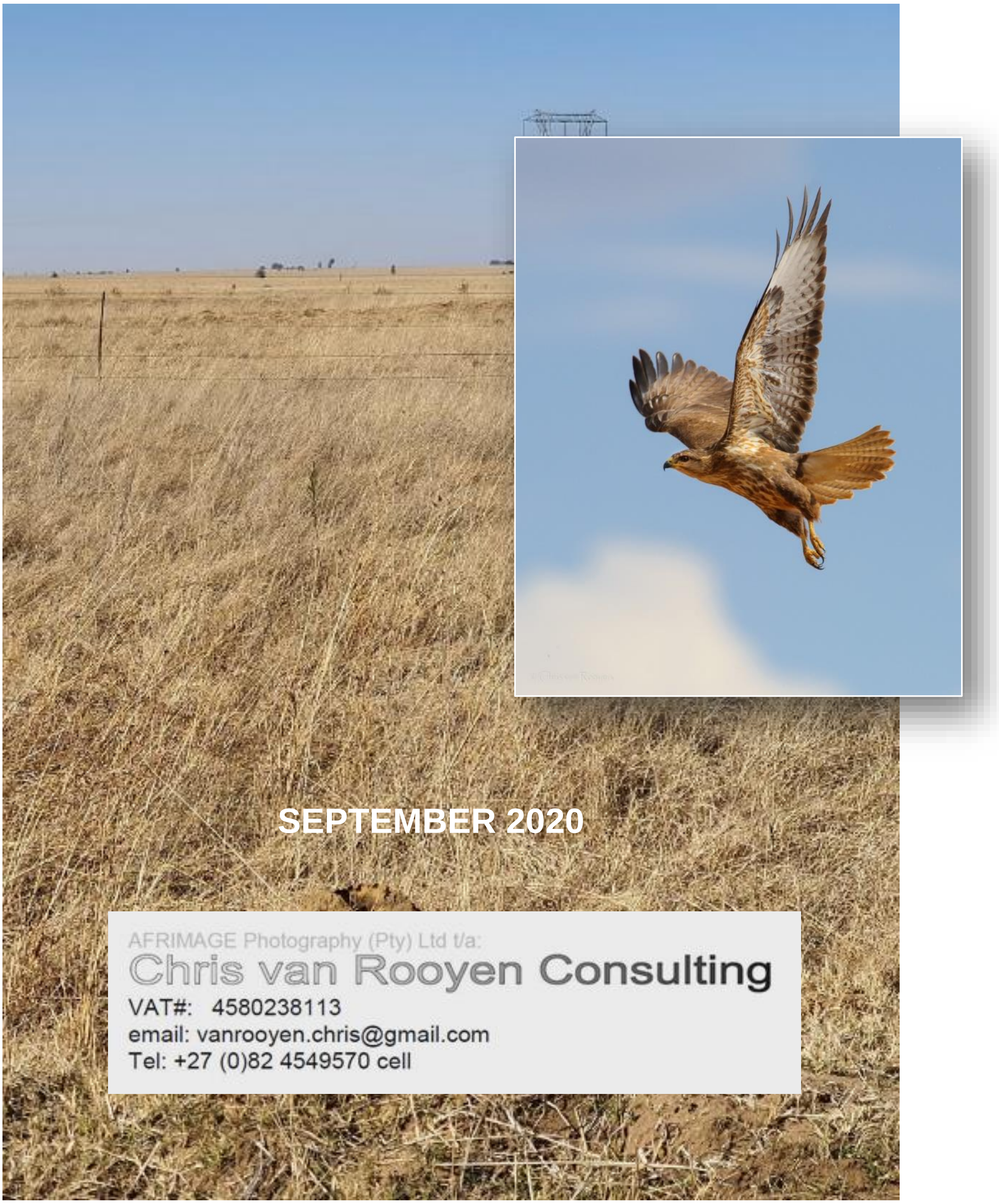
AVIFAUNAL IMPACT ASSESSMENT

DEVELOPMENT OF THE WILDEBEESTKUIL PV 2, 9.9MW AND ASSOCIATED INFRASTRUCTURE NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE



SEPTEMBER 2020

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EXECUTIVE SUMMARY

Wildebeestkuil PV Generation (Pty) Ltd (hereafter referred to as “Wildebeestkuil PV Generation”) is proposing to construct a solar photovoltaic (PV) plant, 132kV power line and associated infrastructure approximately 4km east of the town of Leeudoringstad in the Maquassi Hills Local Municipality, within the Dr Kenneth Kaunda District Municipality of the North-West Province (hereafter referred to as the “proposed development”). The proposed development will have a total maximum generation capacity of up to approximately 9.9 megawatt (MW) and will be referred to as the Wildebeestkuil 2 Solar PV Plant and 132kV Power Line. The overall objective of the project is to generate electricity (by capturing solar energy) to feed into the national electricity grid and “wheel” the power to customers based on a power purchase agreement. Additionally, an agreement is in place to sell the energy to PowerX, who hold a National Energy Regulator of South Africa (NERSA)-issued electricity trading license which allows them to purchase energy generated from clean and renewable resources and sell it to its customers.

The potential impacts of the Wildebeestkuil 2 Solar PV Plant and 132kV Power Line 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)
	Collisions of priority species with the proposed 132kV line.	-22 (low negative)	-20 (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 grid connection and entrapment in fences	-24 (low negative)	-22 (low negative)
	Average	24.2 (medium negative)	22.4 (low negative)

The proposed Wildebeestkuil 1 Solar PV Plant and 132kV Power Line 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.

The cumulative impact of the facility on priority avifauna within a 50km 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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DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT

Chris van Rooyen

Chris has 22 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.

SPECIALIST DECLARATION

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

Full Name: Chris van Rooyen

Position: Director

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;	Section 3
	(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;	Section 3
	(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

1.1 Project history

The original BA process for the proposed Wildebeestkuil PV Generation (Pty) Ltd (hereafter referred to as “Wildebeestkuil PV Generation”) solar photovoltaic (PV) plant was initiated in August 2016. All specialist studies were undertaken and subsequently all site sensitivities were identified. The specialist studies and draft basic assessment reports (DBARs) were completed and released for 30-day public review. The BA was however put out on hold prior to submitting the final basic assessment reports (FBARs) to the Department of Environmental Affairs (DEA). In February 2017, the proposed capacity and layout of the solar PV plant was amended, and a new connection point and associated power line corridors were assessed. However, the project was put on hold prior to submitting the application forms to the DEA or commencing with the legislated public participation process. In August of 2020, Wildebeestkuil PV Generation proposed an additional 9.9MW PV plant on the Wildebeestkuil site (now referred to as the Wildebeestkuil 1 Solar PV Plant & 132kV Power Line and Wildebeestkuil 2 Solar PV Plant & 132kV Power Line) outside of all site sensitivities that were identified in 2016, and as such specialist studies have been commissioned to assess and verify the now two (2) solar PV plants and 132kV power lines under the new Gazetted specialist protocols[1].

1.2 Project location

Wildebeestkuil PV Generation is proposing to construct a solar PV plant, 132kV power line and associated infrastructure approximately 4km east of the town of Leeudoringstad in the Maquassi Hills Local Municipality, which falls within the Dr Kenneth Kaunda District Municipality in the North West Province of South Africa (hereafter referred to as the “proposed development”) (Department Ref No.: To be Allocated). The proposed development will have a total maximum generation capacity of up to approximately 9.9 megawatt (MW) and will be referred to as the Wildebeestkuil 2 Solar PV Plant and 132kV Power Line. SiVEST Environmental Division (hereafter referred to as “SiVEST”) has subsequently been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the BA process for the proposed construction of the Wildebeestkuil 2 Solar PV Plant, 132kV power line and associated infrastructure. The overall objective of the solar PV plants and power lines is to generate electricity (by capturing solar energy) to feed into the national electricity grid and “wheel” the power to customers based on a power purchase agreement. Additionally, an agreement is in place to sell the energy to PowerX, who hold a National Energy Regulator of South Africa (NERSA)-issued electricity trading license which allows them to purchase energy generated from clean and renewable resources and sell it to its customers.

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

- Portion 13 of the Farm Wildebeestkuil No. 59;
- Portion 14 of the Farm Wildebeestkuil No. 59; and
- Remainder of Portion 22 of the Farm Wildebeestkuil No. 59.

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[1] GOVERNMENT GAZETTE No. 43110, PROCEDURES FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING ON IDENTIFIED ENVIRONMENTAL THEMES IN TERMS OF SECTIONS 24(5)(a) AND (h) AND 44 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, WHEN APPLYING FOR ENVIRONMENTAL AUTHORISATION, 20 MARCH 2020.

In terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998, prescribe general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation, as contained in the Schedule hereto. When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements. Each protocol applies exclusively to the environmental theme identified within its scope. Multiple themes may apply to a single application for environmental authorisation, and assessments for these themes must be undertaken in accordance with the relevant protocol, or where no specific protocol has been prescribed, in accordance with the requirements of the EIA Regulations.

The combined extent of the above-mentioned properties is approximately 115.5 hectares (ha). The proposed solar PV plant and associated infrastructure assessed as part of this BA will however only occupy a portion of the above-mentioned properties.

The power line corridor alternatives associated with each proposed solar PV plant which were assessed as part of the respective BA processes traverse the following properties:

- Portion 13 of the Farm Wildebeestkuil No. 59;
- Portion 14 of the Farm Wildebeestkuil No. 59;
- Remainder of Portion 5 of the Farm Wildebeestkuil No. 59;
- Remainder of Portion 7 of the Farm Leeuwbosch No. 44;
- Remainder of Portion 29 of the Farm Leeuwbosch No. 44;
- Remainder of Portion 22 of the Farm Wildebeestkuil No. 59;
- Portion 35 of the Farm Leeuwbosch No. 44;
- Portion 36 of the Farm Leeuwbosch No. 44;
- Portion 37 of the Farm Leeuwbosch No. 44; and
- Portion 38 of the Farm Leeuwbosch No. 44.

