AVIFAUNAL IMPACT ASSESSMENT

BASIC ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE 15MW LEEUWBOSCH 3 SOLAR PHOTOVOLTAIC (PV) PLANT AND ASSOCIATED INFRASTRUCTURE NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE

August 2022

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EXECUTIVE SUMMARY

Leeuwbosch PV Generation (Pty) Ltd has appointed SiVEST Environmental (hereafter referred to as "SiVEST") to undertake the required BA Process for the proposed construction of the solar photovoltaic (PV) plant and associated infrastructure approximately 6km north-east of the town of Leeudoringstad in the North West Province. The EA that is required for the proposed solar PV plant and associated infrastructure is as follows:

▪ Leeuwbosch 3 Solar PV Plant (up to 15MW)

The overall objective of the proposed development is to generate electricity (by capturing solar energy) to feed into the national electricity grid and "wheel" the power to private off-takers based on a Power Purchase Agreement (PPA).

The potential impacts of the Leeuwbosch 3 Solar PV Plant on avifauna are tabled below:

Environmental parameter	Issues	Rating prior to mitigation	Rating post mitigation
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	-33 (Medium negative)	-30 (Medium negative)
	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	-42 (Medium negative)	-39 (Medium negative)
	Mortality of priority species due to collisions with solar panels	-20 (low negative)	-20 (low negative)
	Entrapment of large-bodied birds in the double perimeter fence	-20 (low negative)	-18 (low negative)
	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	-9 (low negative)	-8 (low negative)
	Cumulative impact of displacement due to construction and habitat transformation, collisions with solar panels and entrapment in fences	-24 (medium negative)	-22 (low negative)
	Average	24.6 (medium-low negative)	22.8 (low negative)

The proposed Leeuwbosch 3 Solar PV Plant will have a medium pre-mitigation negative impact on priority avifauna, which in most instances, can be reduced to low with appropriate mitigation. The development is supported provided the mitigation measures listed in this report is strictly implemented. No fatal flaws were discovered in the course of the investigations.

The cumulative impact of the facility on priority avifauna within a 35km radius around the proposed development (considering all current impacts on avifauna) is assessed to be low post mitigation, mainly due to the small size of the proposed development.

CONTENTS

DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT

Chris van Rooyen

Chris has 26 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous 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

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

Megan Loftie-Eaton (Bird Specialist and Ecologist)

Megan is a registered Professional Natural Scientist with the South African Council of Natural Scientific Professionals (SACNASP) in the field of Ecology, and she is a member of the Zoological Society of Southern Africa (ZSSA). Megan is also assists with Environmental Impact Assessments (EIA's), Basic Assessments (BA's) and provides specialist input within the avifaunal and ecological fields. She obtained her BSc in Environmental & Conservation Sciences with distinction through the University of Alberta in Edmonton, Canada. After moving back to South Africa in 2011 she went on to complete her MSc in Zoology (2014) at the University of Cape Town, and her PhD in Biological Sciences (2018), looking at the impacts of bush encroachment on bird distributions in the savanna biome of South Africa. Megan has conducted avifaunal field surveys and has experience with conducting avifaunal impact assessments.

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations 2014 (as amended) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations 2014 (as amended)		Clause	Section in Report
Appendix 6	(1)	A specialist report prepared in terms of these Regulations must contain —	
	(a)	details of –	
		(i) the specialist who prepared the report; and	Pg.5
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Pg.5
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Pg.5
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 2
	(cA)	An indication of the quality and age of base data used for the specialist report;	Sections 3 and 4
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 7
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Sections 3 and 4
	(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 6 - 9
	(g)	An indication of any areas to be avoided, including buffers;	Not applicable
	(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Not applicable
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
	(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Sections 9 and 10
	(k)	Any mitigation measures for inclusion in the EMPr;	Section 9
	(l)	Any conditions for inclusion in the environmental authorization;	Section 9
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Not applicable
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Sections 9 -10
		(iA) regarding the acceptability of the proposed activity or activities; and	Sections 9 -10
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 10

	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	No comments received
	(q)	Any other information requested by the authority.	Not applicable
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

1. INTRODUCTION

Leeuwbosch PV Generation (Pty) Ltd has appointed SiVEST Environmental (hereafter referred to as “SiVEST”) to undertake the required BA Process for the proposed construction of the solar photovoltaic (PV) plant and associated infrastructure approximately 6km north-east of the town of Leeudoringstad in the North West Province. The EA that is required for the proposed solar PV plant and associated infrastructure is as follows:

- Leeuwbosch 3 Solar PV Plant (up to 15MW).

The overall objective of the proposed development is to generate electricity (by capturing solar energy) to feed into the national electricity grid and “wheel” the power to private offtakers based on a Power Purchase Agreement (PPA).

Additionally, the proposed solar PV plant will be connecting to the Leeudoringstad Solar Plant Substation located on the Leeuwbosch Farm (namely Portion 37 of the Farm Leeuwbosch No. 44). The Leeudoringstad Solar Plant Substation is the subject of a separate Basic Assessment (BA) process and Environmental Authorisation (EA).

The proposed Solar Energy Facility (SEF) is subject to a Basic Assessment (BA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended and EIA Regulations, 2014 (as amended). Since the power generated by the proposed solar PV plant will be purchased by a private off-taker and will not form part of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), the proposed construction and operation of the solar PV plant project requires Environmental Authorisation (EA) from the provincial competent authority, namely the North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT).

This bird impact assessment report deals only with the proposed Leeuwbosch 3 Solar PV Plant proposed on Portion 37 of the Farm Leeuwbosch No. 44.

1.1 Project location

Leeuwbosch PV Generation (Pty) Ltd proposes the development of a solar Photovoltaic (PV) plant and associated infrastructures on a site located approximately 6km north-east of the town of Leeudoringstad (Figures 1 and 2). The solar PV plant will comprise several arrays of PV panels, and associated infrastructure. The associated infrastructure would include, but not be limited to, internal access roads, one (1) switching substation, one (1) permanent guard house and one (1) temporary building zone. The solar PV plant will have a contracted capacity of up to 15MW and will be known as the Leeuwbosch 3 Solar PV Plant.

A preferred project site has been identified by Leeuwbosch PV Generation (Pty) Ltd as a technically suitable area for the development of the solar PV plant. The project site falls within the Maquassi Hills Local Municipality within the Dr Kenneth Kaunda District Municipality in the North West Province. The site is accessible via an existing gravel road which branches off the tarred R502 Provincial Road.

The proposed solar PV plant will be located on the following property:

- Portion 37 of the Farm Leeuwbosch No. 44

The above-mentioned property is approximately 124.691 ha in extent. The proposed solar PV plant and associated infrastructure assessed as part of this BA will however only cover an area of up to approximately 20 ha.

