# BIRD IMPACT ASSESSMENT

## DYASONS KLIP 5

**Basic Assessments for the proposed construction of a Solar Photovoltaic (PV) Facility in the Northern Cape near Upington.**

*Report prepared for:*
Cape EAPrac

*Report prepared by:*
Chris van Rooyen Consulting

MAY 2020

## Specialist Expertise

Curriculum vitae: Chris van Rooyen

| | | |
|---|---|---|
| Profession/Specialisation | : | Avifaunal Specialist |
| Highest Qualification | : | 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.

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 20 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 (Registration Number 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

## Specialist Declaration

I, Chris van Rooyen, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Chris van Rooyen

Signature of the specialist: ______________________________

Date: 25 May 2020

## EXECUTIVE SUMMARY

This report presents the Bird Impact Assessment that was prepared by Chris van Rooyen of Chris van Rooyen Consulting as part of the Basic Assessment (BA) Process for the proposed construction of the Photovoltaic Facilities on the Remainder of Farm Dyasons Klip 454, near Upington in the Northern Cape Province.

The Solar PV Development will be known as Dyasons Klip PV 5, and is to consist of solar photovoltaic (PV) technology, fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures, with a net generating capacity of 100 MW, as well as associated infrastructure.

### 1. Avifauna

It is estimated that a total of 203 bird species could potentially occur in the broader area – Appendix 2 provides a comprehensive list of all the species, including those recorded during the pre-construction monitoring. Of the priority species potentially occurring in the broader area, 35 could potentially occur in the study area. Eight of these are South African Red Data species, and three are globally Red listed.

The proposed project will have the following potential impacts on avifauna:

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.
- Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure
- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the onsite substation, inverter station and 132kV powerline
- Collisions with the 132kV powerline
- Displacement due to disturbance associated with the decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection

### 2. Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.

**The impact is assessed to be Moderate before mitigation, and Low after mitigation**. Suggested mitigation measures are (a) activity should as far as possible be restricted to the footprint of the infrastructure, (b) measures to control noise and dust should be applied according to current best practice in the industry (c) maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical (d) access to the rest of the property must be restricted (e) the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.

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

Priority species that could be affected by displacement due to habitat transformation are the following:

- Lanner Falcon
- Spotted Eagle-owl
- Martial Eagle
- Tawny Eagle

- Greater Kestrel
- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Pygmy Falcon
- Black-shouldered Kite
- Booted Eagle
- Common Ostrich
- Pearl-spotted Owlet
- Rock Kestrel
- Southern Pale Chanting Goshawk
- Steppe Buzzard
- Black-eared Sparrowlark
- Fiscal Flycatcher
- Black-headed Heron.

**The impact is assessed to be High before mitigation, and Moderate after mitigation.** The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. Other than that, not much can be done to limit this unavoidable impact on the avifauna.

## 4. Collisions with the solar panels

The priority species which would most likely be potentially affected by this impact are mostly small birds which forage between the solar panels, and possibly raptors which prey on them:

- Lanner Falcon
- Spotted Eagle-owl
- Pygmy Falcon
- Southern Pale Chanting Goshawk
- Black-eared Sparrowlark
- Fiscal Flycatcher

**The risk is assessed to be Very Low**. No mitigation is required due to the very low expected magnitude.

## 5. Entrapment in perimeter fences

The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species:

- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard

**The risk is assessed to be Low, but it can be reduced to Very Low through the application of mitigation measures**. Suggested mitigation is that a single perimeter fence should be used[1].

## 6. Electrocutions in the onsite substation and inverter station yard, and on the 132kV poles

Species potentially at risk of electrocution in the substation and inverter station yard are the following:

- Lanner Falcon
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Martial Eagle
- Tawny Eagle
- Greater Kestrel
- Steppe Buzzard
- Egyptian Goose
- Barn Owl
- Spur-winged Goose

**The impact is assessed to be Low before mitigation, and Very Low after mitigation.** With regards to the infrastructure within the substation and inverter station yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively. A perch should be fitted to the electricity poles to reduce the risk of electrocution (see Appendix 7).

## 7. Collisions with the 132kV grid connection

Species potentially at risk of collisions with the 132kV grid connection are the following:

- Abdim's Stork
- Booted Eagle
- Egyptian Goose
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Martial Eagle
- Secretarybird
- South African Shelduck
- Spur-winged Goose
- Tawny Eagle
- White-faced Duck
- Yellow-billed Duck

**The impact is considered to be Moderate, but can be reduced to Low through the application of mitigation measures.** Suggested mitigation is the identification of high risk sections of power line by a qualified avifaunal specialist during the walk through phase of the project, once the alignment has been finalized. If power line marking is required, bird flappers must be installed on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be

[1] In this instance, according to the design specifications, a fence will be used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100mm. This should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

alternated so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

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

The activities associated with the decommissioning of the solar PV plant and associated infrastructure will impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary displacement. All priority species could be temporarily displaced. **The impact is assessed to be Moderate before mitigation, and Low after mitigation.** Suggested mitigation measures are (a) activity should as far as possible be restricted to the footprint of the infrastructure, (b) measures to control noise and dust should be applied according to current best practice in the industry (c) maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical (d) access to the rest of the property must be restricted (e) the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.

## 9. Cumulative impacts

In the case of solar energy projects, the potentially most significant impact from an avifaunal perspective is the transformation of the natural habitat. The total footprint taken up by existing and proposed solar energy projects is approximately 12 600ha. This project comprises 260 hectares of this footprint. The total area of the 30km radius around the proposed projects equates to about 285 000ha of very similar habitat. The total combined size of the footprint taken up by solar energy projects equates to 4.4% of the available habitat in the 30km radius. The cumulative impact of the habitat transformation which will come about as a result of the proposed PV project, should therefore be L**ow**.

The grid connection will add between 12 and 20km of high voltage line to the existing high voltage network within the 30km radius. This, together with the planned grid connections of the other planned or constructed projects within the 30km radius, will result in a significant increase in the total length of the high voltage network. The cumulative impact of the increase in the total length of high voltage lines, particularly mortality due to collisions, is rated as **Moderate**.

## 10. Identification of Environmental Sensitivities

*High sensitivity*

Included are areas within 300m of water troughs and ephemeral pans. These areas are highly sensitive for the following reasons:

- Surface water in this arid habitat is crucially important for priority avifauna, including several Red Data species such as Martial Eagle, Tawny Eagle, Lanner Falcon, Secretarybird and Kori Bustard, and many non-priority species. Ephemeral pans could also attract waterbirds on occasion, such as African Sacred Ibis, Black-headed Heron, Blacksmith Lapwing, Cattle Egret, Common Greenshank, Common Sandpiper, Egyptian Goose, South African Shelduck, Spur-winged Goose, Three-banded Plover, White-faced Duck, Wood Sandpiper, Yellow-billed Duck, Hamerkop. It is important to leave open space for birds to access and leave the surface water area unhindered, especially large terrestrial species. Surface water is also important area for raptors to hunt birds, and they should have enough space for fast aerial pursuit.

*Medium sensitivity*

The entire study area can be classified as medium sensitive, due to the fact that it is largely untransformed and potentially supports up to 35 priority species, eight of which are Red Listed.

See Appendix 5 for a sensitivity map of the development footprint.

## 11. Selection of preferred alternative for grid connection and on site substation

There are no pertinent features to distinguish the two substation sites as far as potential impacts on birds are concerned, as both are situated in similar habitat, and both are likely to pose the same risk to birds as far as potential electrocutions are concerned. Both sites are therefore deemed to be equally suitable from a bird impact perspective.

There are likewise no pertinent features (except total length) to distinguish the various powerline corridor alternatives as far as potential impacts on birds are concerned, as they are all situated in similar habitat, and all are likely to pose similar risks to birds as far as potential electrocutions are concerned. The only distinguishable feature is the length of the alignments, therefore with all things being equal, the shortest one would be the preferred one. In this case, that is Alternative 2.

### 12. Final Specialist Statement and Authorisation Recommendation

In terms of an average, the pre-mitigation significance of all potential impacts identified in this specialist study is assessed as halfway between **Low** and **Moderate**, and the average post-mitigation significance is assessed as Low to Very Low, leaning more towards **Very Low**. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the EMPr (Appendix 4) are strictly implemented.

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## List of Abbreviations

| | |
|---|---|
| BA | Basic Assessment |
| BFD | Bird Flight Diverters |
| BLSA | BirdLife South Africa |
| DEFF | Department of Environmental Affairs and Forestry |
| EIA | Environmental Impact Assessment |
| EMPr | Environmental Management Programme |
| EWT | Endangered Wildlife Trust |
| IBA | Important Bird Area |
| SABAP 2 | Southern African Bird Atlas Project 2 |

## Glossary

| **Definitions** | |
|---|---|
| Broader area | The area covered by the SABAP 2 pentads where the proposed development is located. |
| Study area | The area taken up by the Remainder of Farm Dyason's Klip 454 |
| Development footprint | This includes the total footprint of PV panels, auxiliary buildings, onsite substation, inverter stations and internal roads. |
| Priority species | Priority solar species are defined as follows:<br>○ South African Red Data species;<br>○ South African endemics and near-endemics;<br>○ Raptors<br>○ Waterbirds |
| Pentad Grid | A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude |

# COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

| **Requirements of Appendix 6 – GN R982** | **Addressed in the Specialist Report** |
| --- | --- |
| 1. (1) A specialist report prepared in terms of these Regulations must contain-<br>a) details of-<br>i. the specialist who prepared the report; and<br>ii. the expertise of that specialist to compile a specialist report including a curriculum vitae; | Pg. 2 - 3 |
| b) a declaration that the specialist is independent in a form as may be specified by the competent authority; | Pg.3 |
| c) an indication of the scope of, and the purpose for which, the report was prepared; | Section 1 and 2 |
| (cA) an indication of the quality and age of base data used for the specialist report; | Section 2 |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Section 4 and Section 6 |
| d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment; | Section 2 |
| e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | Section 2 |
| f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | Section 4 and Appendix 4 |
| g) an identification of any areas to be avoided, including buffers; | Section 4 and Appendix 4 |
| h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers; | Appendix 4 |
| i) a description of any assumptions made and any uncertainties or gaps in knowledge; | Section 2 |
| j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities; | Section 6 and Section 10 |
| k) any mitigation measures for inclusion in the EMPr; | Appendix 4 |
| l) any conditions for inclusion in the environmental authorisation; | Appendix 4 |
| m) any monitoring requirements for inclusion in the EMPr or environmental authorisation; | Appendix 4 |
| n) a reasoned opinion-<br>i. whether the proposed activity, activities or portions thereof should be authorised;<br>(iA) regarding the acceptability of the proposed activity or activities; and<br>ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | Section 10 and Section 11 |
| o) a description of any consultation process that was undertaken during the course of preparing the specialist report; | Section 2 |
| p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | n/a |
| q) any other information requested by the competent authority. | n/a |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | n/a |

# BIRD IMPACT ASSESSMENT

This report presents the Bird Impact Assessment that was prepared by Chris van Rooyen of Chris van Rooyen Consulting as part of the Basic Assessment (BA) Process for the proposed construction of the Photovoltaic Facilities on the Remainder of Farm Dyasons Klip 454, near Upington in the Northern Cape Province.

The Solar PV Development will be known as Dyasons Klip 5, and is to consist of solar photovoltaic (PV) technology, fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures, with a net generating capacity of 100 MW as well as associated infrastructure, which will include:

- Solar photovoltaic (PV) technology with fixed, single or double axis tracking mounting structures, with a net generation (contracted) capacity of 100 $MW_{AC}$ (MegaWatts), as well as associated infrastructure, which will include:
  - Auxiliary buildings (gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
  - Access (at an existing access on the N14) and internal road network that extends beyond that authorised for DK SEF 1;
  - Laydown area;
  - Battery storage area;
  - Rainwater tanks;
  - Perimeter fencing and security infrastructure;
  - Inverter-stations, transformers and internal electrical reticulation (underground cabling);
  - On-site switching-station / substation; and
  - Overhead 132kV electrical transmission line / grid connection.

## 1. Introduction and Methodology

### 1.1 Scope, Purpose and Objectives of this Specialist Report

The objectives of the report are to investigate the potential impacts of the proposed project on avifauna in order to assess whether the project is fatally flawed from an avifaunal impact perspective and, if not, what mitigation measures should be implemented to reduce the potential impacts.

### 1.2 Terms of Reference

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

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Compile a sensitivity map for the project site;
- Assess and evaluate the potential impacts;
- Recommend mitigation measures to reduce the impact of the expected impacts; and
- Provide a reasoned opinion as to whether the proposed development should proceed or not.

### 1.3 Assessment Details

| | |
|---|---|
| Type of Specialist Investigation | Bird Impact Assessment Study: Solar energy facilities |
| Date of Specialist Site Investigation | 24-26 December 2019; 16 – 18 March 2020 |
| Season | Mid-Summer; Late Summer |
| Relevance of Season | The fieldwork was timed to take place in the high season after a period of exceptional rains, resulting in optimal conditions. |

## 2. Approach and Methodology

The survey methodology took into account the best practice guidelines for avifaunal impact studies at solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al.* 2017), adapted for the specific situation[2].

- On-site surveys were conducted at the study area from 24 - 26 December 2019 and again from 16 - 18 March 2020 (6 days in total) in the following manner:
  - Ten walk transects were identified within the study area, totalling 1km each, covering all the major habitat types.
  - Each transect was counted twice over a period of 3 days.
  - The observer recorded all species on both sides of the walk transect. The observer stopped at regular intervals 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 in and around the proposed study areas were also recorded.
- A total of 2 focal points (FPs) were identified consisting of one borehole and one natural pan within the study area, and monitored once in the course of each survey.

See Appendix 1 for a map of the study area, showing the location of transects and focal points used for purposes of the surveys.

### 2.1 Information Sources

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed study areas are located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. In order to get a more representative impression of the birdlife, a consolidated data set was obtained for a block of 15 pentads, within which the proposed development is located, henceforth called the broader area[3]. The SABAP2 data covers the period 2007 to 2020.
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).

[2] It was decided to implement two surveys in the peak season to take advantage of the optimal conditions, instead of doing the second survey in sub-optimal conditions.
[3] The relevant pentads are 2825_2050,2825_2055, 2825_2100, 2825_2105, 2825_2110, 2830_2050, 2830_2055, 2830_2100, 2830_2105, 2830_2110, 2835_2050, 2835_2055, 2835_2100, 2835_2105, 2835_2110.

- The global threatened status of all priority species was determined by consulting the latest (2020.1) IUCN Red List of Threatened Species).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2020) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the study area relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the Northern Cape.
- The DEFF National Screening Tool was used to determine the assigned avian sensitivity of the study area.
- The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa (Solar and Wind SEA) was consulted to determine what level of avifaunal sensitivity is assigned to the study area (CSIR 2015).