The proposed development is located directly west of the Harvard Substation, where the current supply of electricity for the local areas and businesses is extracted from.

1.3 Solar PV Plant Components

The key components to be constructed are listed below:

- Solar PV field (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 2.5m long and 1.2m wide and mounted on supporting structures above ground. 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.

In addition, related infrastructure required are:

- Underground cabling (≈0.8m × 0.6 wide)
- Permanent Guard House (≈876m²)
- Temporary building zone (≈2994m²)
- Switching Substation (≈2000m²)
- Internal gravel roads (≈3.5m width)
- Upgrade to existing roads; and
- Site fencing (≈2.1m high)

In addition to the above, the electricity generated by the proposed solar PV plant will be fed into the national electricity grid via a 132kV power line, which will connect to the Leeudoringstad Solar Plant Substation (part of a separate BA process)[2]. The proposed 132kV power line will consist of a series of towers anticipated to be located approximately 200m to 250m apart at this stage. The type of power line towers will be determined during the final design stages of the proposed development, prior to construction commencing. The height will vary based on the terrain, but will ensure

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[2] Proposed Leeudoringstad Solar Plant Substation part of separate BA process and will be authorised under a separate EA.

minimum overhead line (OHL) line clearances with buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the proposed development.

For the purpose of this BA, corridors between approximately 60m and 150m wide were assessed for the proposed power line corridor route alternatives (see **Section 4** below). This is to allow for flexibility to route the power lines within the assessed corridors. As such, the selected preferred power lines will be routed within the assessed corridors. The final servitudes will be routed within the power line corridors, and it expected that the servitude swill not exceed 32m.

Once fully developed, the intention is to generate electricity (by capturing solar energy) to feed into the national electricity grid and "wheel" the power to customers based on a power purchase agreement. Additionally, an agreement is in place to sell the energy to PowerX, who hold a NERSA-issued electricity trading license which allows them to purchase energy generated from clean and renewable resources and sell it to its customers.

The construction phase will be between 12 and 24 months and the operational lifespan will be approximately 20 years, depending on the length of the power purchase agreement with the relevant off taker.

1.4 Location alternatives

No site alternatives for the proposed developments are being considered as the placement of solar PV installations and power lines is dependent on several factors, all of which are favourable at the proposed site location. This included land availability and topography, environmental sensitivities, distance to the national grid, solar resource site accessibility and current land use.

1.5 Technology alternatives

No other activity / technology alternatives are being considered. Renewable energy development in South Africa is highly desirable from a social, environmental and development point of view. Based on the flat terrain, the climatic conditions and current land use being agricultural, it was determined that the proposed site would be best-suited for a solar PV plant and associated power line, instead of any other type of renewable energy technology. It is generally preferred to install wind energy facilities (WEFs) on elevated ground. In addition, concentrated solar power (CSP) installations are not feasible because they have a high water requirement and the project site is located in a relatively arid area. There is also not enough rainfall in the area to justify a hydro-electric plant. Therefore, the only feasible technology alternative on this site is solar PV with associated power line, and as such this is the only technology alternative being considered.

1.6 Lay-out alternatives

No design or layout alternatives for the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) are being considered or assessed as part of the current BA process. Design and layout alternatives were considered and assessed as part of a previous BA process that was never completed, and as such the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) have been placed to avoid site sensitivities identified as part of a previous BA process as well as the current BA process. Specialist studies were originally undertaken in 2016 and all current layouts and/or positions being proposed were selected based on the environmental sensitivities identified as part of these studies in 2016. All specialist studies which were undertaken in 2016 were however updated in 2020 (including ground-truthing, where required) to focus on the impacts of the layout being proposed as part of the current project. The results of the updated specialist assessments have informed the layout being proposed as part of the current BA process. The proposed layout has therefore been informed by the identified environmental sensitive and/or "no-go" areas.

Three (3) power line corridor route alternatives for the proposed 132kV power line were however identified and assessed by the respective specialists as part of the current BA process. These alternatives essentially provide for different power line route alignments contained within an assessment corridor. The power line corridor route alternatives were informed by the identified environmental sensitive and/or "no-go" areas. The power line corridor route alternatives work as follows:

- **Power Line Corridor Option 1:**

This involves an overhead power line which will run north of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as "preferred" for the Leeudoringstad Solar Plant Substation site[3]. The Leeudoringstad Solar Plant Substation site alternatives are situated approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

- **Power Line Corridor Option 2A:**

This involves an overhead power line which will run south of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as "preferred" for the Leeudoringstad Solar Plant Substation site[3]. The Leeudoringstad Solar Plant Substation site alternatives are situated approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

- **Power Line Corridor Option 2B:**

This involves an underground power line which will run south of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as "preferred" for the Leeudoringstad Solar Plant Substation site[3]. The Leeudoringstad Solar Plant Substation site alternatives are situated approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

See Figures 1 – 4 for maps of the location and layout of the solar PV plant and 132kV power line (including power line corridor route alternatives).

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[3] 132kV power line corridor route associated with solar PV plant intrinsically linked to Leeudoringstad Solar Plant Substation site (part of separate on-going BA process). Leeudoringstad Solar Plant Substation site chosen as "preferred" by respective specialists as part of that separate BA process therefore informed connection point for power line corridor being proposed as part of this BA application.

