AVIFAUNAL IMPACT ASSESSMENT: SCOPING

Camden 1 : Solar Energy Facility, Mpumalanga Province

November 2021

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EXECUTIVE SUMMARY

Enertrag South Africa is proposing to develop the Camden Renewable Energy Complex in Mpumalanga, South Africa. The Complex is being developed in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) or similar programmes under the IRP. In addition, private off-take agreements are considered where possible.

The Cluster comprises eight (8) distinct projects, namely:

i. Camden I Wind Energy Facility (up to 210MW).
ii. Camden I Wind Grid Connection (up to 132kV).
iii. Camden up to 400kV Gid Connection and Collector substation.
iv. Camden I Solar (up to 100MW).
v. Camden I Solar up to 132kV Gid Connection.
vi. Camden Green Hydrogen and Ammonia Facility, including grid connection infrastructure.
vii. Camden II Wind Energy Facility (up to 210MW).
viii. Camden II Wind Energy Facility up to 132kV Gid Connection.

This report deals with the Camden 1 Solar Energy Facility (SEF).

IMPACT RATING

The table below is a summarised scoping level assessment of the anticipated impacts.

Summarised scoping level assessment of the anticipated impacts

Issue	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	No-Go Areas	Mitigation measures
During construction: Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	At the PV facility, the priority species which would be most severely affected by disturbance would be ground nesting species which are the following: White-bellied Bustard, Cloud Cisticola, Blue Crane, Western Cattle Egret, Grey-winged Francolin, Cape Grassbird, Blue Korhaan, African Grass Owl, Marsh Owl, Drakensberg Prinia, and Pied Starling. Secretarybirds breeding or roosting the project site might also be affected.	Local	High	• 100m buffer around drainage lines, wetlands, and pans – all infrastructure	• Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.

During construction: Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	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 will manifest itself at the proposed PV facility. In addition, ground nesting species and some raptors are also likely to be impacted by the habitat transformation, as it will result in reduced prey availability and accessibility. Priority species that could be negatively affected by displacement due to habitat loss are the following: Common Buzzard, Jackal Buzzard, Cloud Cisticola, Blue Crane, Black-chested Snake Eagle, Long-crested Eagle, Western Cattle Egret, Amur Falcon, Lanner Falcon, Grey-winged Francolin, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, Rock Kestrel, Black-winged Kite, Blue Korhaan, African Grass Owl, Marsh Owl, Pied Starling, White Stork, and South African Cliff Swallow.	Local	Medium	• 100m buffer around drainage lines, wetlands, and pans – all infrastructure	• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly implemented. • Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.
During operation: Mortality of priority species due to collisions with solar panels	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 to medium-sized, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them, or forage for insects between the PV panels, e.g. Amur Falcons (i.e. if they are not completely displaced due to the habitat transformation). Due to the absence of large permanent waterbodies at or close to the development area, it is unlikely that waterbirds will be attracted in large numbers to the solar arrays due to the “lake effect”.	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Due to the expected low significance of this impacts, no mitigation measures are recommended at this stage.

	Priority species which occur regularly and could potentially be impacted due to collisions with the solar panels are the following: Western Cattle Egret, Amur Falcon, Lanner Falcon, Fiscal Flycatcher, Grey-winged Francolin, Egyptian Goose, Spur-winged Goose, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, Blacksmith Lapwing, African Grass Owl, Marsh Owl, Three-banded Plover, Drakensberg Prinia, South African Shelduck, African Snipe, Black Sparrowhawk, Pied Starling, South African Cliff Swallow and Cape Weaver.				
During operation: Entrapment of large-bodied birds in the double perimeter fence	It is not foreseen that entrapment of priority species in perimeter fences will be a significant impact at the PV facility. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species. Priority species which could potentially be impacted due entrapment are the following: Secretarybird, White-bellied Bustard, Blue Crane, Blue Korhaan, African Grass Owl, Grey-winged Francolin and Marsh Owl.	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	It is recommended that a single perimeter fence is used.
During operation: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines will run above ground. Priority species which could be at risk of electrocution on the medium voltage powerlines are the following: Common Buzzard, Jackal Buzzard, Black-chested Snake Eagle, Long-crested Eagle, Lanner Falcon, Egyptian Goose, Spur-winged Goose, African Harrier-Hawk, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, African Grass Owl, Marsh Owl and Black Sparrowhawk.	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	A raptor -friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.

During operation: Mortality of priority species due to collisions with the medium voltage internal reticulation network	While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines could run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Secretarybird, White-bellied Bustard, Blue Crane, Western Cattle Egret, Egyptian Goose, Spur-winged Goose, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, African Grass Owl, Marsh Owl, South African Shelduck and White Stork.	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	All internal medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.

ENVIRONMENTAL SENSITIVITIES

The following specific environmental sensitivities were identified from an avifaunal perspective:

- **100m all infrastructure exclusion zone around drainage lines, associated wetlands and pans.** Wetlands are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for African Grass Owl (SA status Vulnerable), Grey Crowned Crane (SA status Endangered) and African Marsh Harrier (SA status Endangered).
- **High sensitivity grassland - Limited infrastructure zone**. Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), White-bellied Bustard (SA Status Vulnerable), Denham's Bustard (SA Status Vulnerable).

See Figure 6 for the avifaunal sensitivities identified from a Solar PV energy perspective.

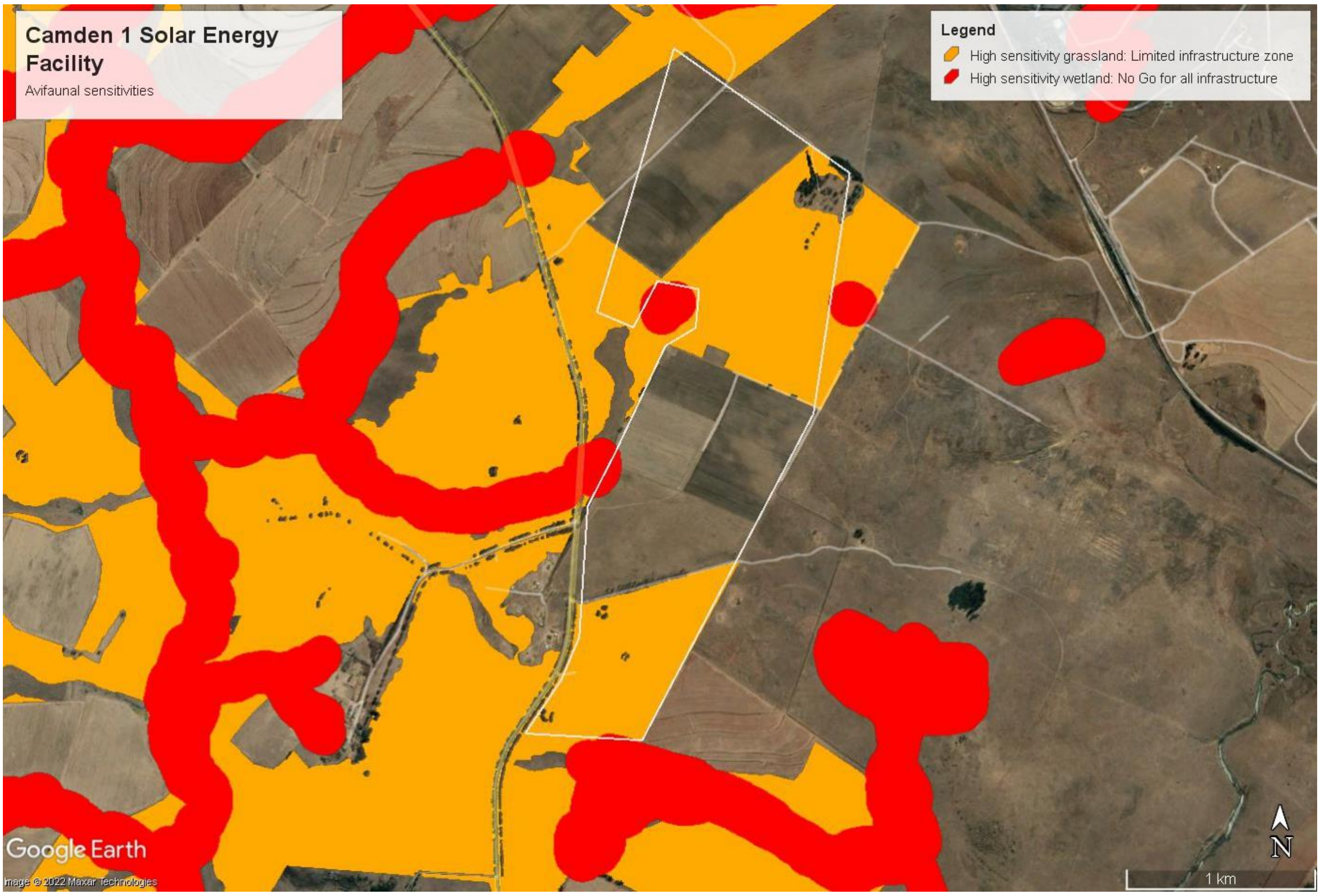

Figure 1: Avifaunal sensitivity zones at the Camden 1 Solar Energy Facility.

EIA PHASE

Plan of study

The following are proposed for the EIA Phase:

- The implementation of four seasonal avifaunal surveys, utilising transects and incidental counts, to inform the assessment of the potential impacts of the planned infrastructure within the development footprint (see Appendix 3)[1]. The monitoring protocol is guided by the following:
  - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
  - Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
  - The BirdLife South Africa (BLSA) Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa by Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017 (hereafter referred to as the Solar Guidelines) were consulted to determine the level of survey effort that is required.
- The avifaunal specialists report will be structured around the following terms of reference:
  - Description of the affected environment from an avifaunal perspective.
  - Discussion of gaps in baseline data and other limitations.
  - Description of the methodology that was used for the field surveys.
  - Comparison of the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjustment if necessary.
  - Provision of an overview of all applicable legislation.
  - Provision of an overview of assessment methodology.
  - Identification and assessment of the potential impacts of the proposed development on avifauna including cumulative impacts.
  - Provision of sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
  - Conclusion with an impact statement whether the PV facility is fatally flawed or may be authorised.