### 2.2 Assumptions, Knowledge Gaps and Limitations

- A total of 176 SABAP 2 full protocol lists had been completed for the broader area where the proposed project is located (i.e. bird listing surveys lasting a minimum of two hours each). In addition, 97 ad hoc protocol lists (i.e. bird listing surveys lasting less than two hours but still giving useful data) and 486 incidental sightings were also recorded. The SABAP2 data was therefore regarded as a good indicator of the avifauna which could occur in the study area, and it was further supplemented by data collected during the on-site surveys.
- The focus of the study is primarily on the potential impacts on solar priority species.
- Solar priority species are defined as follows:
    - South African Red Data species;
    - South African endemics and near-endemics;
    - Raptors
    - Waterbirds
- The impact of solar installations on avifauna is a new field of study, with only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser *et al.* 2019). Strong 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 exists at the study area when the surveys were conducted.
- Cumulative impacts include all proposed and existing renewable energy projects within a 30km radius around the study areas.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.

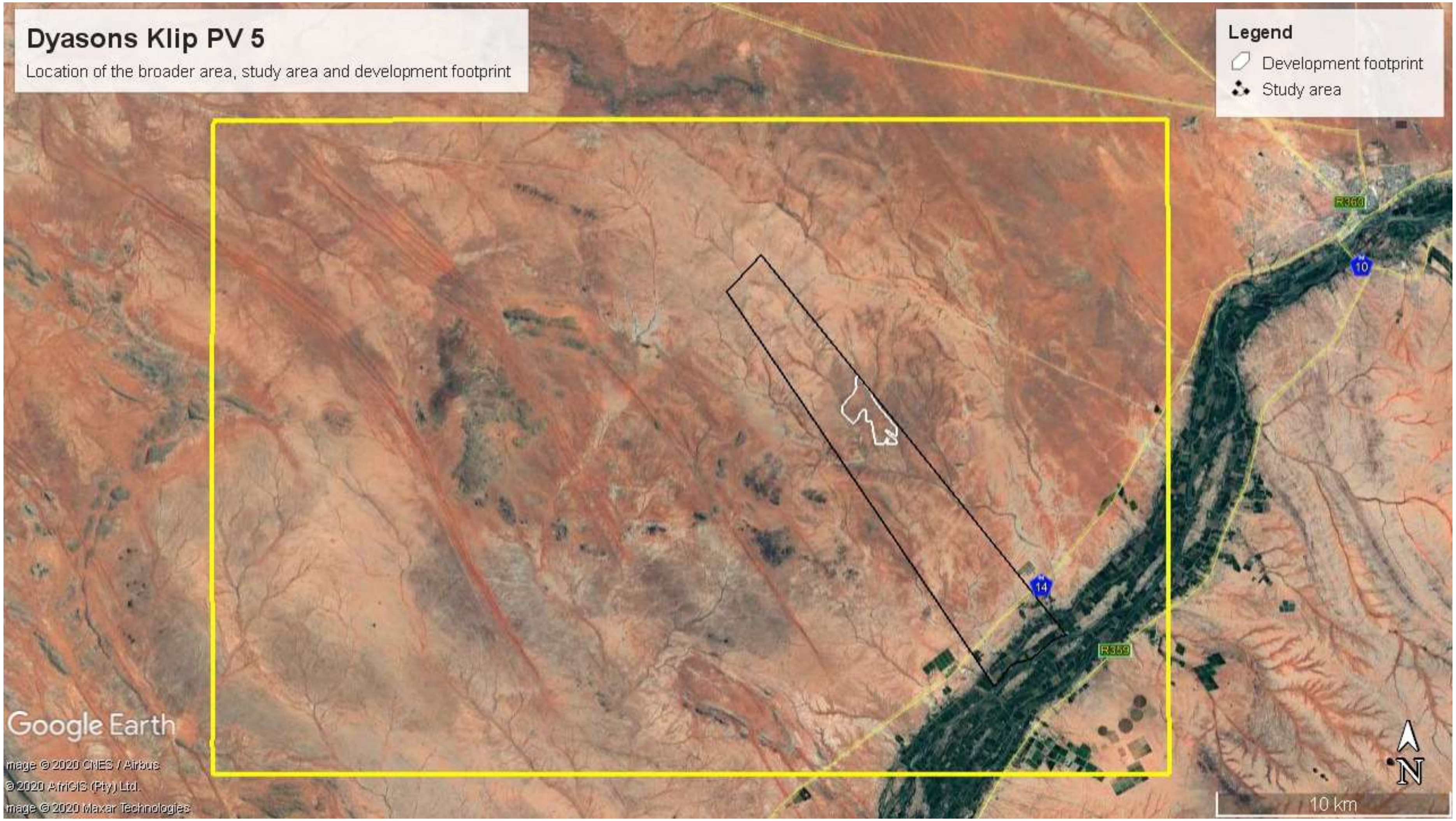


**Figure 1: The location of the proposed Dyasons Klip PV 5 solar facility. The yellow rectangle represents the broader area, the black outline area the study area, and the white outline the development footprint.**

## 3. Description of Project Aspects relevant to Avifaunal Impacts

The following aspects of the project is relevant to avifaunal impacts:

| Site Details | | | |
|---|---|---|---|
| **Size of the property** | Description and Size in hectares of the affected property. | **Study area**:<br><br>the Remainder of Farm Dyason's Klip 454, Total Property Size: 5725.28 ha | |
| **Development Footprint** | This includes the total footprint of PV panels, auxiliary buildings, onsite substation, inverter stations and internal roads. | Approximately 267ha | |
| **Technology Details** | | | |
| **Capacity of the facility** | Capacity of facility (in MW) | Net generating capacity of 100MWac | |
| **Solar Technology selection** | Type of technology | Solar photovoltaic (PV) with either of fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures.<br>PV structures/ modules: up to a maximum of 250ha<br>Laydown area: ± 3 - 5ha<br>Internal roads ± 6.5ha<br>Auxiliary buildings: ± 1ha<br>Facility substation: up to 1ha<br>Battery storage area: up to ± 4ha | |
| | Structure height | Solar panels a maximum of ± 3.5m from ground level | |
| | Surface area to be covered (including associated infrastructure such as roads) | Approximately 267ha | |
| | Structure orientation | Fixed-tilt: north-facing at a defined angle of tilt<br>Single-axis: horizontal axis mounted in a north-south orientation, tracking from east to west | |
| | Laydown area dimensions | Approximately 3 - 5ha of temporary laydown area will be required (the laydown areas will not exceed 5ha and will be situated within the assessed footprint). Permanent laydown area will not exceed 1ha and will be contained within the footprint of the temporary laydown area. | |
| **Grid connection** | Substation to which project will connect. | There are two substation alternatives (Alt 1 and Alt 2), both 100m x 100m:<br>- **Alternative 1 (preferred)** is located near the north-eastern corner of the Dyasons Klip 5 development footprint;<br>- **Alternative 2** is located at the south-eastern corner of the development footprint which borders Dyasonsklip Solar Energy Facility 1 (DK SEF 1), or otherwise referred to as Dyasons Klip 4 (DK4). | |
| | Capacity of substation to connect facility | There are three power line options, each has a 200m buffer either side of the proposed lines routes (i.e. the 400m wide corridors will be the focus areas):<br>- **Alternative 1** runs past (switches into) the Dyasonsklip Solar Energy Facility 1 substation, along the north and then western boundary of DK3 into DK1/2 Switching Station, and then parallel to the existing 132kV line all the way back to Upington MTS.<br>- **Alternative 2** runs past (switches into) the Dyasonsklip Solar Energy Facility 1 substation, runs down the eastern boundary, and then parallel to the existing 132kV line all the way back to the MTS.<br>- **Alternative 3** runs past (switches into) the Dyasonsklip Solar Energy Facility 1 substation, runs down the eastern boundary, and then parallel to the proposed 400kV Aries-Upington line all the way back to the MTS. | |

| Auxiliary Infrastructure | | |
|---|---|---|
| **Other infrastructure** | Additional Infrastructure | Auxiliary buildings of approximately 1 ha.<br>The functions within these buildings include (but are not limited to) a gate house, ablutions, workshops, storage and warehousing area, site offices, and control centre.<br>Substation Sizes:<br>Dyasonsklip 5 is 100m x 100m it total; ± 100m x 50m for the facility side, and ± 100m x 50m for the Eskom Switching Station side.<br>Electrified Perimeter Fencing not exceeding 3.5m in height. |
| | Details of access roads | The internal access roads will not exceed 5m in width, and main access roads will not exceed 8m in width. |
| | Extent of areas required for laydown of materials and equipment | Approximately 2-5ha of laydown areas will be required (laydown areas will not exceed 5ha). A permanent laydown area of a maximum of 1ha will remain. |

# 4. Description of the Receiving Environment

## 4.1 Baseline Environmental Description

### *4.1.1 Important Bird Areas*

There are no Important Bird Areas (IBA) within a 65km radius around the proposed development. It is therefore highly unlikely that the proposed development will have a negative impact on any IBA.

### *4.1.2 Critical Biodiversity Area (CBA)*

A portion of the study area in the south is classified as a CBA, but the rest is classified as Other Natural Areas and Ecological Support Areas. The development footprint itself is classified as Other Natural Areas.

### *4.1.3 DEFF National Screening Tool*

The DEFF National Screening Tool classifies the study area as predominantly medium sensitive from an avifaunal perspective, with only drainage lines classified as high sensitive.

### *4.1.4 National Protected Areas Expansion Strategy (NPEAS) focus areas*

The study area does not form part of an NPEAS focus area.

### *4.1.5 Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa (Solar and Wind SEA)*

The study is classified as “unknown area of medium importance” for avifauna in the Solar and Wind SEA.

### *4.1.6 Habitat classes*

Vegetation structure, rather than the actual plant species, is more significant for bird species distribution and abundance (Harrison *et al.* 1997). The description of the vegetation types occurring in the study area largely follows the classification system presented in the Atlas of southern African birds (Harrison *et al.* 1997). The criteria used 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. The description of vegetation presented in this study therefore concentrates on factors relevant to the bird species present and is not an exhaustive list of plant species present.

Whilst the distribution and abundance of the bird species in the study area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine external modifications to the environment that might have relevance for priority species. Anthropogenic avifaunal-relevant habitat modifications which could potentially influence the avifaunal community that were recorded in or close to the study area are boreholes with water troughs, providing accessible surface water. These are discussed in more detail below.

- Biomes and vegetation types

The study area is situated on a vast, flat plain, with the no topographically notable features. It is located in the interface between the Nama Karoo Biome and the Savanna Biome, but the study area is predominantly Nama Karoo Biome. Two types of vegetation intermingle in the study area, namely Bushmanland Arid Grassland and Kalahari Karroid Shrubland (see Figures 2 and 3). Bushmanland Arid Grassland consists of grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semidesert 'steppe' in years of high rainfall. In places low shrubs change the vegetation structure, particularly in drainage lines. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford, 2006). Kalahari Karroid Shrubland occurs in flat gravelly areas in the study area. The land-use in the study area is livestock farming.

**Figure 2: Bushmanland Arid Grassland intermingled with Kalahari Karroid Shrubland in the study area.**

**Figure 3: Kalahari Karroid Shrubland in the study area.**

The climate in the Upington area is arid, with high summer temperatures and mild winters. Average rainfall is around 180mm per year. Table 1 below displays the average temperatures and rainfall for Upington (climate-data.org).

**Table 1: Annual temperatures and precipitation at Upington (climate-data.org)**

| | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Avg. Temperature (°C) | 26.2 | 25.6 | 23.7 | 19.3 | 14.8 | 11.8 | 11.5 | 13.1 | 17 | 20.1 | 23 | 25.2 |
| Min. Temperature (°C) | 17.8 | 17.7 | 15.9 | 11.2 | 6.2 | 3.1 | 2.5 | 3.9 | 7.6 | 11.1 | 14.2 | 16.7 |
| Max. Temperature (°C) | 34.6 | 33.6 | 31.5 | 27.5 | 23.4 | 20.5 | 20.6 | 22.4 | 26.4 | 29.2 | 31.9 | 33.8 |
| Avg. Temperature (°F) | 79.2 | 78.1 | 74.7 | 66.7 | 58.6 | 53.2 | 52.7 | 55.6 | 62.6 | 68.2 | 73.4 | 77.4 |
| Min. Temperature (°F) | 64.0 | 63.9 | 60.6 | 52.2 | 43.2 | 37.6 | 36.5 | 39.0 | 45.7 | 52.0 | 57.6 | 62.1 |
| Max. Temperature (°F) | 94.3 | 92.5 | 88.7 | 81.5 | 74.1 | 68.9 | 69.1 | 72.3 | 79.5 | 84.6 | 89.4 | 92.8 |
| Precipitation / Rainfall (mm) | 23 | 31 | 39 | 22 | 12 | 4 | 2 | 3 | 4 | 9 | 15 | 16 |

- Surface water

Surface water is of specific importance to avifauna in this semi-arid environment. The study area contains a number of open water troughs that provide drinking water to livestock. Open water troughs are important sources of surface water and could potentially be used extensively by various bird species, including large raptors, to drink and bath. There are also a number of small ephemeral pans in the study area. Due to the good rains that the study area experienced in the summer, several pans held water or had evidence of recently holding water (see Figure 4). Pans are attractive to various bird species, including large raptors, to drink and bath. Pans could also serve as an attraction to waterbirds when they contain water. The development footprint itself contains no surface water.