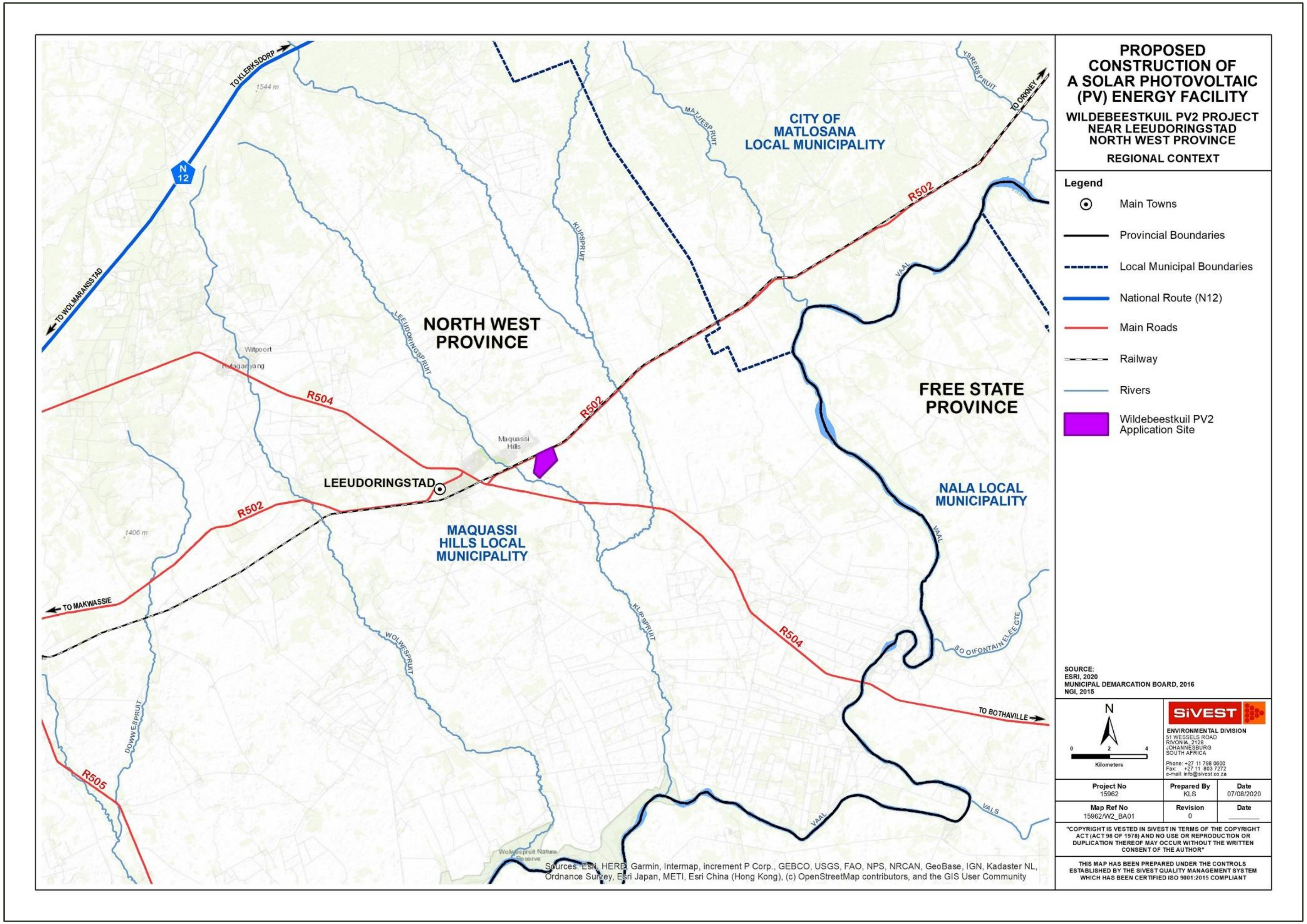

Figure 1: Regional context map of application site

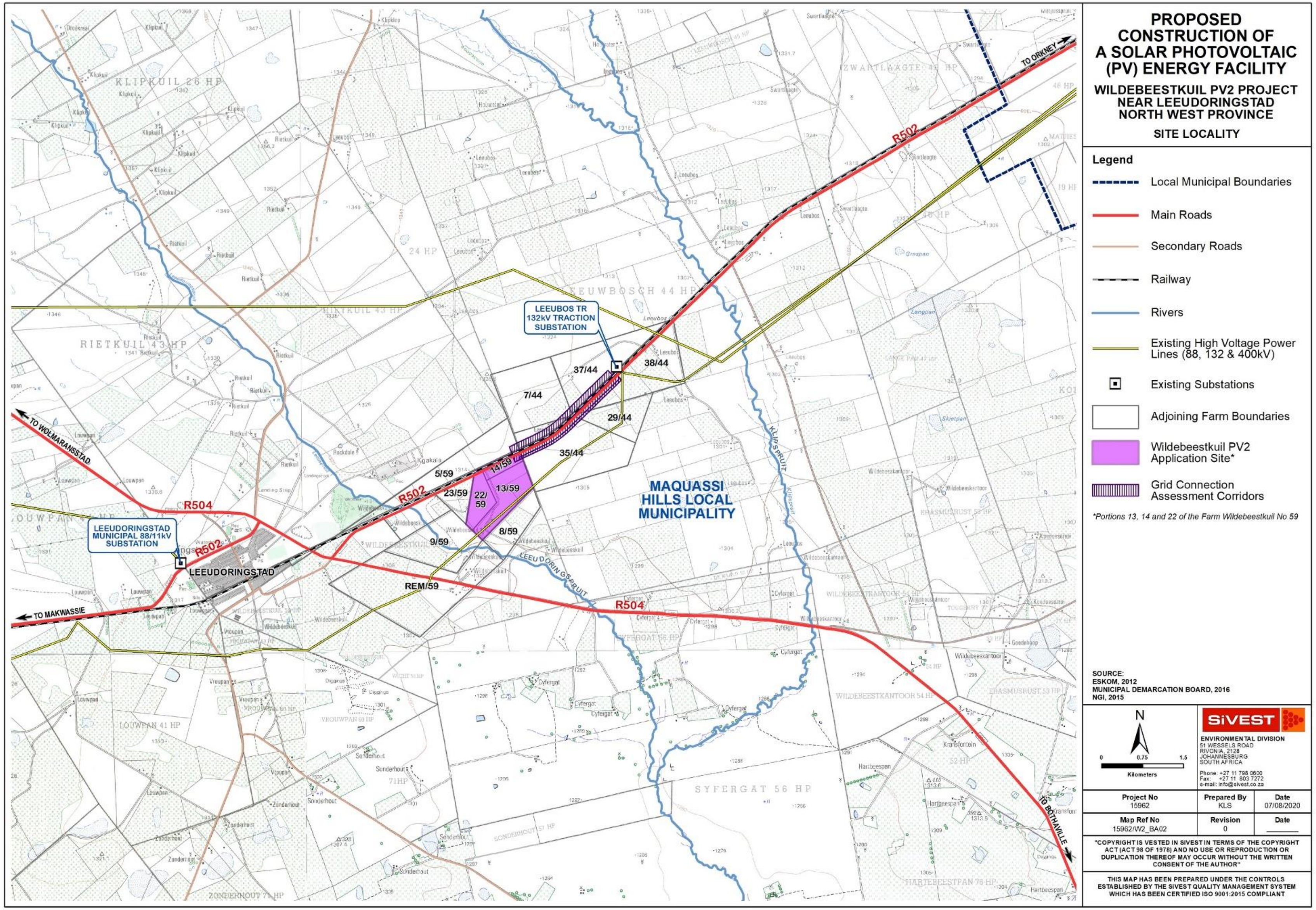

Figure 2: Locality map of Wildebeestkuil 2 Solar PV Plant application site and 132kV Power Line Corridor Route Alternatives

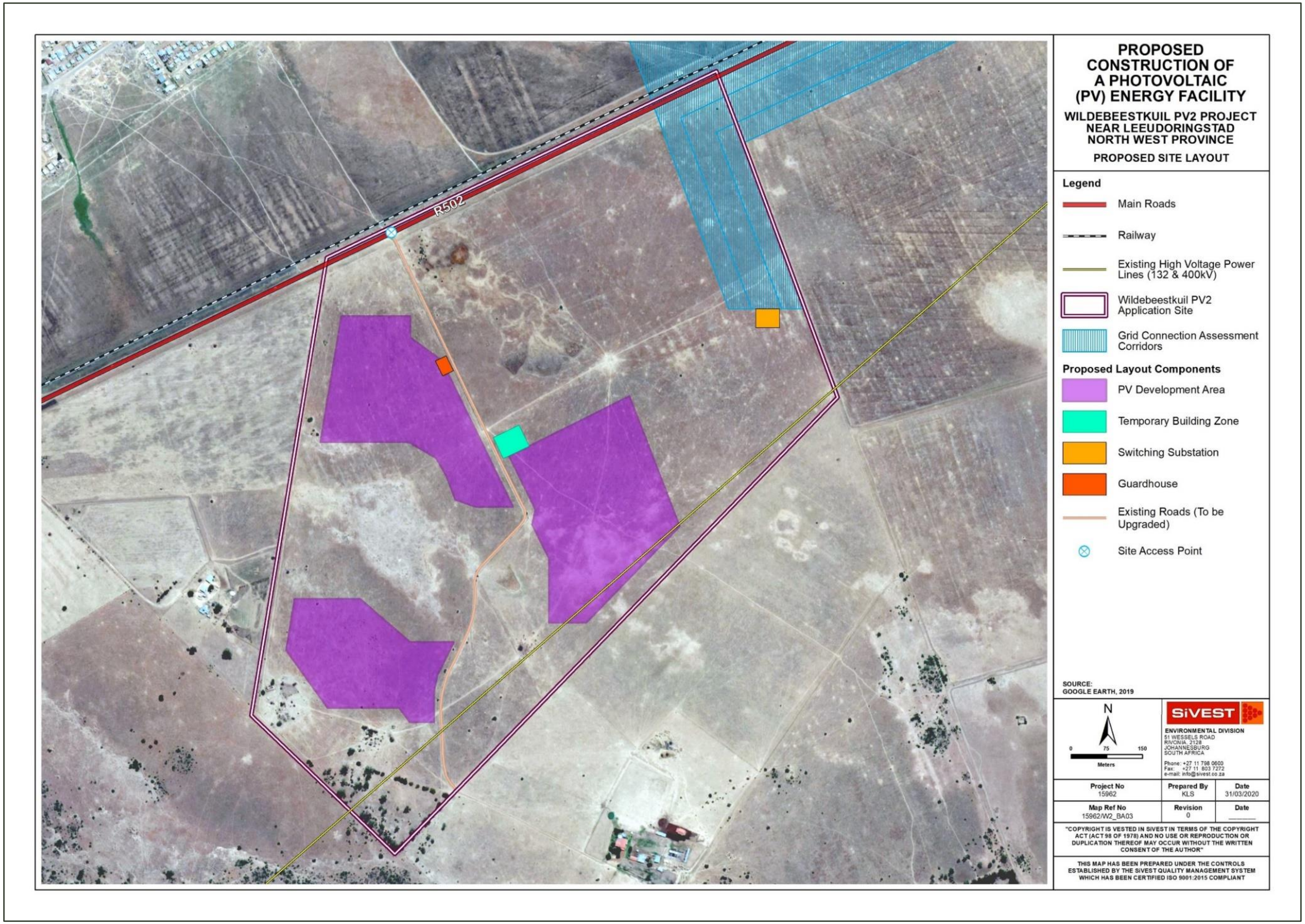

Figure 3: Lay-out of proposed solar plant PV 2.

