term | Long term |
| **Extent** | Local | Local |
| **Consequence** | Medium | Medium |
| **Probability** | Probable | Improbable |
| **Significance** | **Medium** | **Low** |
| **Status** | Negative | Negative |
| **Confidence** | Medium | Medium |
| | | |
| Degree to which impact can be reversed | Irreversible | |
| Degree to which impact may cause irreplaceable loss of resources | Low | |
| Degree to which impact can be mitigated | Medium | |
| PROPOSED MITIGATION | | |
| • Increasing the spacing between at least the top two wires (to a minimum of 30cm) and ensuring they are correctly tensioned will reduce the snaring risk.<br>• If possible, a single perimeter fence should be used. | | |

| Electrocution of priority species in the onsite substations. | | |
|---|---|---|
| **CRITERIA** | **WITHOUT MITIGATION** | **WITH MITIGATION** |
| **Intensity** | Medium | Medium |
| **Duration** | Long term | Long term |
| **Extent** | Local | local |
| **Consequence** | Medium | Medium |
| **Probability** | Possible | Improbable |
| **Significance** | **Low** | **Low** |
| **Status** | Negative | Negative |
| **Confidence** | High | High |
| | | |
| Degree to which impact can be reversed | Irreversible | |
| Degree to which impact may cause irreplaceable loss of resources | Low | |
| Degree to which impact can be mitigated | Medium | |
| PROPOSED MITIGATION | | |
| Due to the complicated design of the substation hardware, pro-active mitigation is not a practical option. Instead, the situation must be monitored, and should electrocutions of priority species be recorded, reactive mitigation could be applied in the form of insulation of live components. | | |

| Mortality of priority species due to collisions with the 132kV OHL | | |
|---|---|---|
| **CRITERIA** | **WITHOUT MITIGATION** | **WITH MITIGATION** |
| **Intensity** | Medium | Medium |
| **Duration** | Long term | Long term |
| **Extent** | Local | Local |
| **Consequence** | Medium | Medium |
| **Probability** | Probable | Possible |
| **Significance** | **Medium** | **Low** |
| **Status** | Negative | Negative |
| **Confidence** | High | High |
| | | |
| Degree to which impact can be reversed | Medium | |
| Degree to which impact may cause irreplaceable loss of resources | Low | |
| Degree to which impact can be mitigated | Medium | |
| PROPOSED MITIGATION | | |
| The whole grid connection needs to be marked with Eskom approved bird flight diverters. The bird flight diverters should be installed on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung. | | |

## 9.3 Decommissioning Phase

| Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure. | | |
|---|---|---|
| **CRITERIA** | **WITHOUT MITIGATION** | **WITH MITIGATION** |
| **Intensity** | High | High |
| **Duration** | Short term | Short term |
| **Extent** | Local | Local |
| **Consequence** | Medium | Medium |
| **Probability** | Definite | Definite |
| **Significance** | **Medium** | **Medium** |
| **Status** | Negative | Negative |
| **Confidence** | High | High |
| | | |
| Degree to which impact can be reversed | High | |
| Degree to which impact may cause irreplaceable loss of resources | Low | |
| Degree to which impact can be mitigated | Low | |
| PROPOSED MITIGATION | | |
| • Decommissioning activity should be restricted to the immediate footprint of the infrastructure.<br>• Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.<br>• Measures to control noise and dust should be applied according to current best practice in the industry. | | |

A comparison between pre-and post-mitigation phases is shown in Table 4 below.

**Table 4: Comparison of impacts on environmental parameters pre- and post-mitigation**

| Environmental parameter | Issues | Significance rating prior to mitigation | Significance rating post mitigation |
|---|---|---|---|
| Avifauna | *Displacement of priority species due to disturbance and habitat destruction associated with construction of the PV plant and associated infrastructure.* | High | High |
| | *Mortality of priority species due to collisions with solar panels* | Very low | Very low |
| | *Entrapment of birds in the perimeter fence* | Medium | Low |
| | *Mortality of priority species due to electrocution in the onsite substations* | Low | Low |
| | *Mortality of priority species due to collisions with the 132kV OHL* | Medium | Low |
| | *Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.* | Medium | Medium |

## 10 ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

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

## 11 IDENTIFICATION OF A PREFERRED GRID CONNECTION ALIGNMENT AND LAY-DOWN AREA

### 11.1 132kV Grid connection

Two options have been put forward for assessment, namely Option 1 (0.93km) and Option 2 (1.66km). There is very little to choose between the two options from an avifaunal impact perspective, as they both traverse essentially the same habitat, namely woodland. However, Option 1 is the preferred option on the basis of it being the shorter of the two options. However, both options are deemed acceptable.

### 11.2 Lay-down areas

All the proposed lay-down areas are situated in the same habitat, namely woodland. The impact (displacement due to disturbance and habitat transformation) would therefore be identical as far as the avifauna is concerned. All the laydown areas are deemed acceptable, no preferred area can be identified.

## 12 FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

### 12.1 Statement and Reasoned Opinion

The study area and immediate environment is classified as Low to Medium sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. The medium sensitivity classification is not linked to avifauna. The project site contains marginal 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. The absence of SCC at the Roan 1 development area was confirmed during the site surveys. Based on these criteria, the development area is correctly classified as Low sensitivity for avifauna. No fatal flaws were discovered during the investigations. 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 C) are strictly implemented.

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**Appendices**

Appendix A: Specialist Expertise
Appendix B: Species List
Appendix C: Environmental Management Plan
Appendix D: Impact Assessment Methodology
Appendix E: Site Sensitivity Verification Report

## APPENDIX A - SPECIALIST EXPERTISE

Curriculum vitae: Chris van Rooyen

| | | |
|---|---|---|
| Profession/Specialisation | : | Avifaunal Specialist |
| Highest Qualification | : | BA LLB |
| Nationality | : | South African |
| Years of experience | : | 22 years |

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 Facility (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, 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 Roan 1 & 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, Northern Cape, Screening Report (Atlantic Energy)
67. Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

**Bird Impact Assessment Studies for Solar Energy Plants:**

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

9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. Scatec Solar Kenhardt PV 4, PV 5 and PV6 Projects, Kenhardt, Northern Cape
15. NamPower CSP Facility near Arandis, Namibia
16. Dyason Klip PV Facility near Upington, Northern Cape
17. Geelkop PV Facility near Upington, Northern Cape
18. Oya PV Facility, Ceres, Western Cape
19. Vrede and Rondawel PV Facilities, Free State
20. Veroniva Ceres PV Facilities, Western Cape
21. Leeudoringstad PV Facility, North-West

**Bird Impact Assessment Studies for the following overhead line projects:**

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line

43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV

103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

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

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs to Leandra – “Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of the Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of the Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba’s Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine

20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

## Professional affiliations

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

Curriculum vitae: Albert Froneman

| | | |
|---|---|---|
| Profession/Specialisation | : | Avifaunal Specialist |
| Highest Qualification | : | MSc (Conservation Biology) |
| Nationality | : | South African |
| Years of experience | : | 20 years |

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 Facility (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 Roan 1 & 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, Northern 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 Assessment 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.