**Figure 4: An ephemeral pan in the study area, showing evidence of recent standing water.**

## 4.2. Avifauna

### *4.2.1 Southern African Bird Atlas 2*

The SABAP 2 data indicate that a total of 203 bird species could potentially occur in the broader area – Appendix 2 provides a comprehensive list of all the species, including those recorded during the pre-construction monitoring. Of the priority species potentially occurring in the broader area, 35 could potentially occur in the study area (see Section 4 for definition of a priority species), 8 of these are South African Red Data species, and 5 are globally Red listed. The probability of a priority species occurring 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 solar energy infrastructure. The following abbreviations and acronyms are used:

EN = Endangered
VU = Vulnerable
NT = Near-threatened
LC = Least concern

**Table 2: Priority species which could potentially occur in the study area. Red listed species are shaded in red.**

| | | Status | | | | Class | | | | Habitat | | | Impact | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | Taxonomic name | SABAP2 full protocol reporting rate | Red Data Global | Red Data Regional | Endemic/near endemic - South Africa | Waterbird | Raptor | Probability of occurrence | Recorded during surveys | Arid shrubland and rocky outcrops | Arid grassland | Surface water: Pans | Collision: PV panels | Displacement: Disturbance PV | Displacement: Habitat loss PV | Entrapment in fences | Displacement: Disturbance grid construction | Collision with the 132kV grid connection | Electrocutions: Electrical hardware |
| Abdim's Stork | *Ciconia abdimii* | 9.66 | LC | NT | | | | Low | | x | | x | | x | x | x | x | x | |
| African Sacred Ibis | *Threskiornis aethiopicus* | 51.14 | | | | x | | Low | | | | x | | x | | | | | |
| Barn Owl | *Tyto alba* | 19.89 | | | | | x | High | | x | x | | | x | | | x | | x |
| Black-eared Sparrowlark | *Eremopterix australis* | 5.68 | | | Near endemic | | | High | x | x | x | x | x | x | x | | | | |
| Black-headed Heron | *Ardea melanocephala* | 29.55 | | | | x | | High | | | x | x | | x | x | | | | |
| Black-shouldered Kite | *Elanus caeruleus* | 28.41 | | | | | x | High | | x | x | x | | x | x | | x | | |
| Blacksmith Lapwing | *Vanellus armatus* | 55.68 | | | | x | | Medium | | | | x | | x | | | | | |
| Booted Eagle | *Aquila pennatus* | 6.25 | | | | | x | High | | x | x | x | | x | x | | x | x | |
| Cattle Egret | *Bubulcus ibis* | 61.36 | | | | x | | Low | | x | x | x | | x | | | | | |
| Common Greenshank | *Tringa nebularia* | 3.98 | | | | x | | Low | | | | x | | x | | | | | |
| Common Ostrich | *Struthio camelus* | 1.70 | | | | | | High | | x | x | x | | x | x | | x | | |
| Common Sandpiper | *Actitis hypoleucos* | 2.27 | | | | x | | Low | | | | x | | x | | | | | |
| Egyptian Goose | *Alopochen aegyptiacus* | 59.66 | | | | x | | High | x | | | x | | x | | | | x | x |
| Fiscal Flycatcher | *Sigelus silens* | 15.34 | | | Near endemic | | | High | | x | x | x | x | x | x | | | | |
| Greater Kestrel | *Falco rupicoloides* | 3.98 | | | | | x | High | | x | x | | | x | x | | x | | x |
| Hamerkop | *Scopus umbretta* | 31.25 | | | | x | | Medium | | | | x | | x | | | | | |
| Karoo Korhaan | *Eupodotis vigorsii* | 35.23 | LC | NT | | | | Very high | x | x | x | | | x | x | x | x | x | |
| Kori Bustard | *Ardeotis kori* | 5.11 | NT | NT | | | | High | x | x | x | x | | x | x | x | x | x | |

| | | Status | | | | Class | | | | Habitat | | | Impact | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | Taxonomic name | SABAP2 full protocol reporting rate | Red Data Global | Red Data Regional | Endemic/near endemic - South Africa | Waterbird | Raptor | Probability of occurrence | Recorded during surveys | Arid shrubland and rocky outcrops | Arid grassland | Surface water: Pans | Collision: PV panels | Displacement: Disturbance PV | Displacement: Habitat loss PV | Entrapment in fences | Displacement: Disturbance grid construction | Collision with the 132kV grid connection | Electrocutions: electrical hardware |
| Lanner Falcon | *Falco biarmicus* | 10.80 | LC | VU | | | x | High | | x | x | x | x | x | x | | x | | x |
| Ludwig's Bustard | *Neotis ludwigii* | 3.41 | EN | EN | | | | Medium | x | x | | | | x | x | x | x | x | |
| Martial Eagle | *Polemaetus bellicosus* | 2.27 | VU | EN | | | x | High | | x | x | x | | x | x | | x | x | x |
| Pearl-spotted Owlet | *Glaucidium perlatum* | 2.27 | | | | | x | Medium | | | x | | | x | x | | x | | |
| Pygmy Falcon | *Polihierax semitorquatus* | 7.39 | | | | | x | High | | x | x | x | x | x | x | | x | | |
| Rock Kestrel | *Falco rupicolus* | 6.82 | | | | | x | High | | x | x | | | x | x | | x | | |
| Secretarybird | *Sagittarius serpentarius* | 1.14 | VU | VU | | | x | Medium | | x | x | x | | x | x | x | x | x | |
| South African Shelduck | *Tadorna cana* | 22.73 | | | | x | | Medium | | | | x | | x | | | | x | |
| Southern Pale Chanting Goshawk | *Melierax canorus* | 15.34 | | | | | x | Very high | x | x | x | x | x | x | x | | | | x |
| Spotted Eagle-owl | *Bubo africanus* | 2.27 | | | | | x | High | x | x | x | x | x | x | x | | x | | x |
| Spur-winged Goose | *Plectropterus gambensis* | 18.18 | | | | x | | Medium | | | | x | | x | | | | x | x |
| Steppe Buzzard | *Buteo vulpinus* | 2.27 | | | | | x | Low | | x | x | x | | x | x | | | | x |
| Tawny Eagle | *Aquila rapax* | 0.00 | VU | EN | | | x | High | x | x | x | x | | x | x | | x | x | x |
| Three-banded Plover | *Charadrius tricollaris* | 38.07 | | | | x | | Medium | | | | x | | x | | | | | |
| White-faced Duck | *Dendrocygna viduata* | 13.64 | | | | x | | Low | | | | x | | x | x | | | x | |
| Wood Sandpiper | *Tringa glareola* | 7.95 | | | | x | | Low | | | | x | | x | | | | | |
| Yellow-billed Duck | *Anas undulata* | 9.66 | | | | x | | Low | | | | x | | x | x | | | x | |

### *4.2.2 Pre-construction surveys*

On-site surveys were conducted from 24 - 26 December 2019 and again from 16 - 18 March 2020 (6 days in total). Please see Section 2 for details of the methodology used in the surveys.

- Species diversity and abundance

The abundance of species recorded during the walk transects and focal points are displayed in Figures 5, 6 and 7. A total of 75 individual birds were counted at the two focal points in the course of the surveys.

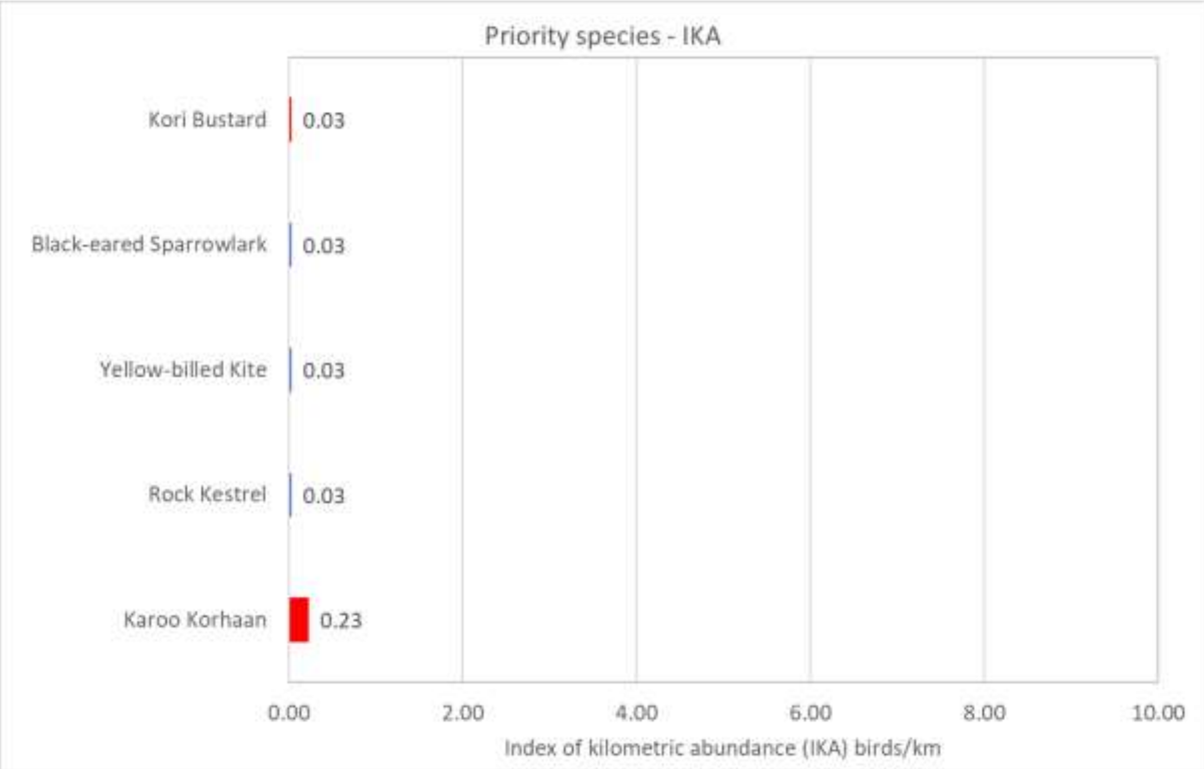


**Figure 5: Index of kilometric abundance (IKA) for all priority species recorded by means of walk transects during the surveys in the study area, conducted in February and March 2020. Red Data species are indicated in red bars.**


**Figure 6: Index of kilometric abundance (IKA) for all non-priority species recorded by means of walk transects during the surveys, conducted in December 2019 and March 2020.**

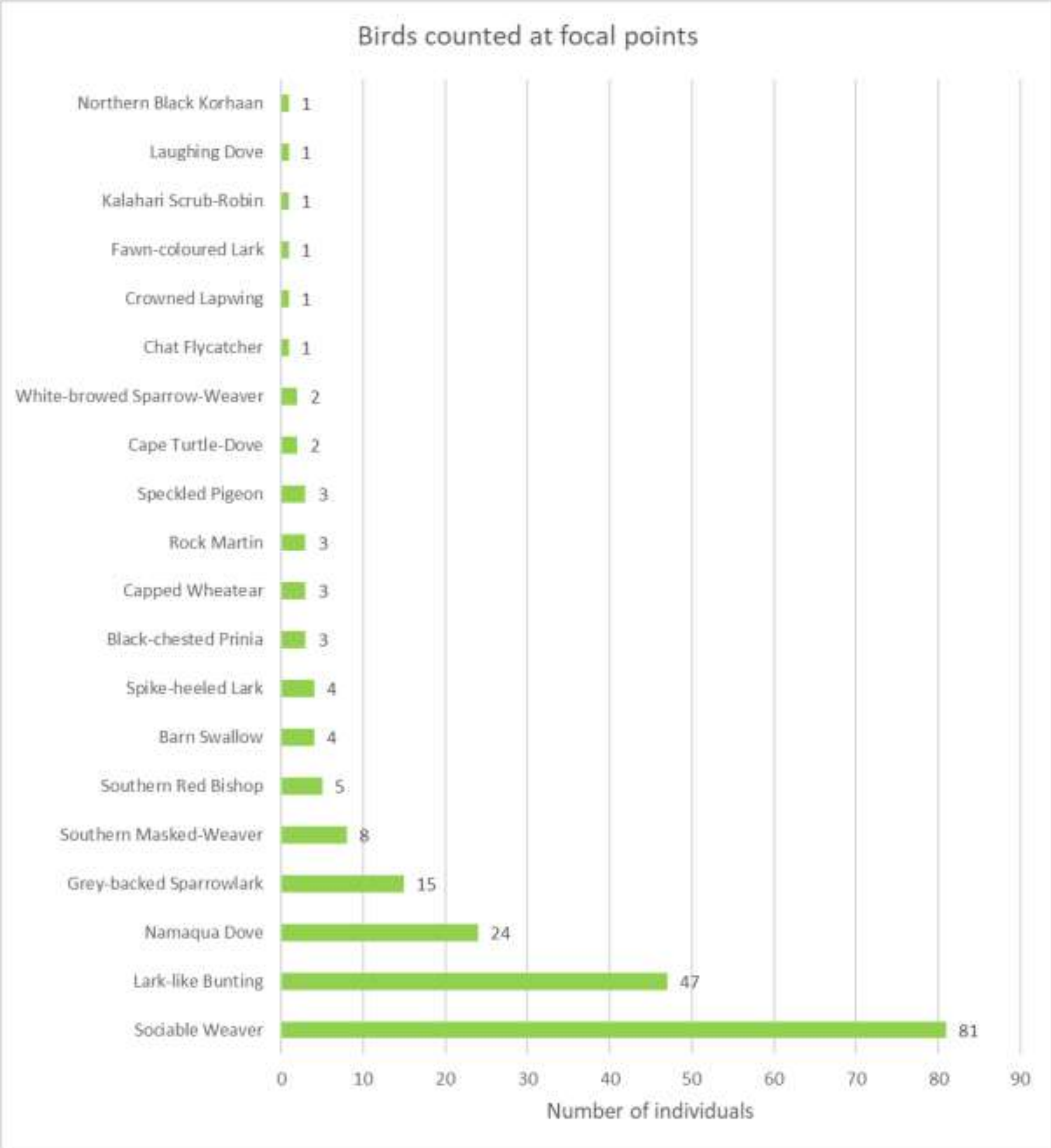


**Figure 7: The variety and number of birds counted at focal points in the study area. No priority species were recorded at focal points.**

## 4.3 Identification of Environmental Sensitivities

### *4.3.1 High sensitivity*

Included are areas within 300m of water troughs and ephemeral pans. These areas are highly sensitive for the following reasons:

- Surface water in this arid habitat is crucially important for priority avifauna, including several Red Data species such as Martial Eagle, Tawny Eagle, Lanner Falcon, Secretarybird and Kori Bustard, and many non-priority species. Ephemeral pans could also attract waterbirds on occasion, such as African Sacred Ibis, Black-headed Heron, Blacksmith Lapwing, Cattle Egret, Common Greenshank, Common Sandpiper, Egyptian Goose, South African Shelduck, Spur-winged Goose, Three-banded Plover, White-faced Duck, Wood Sandpiper, Yellow-billed Duck, Hamerkop. It is important to leave open space for birds to access and leave the surface water area unhindered, especially large terrestrial species. Surface water is also important area for raptors to hunt birds, and they should have enough space for fast aerial pursuit.

#### *4.3.2 Medium sensitivity*

The entire study area can be classified as medium sensitive, due to the fact that it is largely untransformed and potentially supports up to 35 priority species, eight of which are Red Listed.

See Appendix 4 for a sensitivity map of the development footprint.

## 5. Issues, Risks and Impacts

### 5.1 Summary of Issues identified during the Project Notification Phase

No issues were raised pertaining to avifauna during the Project Notification Phase.

### 5.2 Identification of Potential Impacts/Risks

The potential impacts identified during the BA are:

#### *5.2.1 Construction Phase*

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

#### *5.2.2 Operational Phase*

- Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure
- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the on-site substation and inverter station
- Collisions with the 132kV grid connection

#### *5.2.3 Decommissioning Phase*

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

#### *5.2.4 Cumulative Impacts*

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure
- Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure
- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in on-site substation and inverter station
- Collisions with the 132kV grid connection

# 6. Impact Assessment

## 6.1 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 WWF Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth, J. & Mallon, K. 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;
- In future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers 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 *et al.* 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).

## 6.2 Impacts associated with PV plants

### *6.2.1 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 (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). However, until such time that enough scientific evidence has been collected to discount the "lake effect" hypothesis, it must be considered as a potential source of impacts.

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.

[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.