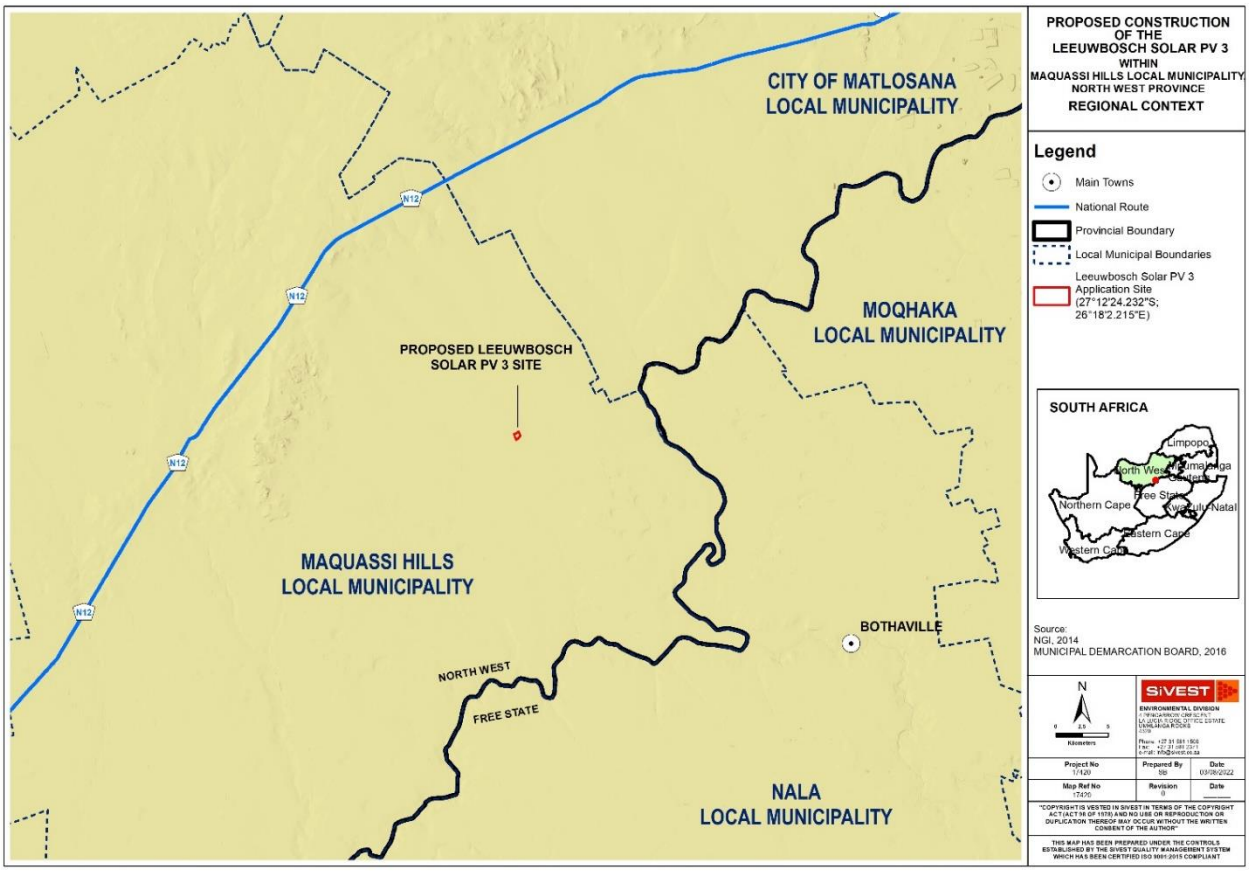

Figure 1: Project location – regional context

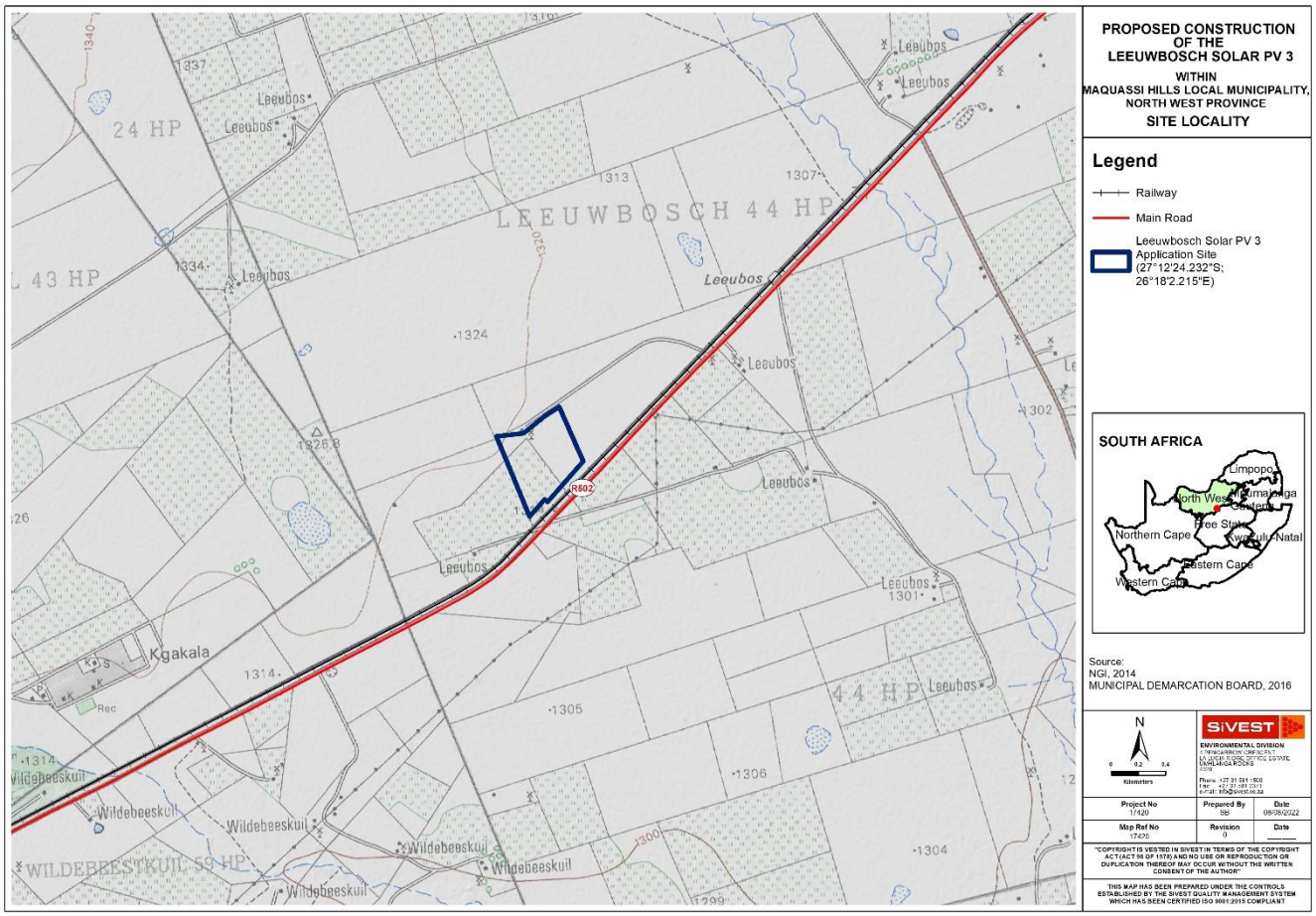

Figure 2: Location of proposed Leeuwbosch 3 Solar PV Plant.

1.2 Solar PV Plant Components

It is anticipated that the proposed Solar PV energy facility will include PV fields (arrays) comprising of multiple PV panels. In summary, the proposed SEF development will include the following components:

- The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules;
- PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology;
- Each PV module will be approximately 2274mm (≈2.3m) long and 1134mm (≈1.1m) wide and mounted on supporting structures above ground;
- The foundations will most likely be either concrete or rammed piles;
- Generation capacity of up to 15MWac;
- The dimension of the PV panels will be approximately 2.3 m wide by 1.1 m long;
- One (1) new 33/132kV on-site substation (facility substation) occupying an area of up to approximately 0.2003ha (2 003m^2);
- Site and internal access roads, up to 4m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary;
- One (1) guard house approximately 0.0876 ha (876m^2) in size;
- One (1) temporary building zone 0.2944 ha (2 944m^2);
- Galvanized steel fencing with electrification approximately 2.1m in height;
- Existing boreholes will be used where possible. Water will potentially be stored in water storage tanks;

Component	Description / Dimensions
Location of site (centre point)	Latitude: 27°12'24.03" S Longitude: 26°18'2.64" E
Technology	▪ The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules. ▪ PV panel mountings. PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. ▪ Each PV module will be approximately 2274mm (≈2.3 m) long and 1134 mm (≈1.1 m) wide and mounted on supporting structures above ground. At this stage it is anticipated that the structures will be mono-facial modules. The final design details will become available during the detailed design phase of the proposed development, prior to the start of construction. ▪ The foundations will most likely be either concrete or rammed piles. The final foundation design will be determined at the detailed design phase of the proposed development.
SG codes	T0HP00000000004400037
Generation Capacity of Solar PV Plant	Maximum of up to ± 15MW ac
Capacity of Switching Substation	More than 33 kV but less than 275 kV. Exact capacity of the proposed on-site switching substation will be determined and confirmed at a later stage.
Dimensions of PV Panels	▪ Width: up to ± 2274mm (≈2.3m) ▪ Length: up to ± 1134mm (≈1.1m)
On-site Switching Substation	▪ One (1) new on-site switching substation with a capacity of more than 33 but less than 275 kV. ▪ Total footprint: up to ± 0.2003 ha (2 003 m^2). ▪ To contain transformers for voltage, step up from medium voltage to high voltage. DC power from the PV modules will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers.

Component	Description / Dimensions
Guard House	One (1) permanent guard house of ± 0.0876ha (876 m^2).
Temporary Building Zone	One (1) temporary building zone of ± 0.2944ha (2 944 m^2).
Area Occupied by Buildings	Up to ± 1.3807 ha (13 807 m^2)
Width of Existing Internal Gravel Roads	▪ Up to ± 4 m; ▪ Existing internal gravel site roads will be used wherever possible. However, where required, new internal gravel roads may be constructed.
Length of existing internal roads (to be potentially upgraded)	▪ Up to ± 1.57 km
Site Access	Access to the proposed development will be via an existing gravel road which connects to the tarred R502 road.
Proximity to grid connection	▪ Grid connection is to the 132/11kV Leeudoringstad Solar Plant Substation, which has been applied for as part of a separate BA process; and ▪ The 132/11kV Leeudoringstad Solar Plant Substation is located within the proposed Leeuwbosch 3 Solar PV Plant application site (namely Portion 37 of the Farm Leeuwbosch No. 44). ▪ Medium voltage cabling (anticipated to be ± 0.8m x 0.6m wide at this stage) will link the various PV arrays to the switching substation, as well as the Leeudoringstad Solar Plant Substation. These cables will be laid underground, wherever technically feasible.
Height of fencing	▪ ± 2.1 m high ▪ Fencing will surround the entire proposed solar PV plant.
Type of fencing	Galvanised steel with electrification on top.
Area covered by fencing	Up to approximately 18 ha
Boreholes and storage tanks	▪ At this stage it is anticipated that existing boreholes will be utilised; ▪ Water will potentially be stored in temporary water storage tanks.

1.3 Alternatives

1.3.1 Location Alternatives

The placement of a solar PV facility is dependent on several other factors including land suitability, environmental sensitivities, climatic conditions (solar irradiation levels), topography, the location and extent of the study area, availability of grid connection infrastructure and the need and desirability of the project.

Furthermore, the North West Province in South Africa has a favourable solar irradiation potential. The area receives an annual Global Horizontal Irradiation (GHI) ranging between 1972 and 2118kWh/m2/year. Based on the site-specific attributes, the Applicant considers the preferred application site placed within the study area as being highly favourable and suitable for the establishment of a solar PV plant. No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development.

1.3.2 Technology Alterntives

Few technology options are available for solar PV facilities, and the use of those that are considered are usually differentiated by weather and temperature conditions that prevail in the area, so that optimality is obtained by the final site selection. Solar energy is considered to be the most suitable renewable energy technology for the project area, based on the site location, ambient conditions and energy resource availability.

No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view.

1.3.3 SEF Layout Alternatives

An environmental sensitivity map will be provided in order to illustrate the sensitive environmental features located within the project site which needs to be considered and, in some instances completely avoided by the development footprint. Once more detailed information is available, the layout of the PV plant footprint and infrastructure will be adjusted if necessary to ensure avoidance of any identified sensitive areas.

Design and layout alternatives will be considered and assessed as part of the Basic Assessment Process.

1.3.4 No-Go Alternative

The 'no-go' alternative is the option of not undertaking the proposed SEF and associated infrastructures. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or the surrounding local area.

2 PROJECT SCOPE

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

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts associated with the solar facilities and associated infrastructure;
- Do an assessment of the potential impacts;
- Rank the alternatives (if any) in order of preference; and
- 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 9 pentads some of which intersect and others that are near the development. The decision to include multiple pentads around the project site was influenced by the fact that many of the pentads in the area have very few completed full protocol surveys. Given that the habitat is largely homogenous the additional pentads and their data augments the otherwise sparse bird distribution data. The 9 pentad grid cells are the following: 2705_2610; 2705_2615; 2705_2620; 2710_2610; 2710_2615; 2710_2620; 2715_2610; 2715_2615; 2715_2620 (**Figure** 3**3**). A total of 26 full protocol lists (i.e., bird listing surveys lasting a minimum of two hours each) and 20 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 9 pentads where the project site is located, with a total of 1 220 birds recorded. 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 habitat in the Project Site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2022.1) 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 facilities on avifauna.
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the application site relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the North-West Province.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the application site.
- 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 following sources were used 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);
    - Guidelines for the Implementation of the Terrestrial Flora & Terrestrial Fauna Species Protocols for EIAs in South Africa produced by the SANBI on behalf of the Department of Environment, Forestry and Fisheries (2020); and
    - 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).
- A site visit was conducted in November 2016 and again in August 2020. During the latter, data was collected by means of transect and incidental counts.

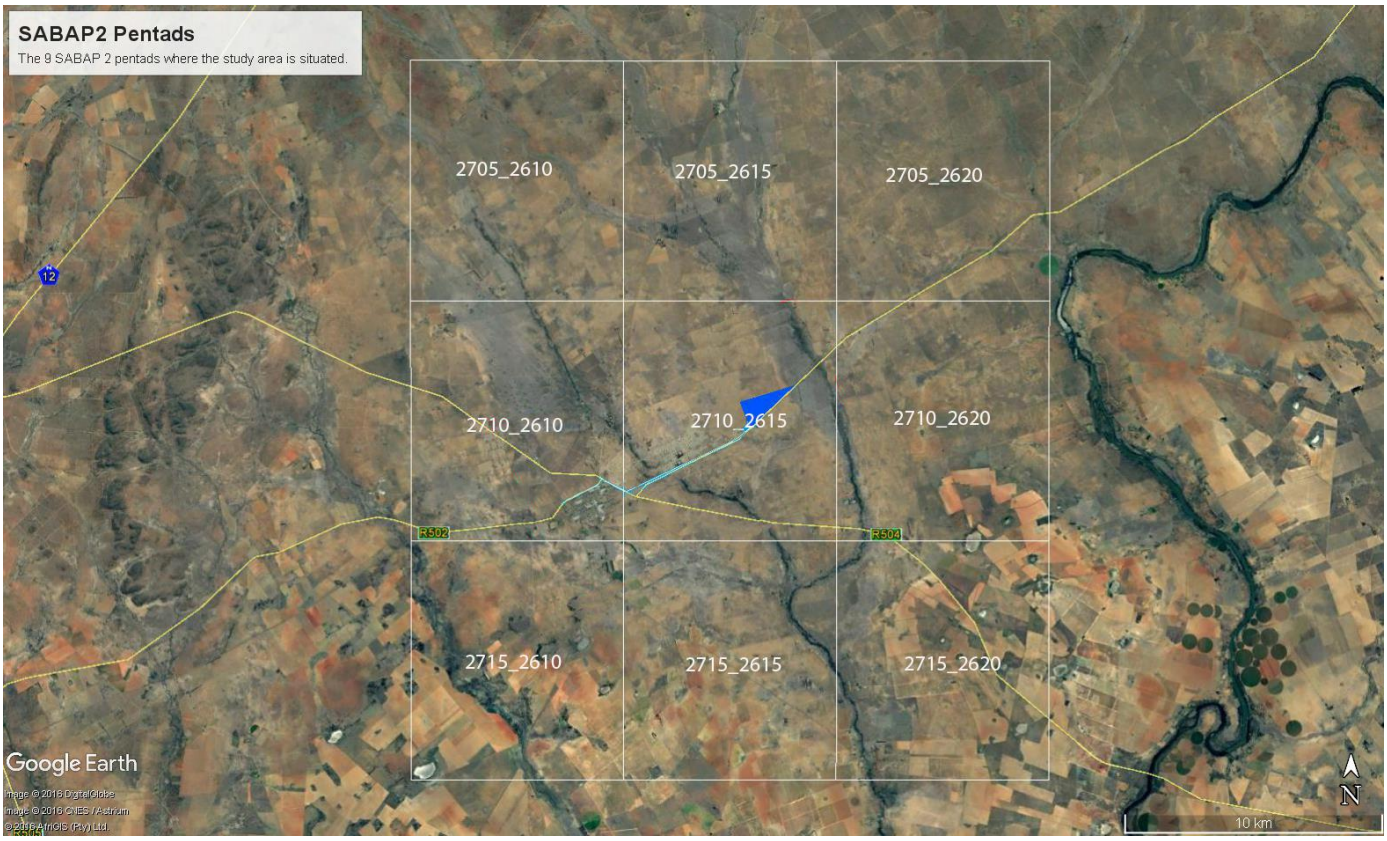

Figure 3: Area covered by the nine SABAP2 pentads. The project site is indicated by the blue polygon.