## APPENDIX B: SPECIES LIST FOR BROADER AREA

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| Abdim's Stork | *Ciconia abdimii* | 1.74 | 0.00 | LC | NT |
| Acacia Pied Barbet | *Tricholaema leucomelas* | 89.53 | 2.22 | LC | - |
| African Black Duck | *Anas sparsa* | 6.40 | 0.00 | LC | - |
| African Cuckoo | *Cuculus gularis* | 0.00 | 2.22 | LC | - |
| African Darter | *Anhinga rufa* | 6.40 | 0.00 | LC | - |
| African Fish Eagle | *Haliaeetus vocifer* | 4.65 | 0.00 | LC | - |
| African Hoopoe | *Upupa africana* | 37.21 | 0.00 | LC | - |
| African Jacana | *Actophilornis africanus* | 0.58 | 0.00 | LC | - |
| African Palm Swift | *Cypsiurus parvus* | 35.47 | 2.22 | LC | - |
| African Paradise Flycatcher | *Terpsiphone viridis* | 12.21 | 0.00 | LC | - |
| African Pipit | *Anthus cinnamomeus* | 50.58 | 8.89 | LC | - |
| African Rail | *Rallus caerulescens* | 2.33 | 0.00 | LC | - |
| African Red-eyed Bulbul | *Pycnonotus nigricans* | 94.77 | 6.67 | LC | - |
| African Reed Warbler | *Acrocephalus baeticatus* | 5.23 | 0.00 | LC | - |
| African Sacred Ibis | *Threskiornis aethiopicus* | 19.77 | 6.67 | LC | - |
| African Snipe | *Gallinago nigripennis* | 5.23 | 0.00 | LC | - |
| African Spoonbill | *Platalea alba* | 15.70 | 0.00 | LC | - |
| African Stonechat | *Saxicola torquatus* | 49.42 | 2.22 | LC | - |
| African Swamphen | *Porphyrio madagascariensis* | 1.74 | 0.00 | LC | - |
| African Wattled Lapwing | *Vanellus senegallus* | 2.91 | 0.00 | LC | - |
| Amethyst Sunbird | *Chalcomitra amethystina* | 2.91 | 0.00 | LC | - |
| Amur Falcon | *Falco amurensis* | 8.72 | 0.00 | LC | - |
| Ant-eating Chat | *Myrmecocichla formicivora* | 25.58 | 0.00 | LC | - |
| Ashy Tit | *Melaniparus cinerascens* | 22.67 | 0.00 | LC | - |
| Banded Martin | *Riparia cincta* | 2.33 | 0.00 | LC | - |
| Barn Swallow | *Hirundo rustica* | 31.40 | 0.00 | LC | - |
| Barred Wren-Warbler | *Calamonastes fasciolatus* | 4.07 | 0.00 | LC | - |
| Bar-throated Apalis | *Apalis thoracica* | 4.65 | 0.00 | LC | - |
| Black Crake | *Zapornia flavirostra* | 4.07 | 0.00 | LC | - |
| Black Heron | *Egretta ardesiaca* | 0.58 | 0.00 | LC | - |
| Black-chested Prinia | *Prinia flavicans* | 93.60 | 8.89 | LC | - |
| Black-chested Snake Eagle | *Circaetus pectoralis* | 1.74 | 0.00 | LC | - |
| Black-collared Barbet | *Lybius torquatus* | 47.09 | 0.00 | LC | - |
| Black-crowned Night Heron | *Nycticorax nycticorax* | 1.74 | 0.00 | LC | - |
| Black-faced Waxbill | *Brunhilda erythronotos* | 7.56 | 0.00 | LC | - |
| Black-headed Heron | *Ardea melanocephala* | 23.84 | 4.44 | LC | - |
| Blacksmith Lapwing | *Vanellus armatus* | 88.37 | 15.56 | LC | - |
| Black-throated Canary | *Crithagra atrogularis* | 86.05 | 6.67 | LC | - |
| Black-winged Kite | *Elanus caeruleus* | 36.63 | 8.89 | LC | - |
| Black-winged Stilt | *Himantopus himantopus* | 42.44 | 2.22 | LC | - |
| Blue Waxbill | *Uraeginthus angolensis* | 43.02 | 2.22 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| Blue-billed Teal | *Spatula hottentota* | 0.58 | 0.00 | LC | - |
| Bokmakierie | *Telophorus zeylonus* | 40.70 | 2.22 | LC | - |
| Booted Eagle | *Hieraaetus pennatus* | 1.16 | 0.00 | LC | - |
| Brown-backed Honeybird | *Prodotiscus regulus* | 0.58 | 0.00 | LC | - |
| Brown-crowned Tchagra | *Tchagra australis* | 48.84 | 0.00 | LC | - |
| Brown-hooded Kingfisher | *Halcyon albiventris* | 12.21 | 0.00 | LC | - |
| Brown-throated Martin | *Riparia paludicola* | 22.09 | 2.22 | LC | - |
| Brubru | *Nilaus afer* | 27.91 | 0.00 | LC | - |
| Buffy Pipit | *Anthus vaalensis* | 8.72 | 0.00 | LC | - |
| Burchell's Coucal | *Centropus burchellii* | 6.40 | 0.00 | LC | - |
| Cape Bunting | *Emberiza capensis* | 0.58 | 0.00 | LC | - |
| Cape Longclaw | *Macronyx capensis* | 54.07 | 6.67 | LC | - |
| Cape Penduline Tit | *Anthoscopus minutus* | 1.16 | 0.00 | LC | - |
| Cape Robin-Chat | *Cossypha caffra* | 70.35 | 2.22 | LC | - |
| Cape Shoveler | *Spatula smithii* | 29.65 | 4.44 | LC | - |
| Cape Sparrow | *Passer melanurus* | 52.33 | 11.11 | LC | - |
| Cape Starling | *Lamprotornis nitens* | 59.88 | 6.67 | LC | - |
| Cape Teal | *Anas capensis* | 13.95 | 0.00 | LC | - |
| Cape Turtle Dove | *Streptopelia capicola* | 19.19 | 0.00 | LC | - |
| Cape Wagtail | *Motacilla capensis* | 65.12 | 4.44 | LC | - |
| Cape White-eye | *Zosterops virens* | 5.81 | 0.00 | LC | - |
| Capped Wheatear | *Oenanthe pileata* | 7.56 | 0.00 | LC | - |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 13.95 | 0.00 | LC | - |
| Chestnut-backed Sparrow-Lark | *Eremopterix leucotis* | 3.49 | 0.00 | LC | - |
| Chestnut-vented Warbler | *Curruca subcoerulea* | 91.86 | 6.67 | LC | - |
| Chinspot Batis | *Batis molitor* | 5.23 | 0.00 | LC | - |
| Cinnamon-breasted Bunting | *Emberiza tahapisi* | 33.72 | 0.00 | LC | - |
| Cloud Cisticola | *Cisticola textrix* | 11.63 | 0.00 | LC | - |
| Common Buzzard | *Buteo buteo* | 5.23 | 2.22 | LC | - |
| Common Greenshank | *Tringa nebularia* | 15.70 | 4.44 | LC | - |
| Common Moorhen | *Gallinula chloropus* | 20.93 | 0.00 | LC | - |
| Common Myna | *Acridotheres tristis* | 71.51 | 8.89 | LC | - |
| Common Ostrich | *Struthio camelus* | 13.37 | 4.44 | LC | - |
| Common Quail | *Coturnix coturnix* | 1.74 | 0.00 | LC | - |
| Common Ringed Plover | *Charadrius hiaticula* | 1.74 | 0.00 | LC | - |
| Common Sandpiper | *Actitis hypoleucos* | 5.81 | 2.22 | LC | - |
| Common Scimitarbill | *Rhinopomastus cyanomelas* | 39.53 | 0.00 | LC | - |
| Common Waxbill | *Estrilda astrild* | 9.88 | 0.00 | LC | - |
| Common Whitethroat | *Curruca communis* | 8.72 | 0.00 | LC | - |
| Coqui Francolin | *Peliperdix coqui* | 0.58 | 0.00 | LC | - |
| Crested Barbet | *Trachyphonus vaillantii* | 79.07 | 8.89 | LC | - |
| Crimson-breasted Shrike | *Laniarius atrococcineus* | 28.49 | 0.00 | LC | - |
| Crowned Lapwing | *Vanellus coronatus* | 75.00 | 6.67 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| Curlew Sandpiper | *Calidris ferruginea* | 7.56 | 0.00 | NT | LC |
| Dark-capped Bulbul | *Pycnonotus tricolor* | 0.00 | 2.22 | LC | - |
| Desert Cisticola | *Cisticola aridulus* | 44.19 | 0.00 | LC | - |
| Diederik Cuckoo | *Chrysococcyx caprius* | 40.12 | 2.22 | LC | - |
| Domestic Goose | *Anser anser domesticus* | 33.14 | 0.00 | LC | - |
| Dusky Indigobird | *Vidua funerea* | 0.58 | 0.00 | LC | - |
| Eastern Clapper Lark | *Mirafra fasciolata* | 13.95 | 0.00 | LC | - |
| Egyptian Goose | *Alopochen aegyptiaca* | 76.16 | 13.33 | LC | - |
| European Bee-eater | *Merops apiaster* | 32.56 | 2.22 | LC | - |
| European Honey-buzzard | *Pernis apivorus* | 0.58 | 0.00 | LC | - |
| European Roller | *Coracias garrulus* | 1.74 | 0.00 | LC | NT |
| Fairy Flycatcher | *Stenostira scita* | 1.74 | 0.00 | LC | - |
| Familiar Chat | *Oenanthe familiaris* | 13.37 | 2.22 | LC | - |
| Fiery-necked Nightjar | *Caprimulgus pectoralis* | 0.58 | 0.00 | LC | - |
| Fiscal Flycatcher | *Melaenornis silens* | 63.95 | 4.44 | LC | - |
| Fulvous Whistling Duck | *Dendrocygna bicolor* | 1.16 | 0.00 | LC | - |
| Gabar Goshawk | *Micronisus gabar* | 3.49 | 0.00 | LC | - |
| Garden Warbler | *Sylvia borin* | 2.91 | 0.00 | LC | - |
| Glossy Ibis | *Plegadis falcinellus* | 27.33 | 8.89 | LC | - |
| Golden-tailed Woodpecker | *Campethera abingoni* | 4.65 | 0.00 | LC | - |
| Goliath Heron | *Ardea goliath* | 5.81 | 0.00 | LC | - |
| Great Crested Grebe | *Podiceps cristatus* | 5.81 | 0.00 | LC | - |
| Great Egret | *Ardea alba* | 2.33 | 0.00 | LC | - |
| Great Reed Warbler | *Acrocephalus arundinaceus* | 1.74 | 0.00 | LC | - |
| Great Spotted Cuckoo | *Clamator glandarius* | 1.16 | 0.00 | LC | - |
| Greater Flamingo | *Phoenicopterus roseus* | 8.72 | 2.22 | LC | NT |
| Greater Honeyguide | *Indicator indicator* | 1.16 | 2.22 | LC | - |
| Greater Kestrel | *Falco rupicoloides* | 2.33 | 0.00 | LC | - |
| Greater Striped Swallow | *Cecropis cucullata* | 43.02 | 6.67 | LC | - |
| Green Wood Hoopoe | *Phoeniculus purpureus* | 14.53 | 0.00 | LC | - |
| Green-winged Pytilia | *Pytilia melba* | 31.98 | 2.22 | LC | - |
| Grey Go-away-bird | *Crinifer concolor* | 1.74 | 0.00 | LC | - |
| Grey Heron | *Ardea cinerea* | 29.65 | 11.11 | LC | - |
| Grey Plover | *Pluvialis squatarola* | 2.91 | 0.00 | LC | - |
| Grey-backed Sparrow-Lark | *Eremopterix verticalis* | 0.58 | 0.00 | LC | - |
| Grey-headed Gull | *Chroicocephalus cirrocephalus* | 18.02 | 6.67 | LC | - |
| Groundscraper Thrush | *Turdus litsitsirupa* | 3.49 | 0.00 | LC | - |
| Hadada Ibis | *Bostrychia hagedash* | 77.91 | 6.67 | LC | - |
| Hamerkop | *Scopus umbretta* | 5.23 | 0.00 | LC | - |
| Helmeted Guineafowl | *Numida meleagris* | 69.19 | 8.89 | LC | - |
| House Sparrow | *Passer domesticus* | 36.63 | 6.67 | LC | - |
| Icterine Warbler | *Hippolais icterina* | 2.91 | 0.00 | LC | - |
| Indian Peafowl | *Pavo cristatus* | 21.51 | 2.22 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| Intermediate Egret | *Ardea intermedia* | 4.07 | 0.00 | LC | - |