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. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and 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 birds which forage between the solar panels, and possibly raptors which prey on them:

- Lanner Falcon
- Black-eared Sparrowlark
- Fiscal Flycatcher
- Pygmy Falcon
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl

#### *6.2.2 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.

It is not foreseen that entrapment in perimeter fences will be a significant impact. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species:

- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard

### *6.2.3 Displacement due to disturbance and habitat transformation associated with the construction of the solar PV facility*

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 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. Her most significant finding 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, either completely or more likely partially (reduced densities) during the construction phase, due to the disturbance associated with the construction activities.

As far as displacement, either completely or partially (reduced densities) due to habitat loss is concerned, it is highly likely that the same pattern of reduced avifaunal densities and possible changes in densities and composition favouring grassland species will manifest itself at the proposed PV facility. In addition, raptors, large terrestrial species and waterbirds are also likely to be impacted. Species that could be affected by displacement due to habitat loss are listed below:

- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Lanner Falcon
- Black-eared Sparrowlark
- Fiscal Flycatcher
- Pygmy Falcon
- Southern Pale Chanting Goshawk
- Spotted Eagle-owl
- Black-headed Heron
- White-faced Duck
- Yellow-billed Duck
- Martial Eagle
- Tawny Eagle
- Black-shouldered Kite
- Booted Eagle
- Common Ostrich
- Greater Kestrel
- Pearl-spotted Owlet

- Rock Kestrel
- Steppe Buzzard

## 6.3 Impacts associated with 132kV grid connection, onsite substations and inverter stations

Negative impacts on birds by electricity infrastructure generally take two principal forms, namely electrocution and collisions (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Van Rooyen 2004; Jenkins *et al.* 2010). Birds also impact on the infrastructure through nesting and streamers, which can cause interruptions in the electricity supply (Van Rooyen *et al.* 2002). During the construction phase of power lines and substations, displacement of birds can also happen due to disturbance and habitat transformation.

### *6.3.1 Electrocutions*

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The electrocution risk is largely determined by the design of the electrical hardware. There could be an electrocution risk to certain species, mostly raptors, but also some waterbirds, in the yard of the onsite substation and inverter station. This is however unlikely to be a major problem to the larger Red Listed species, as it is not envisaged that they will frequently perch in this area.

The tower design that that is commonly used for 132kV sub-transmission lines is DT 7611 steel monopole. Clearance between phases on the same side of the steel monopole DT 7611 structure is approximately 2.2m for this type of design, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of most birds on the towers to negligible. The length of the stand-off insulators is approximately 1.6m. If a very large species attempts to perch on the stand-off insulators, e.g. a Martial Eagle, it is potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. To completely eliminate the risk of electrocutions on the 7611 steel monopole structure, it is proposed that a bird perch is added to the pole, to draw birds away from the potentially dangerous insulators to the pole top (see Appendix 7).

Species potentially at risk of electrocution in the substation and inverter station yard are the following:

- Lanner Falcon
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Martial Eagle
- Tawny Eagle
- Greater Kestrel
- Steppe Buzzard
- Egyptian Goose
- Barn Owl

Species potentially at risk of electrocution in the poles themselves are the following:

- Martial Eagle
- Tawny Eagle

- Spur-winged Goose

### *6.3.2 Collisions*

Collisions are probably the biggest single threat posed by power lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. 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 power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with power lines:

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

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

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

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

As mentioned by Shaw (2013) in the extract above, several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is essential to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin *&* Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes and White Storks*.* In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35° respectively are sufficient to render the birds blind in the direction of travel; in storks head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

Thus visual field topographies which have evolved primarily to meet visual challenges associated with foraging may render certain bird species particularly vulnerable to collisions with human artefacts, such as power lines and wind turbines that extend into the otherwise open airspace above their preferred habitats. For these species placing devices upon power lines to render them more visible may have limited success since no matter what the device the birds may not see them. It may be that in certain situations it may be necessary to distract birds away from the obstacles, or encourage them to land nearby (for example by the use of decoy models of conspecifics, or the provision of sites attractive for roosting) since increased marking of the obstacle cannot be guaranteed to render it visible if the visual field configuration prevents it being detected. Perhaps most importantly, the results indicate that collision mitigation may need to vary substantially for different collision prone species, taking account of species specific behaviours, habitat and foraging preferences, since an effective all-purpose marking device is probably not realistic if some birds do not see the obstacle at all (Martin & Shaw 2010).

Despite evidence that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos *et al.* 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Sporer *et al.* 2013; Barrientos *et al.* 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos *et al.* 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A study 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 in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos *et al.* 2011). Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important, as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

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

A potential impact of the proposed 132kV power lines is collisions with the earth wire. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are susceptible to powerline collisions (see Figure 8). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

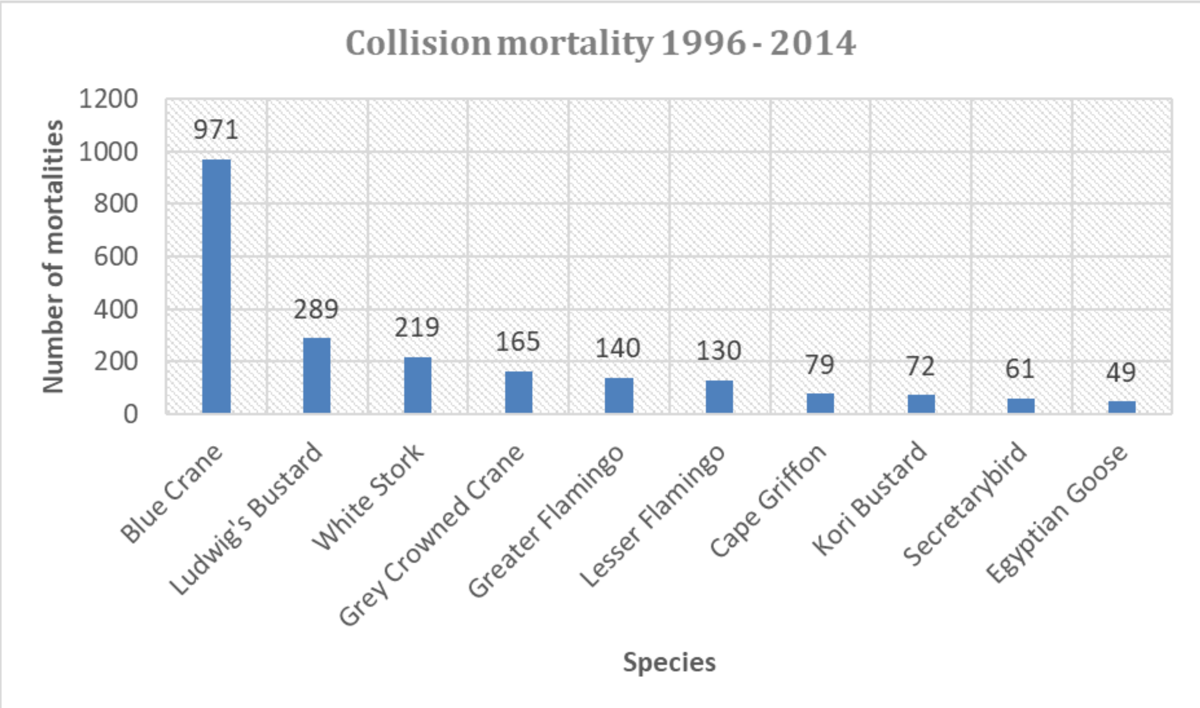


**Figure 8: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data 2014)**

Species potentially at risk of collisions with the 132kV grid connection are the following:

- Abdim's Stork
- Booted Eagle
- Egyptian Goose

- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Martial Eagle
- Secretarybird
- South African Shelduck
- Spur-winged Goose
- Tawny Eagle
- White-faced Duck
- Yellow-billed Duck

#### *6.3.3 Displacement due to disturbance associated with the construction of the 132kV grid connection*

Construction activities could impact on birds through temporary displacement due to disturbance, particularly for larger species. This could lead to breeding failure if the disturbance happens during a critical stage of the breeding cycle. The reporting rates for Red Data species in the broader area are generally low, which is an indication that they are not regularly utilising the area for breeding. However, the possibility of disturbance of a breeding pair of large raptors during the construction of the powerline cannot be entirely excluded, and requires further investigation during the walk-through phase.

Priority species potentially at risk of temporary displacement due to disturbance associated with the 132kV grid connection are the following:

- Abdim's Stork
- Booted Eagle
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Martial Eagle
- Secretarybird
- Tawny Eagle
- Barn Owl
- Black-shouldered Kite
- Common Ostrich
- Greater Kestrel
- Lanner Falcon
- Pearl-spotted Owlet
- Pygmy Falcon
- Rock Kestrel
- Spotted Eagle-owl

### 6.4 Cumulative impacts

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy developments within at least a 30km radius of the proposed site. The locality renewable projects which are planned, authorised or have been constructed already are displayed in Figure 9 and listed in Appendix 3.

In the case of solar energy projects, the potentially most significant impact from an avifaunal perspective is the transformation of the natural habitat. The total footprint taken up by existing and proposed solar energy projects is approximately 12 600ha. This project comprises approximately 260 hectares of this footprint. The total area of the 30km radius around the proposed projects equates to about 285 000ha of very similar habitat. The total combined size of the footprint taken up by solar energy projects equates to 4.4% of the available habitat in the 30km radius. The cumulative impact of the habitat transformation which will come about as a result of the proposed PV project, should therefore be **low**.

The grid connection will add between 12 and 20km of high voltage line to the existing high voltage network within the 30km radius. This, together with the planned grid connections of the other planned or constructed projects within the 30km radius, will result in a significant increase in the total length of the high voltage network. The cumulative impact of the increase in the total length of high voltage lines, particularly mortality due to collisions, is rated as **moderate**.


**Figure 9: Map showing location of land parcels with planned or constructed solar energy projects within a 30km radius around the study area.**

### 6.5 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 (as described in Section 4 of this report), which will be to the advantage of the avifauna.

### 6.6 Potential Impacts during the Construction Phase

| **Aspect/Activity** | Construction of the solar PV plant and associated infrastructure |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | 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. Priority species potentially affected are:<br>▪ All priority species |
| **Status** | Negative |
| **Mitigation Required** | ▪ Activity should as far as possible be restricted to the footprint of the infrastructure. |

| | |
|---|---|
| | ▪ Measures to control noise and dust should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.<br>▪ Access to the rest of the property must be restricted.<br>▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. |
| **Impact Significance (Pre-Mitigation)** | Moderate (Level 3) |
| **Impact Significance (Post-Mitigation)** | Low (Level 4) |
| **I&AP Concern** | No |

## 6.7 Potential Impacts during the Operational Phase

| **Aspect/Activity** | The vegetation clearance and presence of the solar arrays and associated infrastructure amounts to habitat transformation in the development footprint |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plant and associated infrastructure. Priority species potentially affected are the following:<br>▪ Lanner Falcon<br>▪ Spotted Eagle-owl<br>▪ Martial Eagle<br>▪ Tawny Eagle<br>▪ Greater Kestrel<br>▪ Secretarybird<br>▪ Abdim's Stork<br>▪ Karoo Korhaan<br>▪ Kori Bustard<br>▪ Ludwig's Bustard<br>▪ Pygmy Falcon<br>▪ Black-shouldered Kite<br>▪ Booted Eagle<br>▪ Common Ostrich<br>▪ Pearl-spotted Owlet<br>▪ Rock Kestrel<br>▪ Southern Pale Chanting Goshawk<br>▪ Steppe Buzzard<br>▪ Black-eared Sparrowlark<br>▪ Fiscal Flycatcher<br>▪ Black-headed Heron |
| **Status** | Negative |
| **Mitigation Required** | The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. |
| **Impact Significance (Pre-Mitigation)** | High (Level 2) |
| **Impact Significance (Post-Mitigation)** | Moderate (Level 3) |
| **I&AP Concern** | No |

| **Aspect/Activity** | The presence of the PV solar arrays will lead to collisions with the reflective solar panels in the PV footprint |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Birds will get killed or injured through collisions with the solar panels. Priority species potentially affected are: |

| | |
|---|---|
| | ▪ Lanner Falcon<br>▪ Spotted Eagle-owl<br>▪ Pygmy Falcon<br>▪ Southern Pale Chanting Goshawk<br>▪ Black-eared Sparrowlark<br>▪ Fiscal Flycatcher |
| **Status** | Negative |
| **Mitigation Required** | No mitigation is required due to the very low expected magnitude. |
| **Impact Significance (Pre-Mitigation)** | Very Low (Level 5) |
| **Impact Significance (Post-Mitigation)** | Very Low (Level 5) |
| **I&AP Concern** | No |

| **Aspect/Activity** | The presence of a double perimeter fence could lead to entrapment of birds between the fences |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality. Priority species that could potentially be affected are:<br><br>▪ Secretarybird<br>▪ Abdim's Stork<br>▪ Karoo Korhaan<br>▪ Kori Bustard<br>▪ Ludwig's Bustard |
| **Status** | Negative |
| **Mitigation Required** | A single perimeter fence should be used[5]. |
| **Impact Significance (Pre-Mitigation)** | Low (Level 4) |
| **Impact Significance (Post-Mitigation)** | Very Low (Level 5) |
| **I&AP Concern** | No |

| **Aspect/Activity** | Electrocution on the 132kV poles, in the onsite substation and inverter station |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Electrocution of priority species. Potential priority species which could be affected are:<br><br>▪ Lanner Falcon<br>▪ Spotted Eagle-owl<br>▪ Southern Pale Chanting Goshawk<br>▪ Martial Eagle<br>▪ Tawny Eagle<br>▪ Greater Kestrel<br>▪ Steppe Buzzard<br>▪ Barn Owl<br>▪ Egyptian Goose<br>▪ Spur-winged Goose |
| **Status** | Negative |
| **Mitigation Required** | ▪ With regards to the infrastructure within the yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.<br>▪ The poles should be fitted with a bird perch (See Appendix 7) |