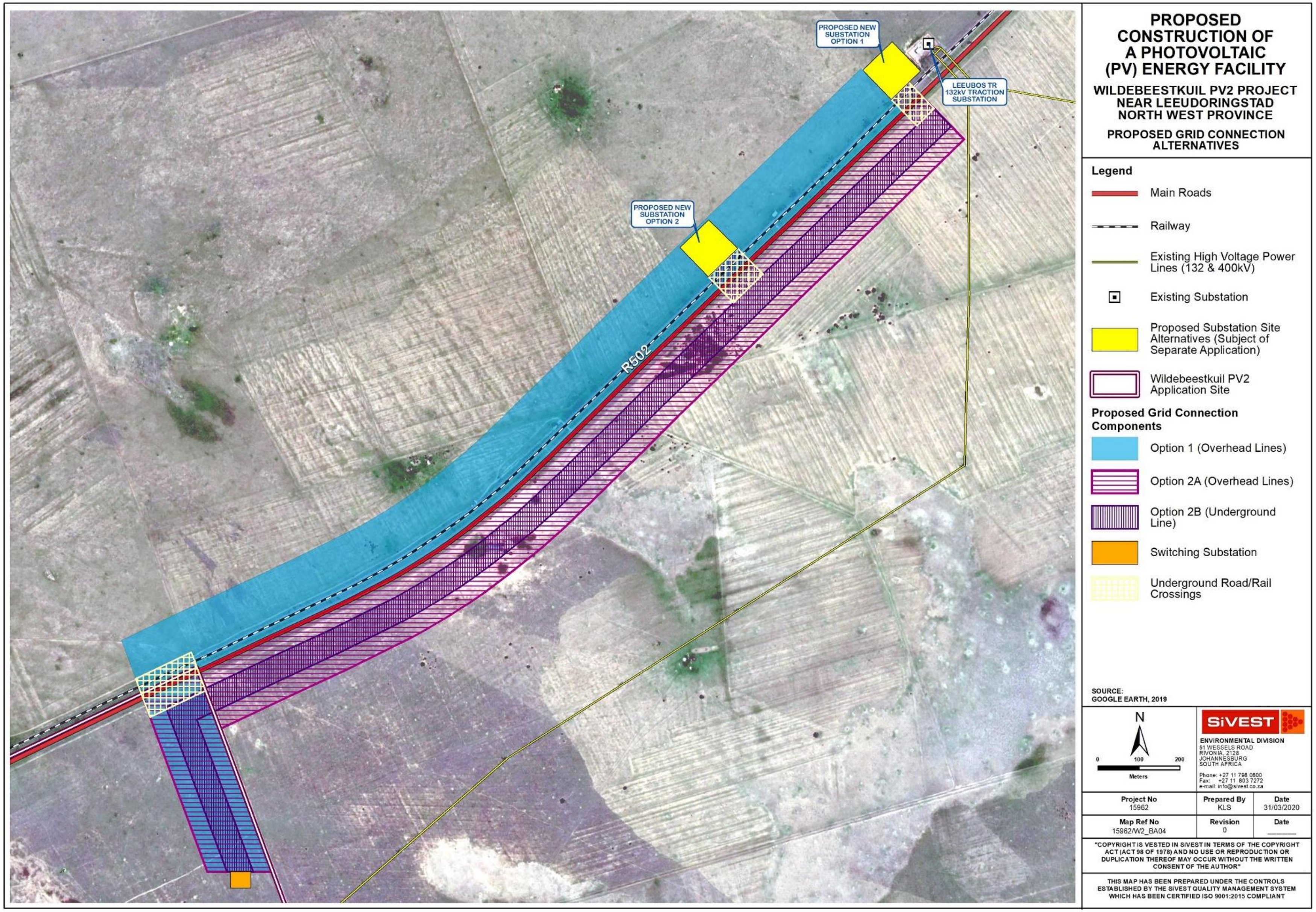

Figure 4: Layout map of proposed 132kV power line corridor route alternatives

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 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 application 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 **Error! Reference source not found.**5). A total of 26 full protocol l ists (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 application 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 vegetation types in the application site was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2020.2) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- An intensive internet search was conducted to source information on the impacts of solar facilities on avifauna.
- Satellite imagery (Google Earth © 2020) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the 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 DEFF 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.

- A one-day 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.

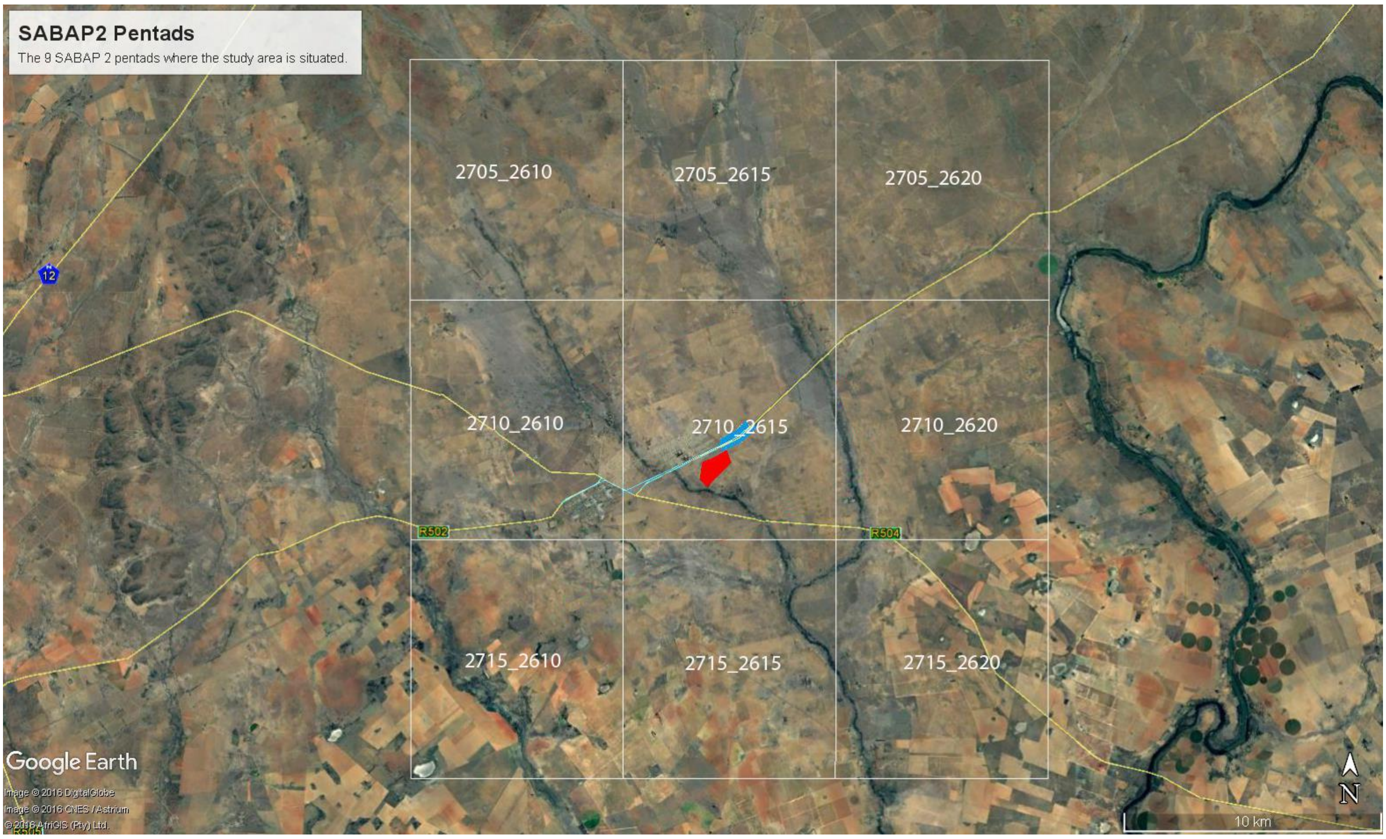

Figure 5: Area covered by the nine SABAP2 pentads. The application site is indicated by the red polygon.

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;
  - South African endemics and near-endemics;
  - Waterbirds; and
  - Raptors
- The impact of solar installations on avifauna is a new field of study, with only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser et al. 2019). Strong reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists in the application site.
- Cumulative impacts include all solar PV projects within a 30km 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.

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[4].

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

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

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

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
  (i) prevent pollution and ecological degradation;
  (ii) promote conservation; and
  (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

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

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

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.

6 BASELINE ASSESSMENT

6.1 Important Bird Areas

There are no Important Bird Areas (IBA) within a 30km radius around the proposed Wildebeestkuil PV Facility. It is therefore highly unlikely that the proposed development will have a negative impact on any IBA.

6.2 6.2 Critical Biodiversity Areas (CBAs)

The application site is not a CBA or Ecological Support Area. The application site for the proposed solar PV plants is not a Critical Biodiversity Area (CBA) or Ecological Support Area (ESA). The proposed power line corridors associated with each proposed solar PV plant however traverse ESA 1 and ESA 2 areas. Please refer to Figure 6 below.

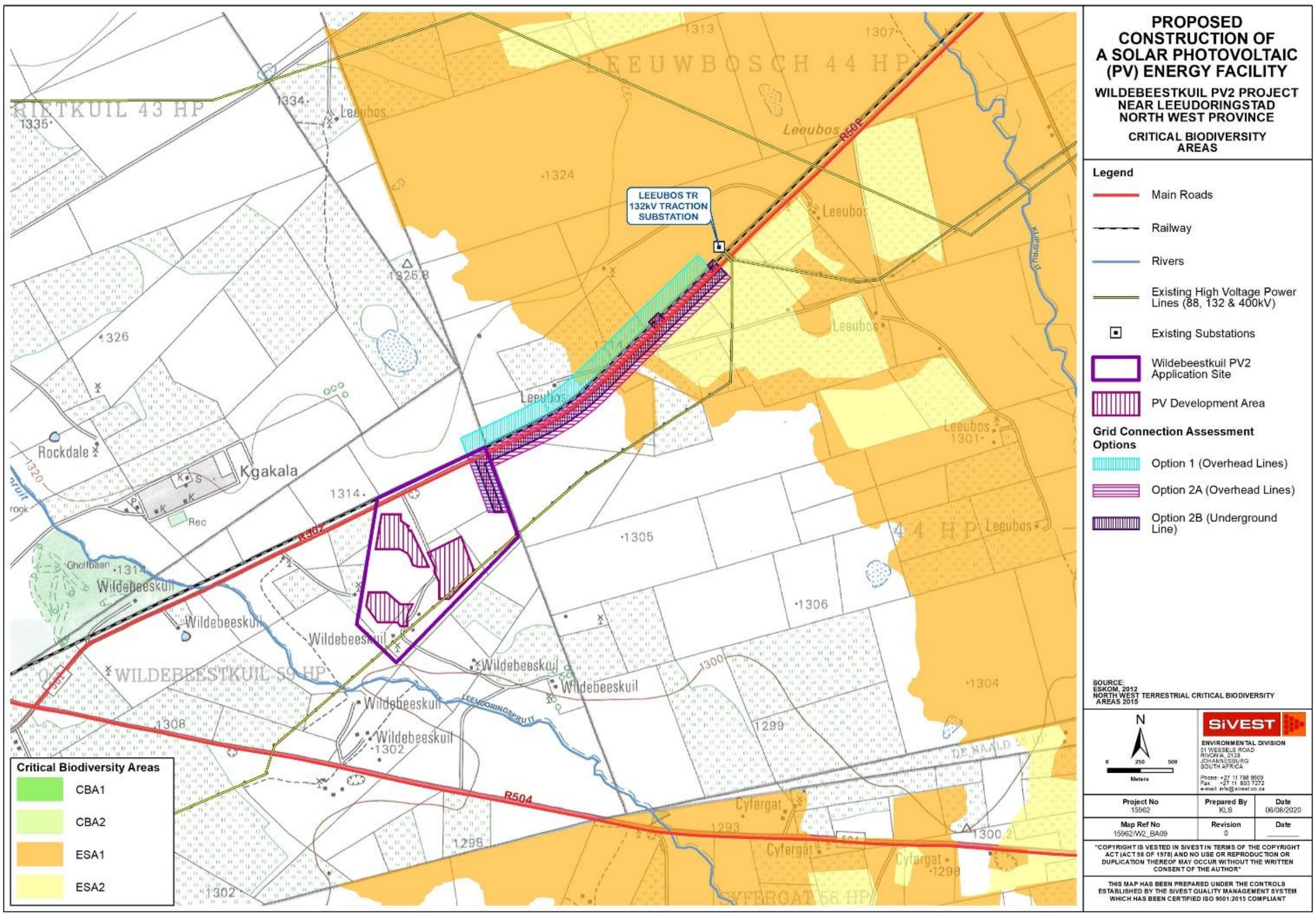

Figure 6: CBA Map – Wildebeestkuil 2 Solar PV Plant and 132kV Power Line.