| Jackal Buzzard | *Buteo rufofuscus* | 0.58 | 2.22 | LC | - |
| Jacobin Cuckoo | *Clamator jacobinus* | 4.65 | 0.00 | LC | - |
| Jameson's Firefinch | *Lagonosticta rhodopareia* | 13.95 | 0.00 | LC | - |
| Kalahari Scrub Robin | *Cercotrichas paena* | 77.91 | 6.67 | LC | - |
| Karoo Thrush | *Turdus smithi* | 30.23 | 6.67 | LC | - |
| Kittlitz's Plover | *Charadrius pecuarius* | 26.16 | 0.00 | LC | - |
| Klaas's Cuckoo | *Chrysococcyx klaas* | 1.16 | 0.00 | LC | - |
| Lanner Falcon | *Falco biarmicus* | 0.58 | 0.00 | LC | VU |
| Lark-like Bunting | *Emberiza impetuani* | 0.58 | 0.00 | LC | - |
| Laughing Dove | *Spilopelia senegalensis* | 91.86 | 22.22 | LC | - |
| Lesser Flamingo | *Phoeniconaias minor* | 4.07 | 4.44 | NT | NT |
| Lesser Grey Shrike | *Lanius minor* | 5.81 | 0.00 | LC | - |
| Lesser Honeyguide | *Indicator minor* | 1.74 | 0.00 | LC | - |
| Lesser Kestrel | *Falco naumanni* | 7.56 | 2.22 | LC | - |
| Lesser Moorhen | *Paragallinula angulata* | 0.58 | 0.00 | LC | - |
| Lesser Swamp Warbler | *Acrocephalus gracilirostris* | 13.37 | 0.00 | LC | - |
| Levaillant's Cisticola | *Cisticola tinniens* | 59.88 | 11.11 | LC | - |
| Lilac-breasted Roller | *Coracias caudatus* | 3.49 | 0.00 | LC | - |
| Little Bee-eater | *Merops pusillus* | 11.63 | 2.22 | LC | - |
| Little Egret | *Egretta garzetta* | 8.14 | 6.67 | LC | - |
| Little Grebe | *Tachybaptus ruficollis* | 43.60 | 4.44 | LC | - |
| Little Rush Warbler | *Bradypterus baboecala* | 3.49 | 0.00 | LC | - |
| Little Stint | *Calidris minuta* | 24.42 | 2.22 | LC | - |
| Little Swift | *Apus affinis* | 35.47 | 6.67 | LC | - |
| Long-billed Crombec | *Sylvietta rufescens* | 11.05 | 0.00 | LC | - |
| Long-tailed Paradise Whydah | *Vidua paradisaea* | 33.14 | 2.22 | LC | - |
| Long-tailed Widowbird | *Euplectes progne* | 34.88 | 0.00 | LC | - |
| Maccoa Duck | *Oxyura maccoa* | 0.00 | 4.44 | VU | NT |
| Malachite Kingfisher | *Corythornis cristatus* | 4.65 | 0.00 | LC | - |
| Marico Flycatcher | *Melaenornis mariquensis* | 0.00 | 2.22 | LC | - |
| Marsh Owl | *Asio capensis* | 4.65 | 0.00 | LC | - |
| Marsh Sandpiper | *Tringa stagnatilis* | 15.70 | 4.44 | LC | - |
| Marsh Warbler | *Acrocephalus palustris* | 6.98 | 0.00 | LC | - |
| Martial Eagle | *Polemaetus bellicosus* | 0.00 | 0.00 | LC | EN |
| Melodious Lark | *Mirafra cheniana* | 0.58 | 0.00 | LC | - |
| Namaqua Dove | *Oena capensis* | 43.60 | 8.89 | LC | - |
| Namaqua Sandgrouse | *Pterocles namaqua* | 0.58 | 0.00 | LC | - |
| Natal Spurfowl | *Pternistis natalensis* | 2.33 | 0.00 | LC | - |
| Neddicky | *Cisticola fulvicapilla* | 65.70 | 4.44 | LC | - |
| Nicholson's Pipit | *Anthus nicholsoni* | 1.74 | 0.00 | LC | - |
| Northern Black Korhaan | *Afrotis afraoides* | 66.28 | 13.33 | LC | - |
| Orange River Francolin | *Scleroptila gutturalis* | 19.77 | 0.00 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| Orange River White-eye | *Zosterops pallidus* | 71.51 | 0.00 | LC | - |
| Pale Chanting Goshawk | *Melierax canorus* | 1.74 | 0.00 | LC | - |
| Pearl-spotted Owlet | *Glaucidium perlatum* | 0.58 | 0.00 | LC | - |
| Pied Avocet | *Recurvirostra avosetta* | 4.65 | 0.00 | LC | - |
| Pied Crow | *Corvus albus* | 48.84 | 17.78 | LC | - |
| Pied Kingfisher | *Ceryle rudis* | 1.74 | 0.00 | LC | - |
| Pied Starling | *Lamprotornis bicolor* | 34.88 | 4.44 | LC | - |
| Pink-billed Lark | *Spizocorys conirostris* | 1.74 | 0.00 | LC | - |
| Pin-tailed Whydah | *Vidua macroura* | 38.37 | 2.22 | LC | - |
| Plain-backed Pipit | *Anthus leucophrys* | 1.16 | 2.22 | LC | - |
| Pririt Batis | *Batis pririt* | 45.93 | 0.00 | LC | - |
| Purple Heron | *Ardea purpurea* | 5.81 | 0.00 | LC | - |
| Purple Indigobird | *Vidua purpurascens* | 5.23 | 0.00 | LC | - |
| Purple Roller | *Coracias naevius* | 0.58 | 0.00 | LC | - |
| Quailfinch | *Ortygospiza atricollis* | 62.21 | 0.00 | LC | - |
| Rattling Cisticola | *Cisticola chiniana* | 41.28 | 2.22 | LC | - |
| Red-backed Shrike | *Lanius collurio* | 16.86 | 0.00 | LC | - |
| Red-billed Firefinch | *Lagonosticta senegala* | 13.95 | 0.00 | LC | - |
| Red-billed Quelea | *Quelea quelea* | 48.84 | 6.67 | LC | - |
| Red-billed Teal | *Anas erythrorhyncha* | 45.93 | 8.89 | LC | - |
| Red-breasted Swallow | *Cecropis semirufa* | 9.88 | 0.00 | LC | - |
| Red-capped Lark | *Calandrella cinerea* | 12.21 | 4.44 | LC | - |
| Red-chested Cuckoo | *Cuculus solitarius* | 2.33 | 0.00 | LC | - |
| Red-chested Flufftail | *Sarothrura rufa* | 1.74 | 0.00 | LC | - |
| Red-collared Widowbird | *Euplectes ardens* | 6.98 | 0.00 | LC | - |
| Red-crested Korhaan | *Lophotis ruficrista* | 1.74 | 0.00 | LC | - |
| Red-eyed Dove | *Streptopelia semitorquata* | 68.02 | 2.22 | LC | - |
| Red-faced Mousebird | *Urocolius indicus* | 90.12 | 2.22 | LC | - |
| Red-headed Finch | *Amadina erythrocephala* | 15.12 | 4.44 | LC | - |
| Red-knobbed Coot | *Fulica cristata* | 75.00 | 13.33 | LC | - |
| Red-throated Wryneck | *Jynx ruficollis* | 0.58 | 0.00 | LC | - |
| Reed Cormorant | *Microcarbo africanus* | 32.56 | 6.67 | LC | - |
| Rock Dove | *Columba livia* | 22.67 | 0.00 | LC | - |
| Rock Kestrel | *Falco rupicolus* | 0.58 | 4.44 | LC | - |
| Ruff | *Calidris pugnax* | 23.26 | 0.00 | LC | - |
| Rufous-cheeked Nightjar | *Caprimulgus rufigena* | 5.81 | 0.00 | LC | - |
| Rufous-eared Warbler | *Malcorus pectoralis* | 0.58 | 0.00 | LC | - |
| Rufous-naped Lark | *Mirafra africana* | 50.58 | 0.00 | LC | - |
| Sabota Lark | *Calendulauda sabota* | 20.93 | 2.22 | LC | - |
| Sand Martin | *Riparia riparia* | 1.16 | 0.00 | LC | - |
| Scaly-feathered Weaver | *Sporopipes squamifrons* | 31.98 | 0.00 | LC | - |
| Secretarybird | *Sagittarius serpentarius* | 0.58 | 2.22 | EN | EN |
| Shaft-tailed Whydah | *Vidua regia* | 12.79 | 2.22 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| South African Cliff Swallow | *Petrochelidon spilodera* | 48.26 | 11.11 | LC | - |
| South African Shelduck | *Tadorna cana* | 59.88 | 4.44 | LC | - |
| Southern Boubou | *Laniarius ferrugineus* | 0.58 | 0.00 | LC | - |
| Southern Fiscal | *Lanius collaris* | 76.16 | 13.33 | LC | - |
| Southern Grey-headed Sparrow | *Passer diffusus* | 68.02 | 4.44 | LC | - |
| Southern Masked Weaver | *Ploceus velatus* | 91.86 | 20.00 | LC | - |
| Southern Pochard | *Netta erythrophthalma* | 24.42 | 6.67 | LC | - |
| Southern Red Bishop | *Euplectes orix* | 59.88 | 8.89 | LC | - |
| Speckled Mousebird | *Colius striatus* | 27.91 | 2.22 | LC | - |
| Speckled Pigeon | *Columba guinea* | 68.60 | 0.00 | LC | - |
| Spike-heeled Lark | *Chersomanes albofasciata* | 2.33 | 2.22 | LC | - |
| Spotted Eagle-Owl | *Bubo africanus* | 4.65 | 0.00 | LC | - |
| Spotted Flycatcher | *Muscicapa striata* | 6.98 | 0.00 | LC | - |
| Spotted Thick-knee | *Burhinus capensis* | 11.63 | 2.22 | LC | - |
| Spur-winged Goose | *Plectropterus gambensis* | 22.67 | 0.00 | LC | - |
| Squacco Heron | *Ardeola ralloides* | 1.74 | 0.00 | LC | - |
| Streaky-headed Seedeater | *Crithagra gularis* | 0.58 | 0.00 | LC | - |
| Swainson's Spurfowl | *Pternistis swainsonii* | 75.00 | 6.67 | LC | - |
| Swallow-tailed Bee-eater | *Merops hirundineus* | 0.58 | 0.00 | LC | - |
| Tawny-flanked Prinia | *Prinia subflava* | 2.91 | 0.00 | LC | - |
| Temminck's Courser | *Cursorius temminckii* | 0.58 | 0.00 | LC | - |
| Three-banded Plover | *Charadrius tricollaris* | 44.19 | 6.67 | LC | - |
| Verreaux's Eagle | *Aquila verreauxii* | 0.58 | 2.22 | LC | VU |
| Village Indigobird | *Vidua chalybeata* | 12.21 | 0.00 | LC | - |
| Violet-backed Starling | *Cinnyricinclus leucogaster* | 0.58 | 0.00 | LC | - |
| Violet-eared Waxbill | *Granatina granatina* | 16.86 | 0.00 | LC | - |
| Wailing Cisticola | *Cisticola lais* | 1.16 | 0.00 | LC | - |
| Wattled Starling | *Creatophora cinerea* | 32.56 | 0.00 | LC | - |
| Western Barn Owl | *Tyto alba* | 5.81 | 2.22 | LC | - |
| Western Cattle Egret | *Bubulcus ibis* | 65.70 | 8.89 | LC | - |
| Whiskered Tern | *Chlidonias hybrida* | 25.58 | 2.22 | LC | - |
| White Stork | *Ciconia ciconia* | 0.58 | 0.00 | LC | - |
| White-backed Duck | *Thalassornis leuconotus* | 4.07 | 0.00 | LC | - |
| White-backed Mousebird | *Colius colius* | 63.95 | 2.22 | LC | - |
| White-bellied Sunbird | *Cinnyris talatala* | 43.60 | 0.00 | LC | - |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 19.19 | 2.22 | LC | - |
| White-browed Scrub Robin | *Cercotrichas leucophrys* | 4.07 | 0.00 | LC | - |
| White-browed Sparrow-Weaver | *Plocepasser mahali* | 84.30 | 28.89 | LC | - |
| White-faced Whistling Duck | *Dendrocygna viduata* | 15.70 | 4.44 | LC | - |
| White-fronted Bee-eater | *Merops bullockoides* | 39.53 | 2.22 | LC | - |
| White-rumped Swift | *Apus caffer* | 32.56 | 2.22 | LC | - |
| White-throated Robin-Chat | *Cossypha humeralis* | 11.05 | 0.00 | LC | - |