Environmental Management Programme

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

PRELIMINARY CONCLUSIONS

According to the DFFE national screening tool, the habitat within the development site is classified as **High** sensitivity for birds according to the Animal Species theme (see Figure 4). This classification is accurate as far as the impact of the proposed SEF is concerned, based on actual conditions recorded on the ground during the 12-months of pre-construction monitoring. The classification of High is justified based on the recorded presence of Red List priority species in and in the immediate vicinity of the project site, namely Secretarybird (Globally Endangered, Locally Vulnerable) White-bellied Bustard (Locally Vulnerable), Blue Crane (Globally Vulnerable, Locally Near-threatened), Grey Crowned Crane (Globally and Locally Endangered), Martial Eagle (Globally and Locally Endangered), Lanner Falcon (Locally Vulnerable), Greater Flamingo (Locally Near-threatened), Lesser Flamingo (Globally and Locally Near-threatened), Black Harrier (Locally and Globally Endangered), Southern Bald Ibis (Locally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), African Grass Owl (Locally Vulnerable) and Cape Vulture (Globally and Locally Endangered).

The proposed Camden 1 Solar Energy Facility will have an anticipated medium to high, medium and low pre-mitigation negative impact on priority avifauna, which is expected to be reduced to medium and low with appropriate mitigation.

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[1] This has been completed.

CONTENTS

DETAILS OF THE SPECIALIST

Chris van Rooyen (Bird Specialist)

Chris has 25 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Bird and GIS Specialist)

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

1 INTRODUCTION

Enertrag South Africa is proposing to develop the Camden Renewable Energy Complex in Mpumalanga, South Africa. The Complex is being developed in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP or similar programmes under the IRP. In addition, private off-take agreements are considered where possible.

The Cluster comprises eight (8) distinct projects, namely:

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This report deals with the Camden 1 Solar Energy Facility (SEF).

Table 1 below summarises the main features of the proposed SEF.

Table 1: Camden 1 Solar Energy Facility summary

Facility Name	Camden I Solar Energy Facility
Applicant	Camden I Solar Energy Facility (RF) Propriety Limited
Municipalities	Msukaligwa Local Municipality of the Gert Sibande District Municipality
Affected Farms[2]	Portion 1 of Welgelegen Farm No. 322
Extent	297 ha
Buildable area	Approximately 280 ha
Capacity	Up to 100MW
Power system technology	Solar PV
Operations and Maintenance (O&M) building footprint:	Located near the substation. Conservancy tanks with portable toilets Typical areas include: - Operations building – 20m x 10m = 200m^2 - Workshop – 15m x 10m = 150m^2 Stores - 15m x 10m = 150m^2
Construction camp and laydown area	Typical construction camp area 100m x 50m = 5,000m2.

[2] Based on the current conceptual layout.

	Typical laydown area 100m x 200m = 20,000m2. Sewage: Septic tanks and portable toilets
Cement batching plant (temporary):	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo. The footprint will be around 0.5ha. Maximum height of the silo will be 20m.
Internal Roads:	Width of internal road – Between 4m and 5m, this can be increased to 6m on bends. Length of internal road – Approximately 8km.
Cables:	Communication, AC and DC cables.
Independent Power Producer (IPP) site substation and battery energy storage system (BESS):	Total footprint will be up to 4ha in extent. The substation will consist of a high voltage substation yard to allow for multiple (up to) 400kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc. The associated BESS storage capacity will be up to 100MW/400MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.

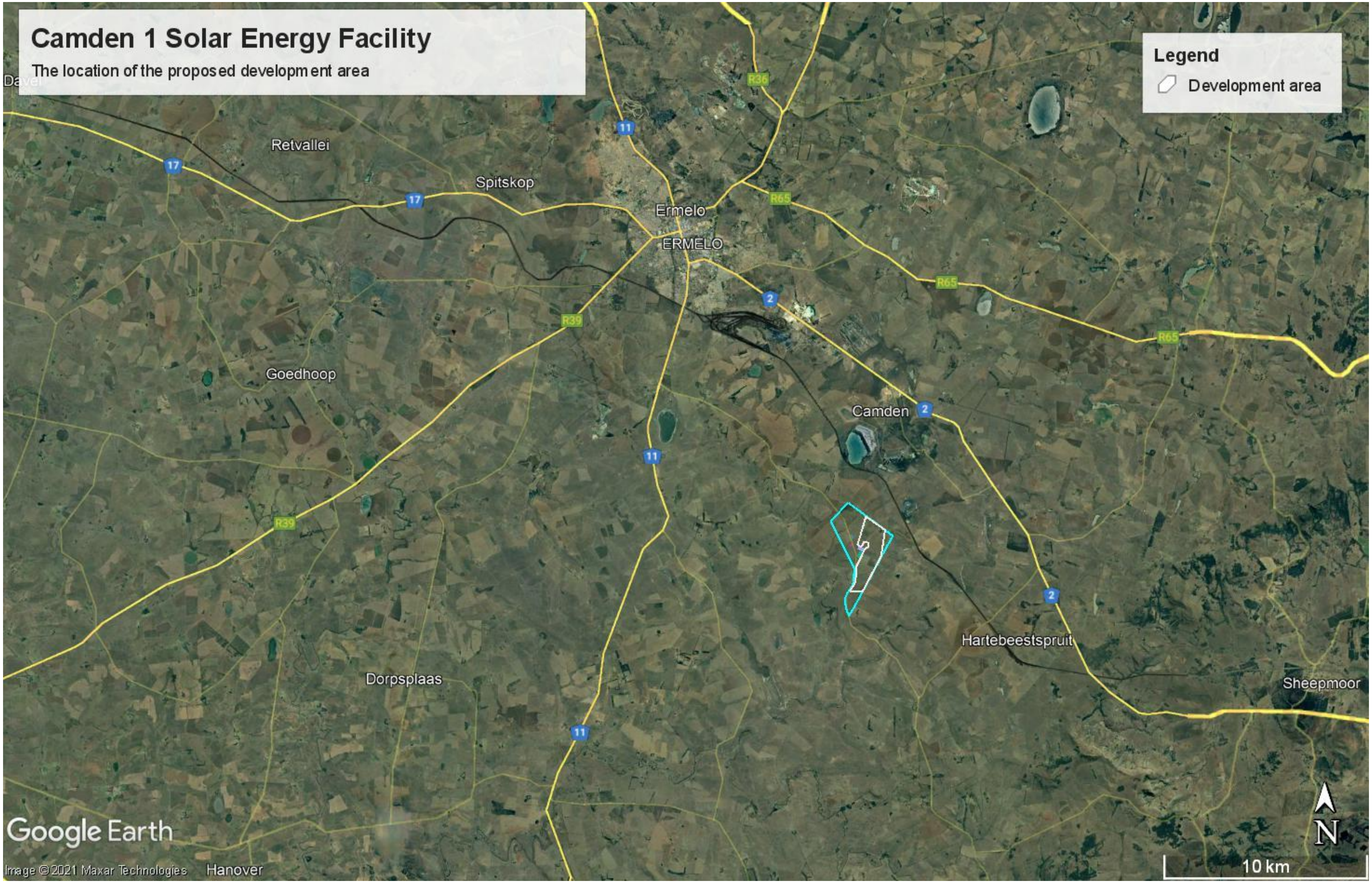

Figure 2: Locality map of the development area of the proposed Camden 1 Solar Energy Facility

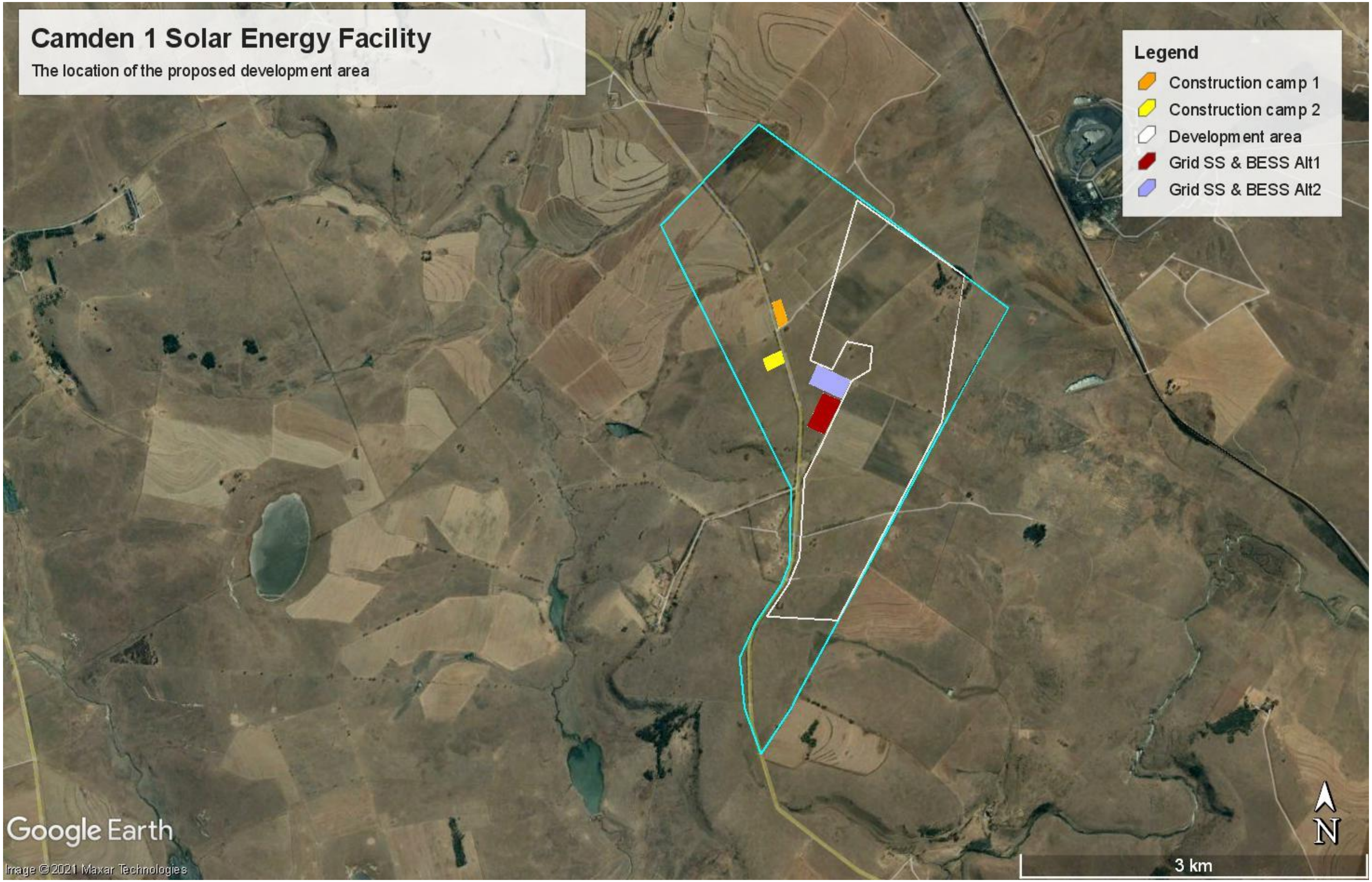

Figure 3: Conceptual lay-out of the proposed Camden 1 Solar Energy Facility development area.