4 ASSUMPTIONS AND LIMITATIONS

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

- The focus of the study is primarily on the potential impacts on priority species which were defined as follows:
  - South African Red Data species: High conservation significance
  - South African endemics and near-endemics: High conservation significance
  - Raptors: High conservation significance. Raptors are at the top of the food chain and play a key role in their ecosystems. When populations of birds of prey go down, then the numbers of their prey species go up, creating an imbalance in the ecosystem.
  - Waterbirds: Evidence indicate that waterbirds may be particularly susceptible to collisions with solar arrays due to the so-called lake effect, caused by the reflection of the sun of the smooth surface of solar panels.
- The impact of solar installations on avifauna is a relatively new field of study, with only two published scientific study on the impact of PV facilities on avifauna in South Africa (Rudman et al., 2017; Visser et al., 2019); and one related study on the impacts of concentrated solar power facilities on wildlife in South Africa (Jeal et al., 2019). Strong reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists in the project site.
- Cumulative impacts include all solar PV projects within a 35km radius that currently have open applications or have been approved by the Competent Authority.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The site was classified as a Low Sensitivity site as defined in the Solar Guidelines, requiring a Regime 1 protocol to be followed for data collection i.e. a minimum of one site visit of 1 to 5 days in duration.

5 LEGISLATIVE CONTEXT

There is no legislation pertaining specifically to the impact of solar facilities and associated electrical infrastructure on avifauna. The Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa (Jenkins *et al*. 2017), compiled by BirdLife South Africa, was followed.

5.1 Agreements and conventions

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

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

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

[1] (BirdLife International (2016) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2016-04-02).

5.2 National legislation

5.2.1 Constitution of the Republic of South Africa, 1996

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

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

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

  (i) prevent pollution and ecological degradation;

  (ii) promote conservation; and

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

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

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

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

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

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

5.3 Provincial Legislation

The North West Biodiversity Management Act No 4 of 2016 was published on 3 January 2017 but has not yet come into force. The purpose of the North West Biodiversity Management Act No 4 of 2016 is to provide for the management and conservation of the North West Province's biophysical environment and protected areas within the framework of the National Environment Management Act, 1998 (Act No 107 of 1998); to provide for the protection of species and ecological-systems that warrant provincial protection; to provide for the sustainable use of indigenous biological resources; and to provide for matters connected therewith.

6 BASELINE ASSESSMENT

6.1 Important Bird Areas

There are no Important Bird Areas (IBAs) within a 30km radius around the proposed Leeuwbosch Solar PV 3 Plant. It is therefore highly unlikely that the proposed development will have a negative impact on any IBAs.

6.2 Critical Biodiversity Areas (CBAs)

The project site is not a Critical Biodiversity Area (CBA) but is classified as an Ecological Support Area (ESA), more specifically an ESA 1. Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species, and ecological processes, as identified in a systematic biodiversity plan. Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services.

6.3 DFFE National Screening Tool

The application site and immediate environment is classified as Low sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (**Figure 4**). However, based on the available SABAP2 data and the Site Sensitivity Verification (**Appendix 4**) survey conducted in August 2020 the application site contains confirmed records of species of conservation concern (SCC), namely, Secretarybird *Sagittarius serpentarius* (Globally Endangered, Regionally Vulnerable). Therefore, a classification of High sensitivity for the application site is recommended.

Figure 4: DFFE National Screening Tool Map of Relative Animal Species Theme Sensitivity – Leeuwbosch Solar PV 3 Plant.

6.4 National Protected Areas Expansion Strategy (NPEAS) focus areas

The project site forms part of the Vaal Grasslands NPEAS focus area.

6.5 Biomes and vegetation types

The application site is situated approximately 5-10km north-east of the towns of Leeudoringstad and Kgagala, in the North-West Province. The application site is located in the Grassland Biome (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org). Only one vegetation type occurs in the application site, namely Vaal-Vet Sandy Grassland (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org) (**Figure 5**).

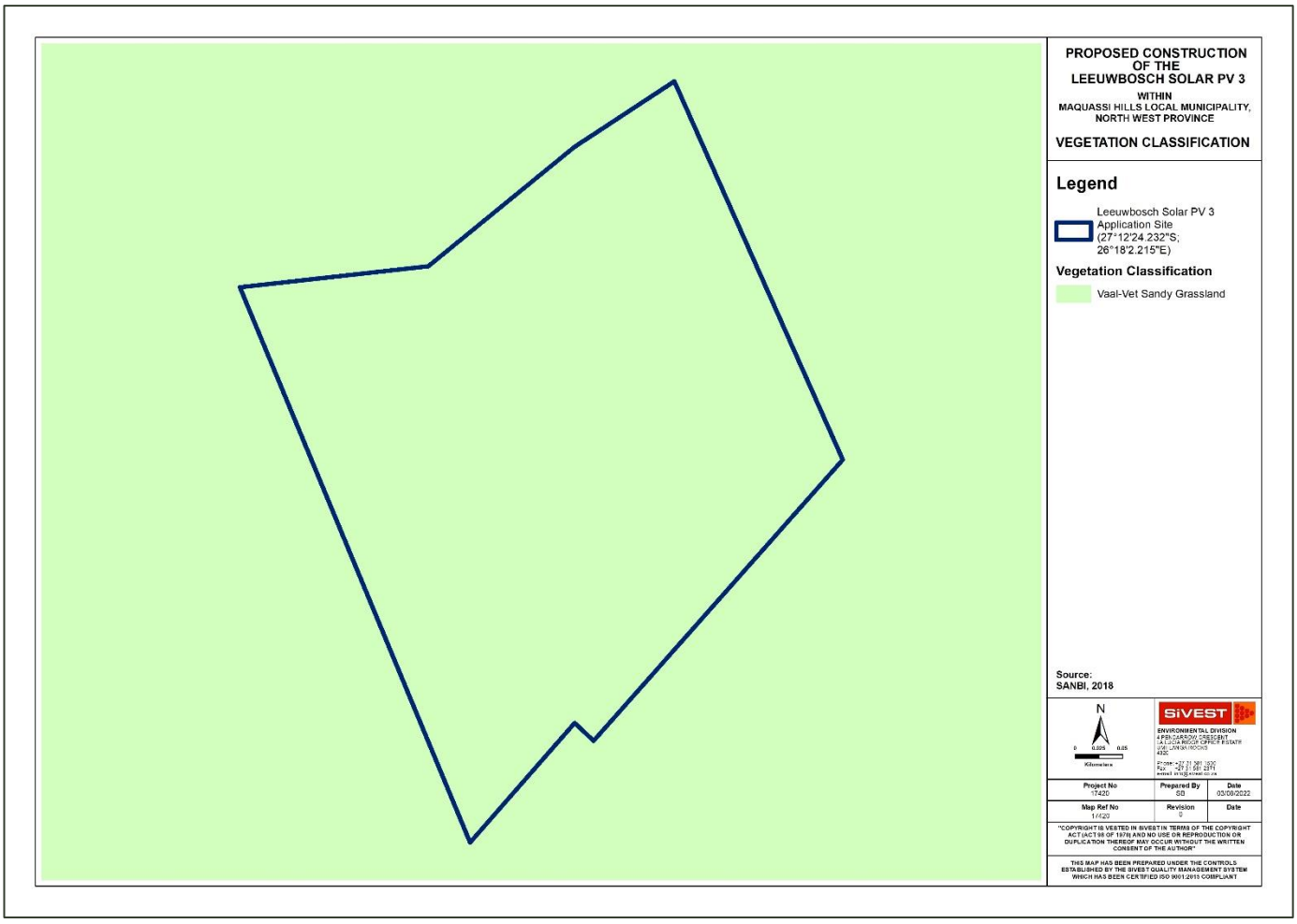

Figure 5: Vegetation Unit Map – Leeuwbosch Solar PV 3 Plant. Only one vegetation type occurs in the application site, namely Vaal-Vet Sandy Grassland.

This vegetation type occurs on plains-dominated landscapes with some scattered, slightly irregular undulating plains and hills. Consists mainly of low-tussock grasslands with an abundant karroid element. Dominance of redgrass/rooigras *Themeda triandra* is an important feature of this vegetation unit. This vegetation type occurs in a warm-temperate, summer-rainfall climate, with overall mean annual precipitation of 530 mm. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford 2006). Average temperatures in the study area range from a low of 2˚C in July to 32˚C in December/January[2].

Whilst the distribution and abundance of the bird species in the project site and application site are mostly associated with natural grassland vegetation, as this comprises virtually all the habitat, it is also necessary to examine micro-habitats in the immediate surroundings that might have relevance for priority species. These are discussed in more detail below.

[2] https://www.worldweatheronline.com/v2/weather-averages.aspx?locid=2756218&root_id=2750634&wc=local_weather&map=~/leeudoringstad-weather-averages/north-west/za.aspx

6.6 Micro-habitats

6.6.1 High voltage lines

High voltage lines are an important roosting substrate for raptors. The application site itself is not bisected by a high voltage line but the Mercury – Mookodi 1 400kV line runs about 1 km north-east of the application site.

6.6.2 Drainage lines

The application site does not contain any drainage lines. One medium-sized, ephemeral drainage line, namely the Klipspruit, runs approximately 3km east of the project site, and a smaller one, namely the Leeuspruit, runs approximately 2.8km south-west of the site. Drainage lines are important corridors of waterbird movement, and the woodland along the banks are a refuge for woodland species.

6.6.3 Dams

The application site does not contain any dams. There is one cement dam immediately adjacent to the northern border of the application site. There is also a cluster of wastewater treatment evaporation ponds which is associated with the two towns, situated approximately 6.5km south-west of the site. Water purification plants are important refuges for waterbirds. There are also artificial waterbodies in Leeudoringstad itself, at the golf course, approximately 6km away.

6.6.4 Exotic trees

There are some stands of exotic trees scattered in the immediate surroundings of the application site. The application site itself contains very few trees. Exotic trees serve as perching and breeding substrate for several priority species, particularly raptors.

6.6.5 Wetlands & Pans

The immediate surroundings contain a few small wetlands which are located in natural depressions in the grassland, and consist of periodically flooded grassland, two areas which are located outside of the application site. When these areas hold water (which is only likely after sustained rainfall events), it may temporarily attract a variety waterbirds. However, due to their small size and ephemeral nature, it is unlikely to be a major attractant to priority species, and they are heavily utilized by cattle for grazing.

See **Appendix 2** for photographic record of the habitat in the project site.

7 AVIFAUNA IN THE PROJECT SITE

7.1 South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 161 bird species could potentially occur within the project site and immediate surroundings – **Appendix 1** provides a comprehensive list of all the species. Of these, 50 species are classified as priority species (see definition of priority species in section 4) and 5 of these are South African Red Data species.

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

- EN = Endangered, VU = Vulnerable, NT = Near threatened, End = South African Endemic, N-End = South African near endemic
- H = High M = Medium L = Low

Table 2: Priority species potentially occurring at the site and immediate surroundings.