[5] In this instance, according to the design specifications, a fence will be used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100mm. This should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

| | |
|---|---|
| **Impact Significance (Pre-Mitigation)** | Low (Level 4) |
| **Impact Significance (Post-Mitigation)** | Very Low (Level 5) |
| **I&AP Concern** | No |

| **Aspect/Activity** | Mortality of priority species due to collisions with the 132kV grid connection |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Mortality of priority species. Potential priority species which could be affected are:<br><br>▪ Abdim's Stork<br>▪ Booted Eagle<br>▪ Egyptian Goose<br>▪ Karoo Korhaan<br>▪ Kori Bustard<br>▪ Ludwig's Bustard<br>▪ Martial Eagle<br>▪ Secretarybird<br>▪ South African Shelduck<br>▪ Spur-winged Goose<br>▪ Tawny Eagle<br>▪ White-faced Duck<br>▪ Yellow-billed Duck<br>▪ |
| **Status** | Negative |
| **Mitigation Required** | High risk sections of power line must be identified by a qualified avifaunal specialist during the walk through phase of the project, once the alignment has been finalized. If power line marking is required, bird flappers must 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 so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung. |
| **Impact Significance (Pre-Mitigation)** | Moderate (Level 3) |
| **Impact Significance (Post-Mitigation)** | Low (Level 4) |
| **I&AP Concern** | No |

| **Aspect/Activity** | Displacement of priority species due to construction activities associated with the 132kV grid connection |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | Temporary displacement of priority species. Potential priority species which could be affected are:<br><br>▪ Abdim's Stork<br>▪ Booted Eagle<br>▪ Karoo Korhaan<br>▪ Kori Bustard<br>▪ Ludwig's Bustard<br>▪ Martial Eagle<br>▪ Secretarybird<br>▪ Tawny Eagle<br>▪ Barn Owl<br>▪ Black-shouldered Kite<br>▪ Common Ostrich<br>▪ Greater Kestrel<br>▪ Lanner Falcon<br>▪ Pearl-spotted Owlet<br>▪ Pygmy Falcon<br>▪ Rock Kestrel<br>▪ Spotted Eagle-owl |

| | |
|---|---|
| **Status** | Negative |
| **Mitigation Required** | ▪ 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 avifauna.<br>▪ Measures to control noise should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>▪ A walk-through must be conducted by the avifaunal specialist when the final pole positions have been determined, to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the final alignment, which could be displaced by the construction activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the breeding birds, through the timing of construction activities. |
| **Impact Significance (Pre-Mitigation)** | Low (Level 4) |
| **Impact Significance (Post-Mitigation)** | Very Low (Level 5) |
| **I&AP Concern** | No |

### 6.8 Potential Impacts during the Decommissioning Phase

| **Aspect/Activity** | Decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | The noise and movement associated with the activities at the study area will be a source of disturbance which would lead to the displacement of avifauna from the area. Priority species potentially affected are:<br>▪ All priority species |
| **Status** | Negative |
| **Mitigation Required** | ▪ Activity should as far as possible be restricted to the footprint of the infrastructure.<br>▪ Measures to control noise and dust should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.<br>▪ Access to the rest of the property must be restricted.<br>▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned. |
| **Impact Significance (Pre-Mitigation)** | Moderate (Level 3) |
| **Impact Significance (Post-Mitigation)** | Low (Level 4) |
| **I&AP Concern** | No |

### 6.9 Cumulative Impacts

| **Aspect/Activity** | The incremental impact of the proposed PV facility and grid connection on priority avifauna, added to the impacts of other past, present or reasonably foreseeable future activities. |
|---|---|
| **Type of Impact (i.e. Impact Status)** | Direct |
| **Potential Impact** | ▪ Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure<br>▪ Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure<br>▪ Collisions with the solar panels |

| | |
|---|---|
| | ▪ Entrapment in perimeter fences<br>▪ Electrocutions in the poles, onsite substation and inverter station yard.<br>▪ Collisions with the 132kV grid connection |
| **Status** | Negative |
| **Mitigation Required** | Please refer to all the proposed mitigation measures as listed in the preceding tables in Section 6 for all the impacts and all the phases |
| **Impact Significance (Pre-Mitigation)** | Moderate (3) |
| **Impact Significance (Post-Mitigation)** | Low (2) |
| **I&AP Concern** | None to date |

## 7. Impact Assessment Tables

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Tables 1 to 4 below. An explanation of the assessment criteria is provided in Appendix 6.

**Table 1: Impact Assessment Summary Table for the Construction Phase**

| Construction Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Direct Impacts** | | | | | | | | | | | | | |
| **Aspect/ Impact Pathway** | **Nature of Potential Impact/ Risk** | **Status** | **Spatial Extent** | **Duration** | **Consequence** | **Probability** | **Reversibility of Impact** | **Irreplaceability** | **Potential Mitigation Measures** | **Significance of Impact and Risk** | | **Ranking of Residual Impact/ Risk** | **Confidence Level** |
| | | | | | | | | | | **Without Mitigation/ Management** | **With Mitigation/ Management (Residual Impact/ Risk)** | | |
| Construction of the solar PV plant and associated infrastructure. | The noise and movement associated with the construction activities at the PV footprint will be a source of disturbance which would lead to the displacement of avifauna from the area. | Negative | Site specific | Short term | Substantial | Very likely | high | Low | ▪ Activity should as far as possible be restricted to the footprint of the infrastructure.<br>▪ Measures to control noise and dust should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.<br>▪ Access to the rest of the property must be restricted.<br>▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. | Moderate (3) | Low (4) | Low (4) | High |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Construction of the 132kV grid connection. | The noise and movement associated with the construction activities at the PV footprint will be a source of disturbance which would lead to the displacement of avifauna from the area. | Negative | Site specific | Short term | Moderate | Very likely | high | Low | ▪ 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 avifauna.<br>▪ Measures to control noise should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>▪ A walk-through must be conducted by the avifaunal specialist when the final pole positions have been determined, to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the final alignment, which could be displaced by the construction activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the breeding birds, through the timing of construction activities. | Low (3) | Very Low (4) | Very Low (4) | High |

**Table 2: Impact Assessment Summary Table for the Operational Phase**

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Direct Impacts** | | | | | | | | | | | | | |
| **Aspect/ Impact Pathway** | **Nature of Potential Impact/ Risk** | **Status** | **Spatial Extent** | **Duration** | **Consequence** | **Probability** | **Reversibility of Impact** | **Irreplaceability** | **Potential Mitigation Measures** | **Significance of Impact and Risk** | | **Ranking of Residual Impact/ Risk** | **Confidence Level** |
| | | | | | | | | | | **Without Mitigation/ Management** | **With Mitigation/ Management (Residual Impact/ Risk)** | | |
| The vegetation clearance and presence of the solar arrays and associated infrastructure amounts to habitat transformation in the PV footprint. | Total or partial displacement of avifauna due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure. | Direct | Site specific | Long term | Severe | Very likely | High | Low | The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. | High (2) | Moderate (3) | Moderate (3) | Medium |
| The presence of the PV solar arrays will lead to collisions with the reflective solar panels in the PV footprint. | Birds will get killed or injured through collisions with the solar panels. | Direct | Site specific | Long term | Slight | Unlikely | High | Low | No mitigation is required due to the very low significance. | Very low (5) | Very low (5) | Very low (5) | Medium |
| The presence of a double perimeter fence could lead to entrapment of birds between the fences. | Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality. | Direct | Site specific | Long term | Moderate | Likely | High | Low | A single perimeter fence should be used[6]. | Low (4) | Very low (5) | Very low (5) | High |

[6] In this instance, according to the design specifications, a fence will be used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100mm. This should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The 132kV poles, on-site substation and inverter station could be a source of electrocutions of priority species | Electrocution of priority species. | Direct | Local | Long term | Moderate | Unlikely | High | Low | ▪ With regards to the infrastructure within the yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.<br>▪ The poles should be fitted with a bird perch (See Appendix 7) | Low | Very low (5) | Very low (5) | High |
| The 132kV grid connection could be a source of collision mortality of priority species | Mortality of priority species due to collisions with the 132kV grid connection. | Direct | Local | Long term | Substantial | Likely | High | Low | ▪ High risk sections of power line must be identified by a qualified avifaunal specialist during the walk through phase of the project, once the alignment has been finalized. If power line marking is required, bird flappers must 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 so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung. | Moderate | Low | Low | Medium |

**Table 3: Impact Assessment Summary Table for the Decommissioning Phase**

| Decommissioning Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Direct Impacts** | | | | | | | | | | | | | |
| **Aspect/ Impact Pathway** | **Nature of Potential Impact/ Risk** | **Status** | **Spatial Extent** | **Duration** | **Consequence** | **Probability** | **Reversibility of Impact** | **Irreplaceability** | **Potential Mitigation Measures** | **Significance of Impact and Risk** | | **Ranking of Residual Impact/ Risk** | **Confidence Level** |
| | | | | | | | | | | **Without Mitigation/ Management** | **With Mitigation/ Management (Residual Impact/ Risk)** | | |
| Decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection | The noise and movement associated with the activities at the study area will be a source of disturbance which would lead to the displacement of avifauna from the area. | Direct | Site specific | Short term | Substantial | Very likely | High | Low | ▪ Activity should as far as possible be restricted to the footprint of the infrastructure.<br>▪ Measures to control noise and dust should be applied according to current best practice in the industry.<br>▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.<br>▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned. | Moderate (3) | Low (4) | Very low (5) | High |

**Table 4: Cumulative Impact Assessment Summary Table**

| Cumulative Impacts (Construction, Operational and Decommissioning Phases) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Direct Impacts** | | | | | | | | | | | | | |
| **Aspect/ Impact Pathway** | **Nature of Potential Impact/ Risk** | **Status** | **Spatial** | **Duration** | **Consequence** | **Probability** | **Reversibility of Impact** | **Irreplaceability** | **Potential Mitigation Measures** | **Significance of Impact and Risk** | | **Ranking of Residual Impact/ Risk** | **Confidence Level** |
| | | | | | | | | | | **Without Mitigation/ Management** | **With Mitigation/ Management (Residual Impact/ Risk)** | | |
| The incremental impact of the proposed PV facility and grid connection on priority avifauna, added to the impacts of other past, present or reasonably foreseeable future activities. | ▪ Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure<br>▪ Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure<br>▪ Collisions with the solar panels<br>▪ Entrapment in perimeter fences<br>▪ Electrocutions in the onsite substation and inverter station yard.<br>▪ Collisions with the 132kV grid connection | Direct | Local | Long term | Substantial | Very likely | High | Low | See all the proposed mitigation measures as listed in the preceding tables in Section 6 for all the impacts and all the phases | Moderate (3) | Low (4) | Low (4) | Medium |

## 7.1 Impact Assessment Summary

Table 3 below provides an indication of the overall impact significance with the implementation of mitigation measures for the various phases.

**Table 3: Overall Impact Significance (Post Mitigation)**

| Phase | Overall Impact Significance |
|---|---|
| Construction | Low (Level 4) |
| Operational | Very Low (Level 5) to Moderate (Level 3) |
| Decommissioning | Low (Level 4) |
| Cumulative | Low ( Level 4) |

# 8. Legislative and Permit Requirements

## 8.1 Legislative Framework

There is no legislation pertaining specifically to the impact of solar facilities and associated electrical infrastructure on avifauna. There are best practice guidelines available which were compiled under the auspices of Birdlife South Africa (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. BirdLife South Africa.

### *8.1.1 Agreements and conventions*

**Table 4: 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 3 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 name | Description | Geographic scope |
|---|---|---|
| Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973 | CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. | Global |
| Ramsar Convention on Wetlands of International Importance, Ramsar, 1971 | The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. | Global |
| Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia | The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate. | Regional |

### *8.1.2 National legislation*

#### *8.1.2.1 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.

#### *8.1.2.2 The National Environmental Management Act 107 of 1998*

The National Environmental Management Act 107 of 1998 (as amended) (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 has been done and authorisation has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

*8.1.2.3 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 4 above). The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

# 9. Environmental Management Programme Inputs

Refer to Appendix 4 for the EMPr inputs. It is important to note that a comprehensive EMPr is included in the BA Report, which includes input from all specialists in this regard.

# 10. Summary of Findings and Recommendations

It is estimated that a total of 203 bird species could potentially occur in the broader area – Appendix 2 provides a comprehensive list of all the species, including those recorded during the pre-construction monitoring. Of the priority species potentially occurring in the broader area, 35 could potentially occur in the study area. Eight of these are South African Red Data species, and three are globally Red listed.

The proposed project will have the following potential impacts on avifauna:

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.
- Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure
- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the onsite substation and inverter station, and on the 132kV poles
- Collisions with the 132kV grid connection
- Displacement due to disturbance associated with the decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection

## 10.1 Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.

The construction activities associated with the construction of the solar PV plant and associated infrastructure could impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary displacement. All priority species could temporarily be displaced due to disturbance associated with the construction of the PV facility and associated infrastructure. **The impact is assessed to be Moderate before mitigation, and Low after mitigation**. Suggested mitigation measures are (a) activity should as far as possible be restricted to the footprint of the infrastructure, (b) measures to control noise and dust should be applied according to current best practice in the industry (c) maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical (d) access to the rest of the property must be restricted (e) the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.

### 10.2 Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure

Indications are 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 aspect is that the distribution of birds in the landscape could change, 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. Shrubland specialists appear to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, are favoured by its development (Visser et al. 2019). Species that could be affected by displacement due to habitat transformation are the following:

- Lanner Falcon
- Spotted Eagle-owl
- Martial Eagle
- Tawny Eagle
- Greater Kestrel
- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Pygmy Falcon
- Black-shouldered Kite
- Booted Eagle
- Common Ostrich
- Pearl-spotted Owlet
- Rock Kestrel
- Southern Pale Chanting Goshawk
- Steppe Buzzard
- Black-eared Sparrowlark
- Fiscal Flycatcher
- Black-headed Heron.

**The impact is assessed to be High before mitigation, and Moderate after mitigation.** The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. Other than that, not much can be done to limit this unavoidable impact on the avifauna.

### 10.3 Collisions with the solar panels

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 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. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and based on professional opinion. 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 birds which forage between the solar panels, and possibly raptors which prey on them:

- Lanner Falcon
- Spotted Eagle-owl
- Pygmy Falcon
- Southern Pale Chanting Goshawk
- Black-eared Sparrowlark
- Fiscal Flycatcher

**The risk is assessed to be Very Low**. No mitigation is required due to the very low expected magnitude.

### 10.4 Entrapment in perimeter fences

Visser *et al.* (2019) recorded a fence-line fatality 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 (Visser *et al.* 2019). It is not foreseen that entrapment in perimeter fences will be a significant impact. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species:

- Secretarybird
- Abdim's Stork
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard

**The risk is assessed to be Low, but it can be reduced to Very Low through the application of mitigation measures**. Suggested mitigation is that a single perimeter fence should be used[7].

### 10.5 Electrocutions in the onsite substation and inverter station yard, and on the 132kV poles

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 yard of the onsite substation and inverter station, and on the 132kV poles.

Species potentially at risk of electrocution are the following:

- Lanner Falcon
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Martial Eagle
- Tawny Eagle
- Greater Kestrel
- Steppe Buzzard
- Egyptian Goose
- Barn Owl

[7] In this instance, according to the design specifications, a fence will be used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100mm. This should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

- Spur-winged Goose

**The impact is assessed to be Low before mitigation, and Very Low after mitigation.** With regards to the infrastructure within the yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively. A perch should be fitted to the electricity poles to reduce the risk of electrocution (see Appendix 7).