2 TERMS OF REFERENCE

The purpose of the scoping phase report is to determine the main issues and potential impacts of the proposed project/s based on existing information and field assessments. The terms of reference are as follows:

- Describe the affected environment from an avifaunal perspective.
- Discuss gaps in baseline data and other limitations and describe the expected impacts associated with the solar facility and associated infrastructure.
- Identify potential sensitive environments and receptors that may be impacted on by the proposed solar farm and the types of impacts (i.e., direct, indirect and cumulative) that are most likely to occur.
- Determine the nature and extent of potential impacts during the construction and operational phases.
- Identify 'No-Go' areas, where applicable.
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.
- Recommend mitigation measures to reduce the impact of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 16 pentads some of which intersect and others that are near the development area, henceforth referred to as "the broader area" (see Figure 4). The decision to include multiple pentads around the development area was to get a more representative picture of the bird abundance and variety in the region. The additional pentads and their data augment the bird distribution data. A total of 165 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 227 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 16 pentads where the development area is located. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during the site surveys and general knowledge of the area.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.2) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- An intensive internet search was conducted to source information on the impacts of solar energy facilities on avifauna.
- Satellite imagery (Google Earth © 2021) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the development area relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the development area.

- The following sources were consulted to determine the investigation protocol that is required for the site:
    - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
- The main source of information on the avifaunal diversity and abundance at the project site and development area is an integrated pre-construction monitoring programme which was implemented at the project site, covering all seven proposed sub projects of the Camden Renewable Energy Complex (See Appendix 3).

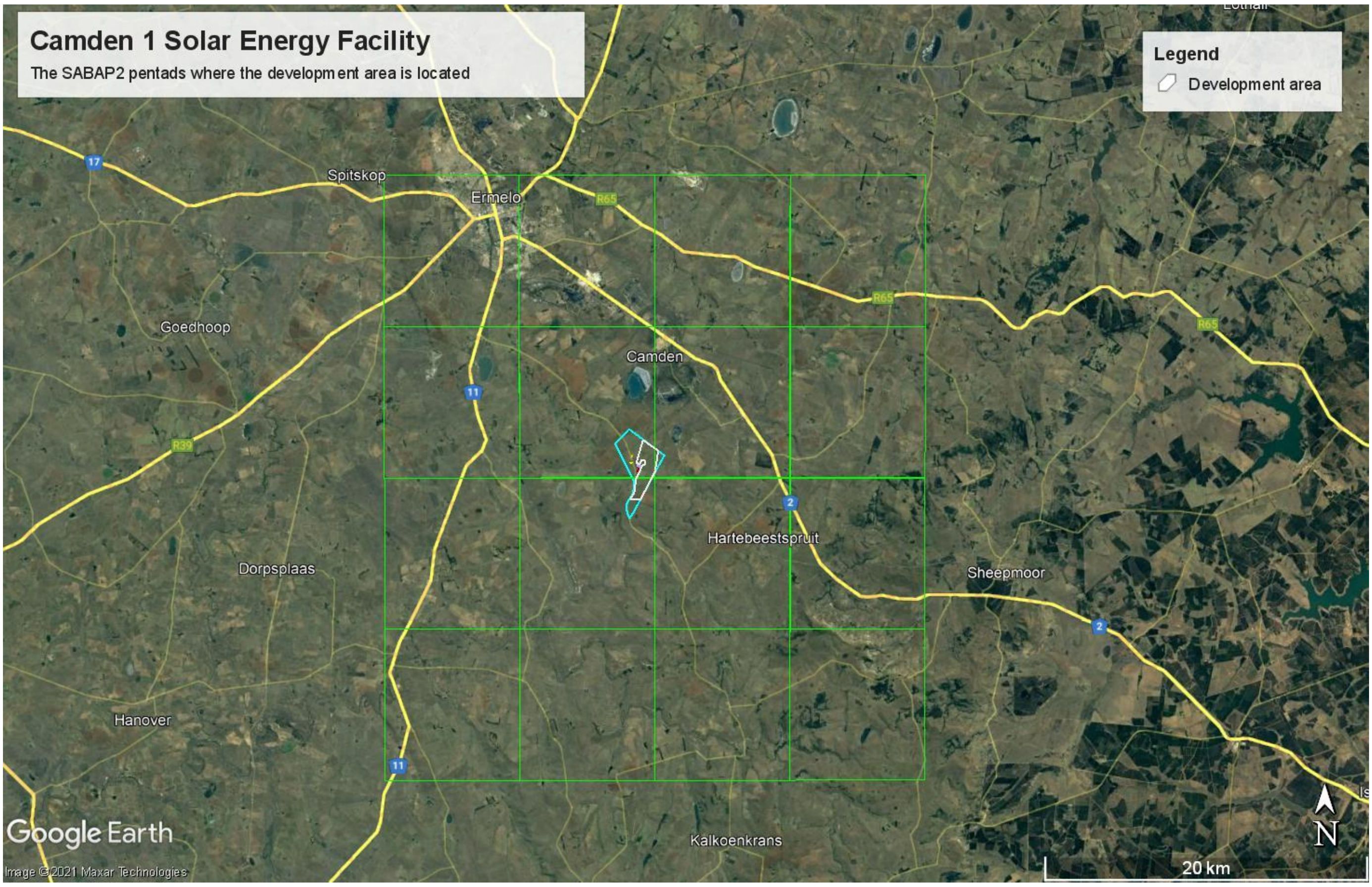

Figure 4: Area covered by the sixteen SABAP2 pentads.

4 ASSUMPTIONS AND LIMITATIONS

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring which was conducted over 12 months.
- Conclusions in this scoping report are based on experience of these and similar species at solar farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- 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.* 2018). 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.

- According to the specifications received from the proponent, the 33kV medium-voltage lines will be buried where practically feasible. It was therefore assumed that there could be 33kV overhead lines which could pose an electrocution risk to priority species.
- The broader area refers to the area covered by the sixteen SABAP2 pentads (see Figure 4).
- The focus of the study is primarily on the potential impacts on solar priority species which were defined as follows:
  - South African Red List species;
  - South African endemics and near-endemics;
  - Waterbirds; and
  - Raptors
- The project site is defined as Portion 1 of Welgelegen Farm No. 322.
- The development area is that identified area (located within the project site) where the planned PV site is located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The development area is 297 ha in extent.

5 LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 1 below lists agreements and conventions which South Africa is party to, and which are relevant to the conservation of avifauna[3].

Table 2: Agreements and conventions which South Africa is party to and which are relevant to the conservation of avifauna.

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

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

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

5.2 National legislation

5.2.1 Constitution of the Republic of South Africa, 1996

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

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

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

  (i) prevent pollution and ecological degradation;

  (ii) promote conservation; and

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

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

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

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. In the case of wind energy developments, the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species where the output is 20MW or more (Government Gazette No 43110, 20 March 2020) is applicable.

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

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

5.5 Provincial Legislation

The current legislation applicable to the conservation of fauna and flora in Mpumalanga is the Mpumalanga Nature Conservation Act 10 of 1998. It consolidated and amended the laws relating to nature conservation within the province and provides for matters connected therewith. All birds are classified as Protected Game (Section 4 (1) (b)), except those listed in Schedule 3, which are classified as Ordinary Game (Section 4 (1)(c)).

6. BASELINE ASSESSMENT

6.1 Important Bird Areas

The project site is not located in an Important Bird Area (IBA), but it is located between three IBAs. The closest IBA to the project site is the Grasslands IBA SA020, which is located 6-7km to the east of the site. The Chrissies Pans IBA SA019 is located 16-17km to the north-east of the site, and the Amersfoort-Bethal-Carolina IBA SA018 is located about 7-8km to the west. Due to the close proximity of the site to the IBAs, it is possible that some highly mobile priority species which are also IBA trigger species, and which occur either permanently or sporadically in the IBAs, might be impacted by the project when they leave to forage or breed beyond the borders of the IBA. Species that were recorded in the broader area and fall within this category are the following:

- Secretarybird
- Pied Avocet
- Denham's Bustard
- Blue Crane
- Grey Crowned Crane
- Wattled Crane
- White-backed Duck
- Yellow-billed Duck
- Martial Eagle
- Lanner Falcon
- Greater Flamingo
- Lesser Flamingo
- Black-necked Grebe
- Little Grebe
- African Marsh Harrier
- Black Harrier
- Southern Bald Ibis
- African Grass Owl
- Southern Pochard
- Cape Shoveler
- White-winged Tern

6.2 DFFE National Screening Tool

According to the DFFE national screening tool, the habitat within the development site is classified as **High** sensitivity for birds according to the Animal Species theme (see Figure 4). This classification is accurate as far as the impact of the proposed SEF is concerned, based on actual conditions recorded on the ground during the 12-months of pre-construction monitoring. The classification of **High** is justified based on the recorded presence of Red List priority species in and in the immediate vicinity of the project site, namely Secretarybird (Globally Endangered, Locally Vulnerable) White-bellied Bustard (Locally Vulnerable), Blue Crane (Globally Vulnerable, Locally Near-threatened), Grey Crowned Crane (Globally and Locally Endangered), Martial Eagle (Globally and Locally Endangered), Lanner Falcon (Locally Vulnerable), Greater Flamingo (Locally Near-threatened), Lesser Flamingo (Globally and Locally Near-threatened), Black Harrier (Locally and Globally Endangered), Southern Bald Ibis (Locally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), African Grass Owl (Locally Vulnerable) and Cape Vulture (Globally and Locally Endangered).