Species	Taxonomic name	Global status	Regional status	SA endemic status	Raptor	Waterbird	SABAP2 reporting rate	Probability of occurrence	Recorded during surveys	Habitat						Impacts			
										Grassland	Exotic trees	Drainage lines	Wetlands/Pans	Dams	HV lines	PV collisions	Displacement disturbance	Displacement habitat loss	Entrapment in fences
Buzzard, Steppe	*Buteo vulpinus*				x		3.85	M		x	x				x			x	
Chat, Sickle-winged	*Cercomela sinuata*			N-end			3.85	L		x						x	x	x	
Cisticola, Cloud	*Cisticola textrix*			N-end			23.08	H	x	x						x	x	x	
Cliff-swallow, South African	*Hirundo spilodera*			End			42.31	H	x	x						x		x	
Coot, Red-knobbed	*Fulica cristata*					x	30.77	L					x	x		x			
Cormorant, Reed	*Phalacrocorax africanus*					x	15.38	L				x		x		x			
Cormorant, White-breasted	*Phalacrocorax carbo*					x	3.85	L						x		x			
Darter, African	*Anhinga rufa*					x	3.85	L						x		x			
Duck, Maccoa	*Oxyura maccoa*	VU	NT				3.85	L						x		x			
Duck, White-faced	*Dendrocygna viduata*					x	15.38	L				x		x		x			
Duck, Yellow-billed	*Anas undulata*						19.23	L						x		x			
Eagle, Martial	*Polemaetus bellicosus*	EN	EN			x	0.00	L		x	x				x			x	
Eagle-owl, Spotted	*Bubo africanus*					x	0.00	M		x	x							x	
Egret, Cattle	*Bubulcus ibis*					x	92.31	H		x	x		x					x	
Egret, Great	*Egretta alba*					x	3.85	L						x					
Egret, Little	*Egretta garzetta*					x	3.85	L						x					
Falcon, Amur	*Falco amurensis*				x		3.85	L		x	x							x	
Falcon, Lanner	*Falco biarmicus*	LC	VU		x		0.00	L		x	x				x	x		x	
Flamingo, Greater	*Phoenicopterus ruber*	LC	NT			x	3.85	L					x	x					
Flamingo, Lesser	*Phoenicopterus minor*	NT	NT			x	3.85	L					x	x					
Flycatcher, Fiscal	*Sigelus silens*			N-end			30.77	M				x							
Goose, Egyptian	*Alopochen aegyptiacus*					x	30.77	M	x		x		x	x	x				
Goose, Spur-winged	*Plectropterus gambensis*					x	11.54	M		x			x	x					
Goshawk, Gabar	*Melierax gabar*				x		3.85	L				x							
Grebe, Little	*Tachybaptus ruficollis*					x	26.92	L						x		x			
Heron, Black-headed	*Ardea melanocephala*					x	26.92	H			x	x	x	x	x			x	
Heron, Grey	*Ardea cinerea*					x	15.38	L			x	x	x	x					
Ibis, Glossy	*Plegadis falcinellus*					x	7.69	L			x		x	x				x	
Kestrel, Greater	*Falco rupicoloides*				x		11.54	M		x	x				x			x	
Kestrel, Lesser	*Falco naumanni*				x		30.77	H		x	x				x			x	

Species	Taxonomic name	Global status	Regional status	SA endemic status	Raptor	Waterbird	SABAP2 reporting rate	Probability of occurrence	Recorded during surveys	Habitat						Impacts			
										Grassland	Exotic trees	Drainage lines	Wetlands/Pans	Dams	HV lines	PV collisions	Displacement disturbance	Displacement habitat loss	Entrapment in fences
Kingfisher, Malachite	*Alcedo cristata*					x	3.85	L				x		x					
Kingfisher, Pied	*Ceryle rudis*					x	7.69	L				x		x					
Kite, Black-shouldered	*Elanus caeruleus*				x		38.46	H	x	x	x				x			x	
Kite, Yellow-billed	*Milvus aegyptius*				x		0.00	L		x	x							x	
Lark, Eastern Long-billed	*Certhilauda semitorquata*			End			3.85	L		x							x	x	
Lark, Melodious	*Mirafra cheniana*			N-end			3.85	L		x							x	x	
Night-Heron, Black-crowned	*Nycticorax nycticorax*					x	3.85	L				x		x		x			
Pochard, Southern	*Netta erythrophthalma*					x	3.85	L						x		x			
Sandpiper, Wood	*Tringa glareola*					x	7.69	M				x	x	x		x			
Secretarybird	*Sagittarius serpentarius*				x		3.85	M		x		x					x	x	x
Shelduck, South African	*Tadorna cana*					x	15.38	M						x		x			
Shoveler, Cape	*Anas smithii*					x	3.85	L						x		x			
Snake-Eagle, Black-chested	*Circaetus pectoralis*				x		0.00	M		x			x	x	x			x	
Spoonbill, African	*Platalea alba*					x	3.85	L						x					
Stilt, Black-winged	*Himantopus himantopus*					x	11.54	M						x		x			
Stonechat, African	*Saxicola torquatus*						23.08	H		x							x	x	
Teal, Cape	*Anas capensis*					x	15.38	L						x		x			
Teal, Red-billed	*Anas erythrorhyncha*					x	15.38	L						x		x			
Tern, Whiskered	*Chlidonias hybrida*					x	7.69	L					x	x		x			
Tern, White-winged	*Chlidonias leucopterus*					x	3.85	L					x	x		x			
Thrush, Karoo	*Turdus smithi*			N-end			15.38	L				x							

7.2 On-site surveys

On-site surveys were conducted on 8 August 2020 by means of transect counts.

The abundance of avifauna recorded during the transect counts are displayed in **Figures 6 and 7**.

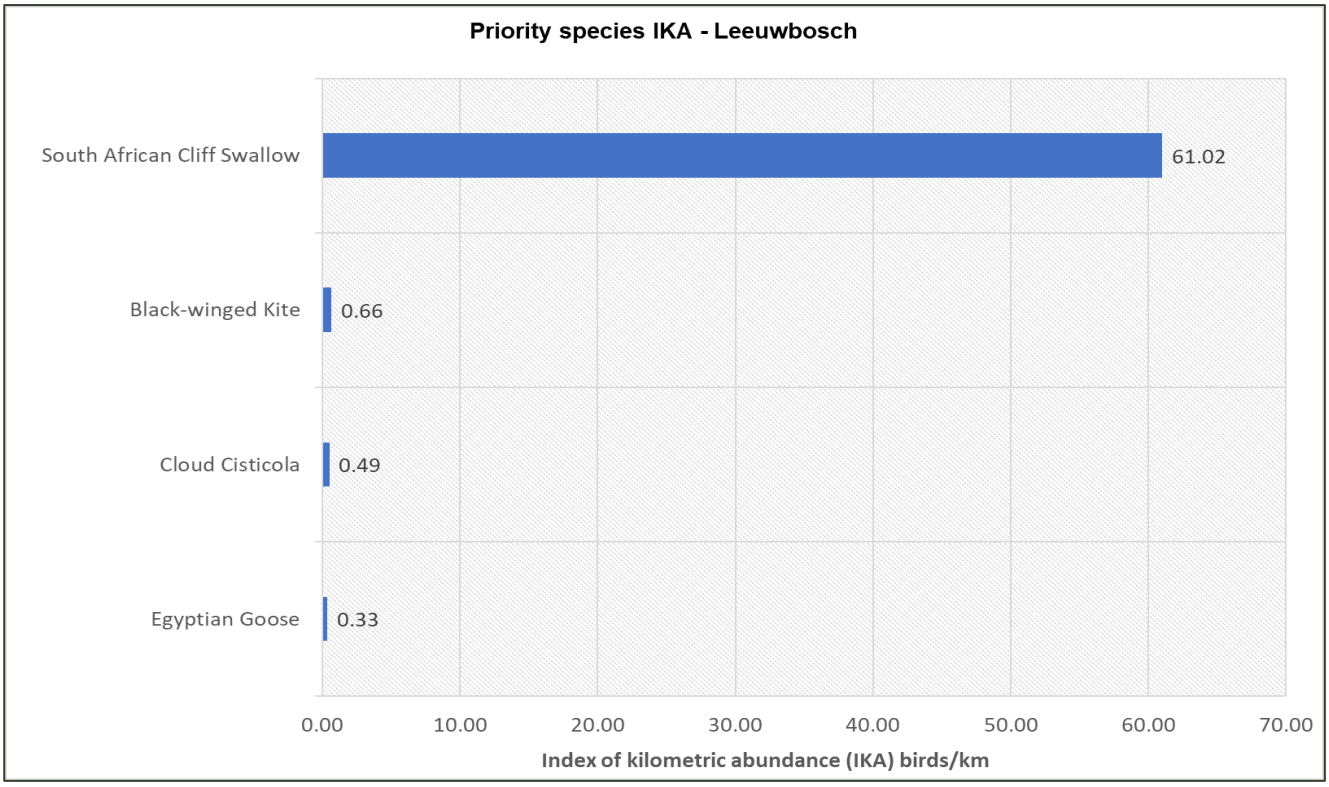

Figure 6: Index of kilometric abundance (IKA) for all priority species recorded by means of walk transects during the surveys in the study area, conducted in August 2020.

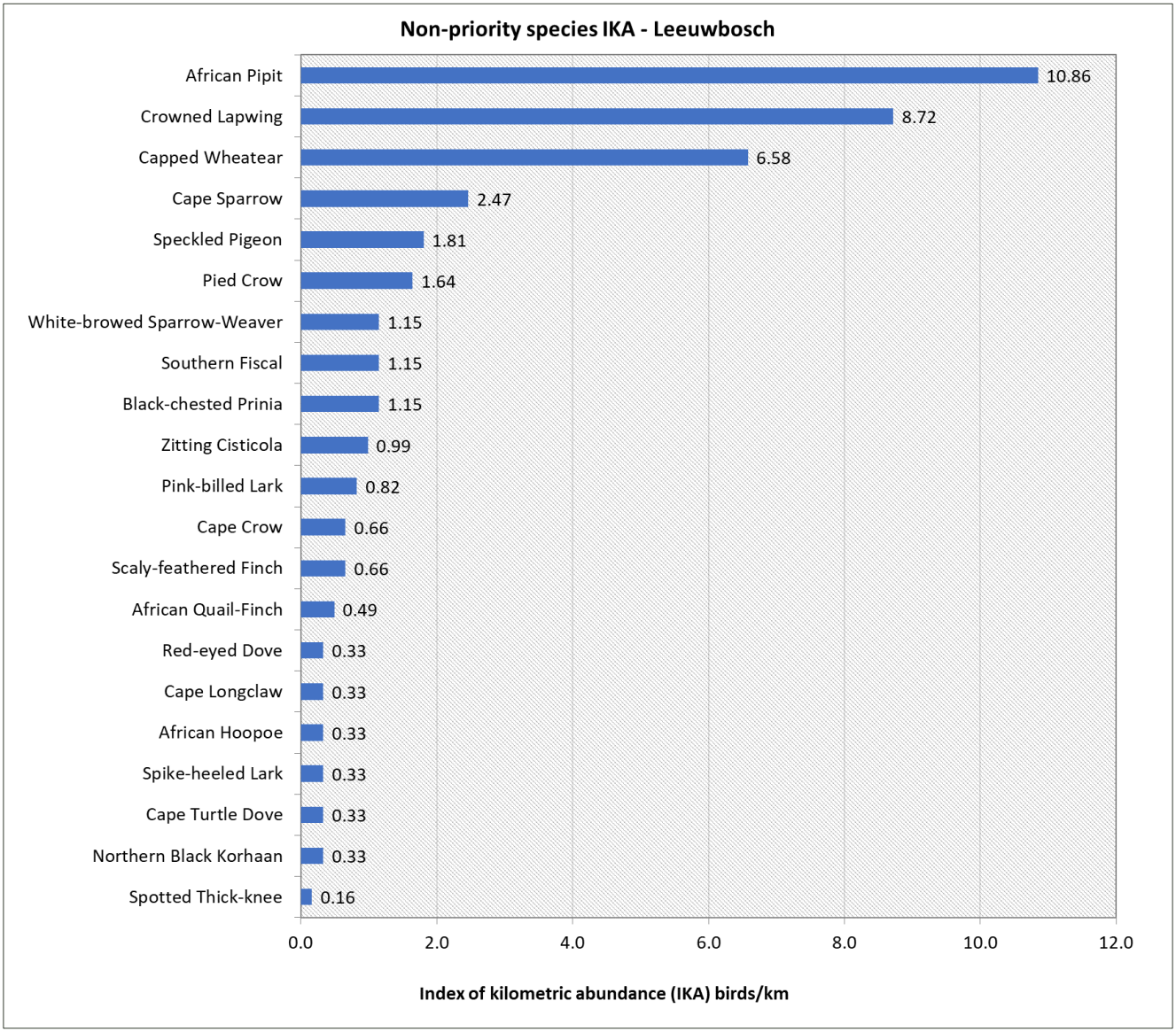

Figure 7: Index of kilometric abundance (IKA) for all non-priority species recorded by means of walk transects during the surveys, conducted in August 2020.