| Species name | Scientific name | Full protocol reporting rate % | Ad hoc protocol reporting rate % | IUCN Red Data status | SA Red Data status |
|---|---|---|---|---|---|
| White-throated Swallow | *Hirundo albigularis* | 22.67 | 4.44 | LC | - |
| White-winged Tern | *Chlidonias leucopterus* | 12.79 | 4.44 | LC | - |
| White-winged Widowbird | *Euplectes albonotatus* | 17.44 | 0.00 | LC | - |
| Willow Warbler | *Phylloscopus trochilus* | 9.88 | 0.00 | LC | - |
| Wing-snapping Cisticola | *Cisticola ayresii* | 2.91 | 0.00 | LC | - |
| Wood Sandpiper | *Tringa glareola* | 20.93 | 4.44 | LC | - |
| Yellow Canary | *Crithagra flaviventris* | 61.05 | 8.89 | LC | - |
| Yellow-bellied Eremomela | *Eremomela icteropygialis* | 5.23 | 0.00 | LC | - |
| Yellow-billed Duck | *Anas undulata* | 70.35 | 13.33 | LC | - |
| Yellow-billed Kite | *Milvus aegyptius* | 0.58 | 0.00 | LC | - |
| Yellow-billed Stork | *Mycteria ibis* | 1.74 | 2.22 | LC | EN |
| Yellow-crowned Bishop | *Euplectes afer* | 24.42 | 4.44 | LC | - |
| Yellow-fronted Canary | *Crithagra mozambica* | 1.16 | 0.00 | LC | - |
| Zitting Cisticola | *Cisticola juncidis* | 14.53 | 2.22 | LC | - |