### 10.6 Collisions with the 132kV grid connection

Collisions are probably the biggest single threat posed by power lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. 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 power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

Species potentially at risk of collisions with the 132kV grid connection are the following:

- Abdim's Stork
- Booted Eagle
- Egyptian Goose
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Martial Eagle
- Secretarybird
- South African Shelduck
- Spur-winged Goose
- Tawny Eagle
- White-faced Duck
- Yellow-billed Duck

**The impact is considered to be Moderate, but can be reduced to Low through the application of mitigation measures.** Suggested mitigation is the identification of high risk sections of power line by a qualified avifaunal specialist during the walk through phase of the project, once the alignment has been finalized. If power line marking is required, bird flappers must 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 so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

### 10.7 Displacement due to disturbance associated with the decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection

The activities associated with the decommissioning of the solar PV plant and associated infrastructure will impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary displacement. All priority species could be temporarily displaced. **The impact is assessed to be Moderate before mitigation, and Low after mitigation.** Suggested mitigation measures are (a) activity should as far as possible be restricted to the footprint of the infrastructure, (b) measures to control noise and dust should be applied according to current best practice in the industry (c) maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical (d) access to the rest of the property must be restricted (e) the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.

### 10.8 Cumulative impacts

In the case of solar energy projects, the potentially most significant impact from an avifaunal perspective is the transformation of the natural habitat. The total footprint taken up by existing and proposed solar energy projects is approximately 12 600ha. This project comprises 260 hectares of this footprint. The total area of the 30km radius around the proposed projects equates to about 285 000ha of very similar habitat. The total combined size of the footprint taken up by solar energy projects equates to 4.4% of the available habitat in the 30km radius. The cumulative impact of the habitat transformation which will come about as a result of the proposed PV project, should therefore be **Low**.

The grid connection will add between 12 and 20km of high voltage line to the existing high voltage network within the 30km radius. This, together with the planned grid connections of the other planned or constructed projects within the 30km radius, will result in a significant increase in the total length of the high voltage network. The cumulative impact of the increase in the total length of high voltage lines, particularly mortality due to collisions, is rated as **Moderate.**

Table 5 below provides a summary of the respective significance ratings, and an average overall rating before and after mitigation.

**Table 5: Overall impact significance rating**

| Impact | Rating pre-mitigation | Rating post-mitigation |
|---|---|---|
| Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure. | Moderate (3) | Low (4) |
| Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure[8] | High (2) | Moderate (3) |
| Collisions with the solar panels | Very Low (5) | Very Low (5) |
| Entrapment in perimeter fences | Low (4) | Very Low (5) |
| Electrocutions in the onsite substation, inverter station yard and 132kV poles. | Low (4) | Very low (5) |
| Collisions with the 132kV grid connection. | Moderate (3) | Low (4) |
| Displacement due to disturbance associated with the decommissioning of the solar PV plant, associated infrastructure and 132kV grid connection. | Moderate (3) | Low (4) |
| Cumulative impacts | Low (4) | Very Low (5) |
| **Average:** | **Moderate (3.5)** | **Low – Very Low (4.4)** |

## 11. Selection of preferred alternative for grid connection and on site substation

### 11.1 Substations

[8] Due to the nature of the habitat, displacement due to habitat destruction associated with the proposed grid connection is likely to be negligible, therefore this is not listed as an impact.

There are no pertinent features to distinguish the two substation sites as far as potential impacts on birds are concerned, as both are situated in similar habitat, and both are likely to pose the same risk to birds as far as potential electrocutions are concerned. Both sites are therefore deemed to be equally suitable from a bird impact perspective.

### 11.2 132kV powerline alignment

There are no pertinent features (except total length) to distinguish the various powerline corridor alternatives as far as potential impacts on birds are concerned, as they are all situated in similar habitat, and all are likely to pose similar risks to birds as far as potential electrocutions are concerned. The only distinguishable feature is the length of the alignments, therefore with all things being equal, the shortest one would be the preferred one. In this case, that is Alternative 2.

## 12. Final Specialist Statement and Authorisation Recommendation

In terms of an average, the pre-mitigation significance of all potential impacts identified in this specialist study is assessed as halfway between **Low** and **Moderate**, and the post-mitigation significance is assessed as Low to Very Low, leaning more towards **Very Low** (i.e. average of 4.4, as shown in Table 5 above). It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the EMPr (Appendix 4) are strictly implemented.

### 12.1 EA Condition Recommendations

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

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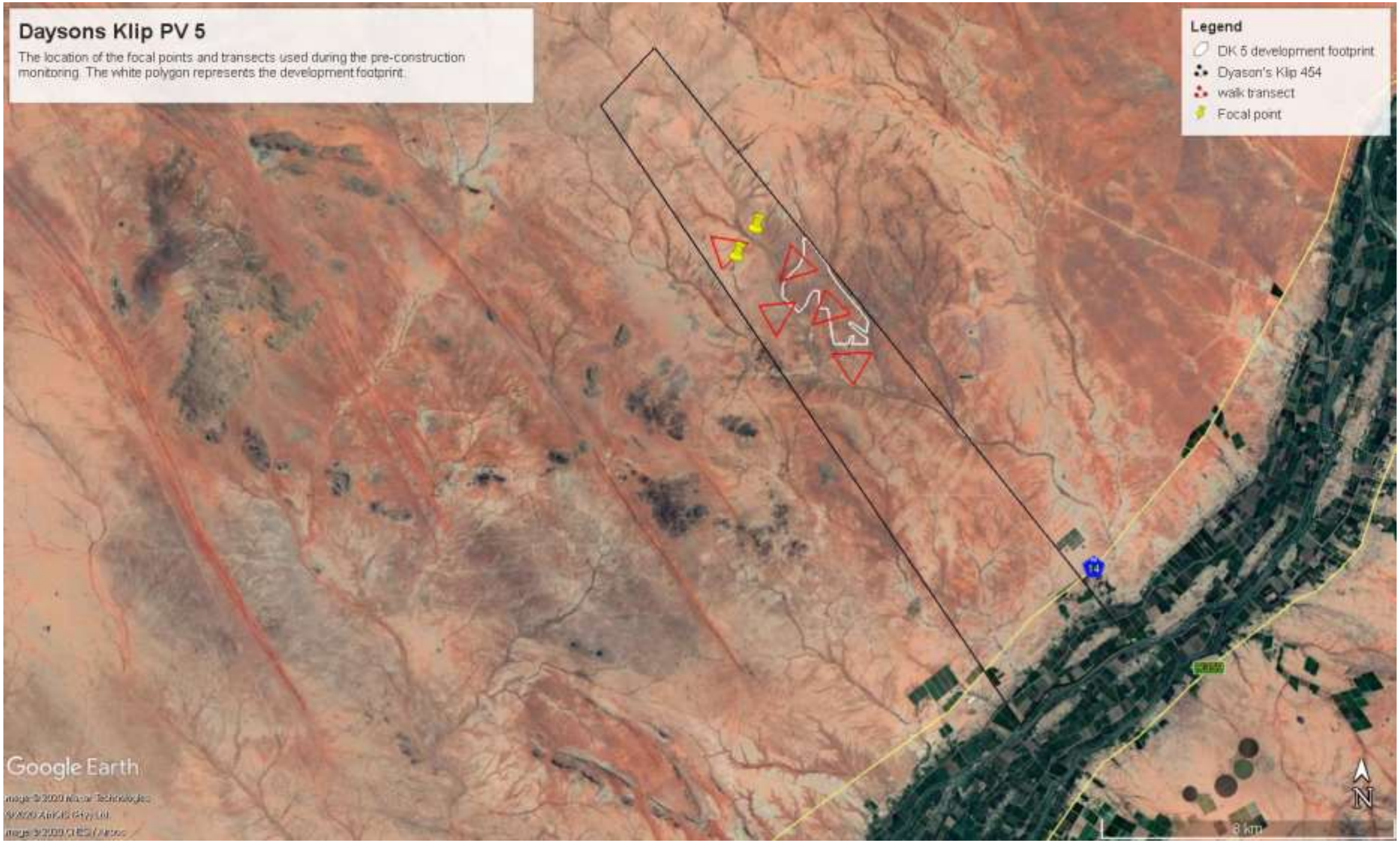
## APPENDIX 1: PRE-CONSTRUCTION MONITORING



# APPENDIX 2: SPECIES OCCURING IN THE BROADER AREA

| Family | Species | Taxonomic name | SABAP2 full protocol reporting rate | Recorded during surveys |
|---|---|---|---|---|
| Barbet | Acacia Pied Barbet | *Tricholaema leucomelas* | 59.66 | x |
| Barbet | Black-collared Barbet | *Lybius torquatus* | 1.14 | |
| Barbet | Crested Barbet | *Trachyphonus vaillantii* | 48.86 | |
| Batis | Pririt Batis | *Batis pririt* | 35.80 | x |
| Bee-eater | European Bee-eater | *Merops apiaster* | 21.02 | x |
| Bee-eater | Swallow-tailed Bee-eater | *Merops hirundineus* | 30.68 | |
| Bee-eater | White-fronted Bee-eater | *Merops bullockoides* | 22.16 | |
| Bishop | Southern Red Bishop | *Euplectes orix* | 64.20 | x |
| Bittern | Little Bittern | *Ixobrychus minutus* | 13.64 | |
| Bokmakierie | Bokmakierie | *Telophorus zeylonus* | 50.00 | x |
| Brubru | Brubru | *Nilaus afer* | 25.00 | |
| Bulbul | African Red-eyed Bulbul | *Pycnonotus nigricans* | 73.86 | |
| Bunting | Cinnamon-breasted Bunting | *Emberiza tahapisi* | 1.14 | |
| Bunting | Lark-like Bunting | *Emberiza impetuani* | 41.48 | x |
| Bustard | Kori Bustard | *Ardeotis kori* | 5.11 | x |
| Bustard | Ludwig's Bustard | *Neotis ludwigii* | 3.41 | x |
| Buzzard | Jackal Buzzard | *Buteo rufofuscus* | 0.57 | |
| Buzzard | Steppe Buzzard | *Buteo vulpinus* | 2.27 | |
| Canary | Black-throated Canary | *Crithagra atrogularis* | 39.77 | |
| Canary | White-throated Canary | *Crithagra albogularis* | 3.98 | |
| Canary | Yellow Canary | *Crithagra flaviventris* | 43.18 | x |
| Chat | Anteating Chat | *Myrmecocichla formicivora* | 21.59 | x |
| Chat | Familiar Chat | *Cercomela familiaris* | 28.41 | |
| Chat | Karoo Chat | *Cercomela schlegelii* | 0.57 | x |
| Chat | Tractrac Chat | *Cercomela tractrac* | 1.14 | |
| Cisticola | Desert Cisticola | *Cisticola aridulus* | 13.64 | x |
| Cisticola | Grey-backed Cisticola | *Cisticola subruficapilla* | 3.41 | |
| Cisticola | Levaillant's Cisticola | *Cisticola tinniens* | 40.34 | |
| Cisticola | Zitting Cisticola | *Cisticola juncidis* | 38.07 | |
| Cliff-swallow | South African Cliff-swallow | *Hirundo spilodera* | 13.64 | |
| Coot | Red-knobbed Coot | *Fulica cristata* | 3.98 | |
| Cormorant | Reed Cormorant | *Phalacrocorax africanus* | 41.48 | |
| Cormorant | White-breasted Cormorant | *Phalacrocorax carbo* | 39.77 | |
| Coucal | Burchell's Coucal | *Centropus burchellii* | 33.52 | |
| Courser | Double-banded Courser | *Rhinoptilus africanus* | 3.98 | |
| Crake | Black Crake | *Amaurornis flavirostris* | 11.36 | |
| Crombec | Long-billed Crombec | *Sylvietta rufescens* | 14.20 | |
| Crow | Pied Crow | *Corvus albus* | 33.52 | x |
| Cuckoo | Diderick Cuckoo | *Chrysococcyx caprius* | 24.43 | |
| Cuckoo | Jacobin Cuckoo | *Clamator jacobinus* | 1.70 | |
| Darter | African Darter | *Anhinga rufa* | 45.45 | |
| Dove | Laughing Dove | *Streptopelia senegalensis* | 75.57 | |
| Dove | Namaqua Dove | *Oena capensis* | 47.73 | x |
| Dove | Red-eyed Dove | *Streptopelia semitorquata* | 62.50 | |
| Dove | Rock Dove | *Columba livia* | 3.41 | |
| Duck | African Black Duck | *Anas sparsa* | 14.20 | |
| Duck | Maccoa Duck | *Oxyura maccoa* | 0.57 | |
| Duck | White-faced Duck | *Dendrocygna viduata* | 13.64 | |
| Duck | Yellow-billed Duck | *Anas undulata* | 9.66 | |

| Common_group | Species | Taxonomic name | SABAP2 full protocol reporting rate | Recorded during surveys |
|---|---|---|---|---|
| Eagle | Booted Eagle | *Aquila pennatus* | 6.25 | |
| Eagle | Martial Eagle | *Polemaetus bellicosus* | 2.27 | |
| Eagle | Tawny Eagle | *Aquila rapax* | 0.00 | x |
| Eagle-owl | Spotted Eagle-owl | *Bubo africanus* | 2.27 | |
| Egret | Cattle Egret | *Bubulcus ibis* | 61.36 | |
| Egret | Little Egret | *Egretta garzetta* | 14.20 | |
| Eremomela | Yellow-bellied Eremomela | *Eremomela icteropygialis* | 14.77 | |
| Falcon | Lanner Falcon | *Falco biarmicus* | 10.80 | |
| Falcon | Peregrine Falcon | *Falco peregrinus* | 1.70 | |
| Falcon | Pygmy Falcon | *Polihierax semitorquatus* | 7.39 | |
| Finch | Red-headed Finch | *Amadina erythrocephala* | 4.55 | |
| Finch | Scaly-feathered Finch | *Sporopipes squamifrons* | 26.70 | x |
| Firefinch | Red-billed Firefinch | *Lagonosticta senegala* | 17.61 | |
| Fiscal | Common (Southern) Fiscal | *Lanius collaris* | 77.27 | |
| Fish-eagle | African Fish-eagle | *Haliaeetus vocifer* | 32.39 | |
| Flamingo | Greater Flamingo | *Phoenicopterus ruber* | 0.57 | |
| Flycatcher | Chat Flycatcher | *Bradornis infuscatus* | 20.45 | x |
| Flycatcher | Fairy Flycatcher | *Stenostira scita* | 1.14 | |
| Flycatcher | Fiscal Flycatcher | *Sigelus silens* | 15.34 | |
| Flycatcher | Spotted Flycatcher | *Muscicapa striata* | 2.27 | |
| Goose | Egyptian Goose | *Alopochen aegyptiacus* | 59.66 | x |
| Goose | Spur-winged Goose | *Plectropterus gambensis* | 18.18 | |
| Goshawk | Southern Pale Chanting Goshawk | *Melierax canorus* | 15.34 | x |
| Grebe | Little Grebe | *Tachybaptus ruficollis* | 15.34 | |
| Greenshank | Common Greenshank | *Tringa nebularia* | 3.98 | |
| Guineafowl | Helmeted Guineafowl | *Numida meleagris* | 46.59 | |
| Hamerkop | Hamerkop | *Scopus umbretta* | 31.25 | |
| Harrier | Montagu's Harrier | *Circus pygargus* | 1.70 | |
| Harrier | Pallid Harrier | *Circus macrourus* | 0.57 | |
| Harrier-Hawk | African Harrier-Hawk | *Polyboroides typus* | 0.00 | |
| Heron | Black Heron | *Egretta ardesiaca* | 0.57 | |
| Heron | Black-headed Heron | *Ardea melanocephala* | 29.55 | |
| Heron | Goliath Heron | *Ardea goliath* | 19.32 | |
| Heron | Green-backed Heron | *Butorides striata* | 1.70 | |
| Heron | Grey Heron | *Ardea cinerea* | 39.77 | |
| Heron | Purple Heron | *Ardea purpurea* | 7.95 | |
| Heron | Squacco Heron | *Ardeola ralloides* | 5.68 | |
| Honeyguide | Lesser Honeyguide | *Indicator minor* | 13.64 | |
| Hoopoe | African Hoopoe | *Upupa africana* | 43.18 | |
| Hornbill | African Grey Hornbill | *Tockus nasutus* | 0.57 | |
| Ibis | African Sacred Ibis | *Threskiornis aethiopicus* | 51.14 | |
| Ibis | Glossy Ibis | *Plegadis falcinellus* | 1.14 | |
| Ibis | Hadeda Ibis | *Bostrychia hagedash* | 73.30 | |
| Jacana | African Jacana | *Actophilornis africanus* | 0.57 | |
| Kestrel | Greater Kestrel | *Falco rupicoloides* | 3.98 | |
| Kestrel | Lesser Kestrel | *Falco naumanni* | 0.57 | |
| Kestrel | Rock Kestrel | *Falco rupicolus* | 6.82 | |
| Kingfisher | Brown-hooded Kingfisher | *Halcyon albiventris* | 4.55 | |
| Kingfisher | Giant Kingfisher | *Megaceryle maximus* | 33.52 | |
| Kingfisher | Malachite Kingfisher | *Alcedo cristata* | 13.07 | |
| Kingfisher | Pied Kingfisher | *Ceryle rudis* | 27.84 | |