8 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-western United States. In South Africa, only two published scientific studies been conducted on the environmental impacts of PV plants in a South African context (Rudman et al., 2017; Visser et al., 2019). A related scientific study has also been conducted upon the effects of concentrated solar power facilities on wildlife in South Africa (Jeal et al., 2019).

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

8.1 Introduction

Anthropogenic climate change poses a global conservation concern and is predicted to drive rapid redistribution of plant and animal species (National Audubon Society, 2015). Such redistribution events include large-scale population displacements alongside species range reductions and fragmentation, alongside population displacements (Ehrlén & Morris, 2015; Pecl et al., 2017), and changes to the timing interactions (Kharouba et al., 2018). Collectively, these anthropogenically-induced changes pose the risk of extinction event occurring at unprecedented rates compared to natural long-term climate (Urban, 2015) – which is itself a fundamental driver behind species distributions. In 2006, WWF Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth & Mallon, 2006). The report found that:

- Anthropogenic 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 of bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72%, depending on the region, climate scenario and potential for birds to shift to new habitat.

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

- 314 of 588 species modelled (53%) lose more than half of their current geographic range in all three modelled scenarios.
- For 126 species, range loss is predicted to occur without accompanying range expansion.
- For 188 species, predicted range 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-emitting technologies into the country's compliment of power generation will greatly facilitate achieving this important objective (Walwyn & Brent, 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri, 2009; Munzhedzi & Sebitosi, 2009), it is clear that solar power generation should feature prominently in future national efforts to convert to a more sustainable energy suite of energy productions to combat human-induced climate change.

From an avifaunal perspective, solar power generation undoubtedly presents a long-term benefit to species viability, given that solar power generation is anticipated to mitigate the environmental threats posed by anthropogenic climate change (i.e. rapid species redistribution and broad-scale habitat transformation). However, renewable energy facilities – including solar PV facilities – themselves can impede the viability of bird species populations. The environmental risks associated with solar PV facilities need to be recognised and addressed to minimise the negate impacts such facilities may have of bird species populations.

8.2 Impacts associated with PV plants

8.2.1 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)[3]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the “lake effect” hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). Koskiuch *et al.* (2020) found that water-obligate birds, which rely on water for take-off and landing, occurred at 90% (9/10) of site-years at 7 sites in the Sonoran and Mojave Deserts Bird Conservation Region in the USA from January 2013 to September 2018. However, they stressed that their statements should not be interpreted as evidence there will be water-obligate bird mortality at PV facilities developed in areas with concentrations of migrating or overwintering water obligates because the causal mechanism for fatality risk is unknown. 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.

[3] 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.

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

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility (28°17′53″S, 23°21′56″E) which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser *et al.* 2019). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser *et al.* 2018).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. Kosciuch *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. Annual fatality rates never exceeded 2.99 fatalities/MW/year (1.03 fatalities/hectare/year), and 3 of the four top species detected were ground-dwelling species.

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, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them.

Species which could potentially be impacted due to collisions with the solar panels are:

- Chat, Sickle-winged
- Cisticola, Cloud
- Cliff-swallow, South African
- Falcon, Lanner
- Falcon, Amur
- Kestrel, Lesser
- Lark, Eastern Long-billed

- Lark, Melodious
- Stonechat, African

8.2.2 Entrapment in perimeter fences

Visser et al. (2019) recorded a fence-line fatality of an Orange River Francolin *Scleroptila gutturalis* resulting being trapped between the inner and outer perimeter fence of the facility; additionally, three Red-crested Korhaans were claimed to be unable to escape between these two fences without intervention from facility personnel. 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. Potentially, too-close a parallel configuration of double-fenced perimeters can cause fatalities, particularly of larger terrestrial birds, by way of entrapment, and especially if disturbed by people. This risk remains low, however, with Visser et al. (2019) tentatively presenting a fatality rate of 0.002 birds per km per month from this risk factor, although qualifying that the single documented fatality was inadequate for robust extrapolations. Owls are also prone to getting entangled in barbed wire fences (personal observation).

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

8.2.3 Displacement due to habitat transformation associated with the construction of the solar PV plant

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

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

- Chat, Sickle-winged
- Cisticola, Cloud
- Cliff-swallow, South African
- Falcon, Lanner
- Falcon, Amur
- Kestrel, Lesser
- Lark, Eastern Long-billed
- Lark, Melodious
- Stonechat, African
- Eagle, Martial
- Eagle-owl, Spotted
- Egret, Cattle
- Heron, Black-headed
- Ibis, Glossy
- Buzzard, Steppe
- Kestrel, Greater
- Kite, Black-shouldered
- Kite, Yellow-billed
- Secretarybird
- Snake-Eagle, Black-chested

8.2.4 Displacement due to disturbance associated with the construction of the solar PV plant

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. The priority species which would be most severely affected would be ground dwelling birds or those that utilise low shrubs for nesting:

- Chat, Sickle-winged
- Cisticola, Cloud
- Lark, Eastern Long-billed
- Lark, Melodious
- Stonechat, African

9 IMPACT RATING

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

9.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in the table below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

9.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- Planning
- Construction
- Operation
- Decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact has been detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).

4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude / intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

9.3 Impact Assessments – All phases

LEEUWBOSCH SOLAR PV 3 PLANT AND ASSOCIATED INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Planning / Pre-construction Phase																				
Avifauna	None										•									
Construction Phase (Direct Impacts)																				
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure	1	4	2	3	1	3	33	-	Medium	• Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.	1	3	2	3	1	3	30	-	Medium
Operational Phase (Direct Impacts)																				
Avifauna	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	1	4	3	3	3	3	42	-	Medium	• Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary degradation of habitat. • 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 enforced.	1	2	2	2	3	2	20	-	Low

LEEUWBOSCH SOLAR PV 3 PLANT AND ASSOCIATED INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Avifauna	Entrapment of large-bodied birds in the double perimeter fence	2	2	1	2	3	2	20	-	Low	It is recommended that a single perimeter fence is used	2	1	1	2	3	2	18	-	Low
Decommissioning Phase (Direct Impacts)																				
Avifauna	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure	1	4	1	2	1	1	9	-	Low	• De-commissioning activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly enforced	1	3	1	2	1	1	8	-	Low
Cumulative Impacts																				
Avifauna	Cumulative impact of displacement due to construction and habitat transformation, collisions with solar panels and entrapment in fences	1	3	3	2	3	2	24	-	Medium	All mitigation measures listed above	1	3	3	2	2	2	22	-	Low

The impacts were summarized, and a comparison made between pre-and post-mitigation phases as shown in Table below. The rating of environmental issues associated with different parameters prior to, and post mitigation of a proposed activity was averaged. A comparison was then made to determine the effectiveness of the proposed mitigation measures. The comparison identified critical issues related to the environmental parameters.

Table 3: Comparison of summarised impacts on environmental parameters – All phases

Environmental parameter	Issues	Rating prior to mitigation	Rating post mitigation
Avifauna	*Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.*	-33 (Medium negative)	-30 (Medium negative)
	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	-42 (Medium negative)	-39 (Medium negative)
	Mortality of priority species due to collisions with solar panels	-20 (low negative)	-20 (low negative)
	Entrapment of large-bodied birds in the double perimeter fence	-20 (low negative)	-18 (low negative)
	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	-9 (low negative)	-8 (low negative)
	Cumulative impact of displacement due to construction and habitat transformation, collisions with solar panels and entrapment in fences	-24 (medium negative)	-22 (low negative)
	Average	24.6 (medium-low negative)	22.8 (low negative)

9.4 Cumulative impacts

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change in an area, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy projects within a 35 km radius that have received an EA at the time of starting the environmental impact process, as well as the proposed Leeuwbosch 3 Solar PV Plant. There are currently four (4) renewable energy projects authorised, operational, or in process within a 35 km radius around the proposed Leeuwbosch 3 Solar PV Plant (**Figure 8**).

The total affected land parcel area taken up by authorised and planned renewable energy projects within the 35 km radius, including the proposed Leeuwbosch 3 Solar PV Plant, is approximately 35.16 km². The total affected land parcel area affected by the Leeuwbosch 3 Solar PV Plant only equates to approximately 0.26km². The proposed Leeuwbosch 3 Solar PV Plant land parcel area therefore constitutes ~0.74% of the total affected land parcel area. The cumulative impact of the proposed Leeuwbosch 3 Solar PV Plant is thus anticipated to be **low** after mitigation.

The total area within the 35km radius around the proposed projects equates to about 2016.19 km² of natural grassland habitat or fallow land (grass) habitat (excluding developed areas). The total combined size of the land parcels potentially affected by renewable energy projects will equate to ~1.74% of the available untransformed habitat in the 35km radius. Assuming that all the projects are actually constructed, the cumulative impact of all the proposed renewable energy projects is estimated to be **low** post mitigation, considering the conservation status of grassland habitats and the avifauna that depend on grasslands. The actual physical footprint of the renewable energy facilities will be smaller than the land parcel areas themselves. Furthermore, several of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction.