## APPENDIX C: ENVIRONMENTAL MANAGEMENT PROGRAMME

# Management Plan for the Planning and Design Phase

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **Avifauna: Entrapment** | | | | | |
| Entrapment of birds in the perimeter fences, leading to mortality. | Prevent mortality of avifauna | Increase the spacing between at least the top two wires (to a minimum of 30cm) and ensure they are correctly tensioned. Use a single perimeter fence if possible. | Design the facility with a bird-friendly perimeter fence. Use a single perimeter fence if possible. | Once-off during the planning phase. | Project Developer |
| **Avifauna: Displacement due to habitat transformation** | | | | | |
| Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plants and associated infrastructure. | Prevent unnecessary displacement of avifauna by ensuring that sensitive habitat is protected. | Maintain 100m solar panel buffer zones around pans, dams, water reservoirs, rivers and wetlands. | Design the facility with a 100m solar panel buffer zones around pans, dams, water reservoirs, rivers and wetlands. | Once-off during the planning phase. | Project Developer |

# Management Plan for the Construction Phase

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

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | report non-compliance.<br>4. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance. | | |
| **Avifauna: Displacement due to habitat transformation** | | | | | |
| Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plants and associated infrastructure. | Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study. | 1. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance. | 1. Appointment of rehabilitation specialist to develop habitat rehabilitation plan.<br>2. Site inspections to monitor progress of rehabilitation.<br>3. Adaptive management to ensure HRP goals are met. | 1. Once-off<br>2. Once a year<br>3. As and when required | 1. Project Developer<br>2. Facility Environmental Manager<br>3. Project Developer and Facility Operational Manager |
| **Avifauna: Mortality due to collision with the 132kV OHL** | | | | | |
| **Mortality of avifauna due to collisions with the 132kV OHL.** | Reduction of avian collision mortality | OHL to be marked with Eskom approved Bird Flight Diverters (BFDs). | 1. Fit Eskom approved Bird Flight Diverters on the earthwire of the OHL. | 2. Once-off<br>3. Once-off | 1. Contractor<br>2. Contractor and ECO |

## Management Plan for the Operational Phase

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **Avifauna: Electrocution in the onsite substations** | | | | | |
| Electrocution of priority species in the onsite substations | Prevent the mortality of Red Data species | Reactive mitigation of hardware if electrocutions of Red Data species are recorded. | Investigate the electrocution incident and implement appropriate mitigation by insulating the hardware | As and when required | Facility Operational Manager |

## Management Plan for the Decommissioning Phase

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

**APPENDIX D: IMPACT ASSESMENT METHODOLOGY**

# Method for Impact Identification and Evaluation

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with the proposed project. The process involves consideration of, *inter alia*: the purpose and need for the project; views and concerns of interested and affected parties (I&APs); social and political norms, and general public interest.

## Identification and Description of Impacts

Identified impacts are described in terms of the nature of the impact, compliance with legislation and accepted standards, receptor sensitivity and the significance of the predicted environmental change (before and after mitigation). Mitigation measures may be existing measures or additional measures that were identified through the impact assessment and associated specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of mitigation.

## Evaluation of Impacts and Mitigation Measures

### INTRODUCTION

Impacts are assessed using SLR's standard convention for assessing the significance of impacts, a summary of which is provided below.

In assigning significance ratings to potential impacts before and after mitigation the approach presented below is to be followed.

1. **Determine the impact consequence rating:** This is a function of the "intensity", "duration" and "extent" of the impact (see Section 0). The consequence ratings for combinations of these three criteria are given in Section 0.
2. **Determine impact significance rating:** The significance of an impact is a function of the consequence of the impact occurring and the probability of occurrence (see Section 0). Significance is determined using the table in Section 0.
3. **Modify significance rating (if necessary):** Significance ratings are based on largely professional judgement and transparent defined criteria. In some instances, therefore, whilst the significance rating of potential impacts might be "low", the importance of these impacts to local communities or individuals might be extremely high. The importance/value which interested and affected parties attach to impacts will be highlighted, and recommendations should be made as to ways of avoiding or minimising these perceived negative impacts through project design, selection of appropriate alternatives and / or management.
4. **Determine degree of confidence of the significance assessment:** Once the significance of the impact has been determined, the degree of confidence in the assessment will be qualified (see Section 0). Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact.