6.3 DEFF National Screening Tool

The Department of Environment, Forestry and Fisheries (DEFF) National Screening Tool classifies a section of the study area as highly sensitive from an avifaunal perspective (Figure 7), but when the classification is further interrogated, it seems to be applicable to bats and not birds. The site investigations revealed that the site is not highly sensitive from an avifaunal perspective.

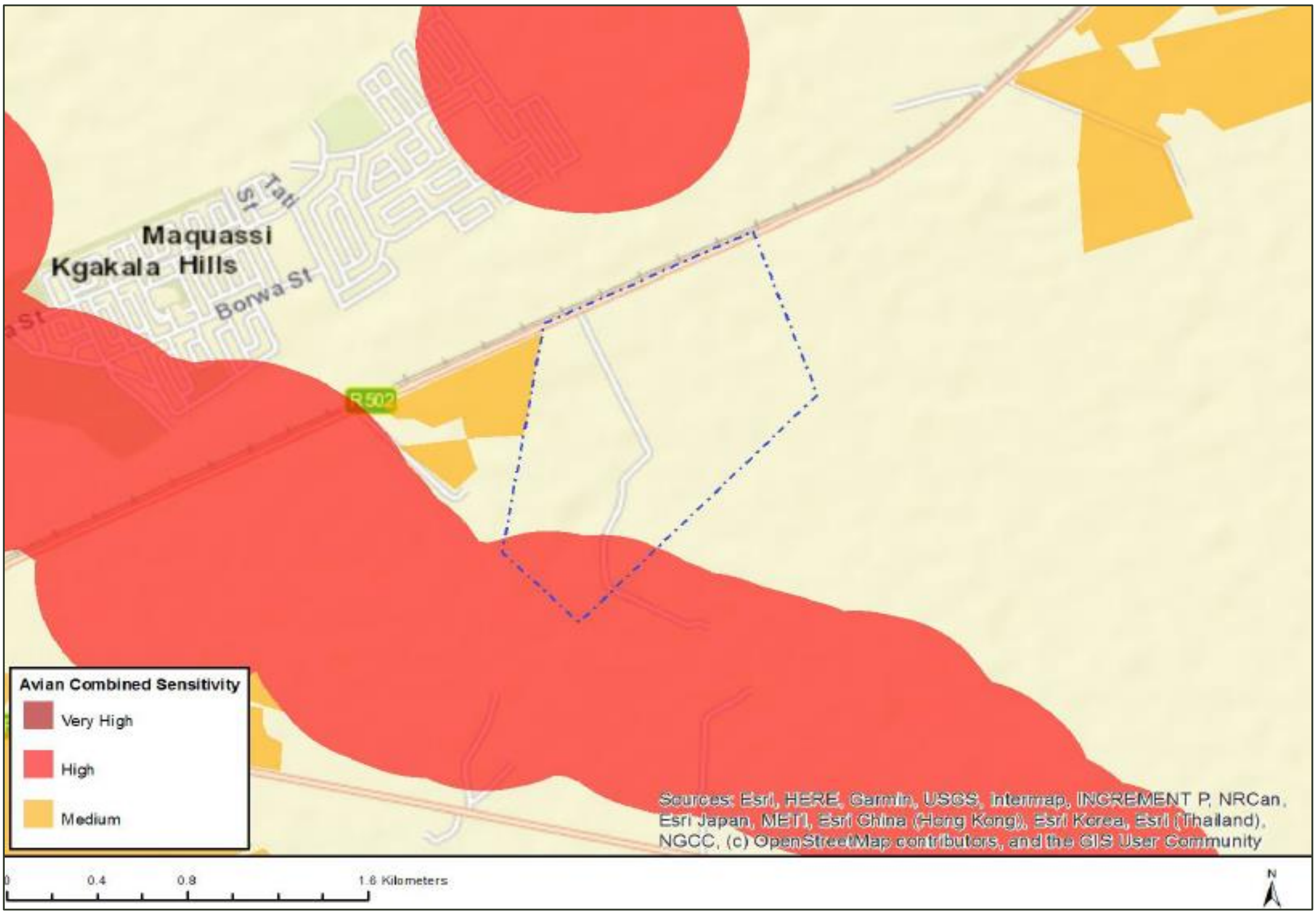

Figure 7: DEFF National Screening Tool Map of Relative Avian Theme Sensitivity – Wildebeestkuil 1 Solar PV Plant Application Site. The High Sensitivity refers to bats, not birds.

Sensitivity	Feature(s)
High	Within 500m of a river

6.4 National Protected Areas Expansion Strategy (NPEAS) focus areas

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

6.5 Biomes and vegetation types

The application site is situated approximately 1-5km east of the towns of Leeudoringstad and Kgagala, in the North-West Province. The development area is located in the grassland biome (Mucina & Rutherford 2006). Only one vegetation types occur in the application site, namely Vaal-Vet Sandy Grassland (Mucina & Rutherford 2006) (Figure 8).

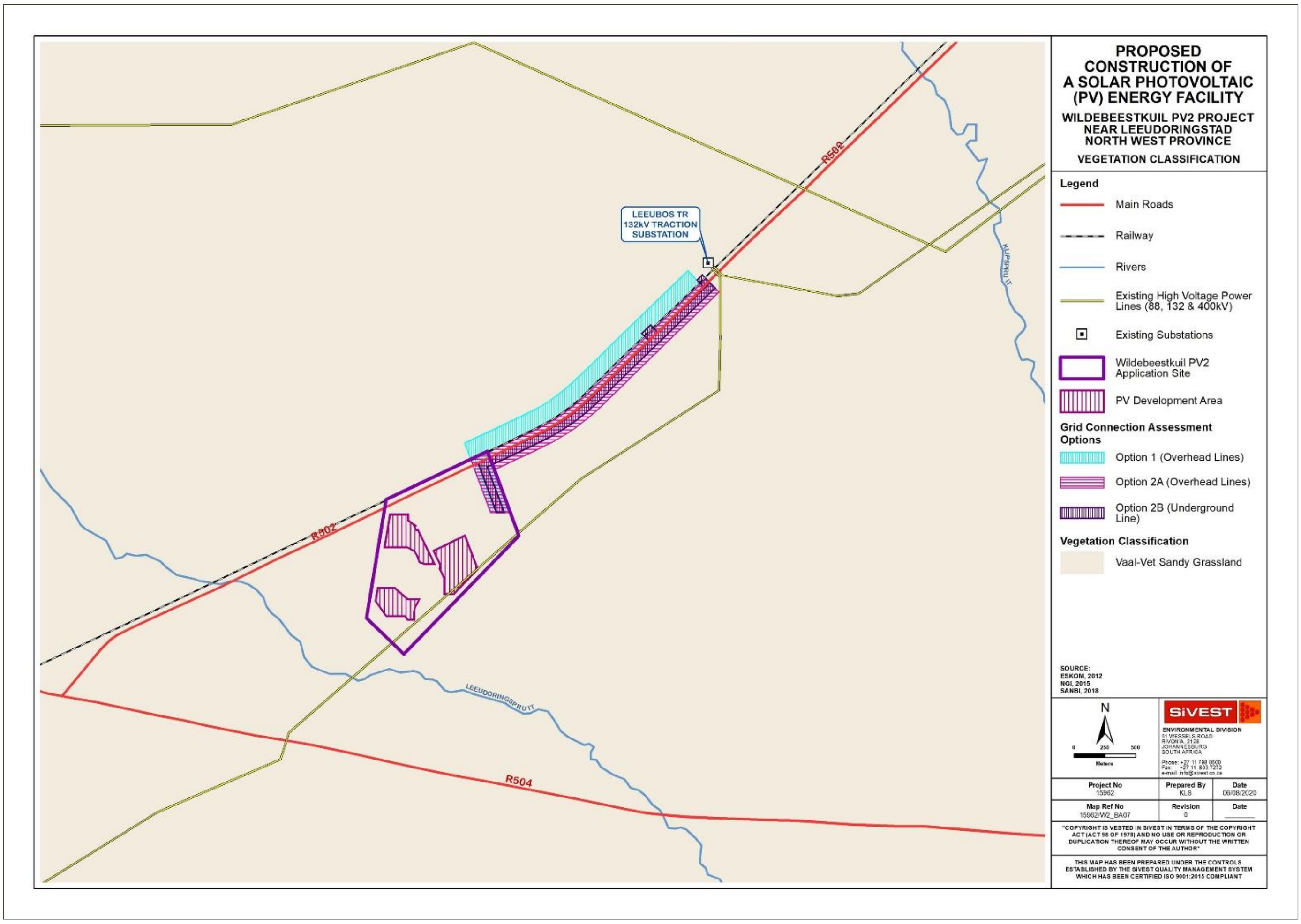

Figure 8: Vegetation Unit Map – Wildebeestkuil 2 Solar PV Plant and 132kV Power Line

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 application site range from a low of 2˚C in July to 32˚C in December/January[5].

Whilst the distribution and abundance of the bird species in the 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.

6.6 Micro-habitats

6.6.1 Water troughs

Surface water is of specific importance to avifauna in this fairly dry environment. The application site contains open water troughs that provide drinking water to cattle. Open water troughs are important sources of surface water and are used extensively by various priority species to drink and bath.