Figure 5: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Avian Wind theme. The classification of High sensitivity based on the presence of Red List species at the site namely African Grass Owl (Local Status Vulnerable) and Southern Bald Ibis (Locally and Globally Vulnerable).

6.3 Protected Areas

According to the South African Protected Areas database (SAPAD), the site overlaps with the Langcarel Private Nature Reserve. No further information could be obtained about the nature reserve. However, from an avifaunal perspective the state of the habitat and land use at the project site is more important than the legal status, which has been surveyed and assessed for this assessment. The results provided are therefore applicable regardless of the legal status of the land parcels considered.

6.4 Biomes and vegetation types

The project site is situated in the Grassland Biome, in the Mesic Highveld Grassland Bioregion (Muchina & Rutherford 2006). Vegetation on site consists predominantly of Eastern Highveld Grassland, which is comprised of undulating grassland plains, with small, scattered patches of dolerite outcrops in areas, low hills and pan depressions. The vegetation is comprised of a short, closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn (Mucina & Rutherford 2006).

Ermelo has a temperate climate. January is the warmest month with a maximum temperature of 24.4 C°. June and July are the coldest months, with a minimum temperature of 0.2 C°. The driest month is June with an average of 3 mm of precipitation. Most of the precipitation falls in December, averaging 151 mm. The average annual precipitation is around 756 mm (Climate – data.org 2021).

The topography in the application site is characterised by gentle undulating plains. The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. The livestock in the project site is a combination of mostly sheep and cattle, with a few horses.

6.5 Bird habitat

Whilst much of the distribution and abundance of the bird species in the project site can be explained by the dominant biomes and vegetation types, it is also important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The following bird habitat classes were identified in the project site (see Appendix 2 for examples of the habitat classes):

6.5.1 Grassland

The majority of the habitat in the project site comprises grassland. The grassland varies from dense stands of relatively high grass to areas of heavily grazed short grass. The priority species which could potentially use the natural grassland in the project site on a regular basis are the following:

- African Grass Owl
- African Harrier-Hawk
- Amur Falcon
- Black-chested Snake Eagle
- Black-headed Heron
- Black-winged Kite
- Blue Crane
- Blue Korhaan
- Cape Grassbird
- Cloud Cisticola
- Common Buzzard
- Grey-winged Francolin
- Jackal Buzzard
- Lanner Falcon
- Long-crested Eagle
- Marsh Owl
- Pied Starling
- Rock Kestrel
- Secretarybird
- South African Cliff Swallow
- Southern Bald Ibis
- Western Cattle Egret

- White Stork
- White-bellied Bustard

The priority species which could occasionally use the grassland in the project site are the following:

- Black Harrier
- Brown Snake Eagle
- Cape Vulture
- Denham's Bustard
- Eastern Long-billed Lark
- Grey Crowned Crane
- Martial Eagle
- Montagu's Harrier
- Peregrine Falcon
- Red-chested Flufftail
- Spotted Eagle-Owl
- Western Barn Owl
- Yellow-billed Kite

6.5.2 Drainage lines and wetlands

There are several wetlands in the project site, most of which are associated with drainage lines. The priority species which could potentially use the wetlands in the project site on a regular basis are the following:

- African Grass Owl
- African Snipe
- Black-headed Heron
- Blacksmith Lapwing
- Blue Crane
- Egyptian Goose
- Marsh Owl

The priority species which could occasionally use the wetlands in the project site are the following:

- African Black Duck
- African Marsh Harrier
- African Rail
- African Swamphen
- Glossy Ibis
- Grey Crowned Crane
- Hamerkop
- Ruff
- Wattled Crane

6.5.3 Agricultural lands

The project site contains a patchwork of agricultural fields, where maize, soya beans and pastures are cultivated. Some fields are lying fallow or are in the process of being re-vegetated by grass. The priority species which could potentially use the agricultural fields in the project site on a regular basis are the following:

- Common Buzzard
- Blue Crane
- Amur Falcon
- Lanner Falcon
- Egyptian Goose
- Spur-winged Goose
- Southern Bald Ibis
- Black-winged Kite

The priority species which could occasionally use the agricultural lands in the project site are the following:

- Grey Crowned Crane

6.5.4 Alien trees

The project site contains few trees. Most trees are alien species, particularly Eucalyptus, Australian Acacia (Wattle), and Salix (Willow) species. Trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have trees growing in them. The priority species which could potentially use the alien trees in the project site on a regular basis are the following:

- Secretarybird
- Common Buzzard
- Jackal Buzzard
- Black-chested Snake Eagle
- Long-crested Eagle
- Western Cattle Egret
- Amur Falcon
- Lanner Falcon
- Fiscal Flycatcher
- African Harrier-Hawk
- Black-headed Heron
- African Sacred Ibis
- Southern Bald Ibis
- Rock Kestrel
- Black-winged Kite
- Black Sparrowhawk
- Pied Starling
- White Stork
- Cape Weaver

The priority species which could occasionally use the alien trees in the project site are the following:

- Reed Cormorant
- White-breasted Cormorant
- Grey Crowned Crane
- African Darter
- African Fish Eagle
- Brown Snake Eagle
- Martial Eagle
- Spotted Eagle-Owl

- Peregrine Falcon
- Black-crowned Night Heron
- Grey Heron
- Giant Kingfisher
- Yellow-billed Kite
- Western Osprey
- Western Barn Owl
- African Spoonbill
- Karoo Thrush
- Cape Vulture
- Cape White-eye

6.5.5 Dams

There are numerous ground dams at the project site, located in drainage lines. The priority species which could potentially use the dams in the project site on a regular basis are the following:

- Egyptian Goose
- Spur-winged Goose
- African Sacred Ibis
- Blacksmith Lapwing
- Three-banded Plover
- South African Shelduck
- Cape Weaver

The priority species which could occasionally use the dams in the project site are the following:

- Hamerkop
- Pied Avocet
- Red-knobbed Coot
- Reed Cormorant
- White-breasted Cormorant
- Black Crake
- African Darter
- Fulvous Whistling Duck
- White-backed Duck
- White-faced Whistling Duck
- Yellow-billed Duck
- African Fish Eagle
- Martial Eagle
- Great Egret
- Intermediate Egret
- Little Egret
- Black-necked Grebe
- Little Grebe
- Common Greenshank
- Grey-headed Gull
- Black Heron
- Black-crowned Night Heron

- Goliath Heron
- Grey Heron
- Purple Heron
- Squacco Heron
- African Jacana
- Giant Kingfisher
- Malachite Kingfisher
- Pied Kingfisher
- Common Moorhen
- Lesser Moorhen
- Western Osprey
- Kittlitz's Plover
- Southern Pochard
- African Rail
- Common Sandpiper
- Wood Sandpiper
- Cape Shoveler
- African Spoonbill
- Black-winged Stilt
- Little Stint
- African Swamphen
- Blue-billed Teal
- Cape Teal
- Red-billed Teal
- Whiskered Tern

6.5.6 Pans

The project site contains a few small pans. These pans are a potential drawcard for many priority species. Lesser and Greater Flamingos could occasionally use these pans for foraging and roosting. Large raptors and vultures could use the pans for bathing and drinking, and Blue Cranes could roost there on occasion. The priority species which could potentially use the pans in the project site on a regular basis are the following:

- Blue Crane
- Egyptian Goose
- Spur-winged Goose
- African Sacred Ibis
- Blacksmith Lapwing
- Three-banded Plover
- African Snipe

The priority species which could <u>occasionally</u> use the pans in the project site are the following:

- Red-knobbed Coot
- Black Crake
- White-faced Whistling Duck
- African Fish Eagle
- Martial Eagle
- Great Egret
- Intermediate Egret

- Little Egret
- Greater Flamingo
- Lesser Flamingo
- Little Grebe
- Common Greenshank
- Grey-headed Gull
- Black Heron
- African Jacana
- Kittlitz's Plover
- African Rail
- Common Sandpiper
- Wood Sandpiper
- African Spoonbill
- Black-winged Stilt
- Little Stint
- Blue-billed Teal
- Red-billed Teal
- Whiskered Tern

See Appendix 2 for photographic record of habitat features in the project site and immediate surroundings.

6.6 AVIFAUNA

6.6.1 South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 234 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 107 species are classified as priority species (see definition of priority species in section 4) and 17 of these are South African Red List species. Of the priority species, 35 are likely to occur regularly in the development area (see Table 2 below).

Table 3 below lists all the priority species that are likely to occur regularly and the possible impact on the respective species by the proposed wind farm. The following abbreviations and acronyms are used:

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

Table 3: Priority species potentially occurring regularly at the development area (Red List species are shaded).