## CRITERIA FOR IMPACT ASSESSMENT

The criteria for impact assessment are provided below.

| Criteria | Rating | Description |
|---|---|---|
| **Criteria for ranking of the INTENSITY (SEVERITY) of environmental impacts** | **ZERO TO VERY LOW** | Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods. |
| | **LOW** | Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable or there is no perceptible change to people's livelihood. |
| | **MEDIUM** | Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way. People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. |
| | **HIGH** | Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease. Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods. |
| **Criteria for ranking the DURATION of impacts** | **SHORT TERM** | < 5 years. |
| | **MEDIUM TERM** | 5 to < 15 years. |
| | **LONG TERM** | > 15 years, but where the impact will eventually cease either because of natural processes or by human intervention. |
| | **PERMANENT** | Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient. |
| **Criteria for ranking the EXTENT / SPATIAL SCALE of impacts** | **LOCAL** | Impact is confined to project or study area or part thereof, e.g. limited to the area of interest and its immediate surroundings. |
| | **REGIONAL** | Impact is confined to the region, e.g. catchment, municipal region, etc. |
| | **NATIONAL** | Impact is confined to the country as a whole, e.g. South Africa, etc. |
| | **INTERNATIONAL** | Impact extends beyond the national scale. |
| **Criteria for determining the PROBABILITY of impacts** | **IMPROBABLE** | Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring. |
| | **POSSIBLE** | Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring. |
| | **PROBABLE** | Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring. |
| | **DEFINITE** | Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring. |
| | **LOW** | ≤ 35% sure of impact prediction. |

| Criteria | Rating | Description |
|---|---|---|
| **Criteria for determining the DEGREE OF CONFIDENCE of the assessment** | **MEDIUM** | > 35% and ≤ 70% sure of impact prediction. |
| | **HIGH** | > 70% sure of impact prediction. |
| **Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED** - the degree to which an impact can be reduced / enhanced | **NONE** | No change in impact after mitigation. |
| | **VERY LOW** | Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact. |
| | **LOW** | Where the significance rating drops by one level, after mitigation. |
| | **MEDIUM** | Where the significance rating drops by two to three levels, after mitigation. |
| | **HIGH** | Where the significance rating drops by more than three levels, after mitigation. |
| **Criteria for LOSS OF RESOURCES** - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable | **LOW** | Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected. |
| | **MEDIUM** | Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way. |
| | **HIGH** | Where the activity results in an irreplaceable loss of a resource. |
| **Criteria for REVERSIBILITY** - the degree to which an impact can be reversed | **IRREVERSIBLE** | Where the impact is permanent. |
| | **PARTIALLY REVERSIBLE** | Where the impact can be partially reversed. |
| | **FULLY REVERSIBLE** | Where the impact can be completely reversed. |

## DETERMINING CONSEQUENCE

Consequence attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity. The ratings and description for determining consequence are provided below.

| Rating | Description * |
|---|---|
| **VERY HIGH** | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level*** and endure in the ***long term***;<br>OR of ***high intensity*** at a ***national level*** in the ***medium term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***long term.*** |
| **HIGH** | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***high intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***national level*** in the ***long term***;<br>OR of ***high intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***long term.*** |
| **MEDIUM** | Impacts could be EITHER:<br>of ***high intensity*** at a ***local level*** and endure in the ***medium term***; |

| Rating | Description * |
|---|---|
| | OR of ***medium intensity*** at a ***regional level*** in the ***medium term***;<br>OR of ***high intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***local level*** in the ***long term***;<br>OR of ***low intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***regional level*** in the ***long term.*** |
| **LOW** | Impacts could be EITHER<br>of ***low intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***national level*** in the ***short term***;<br>OR of ***high intensity*** at a ***local level*** and endure in the ***short term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***low intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.*** |
| **VERY LOW** | Impacts could be EITHER<br>of ***low intensity*** at a ***local level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***;<br>OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.***<br>OR **Zero to very low intensity** with any combination of extent and duration. |

* Note: For any impact that is considered to be "Permanent" or "International" apply the "Long-Term" and "National" ratings, respectively.

## DETERMINING SIGNIFICANCE

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

| | | PROBABILITY | | | |
|---|---|---|---|---|---|
| | | **IMPROBABLE** | **POSSIBLE** | **PROBABLE** | **DEFINITE** |
| **CONSEQUENCE** | **VERY LOW** | **INSIGNIFICANT** | **INSIGNIFICANT** | **VERY LOW** | **VERY LOW** |
| | **LOW** | **VERY LOW** | **VERY LOW** | **LOW** | **LOW** |
| | **MEDIUM** | **LOW** | **LOW** | **MEDIUM** | **MEDIUM** |
| | **HIGH** | **MEDIUM** | **MEDIUM** | **HIGH** | **HIGH** |
| | **VERY HIGH** | **HIGH** | **HIGH** | **VERY HIGH** | **VERY HIGH** |

In certain cases it may not be possible to determine the significance of an impact. In these instances the significance is **UNKNOWN**.

# SITE SENSITIVITY VERIFICATION REPORT

# ROAN 1 & 2 PV SOLAR FACILITIES

Hartbeesfontein, North-West Province

February 2022

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SITE SENSITIVITY VERIFICATION REPORT 68

## 1. Introduction

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project site as identified by the National Web-Based Environmental Screening Tool (Screening Tool). NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020 is applicable in the case of solar PV developments.

The details of the site sensitivity verification are noted below:

| | |
|---|---|
| **Date of Site Visit** | 23 December 2021 |
| **Supervising Specialist Name** | Albert Froneman |
| **Professional Registration Number** | MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09) |
| **Specialist Affiliation / Company** | Chris van Rooyen Consulting |

## 2. Methodology

The following methods were used to compile the SSV report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town (ADU 2021), to ascertain which species occurs within the broader area i.e., within a block consisting of 4 pentad grid cells within which the proposed projects are situated. 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 date, a total of 172 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 45 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al*. 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2021) was used in order to view the broader study area on a landscape level and to help identify sensitive bird habitat.

- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the proposed project areas.
- An on-site survey conducted on 23 December 2021. The development site was inspected with a 4x4 vehicle and on foot. All birds were recorded.
- Priority species were defined as follows:
  - South African Red Data species.
  - South African endemics and near-endemics.
  - Raptors
  - Waterbirds

## 3. Results of site assessment

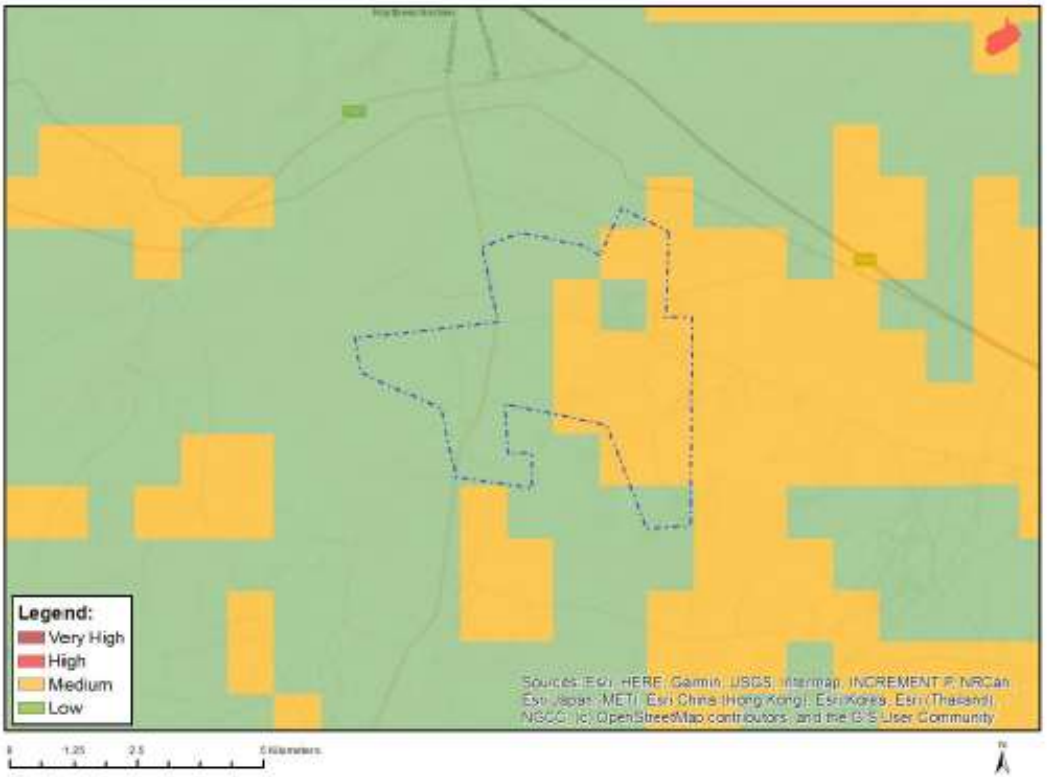
The study area and immediate environment is classified as **Low** and **Medium** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. The Medium classification is due to the possible occurrence of certain mammal species, Spotted-necked Otter *Hydrictis maculicollis* and Makwassie Musk Shrew *Crocidura maquassiensis*, and not due to potential avian species.