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

6.6.2 High voltage lines

High voltage lines are an important roosting substrate for raptors. The Leeudoringstad – Leeubos 132kV sub-transmission line runs along the southern border of the application site.

6.6.3 Drainage lines

The application site does not contain any drainage lines. One medium-sized, ephemeral drainage line, the Klipspruit, runs approximately 4.4km east of the application site, and a smaller one, the Leeuspruit, runs less than 1km west of the site. Drainage lines are important corridors of waterbird movement, and the woodland along the banks are a refuge for woodland species.

6.6.4 Dams

The application site does not contain any dams. There is a cluster of wastewater treatment evaporation ponds which is associated with the two towns, situated approximately 3.8km 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.

6.6.5 Exotic trees

There are several stands of exotic trees scattered in the immediate surroundings of the application site, and in the south-western corner of the site. Other than that, the site itself contains very few trees. Exotic trees serve as perching and breeding substrate for several priority species, particularly raptors.

6.6.6 Wetlands

The site contains two wetland areas which is located in natural depressions in the grassland, and consists basically of periodically flooded grassland. 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 application site.

7 AVIFAUNA IN THE APPLICATION 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 application 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.

										Habitat						Impacts				
Species	**Taxonomic name**	**Global status**	**Regional status**	**SA endemic status**	**Raptor**	**Waterbird**	**SABAP2 Full protocol reporting rate**	**Probability of occurrence**	**Recorded during surveys**	**Grassland**	**Exotic trees**	**Drainage lines**	**Pans**	**Dams**	**HV lines**	**PV collisions**	**Displacement disturbance**	**Displacement habitat loss**	**Entrapment in fences**	**Powerline collisions**
Buzzard, Steppe	*Buteo vulpinus*				x		3.85	M		x	x				x			x		
Falcon, Amur	*Falco amurensis*				x		3.85	L		x	x					x		x		
Falcon, Lanner	*Falco biarmicus*	LC	VU		x		0.00	L		x	x				x	x		x		
Goshawk, Gabar	*Melierax gabar*				x		3.85	L				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		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		
Secretarybird	*Sagittarius serpentarius*				x		3.85	M	x	x		x					x	x	x	x
Snake-Eagle, Black-chested	*Circaetus pectoralis*				x		0.00	M		x			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		
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

Species	Taxonomic name	Global status	Regional status	SA endemic status	Raptor	Waterbird	SABAP2 Full protocol reporting rate	Probability of occurrence	Recorded during surveys	Grassland	Exotic trees	Drainage lines	Pans	Dams	HV lines	PV collisions	Displacement disturbance	Displacement habitat loss	Entrapment in fences	Powerline collisions
Eagle, Martial	*Polemaetus bellicosus*	EN	EN			x	0.00	L		x	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					x		x
Egret, Great	*Egretta alba*					x	3.85	L						x						x
Egret, Little	*Egretta garzetta*					x	3.85	L						x						x
Flamingo, Greater	*Phoenicopterus ruber*	LC	NT			x	3.85	L					x	x						x
Flamingo, Lesser	*Phoenicopterus minor*	NT	NT			x	3.85	L					x	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						x
Grebe, Little	*Tachybaptus ruficollis*					x	26.92	L						x						
Heron, Black-headed	*Ardea melanocephala*					x	26.92	H			x	x	x	x	x			x		x
Heron, Grey	*Ardea cinerea*					x	15.38	L			x	x	x	x						x
Ibis, Glossy	*Plegadis falcinellus*					x	7.69	L			x		x	x				x		
Kingfisher, Malachite	*Alcedo cristata*					x	3.85	L				x		x						
Kingfisher, Pied	*Ceryle rudis*					x	7.69	L				x		x						
Lark, Eastern Long-billed	*Certhilauda semitorquata*			End			3.85	L		x						x	x	x		
Lark, Melodious	*Mirafra cheniana*			N-end			3.85	L		x						x	x	x		
Night-Heron, Black-crowned	*Nycticorax nycticorax*					x	3.85	L				x		x						
Pochard, Southern	*Netta erythrophthalma*					x	3.85	L						x						x

Species	Taxonomic name	Global status	Regional status	SA endemic status	Raptor	Waterbird	SABAP2 Full protocol reporting rate	Probability of occurrence	Recorded during surveys	Grassland	Exotic trees	Drainage lines	Pans	Dams	HV lines	PV collisions	Displacement disturbance	Displacement habitat loss	Entrapment in fences	Powerline collisions
Sandpiper, Wood	*Tringa glareola*					x	7.69	M				x	x	x						
Shelduck, South African	*Tadorna cana*					x	15.38	M						x						x
Shoveler, Cape	*Anas smithii*					x	3.85	L						x						x
Spoonbill, African	*Platalea alba*					x	3.85	L						x						x
Stilt, Black-winged	*Himantopus himantopus*					x	11.54	M						x						
Stonechat, African	*Saxicola torquatus*						23.08	H		x						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						
Tern, White-winged	*Chlidonias leucopterus*					x	3.85	L					x	x						
Thrush, Karoo	*Turdus smithi*			N-end			15.38	L	x			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 9 and 10.

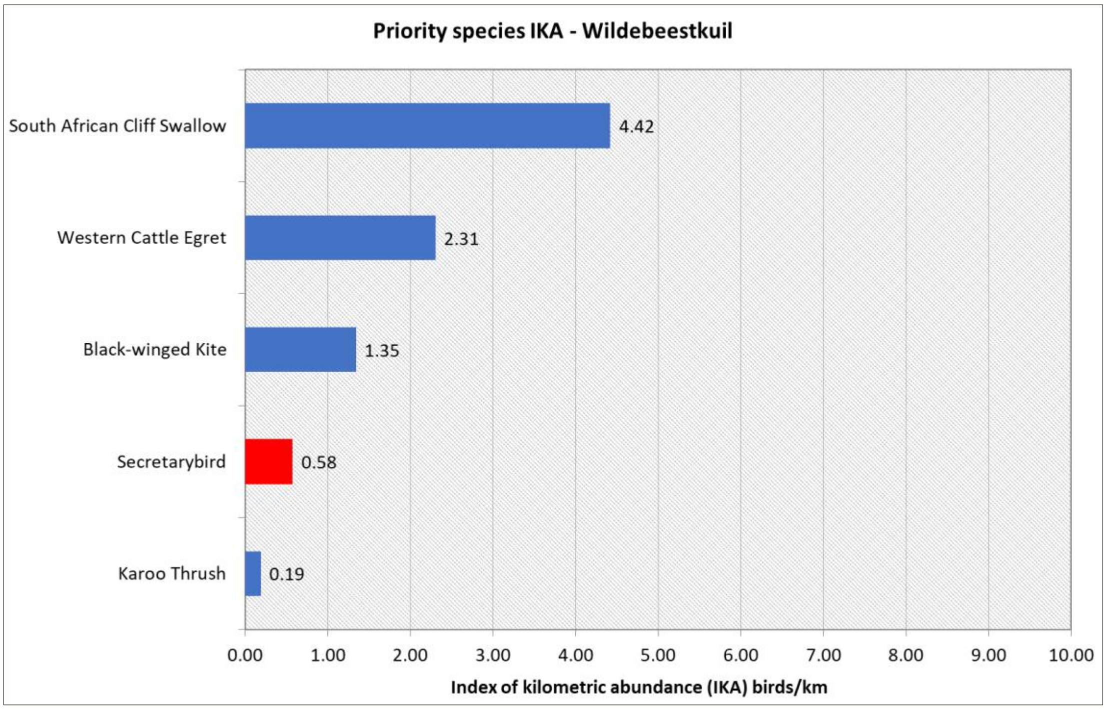

Figure 9: Index of kilometric abundance (IKA) for all priority species recorded by means of walk transects during the surveys in the study area, conducted in August 2020. Red Data species are indicated in red bars.