| Common_group | Species | Taxonomic name | SABAP2 full protocol reporting rate | Recorded during surveys |
|---|---|---|---|---|
| Kingfisher | Striped Kingfisher | *Halcyon chelicuti* | 0.57 | |
| Kite | Black-shouldered Kite | *Elanus caeruleus* | 28.41 | |
| Korhaan | Karoo Korhaan | *Eupodotis vigorsii* | 35.23 | x |
| Korhaan | Northern Black Korhaan | *Afrotis afraoides* | 34.09 | x |
| Korhaan | Red-crested Korhaan | *Lophotis ruficrista* | 0.57 | |
| Lapwing | Blacksmith Lapwing | *Vanellus armatus* | 55.68 | |
| Lapwing | Crowned Lapwing | *Vanellus coronatus* | 21.59 | x |
| Lark | Eastern Clapper Lark | *Mirafra fasciolata* | 19.32 | x |
| Lark | Fawn-coloured Lark | *Calendulauda africanoides* | 38.07 | x |
| Lark | Karoo Long-billed Lark | *Certhilauda subcoronata* | 6.25 | |
| Lark | Pink-billed Lark | *Spizocorys conirostris* | 2.84 | |
| Lark | Red-capped Lark | *Calandrella cinerea* | 0.57 | |
| Lark | Sabota Lark | *Calendulauda sabota* | 36.36 | x |
| Lark | Spike-heeled Lark | *Chersomanes albofasciata* | 29.55 | x |
| Lark | Stark's Lark | *Spizocorys starki* | 9.09 | x |
| Lovebird | Rosy-faced Lovebird | *Agapornis roseicollis* | 0.57 | |
| Martin | Brown-throated Martin | *Riparia paludicola* | 50.57 | |
| Martin | Rock Martin | *Hirundo fuligula* | 34.66 | |
| Masked-weaver | Southern Masked-weaver | *Ploceus velatus* | 75.00 | x |
| Moorhen | Common Moorhen | *Gallinula chloropus* | 11.93 | |
| Mousebird | Red-faced Mousebird | *Urocolius indicus* | 50.00 | |
| Mousebird | White-backed Mousebird | *Colius colius* | 69.32 | x |
| Night-Heron | Black-crowned Night-Heron | *Nycticorax nycticorax* | 5.11 | |
| Nightjar | Rufous-cheeked Nightjar | *Caprimulgus rufigena* | 7.95 | |
| Ostrich | Common Ostrich | *Struthio camelus* | 1.70 | |
| Owl | Barn Owl | *Tyto alba* | 19.89 | |
| Owlet | Pearl-spotted Owlet | *Glaucidium perlatum* | 2.27 | |
| Palm-swift | African Palm-swift | *Cypsiurus parvus* | 52.27 | |
| Penduline-tit | Cape Penduline-tit | *Anthoscopus minutus* | 1.70 | |
| Pigeon | Speckled Pigeon | *Columba guinea* | 59.09 | |
| Pipit | African Pipit | *Anthus cinnamomeus* | 28.98 | x |
| Plover | Kittlitz's Plover | *Charadrius pecuarius* | 0.57 | |
| Plover | Three-banded Plover | *Charadrius tricollaris* | 38.07 | |
| Prinia | Black-chested Prinia | *Prinia flavicans* | 84.66 | x |
| Pytilia | Green-winged Pytilia | *Pytilia melba* | 0.57 | |
| Quail | Common Quail | *Coturnix coturnix* | 1.14 | x |
| Quelea | Red-billed Quelea | *Quelea quelea* | 52.84 | |
| Reed-warbler | African Reed-warbler | *Acrocephalus baeticatus* | 26.14 | |
| Reed-warbler | Great Reed-warbler | *Acrocephalus arundinaceus* | 0.57 | |
| Robin-chat | Cape Robin-chat | *Cossypha caffra* | 55.11 | |
| Rock-thrush | Short-toed Rock-thrush | *Monticola brevipes* | 0.57 | |
| Ruff | Ruff | *Philomachus pugnax* | 1.70 | |
| Sandgrouse | Burchell's Sandgrouse | *Pterocles burchelli* | 0.57 | |
| Sandgrouse | Namaqua Sandgrouse | *Pterocles namaqua* | 47.16 | x |
| Sandpiper | Common Sandpiper | *Actitis hypoleucos* | 2.27 | |
| Sandpiper | Wood Sandpiper | *Tringa glareola* | 7.95 | |
| Scimitarbill | Common Scimitarbill | *Rhinopomastus cyanomelas* | 7.95 | |
| Scrub-robin | Kalahari Scrub-robin | *Cercotrichas paena* | 10.23 | x |
| Scrub-robin | Karoo Scrub-robin | *Cercotrichas coryphoeus* | 41.48 | |
| Secretarybird | Secretarybird | *Sagittarius serpentarius* | 1.14 | |
| Shelduck | South African Shelduck | *Tadorna cana* | 22.73 | |

| Common_group | Species | Taxonomic name | SABAP2 full protocol reporting rate | Recorded during surveys |
|---|---|---|---|---|
| Shoveler | Cape Shoveler | *Anas smithii* | 1.70 | |
| Shrike | Lesser Grey Shrike | *Lanius minor* | 2.27 | |
| Shrike | Red-backed Shrike | *Lanius collurio* | 0.57 | |
| Sparrow | Cape Sparrow | *Passer melanurus* | 77.27 | x |
| Sparrow | House Sparrow | *Passer domesticus* | 59.66 | |
| Sparrow | Southern Grey-headed Sparrow | *Passer diffusus* | 18.75 | |
| Sparrowlark | Black-eared Sparrowlark | *Eremopterix australis* | 5.68 | x |
| Sparrowlark | Grey-backed Sparrowlark | *Eremopterix verticalis* | 19.32 | x |
| Sparrow-weaver | White-browed Sparrow-weaver | *Plocepasser mahali* | 34.09 | |
| Spoonbill | African Spoonbill | *Platalea alba* | 0.57 | |
| Spurfowl | Cape Spurfowl | *Pternistis capensis* | 1.14 | |
| Starling | Cape Glossy Starling | *Lamprotornis nitens* | 53.98 | |
| Starling | Pale-winged Starling | *Onychognathus nabouroup* | 2.27 | |
| Starling | Wattled Starling | *Creatophora cinerea* | 26.14 | x |
| Stilt | Black-winged Stilt | *Himantopus himantopus* | 18.18 | |
| Stork | Abdim's Stork | *Ciconia abdimii* | 9.66 | |
| Stork | White Stork | *Ciconia ciconia* | 0.57 | |
| Stork | Yellow-billed Stork | *Mycteria ibis* | 2.27 | |
| Sunbird | Dusky Sunbird | *Cinnyris fuscus* | 58.52 | x |
| Sunbird | Marico Sunbird | *Cinnyris mariquensis* | 3.41 | |
| Swallow | Barn Swallow | *Hirundo rustica* | 35.23 | x |
| Swallow | Greater Striped Swallow | *Hirundo cucullata* | 42.05 | |
| Swallow | White-throated Swallow | *Hirundo albigularis* | 44.89 | |
| Swamp-warbler | Lesser Swamp-warbler | *Acrocephalus gracilirostris* | 42.61 | |
| Swift | Alpine Swift | *Tachymarptis melba* | 1.70 | |
| Swift | Common Swift | *Apus apus* | 10.80 | x |
| Swift | Little Swift | *Apus affinis* | 64.20 | x |
| Swift | White-rumped Swift | *Apus caffer* | 26.70 | |
| Teal | Cape Teal | *Anas capensis* | 5.68 | |
| Teal | Red-billed Teal | *Anas erythrorhyncha* | 18.75 | |
| Thick-knee | Spotted Thick-knee | *Burhinus capensis* | 21.59 | |
| Thrush | Karoo Thrush | *Turdus smithi* | 52.27 | |
| Tit | Ashy Tit | *Parus cinerascens* | 9.09 | |
| Tit-babbler | Chestnut-vented Tit-babbler | *Parisoma subcaeruleum* | 28.41 | |
| Tit-babbler | Layard's Tit-babbler | *Parisoma layardi* | 1.14 | |
| Turtle-dove | Cape Turtle-dove | *Streptopelia capicola* | 66.48 | |
| Wagtail | African Pied Wagtail | *Motacilla aguimp* | 22.16 | |
| Wagtail | Cape Wagtail | *Motacilla capensis* | 64.77 | |
| Warbler | Icterine Warbler | *Hippolais icterina* | 1.14 | |
| Warbler | Namaqua Warbler | *Phragmacia substriata* | 35.80 | |
| Warbler | Rufous-eared Warbler | *Malcorus pectoralis* | 39.77 | x |
| Warbler | Willow Warbler | *Phylloscopus trochilus* | 2.27 | |
| Waxbill | Black-faced Waxbill | *Estrilda erythronotos* | 1.70 | |
| Waxbill | Common Waxbill | *Estrilda astrild* | 27.27 | |
| Weaver | Sociable Weaver | *Philetairus socius* | 43.18 | x |
| Wheatear | Capped Wheatear | *Oenanthe pileata* | 15.34 | x |
| Wheatear | Mountain Wheatear | *Oenanthe monticola* | 1.14 | x |
| White-eye | Orange River White-eye | *Zosterops pallidus* | 61.36 | |
| Whydah | Pin-tailed Whydah | *Vidua macroura* | 17.05 | |
| Wood-hoopoe | Green Wood-hoopoe | *Phoeniculus purpureus* | 0.57 | |
| Woodpecker | Cardinal Woodpecker | *Dendropicos fuscescens* | 11.93 | |
| Woodpecker | Golden-tailed Woodpecker | *Campethera abingoni* | 23.30 | |

## APPENDIX 3: RENEWABLE ENERGY PROJECTS WITHIN A 30KM RADIUS AROUND THE STUDY AREA

| PROJECT TITLE | FOOTPRINT | TECHNOLOGY | MW | EA STATUS |
|---|---|---|---|---|
| Bloemsmond 1 | 280 | PV | 75 | Authorised |
| Bloemsmond 2 | 275 | PV | 75 | Authorised |
| Bloemsmond 3 | 310 | PV | 100 | Authorised |
| Bloemsmond 4 | 360 | PV | 100 | Authorised |
| Bloemsmond 5 | 390 | PV | 100 | Authorised |
| Dyasonsklip 1 Solar | 209 | PV | 86 | Constructed |
| Dyasonsklip 2 Solar | 210 | PV | 75 | Constructed |
| RE Capital 3 C Solar | 166 | PV | 75 | Authorised |
| Sirius Solar 1 | 244 | PV | 75 | Constructed |
| Sirius Solar 2 | 254 | PV | 75 | Authorised |
| Sirius Solar 3 | 280 | PV | 100 | In process |
| Sirius Solar 4 | 280 | PV | 100 | In process |
| Khi Solar 1 CSP | 600 | CSP | 110 | Constructed |
| McTaggarts Camp PV 1 | 190 | PV | 75 | Under construction |
| McTaggarts Camp PV 2 | 173 | PV | 75 | In process |
| McTaggarts Camp PV 3 | 210 | PV | 75 | In process |
| Klip Punt PV 1 | 200 | PV | 75 | In process |
| Duneveld PV | 240 | PV | 100 | In process |
| Gordonia Solar PV | 250 | PV | 100 | In process |
| Hari PV | 240 | PV | 100 | In process |
| Karroid PV | 240 | PV | 100 | In process |
| Shrubland PV | 245 | PV | 100 | In process |
| GK Solar PV | 260 | PV | 100 | In process |
| Ofir-Zx Photovoltaic | 400 | PV | 200 | Authorised |
| Eenduin PV | 210 | PV | 75 | In process |
| Upington Solar Park | 5 000 | CSP/PV | 1000 | In process |
| Solis 1 CSP | 400 | CSP | 125 | Authorised |
| Bushmanland PV | 260 | PV | 100 | In process |

## APPENDIX 4: 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 medium and large terrestrial birds between the perimeter fences, leading to mortality. | Prevent mortality of avifauna | 1. A single perimeter fence should be used[9]. | Design the facility with a single perimeter fence. | Once-off during the planning phase. | Project Developer |
| Avifauna: Electrocution | | | | | |
| Electrocution of large raptors on the 132kV poles. | Prevent mortality of avifauna | 1. Fit perches to the single steel poles | Design the poles with a bird perch | Once-off during the planning phase. | Project Developer |

[9] In this instance, according to the design specifications, a fence will be used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100mm. This should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

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

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| Avifauna: Disturbance | | | | | |
| The noise and movement associated with the construction activities at the development footprint and 132kV grid connection 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><br>1. No off-road driving;<br>2. Maximum use of existing roads;<br>3. Measures to control noise and dust according to latest best practice;<br>4. Restricted access to the rest of the property;<br>5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint. | 1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.<br>2. Ensure that construction personnel are made aware of the impacts relating to off-road driving.<br>3. Construction access roads must be demarcated clearly. Undertake site inspections to verify.<br>4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.<br>5. Ensure that the construction area | 1. On a daily basis<br>2. Weekly<br>3. Weekly<br>4. Weekly<br>5. Weekly | 1. Contractor and ECO<br>2. Contractor and ECO<br>3. Contractor and ECO<br>4. Contractor and ECO<br>5. Contractor and ECO |