The study area does not seem to contain suitable habitat for avian 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. No SCC were encountered during the field survey.

Only one Endemic species was noted, the South African Cliff Swallow *Petrochelidon spilodera*.

Based on the field survey to date, the classification of **Low** sensitivity for avifauna in the screening tool is confirmed for the proposed study 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) |
|---|---|
| Low | Low sensitivity |
| Medium | Mammalia-Crocidura maquassiensis |
| Medium | Mammalia-Hydrictis maculicollis |

**Figure 1: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Terrestrial Animal Species theme. The Medium sensitivity classification is linked to two mammals, Spotted-necked Otter *Hydrictis maculicollis* and Makwassie Musk Shrew *Crocidura maquassiensis***

## 13.1 Avifauna

A total of 268 species could potentially occur within the broader area where the project is located (see Appendix E). Of these, 97 are classified as priority species for solar developments. Of the 97 priority species, 37 have a medium to very high probability of occurring in the development site. Of the 37 priority species with a medium to high probability of occurrence, six were recorded during the site survey. No regional Red Data species were recorded during the site survey.

## 13.2 Receiving environment

The proposed study area is situated approximately 18,5 km north-west of the town of Klerksdorp, in the North-West Province. It is located in the Grassland Biome, in the Dry Highveld Grassland Bioregion and is situated in area that is made up of a mix of grassland and thorny woodland. The habitat is quite variable and consists of fallow fields (recovering grassland), natural grassland, shrub- and woodland, some wetland and pans, and some agricultural and industrial activities. Mucina & Rutherford (2006) classifies the area as mix between Vaal-Vet Sandy Grassland (an Endangered vegetation type) and Klerksdorp Thornveld.

There is riparian zone, the Jagspruit river and its floodplain and wetlands, in the north of the study area. The area is also scattered with a few artificial wetlands, pans, and round cement dams. The eastern half of the study area is mainly woodland and scattered grassland interspersed with some industrial and agricultural activities. The western half is mainly fallow fields (old lands), grassland and agriculture.

The Klerksdorp area has a semi-arid climate (according to the Köppen-Geiger climate classification), with warm to hot summers and cool, dry winters. The average annual precipitation is 482 mm, with most of the rainfall occurring during summer. It should be noted that photos from the field survey were taken in the rainy season (i.e., summer).

The following distinct habitat features are present in the study area:

- Grassland
- Old Lands (recovering grassland)
- Woodland
- Rivers and Wetlands
- Pans and Dams
- Agriculture
- Industrial

### *3.1.1 Grassland*

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data.

Using this classification system, the natural vegetation in the study area is classified as Grassland. Grassland is dominated by grasses, with geophytes and herbs also well represented. Grasslands are maintained by a combination of relatively high summer rainfall, frequent fires, frost, and grazing, which prevent the presence of shrubs and trees (see **Figures 1 and 2**). But much of the Grassland Biome has been transformed and is under threat from crop farming, urbanization, afforestation, and bush encroachment.

**Figure 9: An area of natural grassland within the study area.**

**Figure 10: Another example of natural grassland habitat in the study area.**

The following priority species with a high or medium likelihood of occurrence could use Grassland habitat in the study area:

- African Sacred Ibis
- Amur Falcon
- Black-headed Heron
- Blacksmith Lapwing
- Black-winged Kite
- Cloud Cisticola
- Common Buzzard

- Egyptian Goose
- Glossy Ibis
- Lesser Kestrel
- Pied Starling
- South African Cliff Swallow
- Western Barn Owl
- Western Cattle Egret

### *3.1.2 Old Lands (Recovering Grassland)*

In the western section of the study area there are tracts of fallow fields or old lands. These areas were used for crop farming in the past but have been left to return to semi-natural grasslands or grazing pastures (see **Figures 3 and 4**).

**Figure 11: Old lands in the study area.**

**Figure 12: Another example of old lands (recovering grassland).**

The following priority species with a high or medium likelihood of occurrence could use old lands (recovering grassland) in the study area:

- African Sacred Ibis
- Amur Falcon
- Black-headed Heron
- Blacksmith Lapwing
- Black-winged Kite
- Cloud Cisticola
- Common Buzzard
- Egyptian Goose
- Lesser Kestrel
- Pied Starling
- South African Cliff Swallow
- Spur-winged Goose
- Western Barn Owl
- Western Cattle Egret

### *3.1.3 Woodland*

The eastern half of the study area is mainly woodland and thornveld. Woodlands can be important nesting areas for avian species. The woodland areas consist of mainly fine-leaved, semi-deciduous *Vachellia*-dominated habitat (see **Figures 5 and 6**).

**Figure 13: Thick woodland habitat in the study area.**

**Figure 14: *Vachellia*-dominated woodland.**

The following priority species with a high or medium likelihood of occurrence could use woodland habitat in the study area:

- Black-winged Kite
- Common Buzzard
- Fiscal Flycatcher
- Karoo Thrush
- Western Barn Owl

### *3.1.4 Rivers and Wetlands*

Rivers and wetlands are important habitats, especially for priority species. There are a few scattered wetlands across the study area. These provide habitat for waterfowl, waders and reedbed dwellers such as rails and crakes. There is riparian zone, the Jagspruit river and its floodplain and wetlands, in the north of the study area (see **Figures 7 and 8**).

**Figure 15: Wetland habitat in the study area.**

**Figure 16: Wetland along the fringes of a pan in the study area.**

The following priority species with a high or medium likelihood of occurrence could use riverine and wetland habitat in the study area:

- African Sacred Ibis
- African Spoonbill
- Black-headed Heron
- Blacksmith Lapwing
- Black-winged Stilt
- Cape Shoveler
- Cape Teal
- Egyptian Goose
- Glossy Ibis
- Grey Heron
- Kittlitz's Plover
- Little Stint
- Marsh Sandpiper
- Red-billed Teal
- Reed Cormorant
- Ruff
- South African Shelduck
- Southern Pochard

- Spur-winged Goose
- Three-banded Plover
- Western Cattle Egret
- Whiskered Tern
- White-breasted Cormorant
- White-faced Whistling Duck
- Wood Sandpiper
- Yellow-billed Duck

### *1.1.1 Pans, dams and water reservoirs*

Surface water is of importance to avifauna in this semi-arid area. The study area contains seasonal pans and some artificial impoundments (ground dams and water reservoirs) which provide habitat for waterbirds (see **Figures 9, 10, and 11**).

**Figure 17: A dam located in the western corner of the study area.**

**Figure 18: Seasonal pan in the study area.**

**Figure 19: A water reservoir with a cement dam in the study area.**

The following priority species with a high or medium likelihood of occurrence could use pans and dams in the study area:

- African Sacred Ibis
- African Spoonbill
- Red-knobbed Coot
- Blacksmith Lapwing
- Black-winged Stilt
- Cape Shoveler
- Cape Teal
- Egyptian Goose
- Grey Heron
- Little Grebe
- Common Buzzard
- Kittlitz's Plover
- Little Stint
- Marsh Sandpiper
- Red-billed Teal
- Reed Cormorant
- South African Shelduck
- Southern Pochard
- Spur-winged Goose
- Three-banded Plover
- Whiskered Tern
- White-breasted Cormorant
- White-faced Whistling Duck
- Wood Sandpiper
- Yellow-billed Duck

### *3.2.6 Agriculture*

There is some agricultural activity within the study area (see **Figure 12**). The fields are mainly used for crop production. Certain bird species have adapted to, and some even thrive, in agricultural habitats.