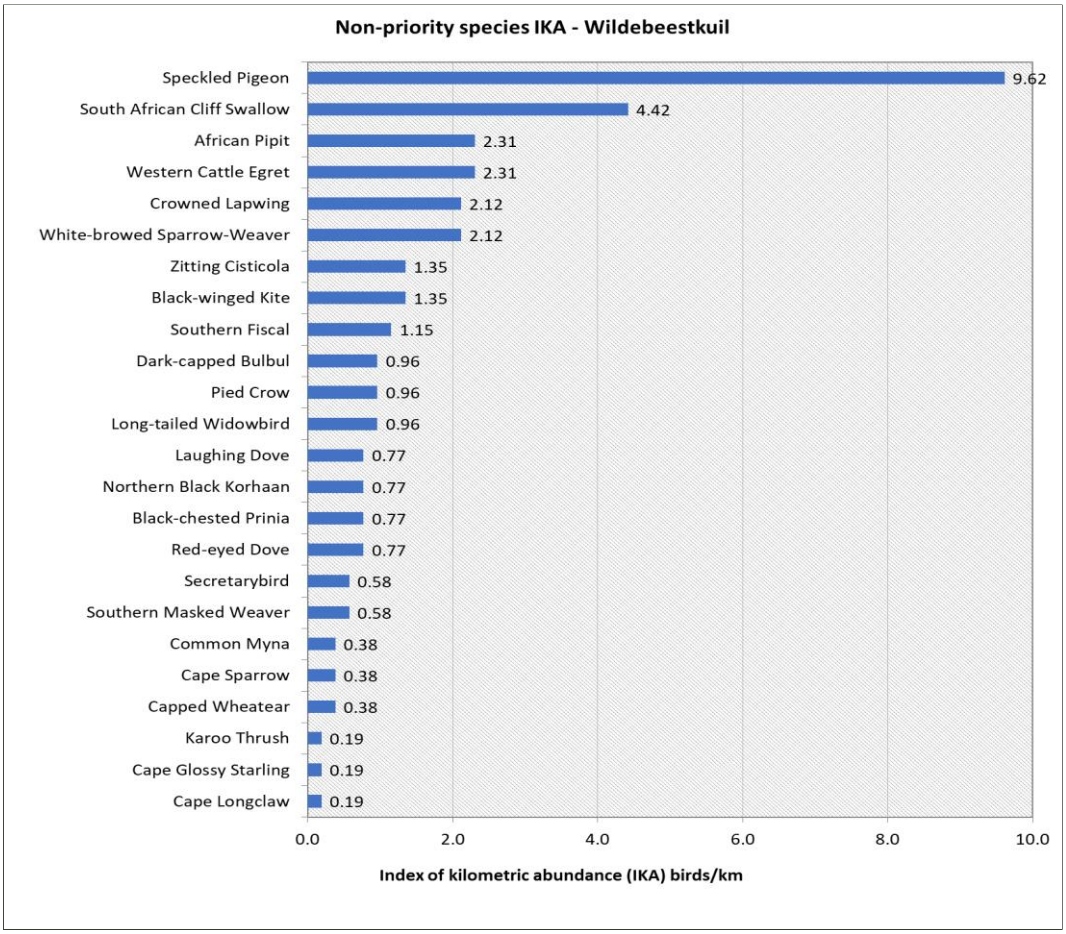

Figure 10: Index of kilometric abundance (IKA) for all non-priority species recorded by means of walk transects during the surveys, conducted in August 2020.

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-west United States. In South Africa, one published scientific study has been completed on the impacts of PV plants in a South African context (Visser 2016).

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

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

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

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

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

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

South Africa is among the world's top 10 developing countries required to significantly reduce their carbon emissions (Seymore *et al.* 2014), and the introduction of low-carbon technologies into the country's compliment of power generation will greatly assist with achieving this important objective (Walwyn & Brent 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri 2009; Munzhedi *et al.* 2009), it is clear that solar power generation should feature prominently in future efforts to convert to a more sustainable energy mix in order to combat climate change, also from an avifaunal impact perspective. However, while the expansion of solar power generation is undoubtedly a positive development for avifauna in the longer term in that it will help reduce the effect of climate change and thus habitat transformation, it must also be acknowledged that renewable energy facilities, including solar PV facilities, in themselves have some potential for negative impacts on avifauna.

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

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)[6]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the “lake effect” hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). However, until such time that enough scientific evidence has been collected to discount the “lake effect” hypothesis, it must be considered as a potential source of impacts.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feather spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and

[6] 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.

missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.
In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

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

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

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

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small birds which forage between the solar panels, and possibly raptors which prey on them, or forage for insects between the PV panels, e.g. Lesser Kestrels (i.e. if they are not completely displaced due to the habitat transformation). Due to the absence of large permanent waterbodies at or close to the application site, it is unlikely that waterbirds will be attracted to the solar arrays due to the “lake effect”.

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

It is not foreseen that entrapment 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 facility

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

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

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

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

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

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

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

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (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 facility

As far as disturbance is concerned, it is likely that all the avifauna, including all the priority species, will be temporarily displaced in the footprint area, either completely or more likely partially (reduced densities) during the construction phase, due to the disturbance associated with the construction activities e.g. increased vehicle traffic, and short-term construction-related noise (from equipment) and visual disturbance. The priority species which would be most severely affected would be ground nesting birds or those that utilise low shrubs for nesting:

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

8.2.5 Collisions with the 132kV grid connection

Collisions are probably the biggest single threat posed by power lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

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

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

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

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

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

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

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

Despite evidence that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos et al. 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Sporer et al. 2013; Barrientos et al. 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos et al. 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A study reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos et al. 2011). Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important, as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin et al. 2010).

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

A potential impact of the proposed 132kV power lines is collisions with the earth wire. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are susceptible to powerline collisions (see Figure 9). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

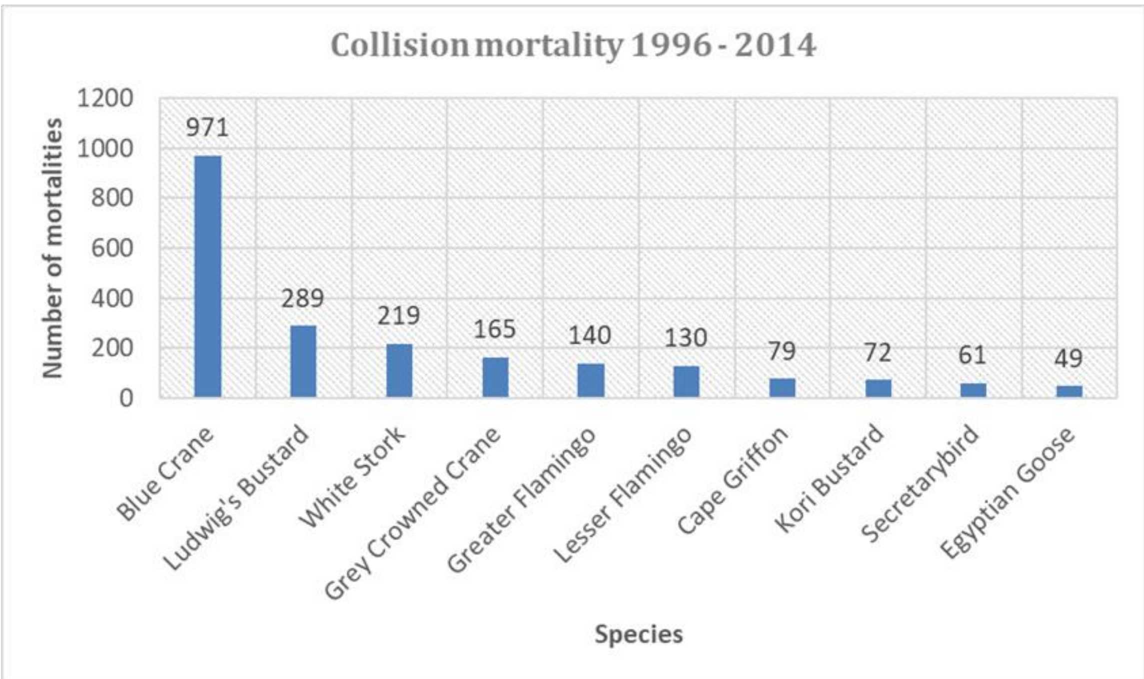

Figure 11: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data 2014)

The most likely priority species candidates for collision mortality on the proposed 132kV power line are large terrestrial species and waterbirds. However, the proposed power line corridor is situated next to the busy R502 road virtually all the way. The presence of the road will in itself be a mitigating factor in that the vicinity of the road will most likely be avoided by most power line sensitive species, or they will naturally cross the road at a higher altitude. The power line corridor does not cross any drainage lines, thereby further reducing the risk of collision. Species potentially at risk of collisions with the 132kV grid connection are the following:

- Secretarybird
- Coot, Red-knobbed
- Cormorant, Reed
- Cormorant, White-breasted
- Darter, African
- Duck, Maccoa
- Duck, White-faced
- Duck, Yellow-billed
- Eagle, Martial
- Egret, Cattle
- Egret, Great
- Egret, Little
- Flamingo, Greater
- Flamingo, Lesser
- Goose, Egyptian
- Goose, Spur-winged
- Heron, Black-headed
- Heron, Grey
- Pochard, Southern
- Shelduck, South African
- Shoveler, Cape
- Spoonbill, African
- Teal, Cape
- Teal, Red-billed

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

9 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

The impacts of the proposed Wildebeestkuil 1 Solar PV Plant and 132kV Power Line during all phases (i.e. planning, construction, operation and decommissioning) are detailed below.

WILDEBEESTKUIL PV2 SOLAR PLANT FACILITY																				
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**
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
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
Avifauna	Mortality of priority species due to collisions with the 132kV grid connection	2	2	2	2	3	2	22	-	Low	A walk-through exercise should be conducted by the avifaunal specialist once the tower positions have been finalised with the objective of demarcating the spans that need to be marked Bird Flight Diverters (BFDs).	2	1	2	2	3	2	20	-	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 grid connection 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)
	Collisions of priority species with the proposed 132kV line.	-22 (low negative)	-20 (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 grid connection and entrapment in fences	-24 (low negative)	-22 (low negative)
	Average	24.2 (medium negative)	22.4 (low negative)

The 2014 EIA Regulations (as amended) also specify that alternatives must be compared in terms of impact assessment. As mentioned in section 1.6, no design or layout alternatives for the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) are being considered or assessed for the solar PV plant. Design and layout alternatives were considered and assessed as part of a previous BA process that was never completed, and as such the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) have been placed to avoid site sensitivities identified as part of a previous BA process as well as the current BA process. The proposed layouts have therefore been informed by the identified environmental sensitive and/or "no-go" areas.

Three (3) power line corridor route alternatives for the 132kV power line associated were however identified and assessed as part of the current BA process (Figure 4). As such, a comparative assessment of alternatives for the proposed power line corridor route alternatives has been undertaken. Tables 4 and 5 below sets out the comparative assessment of the various alternatives.

Table 4: Criteria used to arrive at a preferred alternative

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 5: Alternative Assessment summarising the impacts, highlighting issues/concerns and indicating the preference associated with each proposed power line corridor route alternative

Alternative	Preference	Concerns / Impact Summary	Fatal Flaws
Option 1	The impact will be relatively insignificant due to the short length of the line and the habitat is not highly sensitive	No specific concerns are associated with this alternative	None
Option 2A	The impact will be relatively insignificant due to the short	No specific concerns are associated with this alternative	None

Alternative	Preference	Concerns / Impact Summary	Fatal Flaws
	length of the line and the habitat is not highly sensitive		
Option 2B	Burying the line will mean that the risk of collisions will be eliminated	No specific concerns are associated with this alternative	None

As can be seen from Table 5 above, Option 3 is the preferred option for the proposed 132kV power line corridor route. In addition, no fatal flaws have been identified. The layout being proposed for authorisation (including power line corridor route) is therefore deemed acceptable form an avifauna perspective and should be approved / authorised.