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic/near endemic (SA)	Recorded during monitoring	Likelihood of regular occurrence	Grassland	Drainage line & wetlands	Agriculture	Dams	Pans	Alien trees	Solar - Collisions with solar panels	Solar - Displacement: Disturbance	Solar - Displacement: Habitat transformation	Solar - Entanglement in fences	Powerline - Electrocution MV	Powerline - Collision
Secretarybird	*Sagittarius serpentarius*	13.3	0.0	EN	VU		x	H	x					x		x	x	x		x
White-bellied Bustard	*Eupodotis senegalensis*	7.9	0.0	-	VU		x	M	x						x	x	x	x		x
Common Buzzard	*Buteo buteo*	27.9	9.3	-	-		x	H	x		x			x			x		x	
Jackal Buzzard	*Buteo rufofuscus*	19.4	2.2	-	-	x	x	H	x					x			x		x	
Cloud Cisticola	*Cisticola textrix*	7.9	0.9	-	-	x	x	M	x						x	x	x			
Blue Crane	*Grus paradisea*	11.5	0.4	VU	NT		x	H	x	x	x		x			x	x	x		x
Black-chested Snake Eagle	*Circaetus pectoralis*	3.0	0.4	-	-		x	M	x					x			x		x	
Long-crested Eagle	*Lophaetus occipitalis*	6.7	9.3	-	-		x	M	x					x			x		x	
Western Cattle Egret	*Bubulcus ibis*	44.8	12.3	-	-		x	H	x		x			x	x	x	x			x
Amur Falcon	*Falco amurensis*	29.1	6.6	-	-		x	H	x		x			x	x		x			
Lanner Falcon	*Falco biarmicus*	7.3	0.0	-	VU		x	M	x		x			x	x		x		x	
Fiscal Flycatcher	*Melaenornis silens*	17.0	0.9	-	-	x	x	M						x	x					
Grey-winged Francolin	*Scleroptila afra*	27.3	2.2	-	-	x	x	H	x						x	x	x	x		
Egyptian Goose	*Alopochen aegyptiaca*	78.2	6.2	-	-		x	H		x	x	x	x		x				x	x
Spur-winged Goose	*Plectropterus gambensis*	44.2	1.8	-	-		x	M			x	x	x		x				x	x
Cape Grassbird	*Sphenoeacus afer*	24.8	0.9	-	-	x	x	H	x	x					x	x	x			
African Harrier-Hawk	*Polyboroides typus*	11.5	1.8	-	-		x	M	x					x					x	
Black-headed Heron	*Ardea melanocephala*	52.1	4.0	-	-		x	H	x	x				x	x		x		x	x
African Sacred Ibis	*Threskiornis aethiopicus*	47.9	6.2	-	-		x	M				x	x	x	x				x	x
Southern Bald Ibis	*Geronticus calvus*	23.0	3.1	VU	VU	x	x	H	x		x			x	x		x		x	x
Rock Kestrel	*Falco rupicolus*	5.5	0.9	-	-		x	M	x					x			x			
Black-winged Kite	*Elanus caeruleus*	60.6	12.8	-	-		x	H	x		x			x			x			
Blue Korhaan	*Eupodotis caerulescens*	6.1	0.0	NT	LC	x	x	M	x						x	x	x	x		x
Blacksmith Lapwing	*Vanellus armatus*	67.9	7.0	-	-		x	H		x		x	x		x					
African Grass Owl	*Tyto capensis*	2.4	0.0	-	VU		x	M	x	x					x	x	x	x	x	x
Marsh Owl	*Asio capensis*	5.5	0.4	-	-		x	H	x	x					x	x	x	x	x	x

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Endemic/near endemic (SA)	Recorded during monitoring	Likelihood of regular occurrence	Grassland	Drainage line & wetlands	Agriculture	Dams	Pans	Alien trees	Solar - Collisions with solar panels	Solar - Displacement: Disturbance	Solar - Displacement: Habitat transformation	Solar - Entanglement in fences	Powerline - Electrocution MV	Powerline - Collision
Three-banded Plover	*Charadrius tricollaris*	35.2	0.9	-	-		x	M				x	x		x					
Drakensberg Prinia	*Prinia hypoxantha*	18.8	0.0	-	-	x	x	M	x	x					x	x				
South African Shelduck	*Tadorna cana*	30.3	3.5	-	-		x	M				x	x		x					x
African Snipe	*Gallinago nigripennis*	20.0	0.9	-	-		x	M		x		x	x		x					
Black Sparrowhawk	*Accipiter melanoleucus*	12.1	0.9	-	-		x	M						x	x				x	
Pied Starling	*Lamprotornis bicolor*	55.2	11.5	-	-	x	x	H	x					x	x	x	x			
White Stork	*Ciconia ciconia*	7.3	1.3	-	-		x	M	x					x			x			x
South African Cliff Swallow	*Petrochelidon spilodera*	38.2	3.5	-	-	x	x	H	x						x		x			
Cape Weaver	*Ploceus capensis*	33.9	2.2	-	-	x	x	H		x		x		x	x					

7. IMPACT ASSESSMENT

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 is 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, one published scientific study has been completed on the impacts of PV plants in a South African context (Visser *et al.* 2018).

In summary, the main impacts of PV plants on avifauna which have emerged so far include the following:

- 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

7.1 Introduction

Increasingly, human-induced climate change is recognized as a fundamental driver of biological processes and patterns. Historic climate change is known to have caused shifts in the geographic ranges of many plants and animals, and future climate change is expected to result in even greater redistributions of species (National Audubon Society 2015). In 2006 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.* 2018).

7.2 Impacts associated with PV plant

7.2.1 Impact trauma (collisions)

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

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

An extremely rare but potentially related problem is the so-called "lake effect" i.e. it seems possible that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014)[4]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (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

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[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.

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. 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.

Koskiuch *et al.* (2020) synthesized results from fatality monitoring studies at 10 photovoltaic solar facilities across 13 site years in California and Nevada in the USA. They concluded that there are consistent patterns in several aspects of their analysis that could provide insight into potential patterns of bird mortality at PV facilities. Four patterns that could provide broader inference to other regions are: 1) the most widely occurring species among site-years have populations in the millions in the areas where studies occurred, and 3 of the top 4 species detected are ground-dwelling birds; 2) most detections occurred in autumn (seasonal variation); 3) there was no evidence of a comparatively large-scale fatality events of nocturnal migrating passerines or migrating water associates or water obligates[5]; 4) most detections were of unknown cause feather spots.

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

[5] They define water-associated birds based on life history traits, and include any species that relies primarily upon aquatic habitats for the purposes of foraging, reproduction, and/or roosting and could be present in the study areas based upon their known range. Water associates can walk on and take off from land. They distinguished water-obligate birds, which rely on water for landing or take off, from water associates because of the importance of water obligates to the foundation of the lake-effect hypothesis.

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.* 2018).

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 to medium-sized, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them, or forage for insects between the PV panels, e.g. Amur Falcons (i.e. if they are not completely displaced due to the habitat transformation). Due to the absence of large permanent waterbodies at or close to the development area, it is unlikely that waterbirds will be attracted in large numbers to the solar arrays due to the "lake effect".

Priority species which occur regularly and could potentially be impacted due to collisions with the solar panels are the following: Western Cattle Egret, Amur Falcon, Lanner Falcon, Fiscal Flycatcher, Grey-winged Francolin Egyptian Goose, Spur-winged Goose, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, Blacksmith Lapwing, African Grass Owl, Marsh Owl, Three-banded Plover, Drakensberg Prinia, South African Shelduck, African Snipe, Black Sparrowhawk, Pied Starling, South African Cliff Swallow and Cape Weaver.

7.2.2 Entrapment in perimeter fences

Visser *et al.* (2018) 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.* 2018). 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 of priority species in perimeter fences will be a significant impact at the PV facility. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species.

Priority species which could potentially be impacted due entrapment are the following: Secretarybird, White-bellied Bustard, Blue Crane, Blue Korhaan, African Grass Owl, Grey-winged Francolin and Marsh Owl.

7.2.3 Displacement due to 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 through the transformation of habitat (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;
- 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 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.* (2018) 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.* 2018).

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 will manifest itself at the proposed PV facility. In addition, ground nesting species and some raptors are also likely to be impacted by the habitat transformation, as it will result in reduced prey availability and accessibility.

Priority species that could be negatively affected by displacement due to habitat loss are the following: Common Buzzard, Jackal Buzzard, Cloud Cisticola, Blue Crane, Black-chested Snake Eagle, Long-crested Eagle, Western Cattle Egret, Amur Falcon, Lanner Falcon, Grey-winged Francolin, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, Rock Kestrel, Black-winged Kite, Blue Korhaan, African Grass Owl, Marsh Owl, Pied Starling, White Stork, and South African Cliff Swallow

7.2.4 Displacement due to disturbance associated with the construction of the solar PV facility

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 e.g. increased vehicle traffic, and short-term construction-related noise (from equipment) and visual disturbance.

At the PV facility, the priority species which would be most severely affected by disturbance would be ground nesting species which are the following: White-bellied Bustard, Cloud Cisticola, Blue Crane, Western Cattle Egret, Grey-winged Francolin, Cape Grassbird, Blue Korhaan, African Grass Owl, Marsh Owl, Drakensberg Prinia, and Pied Starling. Secretarybirds breeding or roosting at or near to the project site might also be affected.

7.3 Impacts associated with the medium voltage network

7.3.1 Electrocution of priority species on the internal medium voltage reticulation network

Medium voltage electricity poles could potentially pose an electrocution risk to raptors. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2000). The electrocution risk is largely determined by the design of the electrical hardware.

While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines will run above ground. Priority species which could be at risk of electrocution on the medium voltage powerlines are the following: Common Buzzard, Jackal Buzzard, Black-chested Snake Eagle, Long-crested Eagle, Lanner Falcon, Egyptian Goose, Spur-winged Goose, African Harrier-Hawk, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, African Grass Owl, Marsh Owl and Black Sparrowhawk.

7.3.2 Collisions with the internal medium voltage overhead lines

Collisions are the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes, and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001).

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 5 below).