**Figure 20: Ploughed field in study area.**

The following species with a high or medium likelihood of occurrence could use agricultural lands in the study area:

- African Sacred Ibis
- Amur Falcon
- Blacksmith Lapwing
- Egyptian Goose
- Black-winged Kite
- Common Buzzard
- Lesser Kestrel
- Pied Starling
- Spur-winged Goose
- Western Cattle Egret
- Western Barn Owl

### *3.2.7 Industrial*

There are some industrial developments and heavily transformed habitats within the study area. Remnants of old mining quarries, extraction pits and stockpiles are still present on site as well as an electrical substation (see **Figures 13 and 14**). There are also some areas with alien trees and residential homes (see **Figure 15**).

**Figure 21: Electrical substation located on the eastern edge of the study area.**

**Figure 22: Remnants of an old mining stockpile in the study area.**

**Figure 23: Alien trees, Eucalyptus, in the study area.**

The following priority species with a high or medium likelihood of occurrence could use industrial habitat (including alien trees) in the study area:

- Amur Falcon
- Black-headed Heron
- Black-winged Kite
- Common Buzzard
- Fiscal Flycatcher
- Lesser Kestrel
- Karoo Thrush
- Western Barn Owl

## 4. Environmental sensitivities

The following environmental sensitivities have been identified to date:

- **Pans, dams and water reservoirs: Very High sensitivity (Solar panel exclusion zone)**

  Included are areas within 100m of waterbodies and wetlands. Wetlands and waterbodies are crucially important for priority avifauna, particularly waterbirds, and many non-priority species. It is therefore important to leave open space for birds to access and leave the waterbodies unhindered.

- **Rivers and wetlands Very High sensitivity (Solar panel exclusion zone):**

Included are areas within 100m of rivers and drainage lines. These areas are important for priority avifauna and many non-priority species. It is important to leave open space for birds to access and leave the riverine areas unhindered.

Please see Appendix B for a map indicating the buffer zones identified to date.

## 5. Conclusions

Based on the field survey to date, the classification of **Low** sensitivity for avifauna in the screening tool is confirmed for the proposed study area.

**Appendix A: Priority Species List for the broader area**

| Species name | Scientific name | Priority species recorded during field survey |
|---|---|---|
| Abdim's Stork | *Ciconia abdimii* | |
| African Black Duck | *Anas sparsa* | |
| African Darter | *Anhinga rufa* | |
| African Fish Eagle | *Haliaeetus vocifer* | |
| African Jacana | *Actophilornis africanus* | |
| African Rail | *Rallus caerulescens* | |
| African Sacred Ibis | *Threskiornis aethiopicus* | |
| African Snipe | *Gallinago nigripennis* | |
| African Spoonbill | *Platalea alba* | |
| African Swamphen | *Porphyrio madagascariensis* | |
| Amur Falcon | *Falco amurensis* | X |
| Black Crake | *Zapornia flavirostra* | |
| Black Heron | *Egretta ardesiaca* | |
| Black-chested Snake Eagle | *Circaetus pectoralis* | |
| Black-crowned Night Heron | *Nycticorax nycticorax* | |
| Black-headed Heron | *Ardea melanocephala* | |
| Blacksmith Lapwing | *Vanellus armatus* | |
| Black-winged Kite | *Elanus caeruleus* | X |
| Black-winged Stilt | *Himantopus himantopus* | |
| Blue-billed Teal | *Spatula hottentota* | |
| Booted Eagle | *Hieraaetus pennatus* | |
| Cape Shoveler | *Spatula smithii* | |
| Cape Teal | *Anas capensis* | |
| Cape White-eye | *Zosterops virens* | |
| Cloud Cisticola | *Cisticola textrix* | |
| Common Buzzard | *Buteo buteo* | |
| Common Greenshank | *Tringa nebularia* | |
| Common Moorhen | *Gallinula chloropus* | |
| Common Ringed Plover | *Charadrius hiaticula* | |
| Common Sandpiper | *Actitis hypoleucos* | |
| Curlew Sandpiper | *Calidris ferruginea* | |
| Egyptian Goose | *Alopochen aegyptiaca* | |
| European Honey-buzzard | *Pernis apivorus* | |
| European Roller | *Coracias garrulus* | |
| Fairy Flycatcher | *Stenostira scita* | |
| Fiscal Flycatcher | *Melaenornis silens* | |
| Fulvous Whistling Duck | *Dendrocygna bicolor* | |
| Gabar Goshawk | *Micronisus gabar* | |
| Glossy Ibis | *Plegadis falcinellus* | |
| Goliath Heron | *Ardea goliath* | |
| Great Crested Grebe | *Podiceps cristatus* | |
| Great Egret | *Ardea alba* | |
| Greater Flamingo | *Phoenicopterus roseus* | |
| Greater Kestrel | *Falco rupicoloides* | |
| Grey Heron | *Ardea cinerea* | |
| Grey Plover | *Pluvialis squatarola* | |

| | | |
|---|---|---|
| Grey-headed Gull | *Chroicocephalus cirrocephalus* | |
| Hamerkop | *Scopus umbretta* | |
| Intermediate Egret | *Ardea intermedia* | |
| Jackal Buzzard | *Buteo rufofuscus* | |
| Karoo Thrush | *Turdus smithi* | |
| Kittlitz's Plover | *Charadrius pecuarius* | |
| Lanner Falcon | *Falco biarmicus* | |
| Lesser Flamingo | *Phoeniconaias minor* | |
| Lesser Kestrel | *Falco naumanni* | X |
| Lesser Moorhen | *Paragallinula angulata* | |
| Little Egret | *Egretta garzetta* | |
| Little Grebe | *Tachybaptus ruficollis* | |
| Little Stint | *Calidris minuta* | |
| Maccoa Duck | *Oxyura maccoa* | |
| Malachite Kingfisher | *Corythornis cristatus* | |
| Marsh Owl | *Asio capensis* | |
| Marsh Sandpiper | *Tringa stagnatilis* | |
| Melodious Lark | *Mirafra cheniana* | |
| Pale Chanting Goshawk | *Melierax canorus* | |
| Pearl-spotted Owlet | *Glaucidium perlatum* | |
| Pied Avocet | *Recurvirostra avosetta* | |
| Pied Kingfisher | *Ceryle rudis* | |
| Pied Starling | *Lamprotornis bicolor* | |
| Purple Heron | *Ardea purpurea* | |
| Red-billed Teal | *Anas erythrorhyncha* | X |
| Red-chested Flufftail | *Sarothrura rufa* | |
| Red-knobbed Coot | *Fulica cristata* | |
| Reed Cormorant | *Microcarbo africanus* | |
| Rock Kestrel | *Falco rupicolus* | |
| Ruff | *Calidris pugnax* | |
| Secretarybird | *Sagittarius serpentarius* | |
| South African Cliff Swallow | *Petrochelidon spilodera* | X |
| South African Shelduck | *Tadorna cana* | |
| Southern Pochard | *Netta erythrophthalma* | |
| Spotted Eagle-Owl | *Bubo africanus* | |
| Spur-winged Goose | *Plectropterus gambensis* | |
| Squacco Heron | *Ardeola ralloides* | |
| Three-banded Plover | *Charadrius tricollaris* | |
| Verreaux's Eagle | *Aquila verreauxii* | |
| Western Barn Owl | *Tyto alba* | |
| Western Cattle Egret | *Bubulcus ibis* | |
| Whiskered Tern | *Chlidonias hybrida* | |
| White Stork | *Ciconia ciconia* | |
| White-backed Duck | *Thalassornis leuconotus* | |
| White-breasted Cormorant | *Phalacrocorax lucidus* | |
| White-faced Whistling Duck | *Dendrocygna viduata* | |
| White-winged Tern | *Chlidonias leucopterus* | |
| Wood Sandpiper | *Tringa glareola* | |
| Yellow-billed Duck | *Anas undulata* | X |
| Yellow-billed Kite | *Milvus aegyptius* | |
| Yellow-billed Stork | *Mycteria ibis* | |

**Appendix B: Buffer zones identified to date**


**Figure 24: Buffer zones (solar panel exclusion zones) around sensitive habitats indicated in red.**