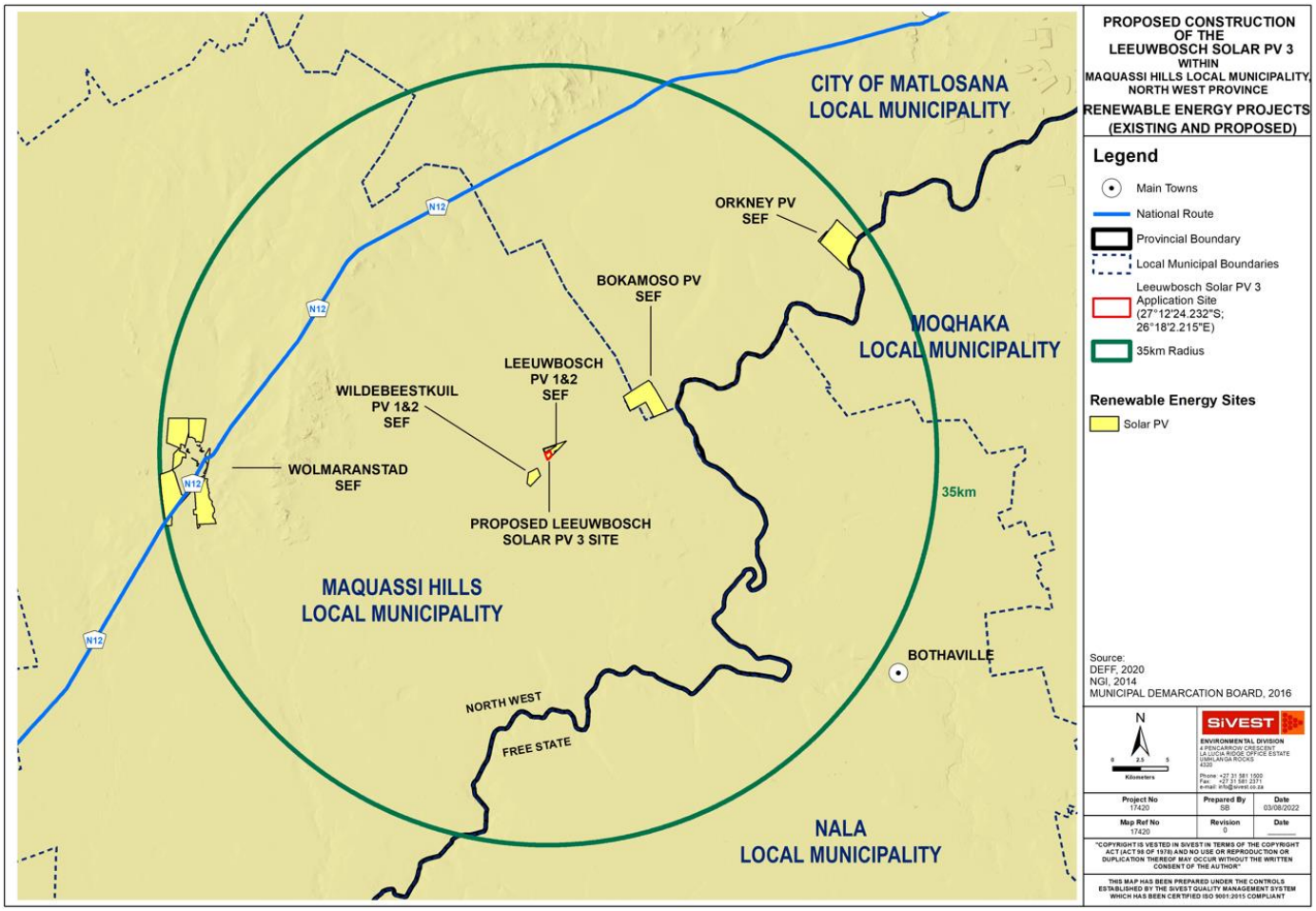

Figure 8: South Africa Renewable Energy EIA Applications Map for the area (35 km radius) near the proposed Leeuwbosch 3 Solar PV Plant (Department of Forestry, Fisheries, and the Environment (DFFE), 2021).

10 ENVIRONMENTAL MANAGEMENT PROGRAMME

For each anticipated impact, management recommendations for the design, construction, and operational phase (where appropriate) are included in the project EMPr (**Appendix 5**).

10.0 No-Go Alternative

The 'no-go' alternative is the option of not undertaking the proposed SEF and associated infrastructures. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or the surrounding local area.

11 CONCLUSIONS

The proposed Leeuwbosch Solar PV 3 Plant will have a medium negative impact on priority avifauna, which can be reduced to low with appropriate mitigation. The development is supported provide the mitigation measures listed in this report is strictly implemented. No fatal flaws were discovered in the course of the investigations.

As mentioned above, the cumulative impact of the facility on priority avifauna within a 35km radius around the proposed development (considering all current impacts on avifauna) is assessed to be low, mainly due to the small size of the proposed development.

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE PROJECT SITE AND SURROUNDINGS

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Acacia Pied Barbet	*Tricholaema leucomelas*	73.08	0
African Black Swift	*Apus barbatus*	3.85	0
African Darter	*Anhinga rufa*	3.85	0
African Hoopoe	*Upupa africana*	26.92	0
African Palm-swift	*Cypsiurus parvus*	15.38	5
African Pipit	*Anthus cinnamomeus*	23.08	0
African Quailfinch	*Ortygospiza atricollis*	69.23	0
African Red-eyed Bulbul	*Pycnonotus nigricans*	73.08	5
African Sacred Ibis	*Threskiornis aethiopicus*	23.08	0
African Spoonbill	*Platalea alba*	3.85	0
African Stonechat	*Saxicola torquatus*	23.08	0
Amur Falcon	*Falco amurensis*	3.85	15
Anteating Chat	*Myrmecocichla formicivora*	53.85	15
Ashy Tit	*Parus cinerascens*	11.54	0
Barn Swallow	*Hirundo rustica*	38.46	15
Black-chested Prinia	*Prinia flavicans*	80.77	0
Black-chested Snake-eagle	*Circaetus pectoralis*	0.00	5
Black-crowned Night-Heron	*Nycticorax nycticorax*	3.85	0
Black-headed Heron	*Ardea melanocephala*	26.92	5
Black-shouldered Kite	*Elanus caeruleus*	38.46	10
Blacksmith Lapwing	*Vanellus armatus*	84.62	0
Black-throated Canary	*Crithagra atrogularis*	57.69	0
Black-winged Stilt	*Himantopus himantopus*	11.54	0
Blue Waxbill	*Uraeginthus angolensis*	23.08	0
Bokmakierie Bokmakierie	*Telophorus zeylonus*	30.77	0
Brown-crowned Tchagra	*Tchagra australis*	30.77	0
Brown-hooded Kingfisher	*Halcyon albiventris*	3.85	0
Brown-throated Martin	*Riparia paludicola*	7.69	0
Brubru Brubru	*Nilaus afer*	3.85	0
Cape Glossy Starling	*Lamprotornis nitens*	61.54	5
Cape Longclaw	*Macronyx capensis*	50.00	0
Cape Penduline-tit	*Anthoscopus minutus*	11.54	0
Cape Robin-chat	*Cossypha caffra*	30.77	0
Cape Shoveler	*Anas smithii*	3.85	0

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Cape Sparrow	*Passer melanurus*	80.77	0
Cape Teal	*Anas capensis*	15.38	0
Cape Turtle-dove	*Streptopelia capicola*	34.62	10
Cape Wagtail	*Motacilla capensis*	42.31	0
Cape White-eye	*Zosterops virens*	11.54	0
Capped Wheatear	*Oenanthe pileata*	3.85	0
Cardinal Woodpecker	*Dendropicos fuscescens*	3.85	0
Cattle Egret	*Bubulcus ibis*	92.31	10
Chestnut-backed Sparrowlark	*Eremopterix leucotis*	3.85	0
Chestnut-vented Tit-babbler	*Parisoma subcaeruleum*	80.77	0
Cinnamon-breasted Bunting	*Emberiza tahapisi*	19.23	0
Cloud Cisticola	*Cisticola textrix*	23.08	0
Common (Southern) Fiscal	*Lanius collaris*	88.46	20
Common Myna	*Acridotheres tristis*	69.23	5
Common Ostrich	*Struthio camelus*	15.38	5
Common Scimitarbill	*Rhinopomastus cyanomelas*	7.69	0
Common Swift	*Apus apus*	3.85	0
Common Waxbill	*Estrilda astrild*	3.85	0
Crested Barbet	*Trachyphonus vaillantii*	69.23	0
Crowned Lapwing	*Vanellus coronatus*	84.62	5
Desert Cisticola	*Cisticola aridulus*	38.46	0
Diderick Cuckoo	*Chrysococcyx caprius*	30.77	0
Domestic Goose	*Anser anser*	3.85	0
Eastern Clapper Lark	*Mirafra fasciolata*	34.62	0
Eastern Long-billed Lark	*Certhilauda semitorquata*	3.85	0
Egyptian Goose	*Alopochen aegyptiacus*	30.77	0
European Bee-eater	*Merops apiaster*	30.77	5
Fiscal Flycatcher	*Sigelus silens*	30.77	0
Fork-tailed Drongo	*Dicrurus adsimilis*	7.69	0
Gabar Goshawk	*Melierax gabar*	3.85	0
Glossy Ibis	*Plegadis falcinellus*	7.69	0
Great Egret	*Egretta alba*	3.85	0
Greater Flamingo	*Phoenicopterus ruber*	3.85	0
Greater Kestrel	*Falco rupicoloides*	11.54	5
Greater Striped Swallow	*Hirundo cucullata*	46.15	10
Green-winged Pytilia	*Pytilia melba*	15.38	0

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Grey Heron	*Ardea cinerea*	15.38	0
Hadeda Ibis	*Bostrychia hagedash*	65.38	10
Helmeted Guineafowl	*Numida meleagris*	53.85	15
House Sparrow	*Passer domesticus*	46.15	0
Kalahari Scrub-robin	*Cercotrichas paena*	50.00	0
Karoo Thrush	*Turdus smithi*	15.38	0
Lark-like Bunting	*Emberiza impetuani*	3.85	0
Laughing Dove	*Streptopelia senegalensis*	96.15	25
Lesser Flamingo	*Phoenicopterus minor*	3.85	0
Lesser Grey Shrike	*Lanius minor*	15.38	0
Lesser Kestrel	*Falco naumanni*	30.77	15
Lesser Swamp-warbler	*Acrocephalus gracilirostris*	7.69	0
Levaillant's Cisticola	*Cisticola tinniens*	26.92	0
Lilac-breasted Roller	*Coracias caudatus*	3.85	0
Little Egret	*Egretta garzetta*	3.85	0
Little Grebe	*Tachybaptus ruficollis*	26.92	0
Little Stint	*Calidris minuta*	3.85	0
Little Swift	*Apus affinis*	57.69	5
Long-billed Crombec	*Sylvietta rufescens*	3.85	0
Long-tailed Paradise-whydah	*Vidua paradisaea*	23.08	0
Long-tailed Widowbird	*Euplectes progne*	69.23	15
Maccoa Duck	*Oxyura maccoa*	3.85	0
Malachite Kingfisher	*Alcedo cristata*	3.85	0
Mallard Duck	*Anas platyrhynchos*	3.85	0
Marsh Sandpiper	*Tringa stagnatilis*	3.85	0
Melodious Lark	*Mirafra cheniana*	3.85	0
Namaqua Dove	*Oena capensis*	38.46	5
Neddicky Neddicky	*Cisticola fulvicapilla*	65.38	0
Northern Black Korhaan	*Afrotis afraoides*	69.23	5
Orange River Francolin	*Scleroptila levaillantoides*	15.38	0
Orange River White-eye	*Zosterops pallidus*	26.92	0
Pied Crow	*Corvus albus*	46.15	20
Pied Kingfisher	*Ceryle rudis*	7.69	0
Pin-tailed Whydah	*Vidua macroura*	11.54	0
Pririt Batis	*Batis pririt*	26.92	0
Rattling Cisticola	*Cisticola chiniana*	3.85	0

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Red-backed Shrike	*Lanius collurio*	30.77	0
Red-billed Firefinch	*Lagonosticta senegala*	15.38	0
Red-billed Quelea	*Quelea quelea*	50.00	0
Red-billed Teal	*Anas erythrorhyncha*	15.38	0
Red-breasted Swallow	*Hirundo semirufa*	15.38	5
Red-capped Lark	*Calandrella cinerea*	11.54	0
Red-crested Korhaan	*Lophotis ruficrista*	3.85	0
Red-eyed Dove	*Streptopelia semitorquata*	65.38	10
Red-faced Mousebird	*Urocolius indicus*	65.38	0
Red-headed Finch	*Amadina erythrocephala*	15.38	0
Red-knobbed Coot	*Fulica cristata*	30.77	0
Reed Cormorant	*Phalacrocorax africanus*	15.38	0
Rock Dove	*Columba livia*	23.08	10
Ruff Ruff	*Philomachus pugnax*	3.85	0
Rufous-naped Lark	*Mirafra africana*	23.08	5
Sabota Lark	*Calendulauda sabota*	26.92	0
Scaly-feathered Finch	*Sporopipes squamifrons*	96.15	0
Secretarybird Secretarybird	*Sagittarius serpentarius*	3.85	0
Shaft-tailed Whydah	*Vidua regia*	7.69	0
Sickle-winged Chat	*Cercomela sinuata*	3.85	0
South African Cliff-swallow	*Hirundo spilodera*	42.31	30
South African Shelduck	*Tadorna cana*	15.38	0
Southern Grey-headed Sparrow	*Passer diffusus*	76.92	0
Southern Masked-weaver	*Ploceus velatus*	84.62	15
Southern Pochard	*Netta erythrophthalma*	3.85	0
Southern Red Bishop	*Euplectes orix*	42.31	5
Southern Yellow-billed Hornbill	*Tockus leucomelas*	3.85	0
Speckled Mousebird	*Colius striatus*	11.54	0
Speckled Pigeon	*Columba guinea*	53.85	5
Spike-heeled Lark	*Chersomanes albofasciata*	3.85	0
Spotted Flycatcher	*Muscicapa striata*	15.38	0
Spur-winged Goose	*Plectropterus gambensis*	11.54	5
Steppe Buzzard	*Buteo vulpinus*	3.85	10
Swainson's Spurfowl	*Pternistis swainsonii*	69.23	0
Swallow-tailed Bee-eater	*Merops hirundineus*	7.69	0
Village Indigobird	*Vidua chalybeata*	11.54	0