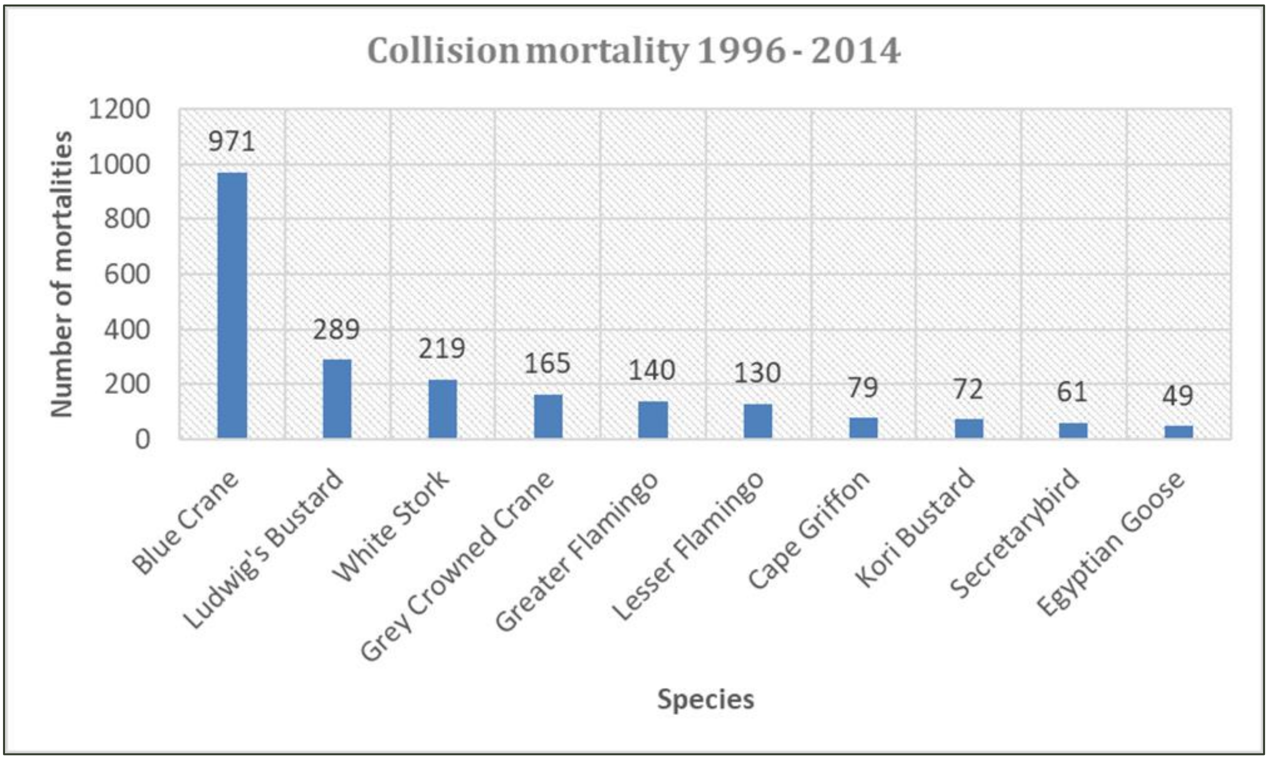

Figure 6: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

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

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing 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).

While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines could run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Secretarybird, White-bellied Bustard, Blue Crane, Western Cattle Egret, Egyptian Goose, Spur-winged Goose, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, African Grass Owl, Marsh Owl, South African Shelduck and White Stork.

8 IMPACT RATING

Table 4 below is a summarised scoping level assessment of the anticipated impacts.

Table 4: Summarised scoping level assessment of the anticipated impacts

Issue	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	No-Go Areas	Mitigation measures
During construction: Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	At the PV facility, the priority species which would be most severely affected by disturbance would be ground nesting species which are the following: White-bellied Bustard, Cloud Cisticola, Blue Crane, Western Cattle Egret, Grey-winged Francolin, Cape Grassbird, Blue Korhaan, African Grass Owl, Marsh Owl, Drakensberg Prinia, and Pied Starling. Secretarybirds breeding or roosting the project site might also be affected.	Local	High	• 100m buffer around drainage lines, wetlands, and pans – all infrastructure	• Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.

During construction: Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	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 will manifest itself at the proposed PV facility. In addition, ground nesting species and some raptors are also likely to be impacted by the habitat transformation, as it will result in reduced prey availability and accessibility. Priority species that could be negatively affected by displacement due to habitat loss are the following: Common Buzzard, Jackal Buzzard, Cloud Cisticola, Blue Crane, Black-chested Snake Eagle, Long-crested Eagle, Western Cattle Egret, Amur Falcon, Lanner Falcon, Grey-winged Francolin, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, Rock Kestrel, Black-winged Kite, Blue Korhaan, African Grass Owl, Marsh Owl, Pied Starling, White Stork, and South African Cliff Swallow.	Local	Medium	• 100m buffer around drainage lines, wetlands, and pans – all infrastructure	• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly implemented. • Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.
During operation: Mortality of priority species due to collisions with solar panels	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 to medium-sized, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them, or forage for insects between the PV panels, e.g. Amur Falcons (i.e. if they are not completely displaced due to the habitat transformation). Due to the absence of large permanent waterbodies at or close to the development area, it is unlikely that waterbirds will be attracted in large numbers to the solar arrays due to the “lake effect”.	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Due to the expected low significance of this impacts, no mitigation measures are recommended at this stage.

	Priority species which occur regularly and could potentially be impacted due to collisions with the solar panels are the following: Western Cattle Egret, Amur Falcon, Lanner Falcon, Fiscal Flycatcher, Grey-winged Francolin, Egyptian Goose, Spur-winged Goose, Cape Grassbird, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, Blacksmith Lapwing, African Grass Owl, Marsh Owl, Three-banded Plover, Drakensberg Prinia, South African Shelduck, African Snipe, Black Sparrowhawk, Pied Starling, South African Cliff Swallow and Cape Weaver.				
During operation: Entrapment of large-bodied birds in the double perimeter fence	It is not foreseen that entrapment of priority species in perimeter fences will be a significant impact at the PV facility. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species. Priority species which could potentially be impacted due entrapment are the following: Secretarybird, White-bellied Bustard, Blue Crane, Blue Korhaan, African Grass Owl, Grey-winged Francolin and Marsh Owl.	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	It is recommended that a single perimeter fence is used.
During operation: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines will run above ground. Priority species which could be at risk of electrocution on the medium voltage powerlines are the following: Common Buzzard, Jackal Buzzard, Black-chested Snake Eagle, Long-crested Eagle, Lanner Falcon, Egyptian Goose, Spur-winged Goose, African Harrier-Hawk, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, African Grass Owl, Marsh Owl and Black Sparrowhawk.	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	A raptor -friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.

During operation: Mortality of priority species due to collisions with the medium voltage internal reticulation network	While the intention is to place the majority of the medium voltage reticulation network underground at the PV facility, there are areas where the lines could run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Secretarybird, White-bellied Bustard, Blue Crane, Western Cattle Egret, Egyptian Goose, Spur-winged Goose, Black-headed Heron, Southern Bald Ibis, African Sacred Ibis, Blue Korhaan, African Grass Owl, Marsh Owl, South African Shelduck and White Stork.	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	All internal medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.

9 ENVIRONMENTAL SENSITIVITIES

The following specific environmental sensitivities were identified from an avifaunal perspective:

- **100m all infrastructure exclusion zone around drainage lines, associated wetlands and pans.** Wetlands are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for African Grass Owl (SA status Vulnerable), Grey Crowned Crane (SA status Endangered) and African Marsh Harrier (SA status Endangered).
- **High sensitivity grassland - Limited infrastructure zone**. Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), White-bellied Bustard (SA Status Vulnerable), Denham's Bustard (SA Status Vulnerable).

See Figure 6 for the avifaunal sensitivities identified from a Solar PV energy perspective.

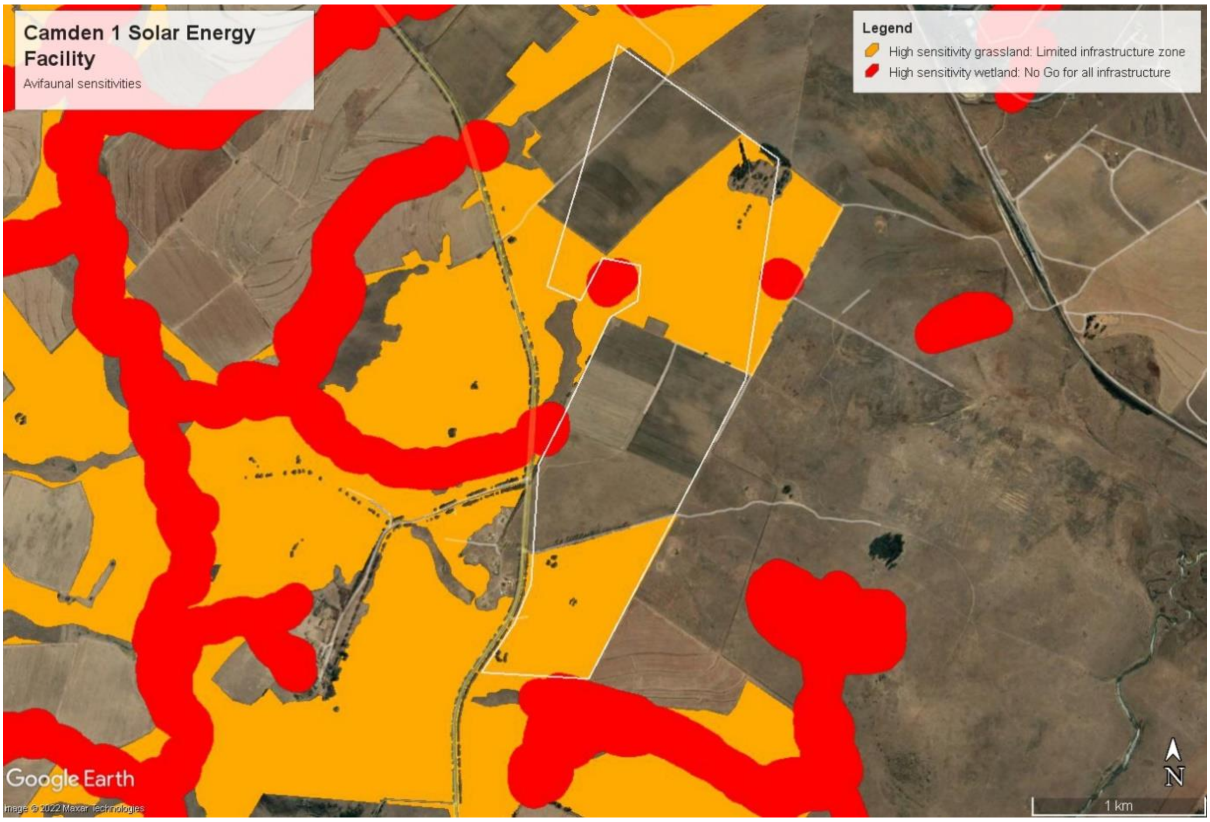

Figure 7: Avifaunal sensitivity zones at the Camden 1 Solar Energy Facility.

10 EIA PHASE

10.1 Plan of study

The following are proposed for the EIA Phase:

- The implementation of four seasonal avifaunal surveys, utilising transects and incidental counts, to inform the assessment of the potential impacts of the planned infrastructure within the development footprint (see Appendix 3)[6]. The monitoring protocol is guided by the following:
    - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
    - Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
    - The BirdLife South Africa (BLSA) Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa by Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017 (hereafter referred to as the Solar Guidelines) were consulted to determine the level of survey effort that is required.
- The avifaunal specialists report will be structured around the following terms of reference:
    - Description of the affected environment from an avifaunal perspective.
    - Discussion of gaps in baseline data and other limitations.
    - Description of the methodology that was used for the field surveys.
    - Comparison of the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjustment if necessary.
    - Provision of an overview of all applicable legislation.
    - Provision of an overview of assessment methodology.
    - Identification and assessment of the potential impacts of the proposed development on avifauna including cumulative impacts.
    - Provision of sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
    - Conclusion with an impact statement whether the PV facility is fatally flawed or may be authorised.