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance. | | |
| Avifauna: Collisions | | | | | |
| Mortality of priority species due to collisions with the 132kV grid connection | Prevent mortality of avifauna | Fit bird flappers to the earthwire on high risk sections of the powerline | High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized. If power line marking is required, bird flappers must 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 so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as | Once off prior to the electrification of the line. | 1. Project Developer<br>2. Contractor and ECO |

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | the conductors are strung | | |

## Management Plan for the Operational Phase

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| Avifauna: Displacement due to habitat transformation | | | | | |
| Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plant and associated infrastructure. | Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study. | 1. Develop a Habitat Restoration Plan (HRP) and ensure that it is approved.<br>2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance. | 1. Appointment of rehabilitation specialist to develop Habitat Restoration Plan (HRP).<br>2. Site inspections to monitor progress of HRP.<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 electrocution | | | | | |
| Electrocution of priority avifauna in the onsite substation and inverter station. | Prevention of ongoing electrocution of avifauna through reactive mitigation if necessary, depending on the gravity of the problem. | 1. Implementation of mitigation measures such as insulation of live parts to prevent further electrocutions. | 1. Site investigation to determine causes of the mortality.<br>2. Implementation of appropriate measures e.g. insulation of live parts with appropriate products. | As and when required | 1. Facility Environmental Manager<br>2. 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 construction activities at the PV 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 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><br>1. No off-road driving;<br>2. Maximum use of existing roads;<br>3. Measures to control noise and dust according to latest best practice;<br>4. Restricted access to the rest of the property;<br>5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint. | 1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.<br>2. Ensure that construction personnel are made aware of the impacts relating to off-road driving.<br>3. Construction access roads must be demarcated clearly. Undertake site inspections to verify.<br>4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.<br>5. Ensure that the construction area | 1. On a daily basis<br>2. Weekly<br>3. Weekly<br>4. Weekly<br>5. Weekly | 1. Contractor and ECO<br>2. Contractor and ECO<br>3. Contractor and ECO<br>4. Contractor and ECO<br>5. Contractor and ECO |

| Impact | Mitigation/Management Objectives and Outcomes | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance. | | |

**APPENDIX 5: SENSITIVITY MAP**

## APPENDIX 6: ASSESSMENT CRITERIA

The identification of potential impacts includes impacts that may occur during the construction, operational and decommissioning phases of the proposed development. The assessment of impacts includes direct, indirect as well as cumulative impacts.

In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed activity is well understood so that the impacts associated with the activity can be understood. The process of identification and assessment of impacts will include:

- Determine the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Determine future changes to the environment that will occur if the activity does not proceed;
- An understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts which are likely to occur if the activity is undertaken.

The impact assessment methodology has been aligned with the requirements for BA Reports as stipulated in Appendix 1 (3) (j) of the 2014 EIA Regulations (as amended), which states the following:

"A BA Report must contain the information that is necessary for the Competent Authority to consider and come to a decision on the application, and must include an assessment of each identified potentially significant impact and risk, including –

- (i) cumulative impacts;
- (ii) the nature, significance and consequences of the impact and risk;
- (iii) the extent and duration of the impact and risk;
- (iv) the probability of the impact and risk occurring;
- (v) the degree to which the impact and risk can be reversed;
- (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and
- (vii) the degree to which the impact and risk can be mitigated".

As per DEA *Guideline 5: Assessment of Alternatives and Impacts* the following methodology is to be applied to the prediction and assessment of impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

- **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

- **Nature of impact** - this reviews the type of effect that a proposed activity will have on the environment and should include "what will be affected and how?"

- **Spatial extent** – The size of the area that will be affected by the risk/impact:
    - Site specific;

- Local (<10 km from site);
- Regional (<100 km of site);
- National; or
- International (e.g. Greenhouse Gas emissions or migrant birds).

- **Duration** – The timeframe during which the risk/impact will be experienced:
  - Very short term (instantaneous);
  - Short term (less than 1 year);
  - Medium term (1 to 10 years);
  - Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or
  - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).

- **Reversibility of impacts** - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase) will be:
  - High reversibility of impacts (impact is highly reversible at end of project life, i.e. this is the most favourable assessment for the environment. For example, the nuisance factor caused by noise impacts associated with the operational phase of an exporting terminal can be considered to be highly reversible at the end of the project life);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment. The impact is permanent. For example, the loss of a palaeontological resource on the site caused by building foundations could be non-reversible).

- **Irreplaceability of resource loss caused by impacts** – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase) will be:
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment. For example, if the project will destroy unique wetland systems, these may be irreplaceable);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

***Using the criteria above, the impacts will further be assessed in terms of the following:***

- **Probability** – The probability of the impact occurring:
  - Extremely unlikely (little to no chance of occurring);
  - Very unlikely (<30% chance of occurring);
  - Unlikely (30-50% chance of occurring)
  - Likely (51 – 90% chance of occurring); or
  - Very Likely (>90% chance of occurring regardless of prevention measures).

- **Consequence** – The anticipated severity of the impact:
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);

- Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
- Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
- Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).

- **Significance** – To determine the significance of an identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 6 below). The approach incorporates internationally recognised methods from the Intergovernmental Panel on Climate Change (IPCC) (2014) assessment of the effects of climate change and is based on an interpretation of existing information in relation to the proposed activity, to generate an integrated picture of the risks related to a specified activity in a given location, with and without mitigation. Risk is assessed for each significant stressor (e.g. physical disturbance), on each different type of receiving entity (e.g. the municipal capacity, a sensitive wetland), qualitatively (very low, low, moderate, high, very high) against a predefined set of criteria (as shown in Figure 1 below). The significance is rated qualitatively as follows against a predefined set of criteria (i.e. probability and consequence) as indicated in Figure 1:

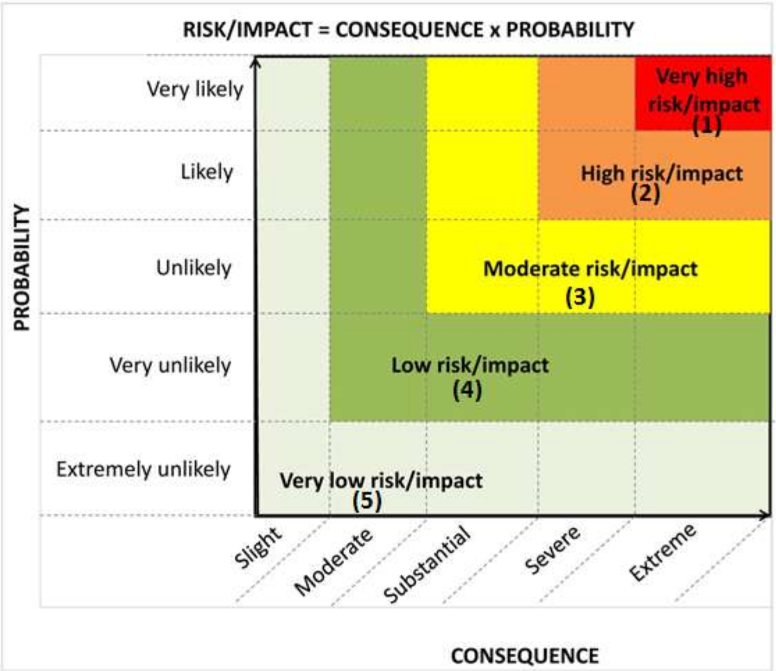



**Figure 1: Guide to assessing risk/impact significance as a result of consequence and probability.**

- **Significance** – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);

- High (the risk/impacts will result in a major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); or
- Very high (the risk/impacts will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

The above assessment must be described in the text (with clear explanation provided on the rationale for the allocation of significance ratings) and summarised in an impact assessment Table in a similar manner as shown in the example below (Table 1).

With the implementation of mitigation measures, the residual impacts/risks must be ranked as follows in terms of significance:

- Very low = 5;
- Low = 4;
- Moderate = 3;
- High = 2; and
- Very high = 1.

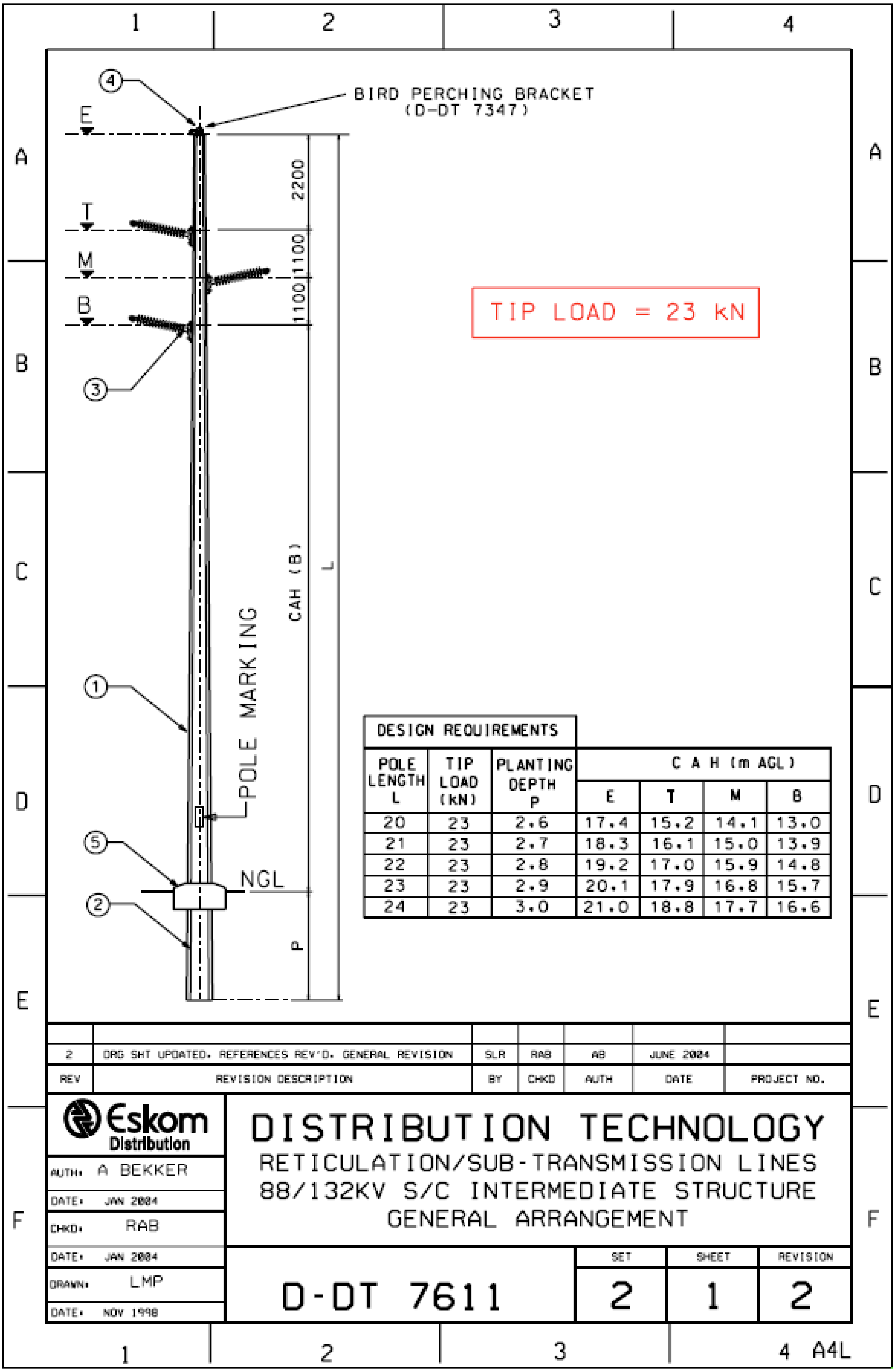
- **Status** - Whether the impact on the overall environment (social, biophysical and economic) will be:
  - Positive - environment overall will benefit from the impact;
  - Negative - environment overall will be adversely affected by the impact; or
  - Neutral - environment overall will not be affected.

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - Low;
  - Medium; or
  - High.

Impacts will then be collated into an EMPr and these will include the following:

- Management actions and monitoring of the impacts;
- Identifying negative impacts and prescribing mitigation measures to avoid or reduce negative impacts; and
- Positive impacts will be identified and enhanced where possible.

## APPENDIX 7: POLE DESIGN FOR THE 132KV GRID CONNECTION




DESIGN REQUIREMENTS

| POLE LENGTH L | TIP LOAD (kN) | PLANTING DEPTH P | C A H (m AGL) E | T | M | B |
|---|---|---|---|---|---|---|
| 20 | 23 | 2.6 | 17.4 | 15.2 | 14.1 | 13.0 |
| 21 | 23 | 2.7 | 18.3 | 16.1 | 15.0 | 13.9 |
| 22 | 23 | 2.8 | 19.2 | 17.0 | 15.9 | 14.8 |
| 23 | 23 | 2.9 | 20.1 | 17.9 | 16.8 | 15.7 |
| 24 | 23 | 3.0 | 21.0 | 18.8 | 17.7 | 16.6 |

| ITEM NØ. | DESCRIPTION | D-DT NØ. |
|---|---|---|
| | STRUCTURE | |
| | TYPE 259A | D-DT 7611 |
| | MANUFACTURER: STRUCTATECH | |
| | TYPE 261A | D-DT 7611 |
| | MANUFACTURER: CIS | |
| 1 | POLE LENGTH (BODY) | |
| | 20m STEEL | D-DT 7100 |
| | 21m STEEL | D-DT 7100 |
| | 22m STEEL | D-DT 7100 |
| | 23m STEEL | D-DT 7100 |
| | 24m STEEL | D-DT 7100 |
| 2 | FOUNDATION | |
| | TYPE 1 (300kPa) | D-DT 7850 SHT 2 |
| | TYPE 2 (150kPa) | D-DT 7850 SHT 3 |
| | TYPE 3 (100kPa) | D-DT 7850 SHT 4 |
| | TYPE 4 (50kPa) | D-DT 7850 SHT 5 |
| | ROCK & SOFT ROCK | D-DT 7850 SHT 1 |
| | ALTERNATE FOUNDATIONS | D-DT 7851 |
| 3 | INSULATOR ASSEMBLY | |
| | INTERMEDIATE ASSEMBLY | D-DT 7321 |
| 4 | EARTH WIRE ASSEMBLIES | |
| | NON INSULATED | D-DT 7326 |
| | INSULATED | D-DT 7327 |
| 5 | CONCRETE CAP AND | D-DT 7857 |
| | EARTHING DETAILS | |

| REV | REVISION DESCRIPTION | BY | CHKD | AUTH | DATE | PROJECT NO. |
|---|---|---|---|---|---|---|
| 2 | DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION | SLR | RAB | AB | JUNE 2004 | |

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CHKD: RAB
DATE: JAN 2004
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DATE: JAN 2004

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| D-DT 7611 | 2 | 2 | 2 |

A4L