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Violet-eared Waxbill	*Granatina granatina*	15.38	0
Wattled Starling	*Creatophora cinerea*	30.77	0
Whiskered Tern	*Chlidonias hybrida*	7.69	0
White-backed Mousebird	*Colius colius*	50.00	0
White-bellied Sunbird	*Cinnyris talatala*	7.69	0
White-breasted Cormorant	*Phalacrocorax carbo*	3.85	0
White-browed Sparrow-weaver	*Plocepasser mahali*	96.15	10
White-faced Duck	*Dendrocygna viduata*	15.38	0
White-fronted Bee-eater	*Merops bullockoides*	15.38	0
White-rumped Swift	*Apus caffer*	7.69	10
White-throated Swallow	*Hirundo albigularis*	3.85	0
White-winged Tern	*Chlidonias leucopterus*	3.85	0
White-winged Widowbird	*Euplectes albonotatus*	7.69	0
Wood Sandpiper	*Tringa glareola*	7.69	0
Yellow Canary	*Crithagra flaviventris*	57.69	0
Yellow-billed Duck	*Anas undulata*	19.23	0
Yellow-crowned Bishop	*Euplectes afer*	19.23	0
Yellow-fronted Canary	*Crithagra mozambicus*	11.54	0
Zitting Cisticola	*Cisticola juncidis*	11.54	0

APPENDIX 2: HABITAT AT THE PROJECT SITE

Figure 1: Typical grassland habitat at the project site and application site.

Figure 2: Alien trees adjacent to the application site.

Figure 3: A small area of flooded grassland near the project site.

Figure 4: A cement dam on the border of the application site of the project site.

PROPOSED DEVELOPMENT OF THE LEEUWBOSCH 3 SOLAR PHOTOVOLTAIC (PV) PLANT (15MW) AND ASSOCIATED INFRASTRUCTURE NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE

TERMS OF REFERENCE (ToR) FOR SPECIALIST STUDIES

1. INTRODUCTION

The purpose of these Terms of Reference is to provide the specialist team with a consistent approach to the specialist studies that are required as part of the Basic Assessment (BA) process being conducted in respect of the Solar Energy Facility (SEF) and associated infrastructure. This will enable comparison of environmental impacts, efficient review and collation of the specialist studies into the BA report, in accordance with the latest requirements of the EIA Regulations, 2014 (as amended).

2. PROCESS

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 (this project is considered a BA process due to energy capacity thresholds of under 20MW and vegetation clearance thresholds of under 20ha), which may have an impact on the environment and therefore require authorisation from the provincial competent authority, namely the North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT), prior to the commencement of such activities.

3. PROJECT DESCRIPTION

3.1. Project history

Leeuwbosch PV Generation (Pty) Ltd has appointed SiVEST Environmental (hereafter referred to as “SiVEST”) to undertake the required BA Process for the proposed construction of the solar photovoltaic (PV) plant and associated infrastructure approximately 6km north-east of the town of Leeudoringstad in the North West Province. The EA that is required for the proposed solar PV plant and associated infrastructure is as follows:

- Leeuwbosch 3 Solar PV Plant (up to 15MW)

The overall objective of the proposed development is to generate electricity (by capturing solar energy) to feed into the national electricity grid and “wheel” the power to private offtakers based on a Power Purchase Agreement (PPA).

3.2. Project location

Leeuwbosch PV Generation (Pty) Ltd proposes the development of a solar Photovoltaic (PV) plant and associated infrastructures on a site located approximately 6km north east of the town of Leeudoringstad. The solar PV plant will comprise several arrays of PV panels, and associated infrastructure. The associated infrastructure would include, but not be limited to, internal access roads, one (1) switching substation, one (1) permanent guard house and one (1) temporary building zone. The solar PV plant will have a contracted capacity of up to 15MW and will be known as the Leeuwbosch 3 Solar PV Plant.

A preferred project site has been identified by Leeuwbosch PV Generation (Pty) Ltd as a technically suitable area for the development of the solar PV plant. The project site falls within the Maquassi Hills Local Municipality within the Dr Kenneth Kaunda District Municipality in the North West Province. The site is accessible via an existing gravel road which branches off the tarred R502 Provincial Road. The Leeuwbosch PV is located on Portion 37 of Farm Leeuwbosch 44.

The above-mentioned property is approximately 124,691 ha in extent. The proposed solar PV plant and associated infrastructure assessed as part of this BA will however only cover an area of up to approximately 26.4ha. The proposed development is located in the North West Province, in the Dr Kenneth Kaunda District Municipality within the Maquassi Hills Local Municipality. It is directly west of the Harvard Substation, where the current supply of electricity for the local areas and businesses is extracted from.

3.3. **Solar PV Energy Facility Components**

The key components to be constructed are listed below:

Project Component	**Description**
Solar PV – Technology	• The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules. • PV panel mountings. PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. • Each PV module will be approximately 2274mm (≈2.3m) long and 1134mm (≈1.1m) wide and mounted on supporting structures above ground. At this stage it is anticipated that the structures will be mono-facial modules. The final design details will become available during the detailed design phase of the proposed development, prior to the start of construction. • The foundations will most likely be either concrete or rammed piles. The final foundation design will be determined at the detailed design phase of the proposed development.
Generation Capacity of Solar PV Plant	Maximum of up to approx. 15MW
Capacity of Switching Substation	More than 33kV but less than 275kV. Exact capacity of the proposed on-site switching substation will be determined and confirmed at a later stage.
Dimensions of PV Panels	• Width: up to approx. 2274mm (≈2.3m) • Length: up to approx. 1134mm (≈1.1m)
Area of Project site	Approximately 124.691ha

Project Component	Description
On-site Switching Substation	• One (1) new on-site switching substation with a capacity of more than 33 but less than 275kV. Exact capacity of the proposed on-site switching substation will be determined and confirmed at later stage; • To connect proposed solar PV plant to 132/11kV Leeudoringstad Solar Plant Substation (part of separate BA process). • Located within Portion 37 of the Farm Leeuwbosch No. 44; • Total footprint: up to approx. 0.2003ha (i.e. 2 003m^2); and • To contain transformers for voltage, step up from medium voltage to high voltage. DC power from the PV modules will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers.
Guard House	• One (1) permanent guard house; and • Total footprint: up to approx. 0.0876ha (i.e. 876m^2).
Temporary Building Zone	• One (1) temporary building zone; and • Total footprint: up to approx. 0.2944ha (i.e. 2 944m^2).
Area Occupied by Buildings	Up to approximately 1.3807ha (i.e. 13 807m^2)
Width of Existing Internal Gravel Roads	• Up to approx. 4m; and • Existing internal gravel site roads will be used wherever possible. However, where required, new internal gravel roads may be constructed.
Length of existing internal roads (to be potentially upgraded)	• Up to approx. 1.57km; and • Final lengths however to be confirmed once contractor has been selected and the design is finalised.
Site Access	Access to the proposed development (solar PV plant project site) will be via an existing gravel road which connects to the tarred R502 road.
Proximity to grid connection	Although the on-site switching substation forms part of this application, the 132kV overhead power lines and 132/11kV Leeudoringstad Solar Plant Substation are not part of this Basic Assessment (BA) and has been applied for as part of separate respective BA process. • Grid connection is to the 132/11kV Leeudoringstad Solar Plant Substation, which has been applied for as part of a separate BA process; and • The 132/11kV Leeudoringstad Solar Plant Substation is located within the proposed Leeuwbosch 3 Solar PV Plant project site (namely Portion 37 of the Farm Leeuwbosch No. 44). • Medium voltage cabling (anticipated to be approx. 0.8m x 0.6m wide at this stage) will link the various PV arrays to the switching substation, as well as the Leeudoringstad Solar Plant Substation. These

Project Component	Description
	cables will be laid underground, wherever technically feasible.
Height of fencing	• Approx. 2.1m high; and • Fencing will surround the entire proposed solar PV plant.
Type of fencing	Galvanised steel with electrification on top
Area covered by fencing	Up to approximately 18ha
Boreholes and storage tanks	• At this stage it is anticipated that existing boreholes will be utilised; • Water will potentially be stored in temporary water storage tanks. This will be confirmed throughout the BA process; and • The necessary approvals from the Department of Water and Sanitation (DWS) will need to be applied for (should this be required).

4. BA ALTERNATIVES

4.1. Location alternatives

The placement of a solar PV facility is dependent on several other factors including land suitability, environmental sensitivities, climatic conditions (solar irradiation levels), topography, the location and extent of the study area, availability of grid connection infrastructure and the need and desirability of the project. Furthermore, the North West Province in South Africa has a favourable solar irradiation potential. The area receives an annual Global Horizontal Irradiation (GHI) ranging between 1972 and 2118kWh/m2/year.

Based on the site-specific attributes, the Applicant considers the preferred development area placed within the study area as being highly favourable and suitable for the establishment of a solar PV plant. No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development.

4.2. Technology alternatives

Few technology options are available for solar PV facilities, and the use of those that are considered are usually differentiated by weather and temperature conditions that prevail in the area, so that optimality is obtained by the final site selection. Solar energy is considered to be the most suitable renewable energy technology for the project area, based on the site location, ambient conditions and energy resource availability.

No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view.

5. LAYOUT ALTERNATIVES

An environmental sensitivity map will be provided in order to illustrate the sensitive environmental features located within the project site which needs to be considered and, in some instances completely avoided by the development

footprint. Once more detailed information is available, the layout of the PV plant footprint and infrastructure will be adjusted if necessary to ensure avoidance of any identified sensitive areas.

Design and layout alternatives will be considered and assessed as part of the Basic Assessment Process.

4. THE OPERATIONAL ASPECTS OF THE ACTIVITY

No operational alternatives were assessed in the BA, as none are available for solar PV installations.

5. 'NO-GO' ALTERNATIVE

The 'no-go' alternative is the option of not undertaking the proposed SEF and associated infrastructures. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or the surrounding local area.

The 'no-go' option is a feasible option; however, this would prevent the Leeuwbosch 3 Solar PV Plant from contributing to the environmental, social and economic benefits associated with the development of the renewables sector.

6. SPECIALIST REPORT REQUIREMENTS

The specialist assessments should include the following sections:

6.1. Project Description

The specialist report must include the project description as provided above.

6.2. Terms of Reference (ToR)

The specialist report must include an explanation of the Terms of Reference (ToR) applicable to the specialist study. In addition, a table must be provided at the beginning of the specialist report listing the requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended) and cross referencing these requirements with the relevant sections in the report. An MS Word version of this table will be provided by SiVEST.

6.3. Legal Requirements and Guidelines

The specialist report must include a thorough overview of all applicable best practice guidelines, relevant legislation and authority requirements.

6.4. Methodology

The report must include a description of the methodology applied in carrying out the specialist assessment.

6.5. Specialist Findings / Identification of Impacts

The report must present the findings of the specialist studies and explain the implications of these findings for the proposed development (e.g. permits, licenses etc.). This section of the report should also identify any sensitive and/or 'no-go' areas on the development site which should be avoided.

The reports should be accompanied with spatial datasets (shapefiles, KML) and accompanying text documents if required.

6.6. **Impact Rating Methodology**

The impacts of the proposed solar PV plant (during the Construction, Operation and Decommissioning phases) are to be assessed and rated according to the methodology developed by SiVEST. Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose. Please note that the significance of Cumulative Impacts should also be rated in this section. Both the methodology and the rating matrix will be provided by SiVEST.

Please be advised that this section must include mitigation measures aimed at minimising the impact of the proposed development.

6.7. **Input to The Environmental Management Program (EMPr)**

The report must include a description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the proposed development for inclusion in the Environmental Management Program (EMPr) or Environmental Authorisation (EA).