10.2 Environmental Management Programme

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

11 PRELIMINARY CONCLUSIONS

According to the DFFE national screening tool, the habitat within the development site is classified as **High** sensitivity for birds according to the Animal Species theme (see Figure 4). This classification is accurate as far as the impact of the proposed SEF is concerned, based on actual conditions recorded on the ground during the 12-months of pre-construction monitoring. The classification of High is justified based on the recorded presence of Red List priority species in and in the immediate vicinity of the project site, namely Secretarybird (Globally Endangered, Locally Vulnerable) White-bellied Bustard (Locally Vulnerable), Blue Crane (Globally Vulnerable, Locally Near-threatened), Grey Crowned Crane (Globally and Locally Endangered), Martial Eagle (Globally and Locally Endangered), Lanner Falcon (Locally Vulnerable), Greater Flamingo (Locally Near-threatened), Lesser Flamingo (Globally and Locally Near-threatened), Black Harrier (Locally and Globally Endangered), Southern Bald Ibis (Locally

[6] This has been completed.

and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), African Grass Owl (Locally Vulnerable) and Cape Vulture (Globally and Locally Endangered).

The proposed Camden 1 Solar Energy Facility will have an anticipated medium to high, medium and low pre-mitigation negative impact on priority avifauna, which is expected to be reduced to medium and low with appropriate mitigation.

12 REFERENCES

- ALONSO, J. A. AND ALONSO, J. C. 1999 Collision of birds with overhead transmission lines in Spain. Pp. 57–82 in Ferrer, M. and Janss, G. F. E., eds. Birds and power lines: Collision, electrocution and breeding. Madrid, Spain: Quercus.Google Scholar
- ANIMAL DEMOGRAPHY UNIT. 2021. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za.
- BARRIENTOS R, PONCE C, PALACIN C, MARTÍN CA, MARTÍN B, ET AL. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. PLoS ONE 7(3): e32569. doi:10.1371/journal.pone.0032569.
- BARRIENTOS, R., ALONSO, J.C., PONCE, C., PALACÍN, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.
- COUNTY OF MERCED. 2014. Draft Environmental Impact Report for the Wright Solar Park Conditional Use Permit Application CUP12-017. Public Draft. July. (ICF 00552.13.) Merced, CA. Prepared by ICF International, Sacramento, CA.
- ENDANGERED WILDLIFE TRUST. 2014. Central incident register for powerline incidents. Unpublished data.
- FLURI, T.P. 2009. The potential of concentrating solar power in South Africa. Energy Policy 37: 5075-5080.
- H. T. HARVEY & ASSOCIATES. 2014a. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 November 2013 - 15 February 2014.
- H. T. HARVEY & ASSOCIATES. 2014b. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 February 2014 - 15 May 2014.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- HERNANDEZ, R.R., et al., 2014, "Environmental Impacts of Utility-Scale Solar Energy," Renewable and Sustainable Energy Reviews 29: 766–779.
- HOCKEY P.A.R., DEAN W.R.J., AND RYAN P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- JEAL. C. 2017. The impact of a 'trough' Concentrated Solar Power facility on birds and other animals in the Northern Cape, South Africa. Minor Dissertation presented in partial fulfilment of the requirements for the degree of Master of Science in Conservation Biology. University of Cape Town.
- JENKINS, A. & SMALLIE, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? Africa Birds and Birding. Vol 14, No 2.
- JENKINS, A., DE GOEDE, J.H. & VAN ROOYEN, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildife Trust.

- JENKINS, A.R., DE GOEDE, J.H., SEBELE, L. & DIAMOND, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International 23: 232-246.
- JENKINS, A.R., 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.
- JENKINS, A.R., SMALLIE, J.J. & DIAMOND, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.
- KAGAN, R. A., T. C. VINER, P. W. TRAIL, AND E. O. ESPINOZA. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.
- KOSCIUCH K, RISER-ESPINOZA D, GERRINGER M, ERICKSON W. 2020. A summary of bird mortality at photovoltaic utility scale solar facilities in the Southwestern U.S.. PLoS ONE 15(4): e0232034. https://doi.org/10.1371/journal.pone.0232034
- LOSS, S.R., WILL, T., LOSS, S.S., & MARRA, P.P. 2014. Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. The Condor 116(1):8-23. 2014.
- LOVICH, J.E. and ENNEN, J.R. 2011, Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States, BioScience 61:982–992.
- MARNEWICK, M.D., RETIEF E.F., THERON N.T., WRIGHT D.R., ANDERSON T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: Birdlife South Africa.
- MARTIN, G., SHAW, J., SMALLIE J. & DIAMOND, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- MCCRARY, M. D., R. L. MCKERNAN, R. W. SCHREIBER, W. D. WAGNER, AND T. C. SCIARROTTA. 1986. Avian mortality at a solar energy plant. J. Field Ornithology 57:135-141.
- MUCINA. L. & RUTHERFORD, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- MUNZHEDI, R. & SEBITOSI, A.B. 2009. Re-drawing the solar map of South Africa for photovoltaic applications. Renewable Energy 34: 165-169.
- NATIONAL AUDUBON SOCIETY. 2015. Audubon's Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors: Gary Langham, Justin Schuetz, Candan Soykan, Chad Wilsey, Tom Auer, Geoff LeBaron, Connie Sanchez, Trish Distler. Version 1.3.
- RAAB, R., SPAKOVSZKY, P., JULIUS, E., SCHÜTZ, C. & SCHULZE, C. 2010. Effects of powerlines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International. Birdlife International.

- RAAB, R., SPAKOVSZKY, P., JULIUS, E., SCHÜTZ, C. & SCHULZE, C. 2010. Effects of powerlines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International. Birdlife International.

- SEYMORE, R., INGLESI-LOTZ, R. & BLIGNAUT, J. 2014. A greenhouse gas emissions inventory for South Africa: a comparative analysis. Renewable & Sustainable Energy Reviews 34: 371-379.
- SHAW, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.

- SHAW, J.M., PRETORIUS, M.D., GIBBONS, B., MOHALE, O., VISAGIE, R., LEEUWNER, J.L.& RYAN, P.G. 2017. The effectiveness of line markers in reducing power line collisions of large terrestrial birds at De Aar, Northern Cape. Eskom Research, Testing and Development. Research Report. RES/RR/17/1939422.
- VAN ROOYEN, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In: The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.
- VISSER, E., PEROLD, V., RALSTON-PATON, S., CARDENAL, A.C., RYAN, P.G. 2018. Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa. https://doi.org/10.1016/j.renene.2018.08.106 Renewable Energy 133 (2019) 1285 – 1294.
- WALSTON, L.J. ROLLINS, K.E. SMITH, K.P. LAGORY, K.E. SINCLAIR, K. TURCHI, C. WENDELIN, T. & SOUDER, H. A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities. U.S. Department of Energy, SunShot Initiative and Office of Energy Efficiency & Renewable Energy. April 2015.
- WALWYN, D.R., BRENT A.C. 2015. Renewable energy gathers steam in South Africa. Renewable and Sustainable Energy 41: 390-401.
- WEST (Western EcoSystems Technology, Inc.), 2014, Sources of Avian Mortality and Risk Factors Based on Empirical Data from Three Photovoltaic Solar Facilities, prepared by Western EcoSystems Technology, Inc., June 17.
- WORMWORTH, J. & MALLON, K. 2006. Bird Species and Climate Change. WWF – Australia. Sydney, NSW, Australia.

APPENDIX 1: SABAP 2 SPECIES LIST FOR THE BROADER AREA

Species name	Scientific name	Global status	Regional status
Hamerkop	*Scopus umbretta*	-	-
Ruff	*Calidris pugnax*	-	-
Secretarybird	*Sagittarius serpentarius*	EN	VU
Pied Avocet	*Recurvirostra avosetta*	-	-
Denham's Bustard	*Neotis denhami*	NT	VU
White-bellied Bustard	*Eupodotis senegalensis*	-	VU
Common Buzzard	*Buteo buteo*	-	-
Jackal Buzzard	*Buteo rufofuscus*	-	-
Buff-streaked Chat	*Campicoloides bifasciatus*	-	-
Cloud Cisticola	*Cisticola textrix*	-	-
Red-knobbed Coot	*Fulica cristata*	-	-
Reed Cormorant	*Microcarbo africanus*	-	-
White-breasted Cormorant	*Phalacrocorax lucidus*	-	-
Black Crake	*Zapornia flavirostra*	-	-
Blue Crane	*Grus paradisea*	VU	NT
Grey Crowned Crane	*Balearica regulorum*	EN	EN
Wattled Crane	*Grus carunculata*	VU	CR
African Darter	*Anhinga rufa*	-	-
African Black Duck	*Anas sparsa*	-	-
Fulvous Whistling Duck	*Dendrocygna bicolor*	-	-
White-backed Duck	*Thalassornis leuconotus*	-	-
White-faced Whistling Duck	*Dendrocygna viduata*	-	-
Yellow-billed Duck	*Anas undulata*	-	-
African Fish Eagle	*Haliaeetus vocifer*	-	-
Black-chested Snake Eagle	*Circaetus pectoralis*	-	-
Brown Snake Eagle	*Circaetus cinereus*	-	-
Long-crested Eagle	*Lophaetus occipitalis*	-	-
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Spotted Eagle-Owl	*Bubo africanus*	-	-
Great Egret	*Ardea alba*	-	-
Intermediate Egret	*Ardea intermedia*	-	-
Little Egret	*Egretta garzetta*	-	-
Western Cattle Egret	*Bubulcus ibis*	-	-
Amur Falcon	*Falco amurensis*	-	-
Lanner Falcon	*Falco biarmicus*	-	VU
Peregrine Falcon	*Falco peregrinus*	-	-
Greater Flamingo	*Phoenicopterus roseus*	-	NT
Lesser Flamingo	*Phoeniconaias minor*	NT	NT