Please make use the Impact Rating Table (in Excel format) provided for each of the phases (i.e. Design, Construction, Operation and Decommissioning).

6.8. **Cumulative Impact Assessment**

Cumulative impact assessments must be undertaken for the proposed solar PV plant in order to determine the cumulative impact that will materialise should other Renewable Energy Facilities (REFs) and large-scale industrial developments be constructed within 50km of the proposed development.

The cumulative impact assessment must contain the following:

- A cumulative environmental impact statement noting whether the overall impact is acceptable; and
- A review of the specialist reports undertaken for other REFs and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered.

In order to assist the specialists in this regard, SiVEST will provide the following documentation / data:

- A summary table listing all REFs identified within 35km of the proposed solar PV plant;
- A map showing the location of the identified REFs;
- KML files; and
- Relevant EIA / BA reports that could be obtained.

The list of renewable energy facilities that must be assessed as part of the cumulative impact will be provided.

6.9. **'No Go' Alternative**

Consideration must be given to the 'no-go' option in the BA process. The 'no-go' option assumes that the site remains in its current state, i.e. there is no construction of a Solar PV Plant and associated infrastructure in the proposed project area and the *status quo* would proceed.

6.10. **Comparative Assessment of Alternatives**

As mentioned, design and layout alternatives for the proposed solar PV plant were identified and comparatively assessed as part of the BA process undertaken in 2016. As the positions of the proposed PV application site, Switching

Substation, Guard house and Temporary Building Zone (as well as all other associated infrastructure) have already been determined taking the identified environmental sensitive and/or 'no-go' areas into consideration, the specialist is to update the comparative assessment as per the latest table provided by SiVEST.

6.11. **Conclusion / Impact Statement**

The conclusion section of the specialist reports must include an **Impact Statement**, indicating whether any fatal flaws have been identified and ultimately whether the proposed development can be authorised or not (i.e. whether EA should be granted / issued or not).

6.12. **Executive Summary**

Specialists must provide an Executive Summary which summarises the findings of their report to allow for easy inclusion in the BA reports.

7. **deliverables**

All specialists will need to submit the following deliverables:

- 1 x Draft Specialist Report for inclusion in DBAR no later than 07 September 2020 and updated version based on EAP and applicant review no later than 11 September 2020;
- 1 x Final Specialist Report for inclusion in FBAR (should updates and/or revisions be required);
- A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures. This form will be provided to the specialists. ***Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner of Oaths***; and
- All data relating to the studies, such as shape files, photos and maps (see **Section 8** below).

8. **GENERAL SUBMISSION REQUIREMENTS**

Please ensure that your specialist report includes the following:

- The report must be in line with the DFFE Screening Tool Specialist theme Protocols (As gazetted 20 March 2020) if they apply. If no specific assessment protocol has been prescribed, the required level of assessment must be based on the findings of the Initial Site Sensitivity Verification and must comply with Appendix 6 of the Environmental Impact Assessment Regulations promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (The Act), where a specialist assessment is required.
- A table at the beginning of your report cross referencing how the requirements for specialist according to Appendix 6 of the EIA Regulations, 2014 (as amended) has been adhered to. An MS Word version will be provided;
- A thorough overview of all applicable legislation, policies, guidelines. etc.;
- Identification of sensitive and/or 'no-go' areas to be avoided;
- Recommend mitigation measures in order to minimise the impact of the proposed development;
- Provide implications of specialist findings for the proposed development (e.g. permits, licenses etc.);
- Specify if any further assessment will be required;
- Include an Impact Statement, concluding whether any fatal flaws have been identified and ultimately whether the proposed development can be authorised or not (i.e. whether EA should be granted / issued or not); and

- A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures, must be appended to all Draft and Final Reports. This form will be provided to the specialists. ***Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner of Oaths.***

9. **deadlines and report submission**

- Draft Specialist Report for inclusion in DBAR no later than 07 September 2020 and updated version based on EAP and applicant review no later than 11 September 2020.
- Any changes arising based on stakeholder engagement no later than 16 October 2020

10. **Report / Data Formats**

- All specialist reports must be provided in MS Word format.
- Where maps have been inserted into the report, we will require a separate map set in PDF format for inclusion in our submission.
- Where figures and/or photos have been inserted into the report, we will require the original graphic in jpg format for inclusion in our submission.
- Delineated areas of sensitivity must be provided in either ESRI shape file format or Google Earth KML format. Sensitivity classes must be included in the attribute tables with a clear indication of which areas are “No-Go” areas.

11. **specialist Specific issues**

Avifauna (Birds)

- Describe the affected environment from an avifaunal perspective, including consideration of the surrounding habitats and avifaunal features (e.g. Ramsar sites, Critical Bird Areas, wetlands, migration routes, feeding, roosting & nesting areas, etc.);
- Describe and map bird habitats on the site, based on on-site monitoring, desk-top review, collation of available information, studies in the local area and previous experience;
- Map the sensitivity of the site in terms of avifaunal features such as habitat use, roosting, feeding and nesting / breeding; and
- Identify and assess the potential impacts of the proposed development on avifauna. Provide sufficient mitigation measures to include in the environmental management plan.

APPENDIX 4: SITE SENSITIVITY VERIFICATION

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

The details of the site sensitivity verification (SSV) are noted below:

Date of Site Visit	08 August 2020
Supervising Specialist Name	Albert Froneman
Professional Registration Number	MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09)
Specialist Affiliation / Company	Chris van Rooyen Consulting

METHODOLOGY

The following methods were used to compile the SSV report:

- 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 9 pentads some of which intersect and others that are near the development. The decision to include multiple pentads around the project site was influenced by the fact that many of the pentads in the area have very few completed full protocol surveys. Given that the habitat is largely homogenous the additional pentads and their data augments the otherwise sparse bird distribution data. The 9 pentad grid cells are the following: 2705_2610; 2705_2615; 2705_2620; 2710_2610; 2710_2615; 2710_2620; 2715_2610; 2715_2615; 2715_2620 (see Figure 34). A total of 26 full protocol lists (i.e., bird listing surveys lasting a minimum of two hours each) and 20 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 9 pentads where the project site is located, with a total of 1 220 birds recorded. 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 habitat in the Project Site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2022.1) 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 facilities on avifauna.
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the application site relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the North-West Province.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the application site.

- 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 following sources were used 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);
    - Guidelines for the Implementation of the Terrestrial Flora & Terrestrial Fauna Species Protocols for EIAs in South Africa produced by the SANBI on behalf of the Department of Environment, Forestry and Fisheries (2020); and
    - 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).
- A site visit was conducted in November 2016 and again in August 2020. During the latter, data was collected by means of transect and incidental counts.

NATURAL ENVIRONMENT AND HABITAT TYPES

The application site is situated approximately 5-10km north-east of the towns of Leeudoringstad and Kgagala, in the North-West Province. The application site is located in the Grassland Biome (Mucina & Rutherford 2006). Only one vegetation type occurs in the application site, namely Vaal-Vet Sandy Grassland (Mucina & Rutherford 2006) (**Figure 1**). This vegetation type occurs on plains-dominated landscapes with some scattered, slightly irregular undulating plains and hills. Consists mainly of low-tussock grasslands with an abundant karroid element. Dominance of redgrass/rooigras *Themeda triandra* is an important feature of this vegetation unit. This vegetation type occurs in a warm-temperate, summer-rainfall climate, with overall mean annual precipitation of 530 mm. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford 2006). Average temperatures in the study area range from a low of 2˚C in July to 32˚C in December/January[4].

Figure 1: Natural grassland habitat at the application site.

Whilst the distribution and abundance of the bird species in the broader area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine the few anthropogenic modifications and micro-habitats in the environment that have relevance for birds. The following avifaunal-relevant habitats were recorded within the application site and the broader area:

[4] https://www.worldweatheronline.com/v2/weather-averages.aspx?locid=2756218&root_id=2750634&wc=local_weather&map=~/leeudoringstad-weather-averages/north-west/za.aspx

- **High Voltage Lines**

High voltage lines are an important roosting substrate for raptors. The application site itself is not bisected by a high voltage line but the Mercury – Mookodi 1 400kV line lies about 1 km north-east of the application site.

- **Drainage Lines**

The application site does not contain any drainage lines. One medium-sized, ephemeral drainage line, namely the Klipspruit, runs approximately 3km east of the project site, and a smaller one, namely the Leeuspruit, runs approximately 2.8km south-west of the site. Drainage lines are important corridors of waterbird movement, and the woodland along the banks are a refuge for woodland species.

- **Dams**

The application site does not contain any dams. There is one cement dam right on the northern border of the application site (**Figure 2**). There is also a cluster of wastewater treatment evaporation ponds which is associated with the two towns, situated approximately 6.5km south-west of the site. Water purification plants are important refuges for waterbirds. There are also artificial waterbodies in Leeudoringstad itself, at the golf course, approximately 6km away.

Figure 2: Cement dam on the border of the application site.

- **Exotic Trees**

There are some stands of exotic trees scattered in the immediate surroundings of the application site (**Figure 3**). The application site itself contains very few trees. Exotic trees serve as perching and breeding substrate for several priority species, particularly raptors.

Figure 3: A stand of alien trees near the application site.

- **Wetlands & Pans**

The immediate surroundings contain a few small wetlands which are located in natural depressions in the grassland, and consist of periodically flooded grassland, two areas which are located outside of the application site. When these areas hold water (which is only likely after sustained rainfall events), it may temporarily attract a variety waterbirds. However, due to their small size and ephemeral nature, it is unlikely to be a major attractant to priority species, and they are heavily utilized by cattle for grazing

RESULTS AND CONCLUSION OF SITE ASSESSMENT

The application site and immediate environment is classified as **Low** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 1). However, based on the available SABAP2 data and the Site Sensitivity Verification survey conducted in August 2020 the application site contains confirmed records of species of conservation concern (SCC), namely, Secretarybirds *Sagittarius serpentarius* (Globally and Regionally Endangered). **Therefore, a classification of High sensitivity for the application site is recommended.** The application site contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020).

Figure 1: The National Web-Based Environmental Screening Tool map of the application site, indicating sensitivities for the Terrestrial Animal Species theme.

APPENDIX 5: ENVIRONMENTAL MANAGEMENT PROGRAMME

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Entrapment					
Entrapment of medium and large terrestrial birds between the perimeter fences of PV plant, leading to mortality.	Prevent mortality of avifauna	1. A single perimeter fence should be used if possible[5].	Design the facility with a single perimeter fence if possible.	Once-off during the planning phase.	Project Developer
Avifauna: Mortality due to electrocutions on the internal 33kV network					
Electrocution of priority species on the 33kV network	Prevention of electrocution mortality	1. Design the facility with underground cables as much as possible. 2. A raptor - friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.	Design the facility with underground cabling and where impractical, use a bird friendly pole design approved by the avifaunal specialist.	Once-off during the planning phase.	Project Developer

Management Plan for the Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving;	1. Implementation of the CEMPr. Overse activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

[5] If a fence is used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100 mm or less, it should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
lead to the displacement of avifauna from the area		2. Maximum use of existing roads, where possible; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
Mortality of priority species due to collisions with the medium voltage internal reticulation network	Prevention of powerline collision mortality	Eskom approved bird flight diverters should be installed on the full span length of all 33kV overhead lines according to the applicable Eskom Engineering Instruction. These devices must be installed as soon as the conductors are strung.	Bird Flight Diverters must be installed as soon as the conductors are strung.	1. Once-off	1. Contractor and ECO

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to habitat transformation					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plants and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	1. Develop a Habitat Restoration Plan (HRP). 2. Monitor rehabilitation via site audits and site inspections to ensure compliance. 3. Record and report any non-compliance.	1. Appointment of rehabilitation specialist to develop HRP. 2. Site inspections to monitor progress of HRP. 3. Adaptive management to ensure HRP goals are met.	1. Once-off 2. Once a year 3. As and when required	1. Project Developer 2. Facility Environmental Manager 3. Project Developer and Facility Operational Manager