Red-chested Flufftail	*Sarothrura rufa*	-	-
Fiscal Flycatcher	*Melaenornis silens*	-	-
Grey-winged Francolin	*Scleroptila afra*	-	-
Egyptian Goose	*Alopochen aegyptiaca*	-	-
Spur-winged Goose	*Plectropterus gambensis*	-	-
Cape Grassbird	*Sphenoeacus afer*	-	-
Black-necked Grebe	*Podiceps nigricollis*	-	-
Little Grebe	*Tachybaptus ruficollis*	-	-
Common Greenshank	*Tringa nebularia*	-	-
Grey-headed Gull	*Chroicocephalus cirrocephalus*	-	-
African Marsh Harrier	*Circus ranivorus*	-	EN
Black Harrier	*Circus maurus*	EN	EN
Montagu's Harrier	*Circus pygargus*	-	-
African Harrier-Hawk	*Polyboroides typus*	-	-
Black Heron	*Egretta ardesiaca*	-	-
Black-crowned Night Heron	*Nycticorax nycticorax*	-	-
Black-headed Heron	*Ardea melanocephala*	-	-
Goliath Heron	*Ardea goliath*	-	-
Grey Heron	*Ardea cinerea*	-	-
Purple Heron	*Ardea purpurea*	-	-
Squacco Heron	*Ardeola ralloides*	-	-
African Sacred Ibis	*Threskiornis aethiopicus*	-	-
Glossy Ibis	*Plegadis falcinellus*	-	-
Southern Bald Ibis	*Geronticus calvus*	VU	VU
African Jacana	*Actophilornis africanus*	-	-
Rock Kestrel	*Falco rupicolus*	-	-
Giant Kingfisher	*Megaceryle maxima*	-	-
Malachite Kingfisher	*Corythornis cristatus*	-	-
Pied Kingfisher	*Ceryle rudis*	-	-
Black-winged Kite	*Elanus caeruleus*	-	-
Yellow-billed Kite	*Milvus aegyptius*	-	-
Blue Korhaan	*Eupodotis caerulescens*	NT	LC
Blacksmith Lapwing	*Vanellus armatus*	-	-
Eastern Long-billed Lark	*Certhilauda semitorquata*	-	-
Common Moorhen	*Gallinula chloropus*	-	-
Lesser Moorhen	*Paragallinula angulata*	-	-
Western Osprey	*Pandion haliaetus*	-	-
African Grass Owl	*Tyto capensis*	-	VU
Marsh Owl	*Asio capensis*	-	-
Western Barn Owl	*Tyto alba*	-	-
Kittlitz's Plover	*Charadrius pecuarius*	-	-
Three-banded Plover	*Charadrius tricollaris*	-	-
Southern Pochard	*Netta erythrophthalma*	-	-
Drakensberg Prinia	*Prinia hypoxantha*	-	-
African Rail	*Rallus caerulescens*	-	-
Chorister Robin-Chat Robin-Chat	*Cossypha dichroa*	-	-

Common Sandpiper	*Actitis hypoleucos*	-	-
Wood Sandpiper	*Tringa glareola*	-	-
South African Shelduck	*Tadorna cana*	-	-
Cape Shoveler	*Spatula smithii*	-	-
African Snipe	*Gallinago nigripennis*	-	-
Black Sparrowhawk	*Accipiter melanoleucus*	-	-
African Spoonbill	*Platalea alba*	-	-
Pied Starling	*Lamprotornis bicolor*	-	-
Black-winged Stilt	*Himantopus himantopus*	-	-
Little Stint	*Calidris minuta*	-	-
White Stork	*Ciconia ciconia*	-	-
South African Cliff Swallow	*Petrochelidon spilodera*	-	-
African Swamphen	*Porphyrio madagascariensis*	-	-
Blue-billed Teal	*Spatula hottentota*	-	-
Cape Teal	*Anas capensis*	-	-
Red-billed Teal	*Anas erythrorhyncha*	-	-
Whiskered Tern	*Chlidonias hybrida*	-	-
White-winged Tern	*Chlidonias leucopterus*	-	-
Karoo Thrush	*Turdus smithi*	-	-
Sentinel Rock Thrush	*Monticola explorator*	NT	LC
Cape Weaver	*Ploceus capensis*	-	-
Cape White-eye	*Zosterops virens*	-	-
Cape Vulture	*Gyps coprotheres*	EN	EN

APPENDIX 2: HABITAT FEATURES AT THE PROJECT SITE

Figure 1: High sensitivity natural grassland

Figure 2: An example of an earth dam in the broader area

Figure 3: Agriculture

Figure 4: Drainage line and associated wetland in the broader area


Figure 5: Alien trees

APPENDIX 3: PRE-CONSTRUCTION MONITORING

Monitoring was conducted in the following manner at the Camden 1 wind and solar facilities:

- One drive transect was identified totalling 10.2km on the development sites and one drive transect in the control site with a total length of 10.5km.
- One monitor travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the transect. The observer stopped at regular intervals (every 500m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- In addition, 4 walk transects of 1km each were identified at the development sites, and two at the control site, and counted 4 times per sampling season. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species
    - Number of birds
    - Date
    - Start time and end time
    - Estimated distance from transect
    - Wind direction
    - Wind strength (estimated Beaufort scale)
    - Weather (sunny; cloudy; partly cloudy; rain; mist)
    - Temperature (cold; mild; warm; hot)
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground) and
    - Co-ordinates (priority species only)

The aim with drive transects is primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects are primarily aimed at recording small passerines. The objective of the transect monitoring is to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind and solar farm activities.

- Four vantage points (VPs) were identified from which the majority of the buildable area can be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:
    - Species
    - Number of birds
    - Date
    - Start time and end time
    - Wind direction
    - Wind strength (estimated Beaufort scale 1-7)
    - Weather (sunny; cloudy; partly cloudy; rain; mist)
    - Temperature (cold; mild; warm; hot)
    - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m)
    - Flight mode (soar; flap; glide; kite; hover) and
    - Flight time (in 15 second-intervals).

The objective of vantage point counts is to measure the potential collision risk with the turbines.

A total of three potential focal points (FPs) of bird activity were identified and monitored. The focal points are as follows:

- FP1: A farm dam in a drainage line in the application site
- FP2: A large salt pan in the application site
- FP3: A large pan situated approximately 3.6km north-west of the application site on the farm Rietspruit 437 IS.

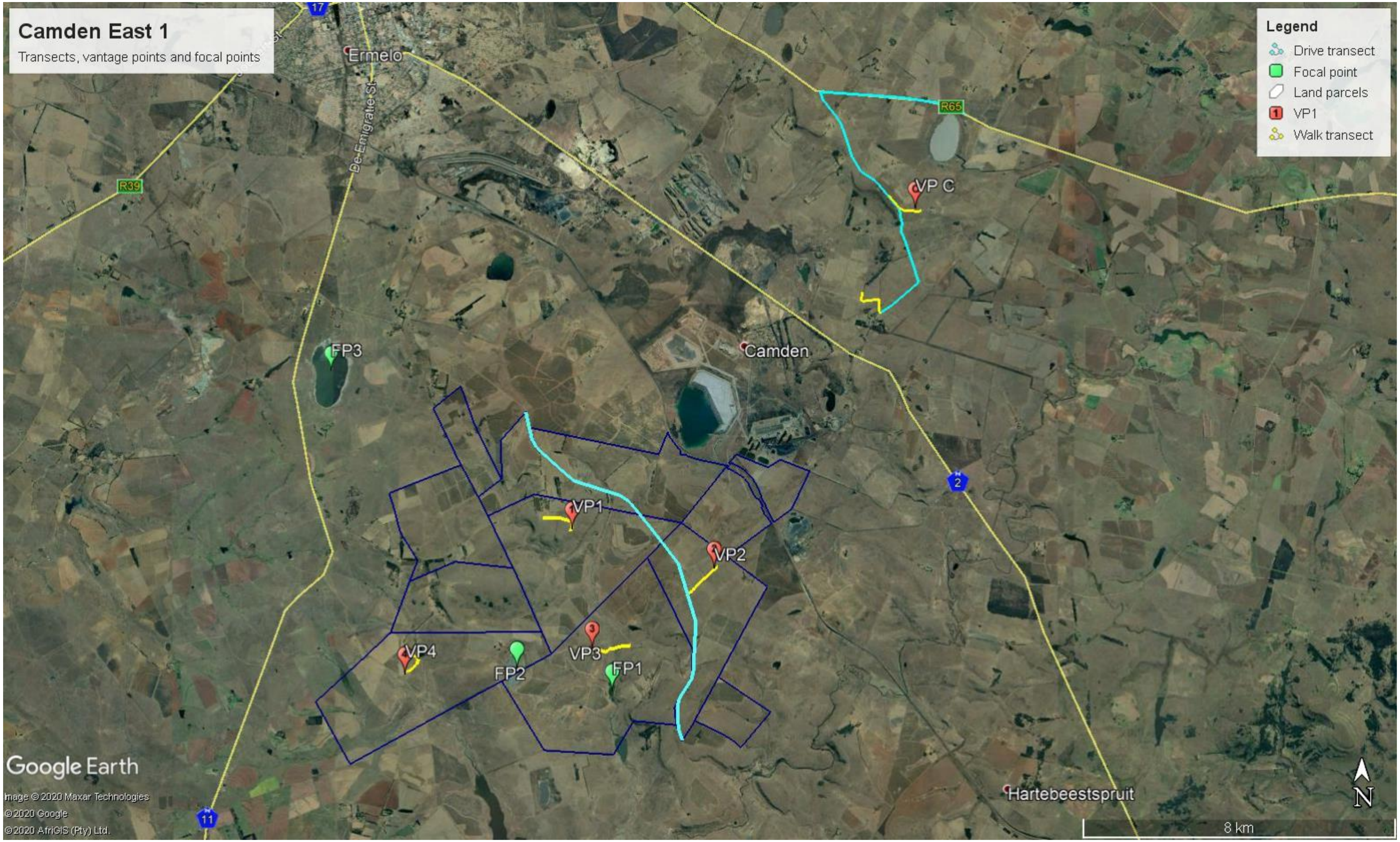

Figure 1: Area where monitoring is taking place, with position of VPs, focal points, drive transects, walk transects and land parcels (dark blue polygon). The area to the north-east of the land parcels is the control area.