9.4 Cumulative impacts

The area has seen a notable interest from developers of various renewable energy projects, which could be associated with the solar energy resource potential found in the region, proximity to the existing sub-station and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered as they have the potential to create numerous cumulative impacts, whether positive or negative, if implemented. Figure 11 displays the projects that were considered when examining the cumulative impacts.

Table 6: Proposed renewable energy projects in the area

Proposed Development	Reference Number	Current Status of BA / EIA	Proponent	Proposed Capacity	Farm Details
Leeuwbosch 1 Solar PV Plant Project	TBA	BA ongoing	Leeuwbosch PV Generation (Pty) Ltd	9.9MW	Farm Leeuwbosch 44
Leeuwbosch 2 Solar PV Plant Project	TBA	BA ongoing	Leeuwbosch PV Generation (Pty) Ltd	9.9MW	Farm Leeuwbosch 44
Wildebeestkuil 1 Solar PV Plant Project	TBA	BA ongoing	Wildebeestkuil PV Generation (Pty) Ltd	9.9MW	Farm Wildebeestkuil 59
Wildebeestkuil 2 Solar PV Plant Project	TBA	BA ongoing	Wildebeestkuil PV Generation (Pty) Ltd	9.9MW	Farm Wildebeestkuil 59
Bokamoso Solar Energy Facility	14/12/16/3/3/2/559	Project has received environmental authorisation	SunEdison	75MW	A portion of the farm Matjesspruit 145

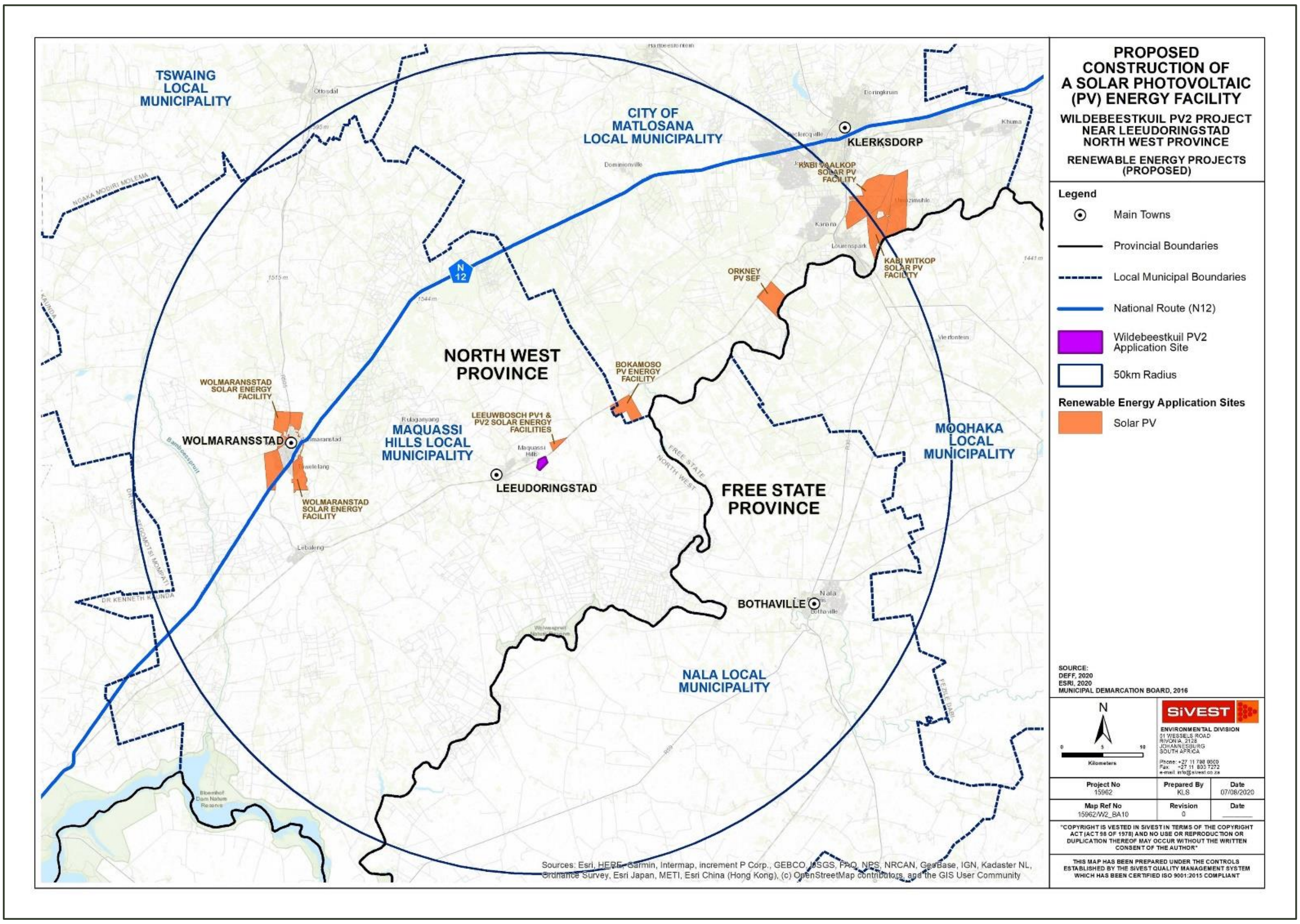

Figure 12: Renewable energy developments within a 50km radius around the proposed development

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors. The Scottish Natural Heritage (2005) recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or 'search area' of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the application site.

Table 7 below sets out the criteria applied to rank potential cumulative impacts.

Table 7: Framework for assessing significance of cumulative effects.

Significance	Effect
Severe	Effects that the decision-maker must consider because the receptor/resource is irretrievably compromised, resulting in a fatal flaw.
Major	Effects that may become a key decision-making issue, potential fatal-flaw.
Moderate	Effects that are unlikely to affect the viability of the project, but mitigation might be required.
Minor	Effects which might be locally/site significant, but probably insignificant for the greater application site.
Not Significant	Effects that are within the ability of the resource to absorb such change both at local/site level and within the greater application site.

9.4.1 Current impacts on avifauna

In the current instance, not all the criteria proposed above by the Scottish Natural Heritage can be met in assessing the cumulative impact of the proposed solar PV facility. In the absence of comprehensive scientifically verified data, general knowledge and experience will have to suffice. The following impacts on avifauna can reasonably be assumed in the 30km radius around the development:

- Overgrazing results in degradation of habitat, potentially reducing populations of wide-ranging species such as bustards, which depend on large foraging areas.
- Extensive agricultural operations have led to large areas of grassland having been converted into agricultural crops, which is relatively sterile environments for most priority species.
- Invasive alien plants are a continuing threat, especially along drainage lines.
- Historically, poisons were used extensively in the region to control damage-causing predators, such as Black-backed Jackal *Canis mesomelas* and Caracal *Caracal caracal*. Poison use may be continuing in the surrounding livestock farming areas, but is likely to be at a lower level than previously. The potential impacts of poison use on several threatened raptor species has not been quantified.
- Renewable energy developments are a new threat (see Figure 6). Possible impacts on birds are loss of habitat, breeding disturbance during construction, collisions with the reflective solar panels. Existing and new power lines from substations to renewable energy facilities are also threats to priority species.

9.4.2 The cumulative impact of the proposed Wildebeestkuil PV Facility on avifauna within a 50km radius

9.4.2.1 Displacement of priority species due to habitat transformation and disturbance

The difficulties associated with the quantification of cumulative impacts of the renewable energy facilities have already been explained above. Stock farming is not displacing any priority species although it may be that periodic overgrazing might have an impact on the habitat and therefore the densities of some species. However, that cannot be categorically confirmed without more research. However, the extensive habitat transformation due to the cultivation of agricultural crops has a catastrophic impact on the natural grassland (Harrison *et al.* 1997). As far as potential future impacts are concerned, the cumulative impact of habitat transformation due to the combined effect of all the proposed solar facilities in the area is currently low, due to the small number and small size of proposed developments.
Overall, the cumulative significance of this impact is rated at **Low**, due to the small size of the proposed development.

9.4.2.2 Potential mortality due to collisions with the proposed photovoltaic panels

Collisions with the solar PV panels are a possible threat to priority species known to potentially occur at the development area. As far as potential future impacts are concerned, the cumulative impact of PV collision mortality due to the combined effect of all the proposed solar facilities in the area is currently low, due to the small number and small size of proposed developments.

Overall, the cumulative significance of this impact is rated at **Low**, due to the small size of the proposed development.

9.4.2.3 Potential mortality due to entrapment in the double perimeter fence

Entrapment in the double perimeter fence is a possible threat to large-bodied priority species known to potentially occur at the development area. As far as potential future impacts are concerned, the cumulative impact of entrapment due to the combined effect of all the proposed solar facilities in the area is currently low, due to the small number and small size of proposed developments.

Overall, the cumulative significance of this impact is rated at **Low**, due to the small size of the proposed development.

9.4.2.4 Potential mortality due to collisions with the proposed 132kV grid connection

Collisions with the 132kV grid connection are a possible threat to priority species known to potentially occur at the development area. As far as potential future impacts are concerned, the cumulative impact of powerline collision mortality due to the combined effect of all the existing and future powerlines in the area is currently moderate, as the area contains a fair number of high voltage lines.

Overall, the cumulative significance of the proposed grid connection is rated at Low, due to the short length of the proposed powerline, and the location of it next to a busy provincial road.

An assessment of the cumulative impacts is conducted in **Section 9.3**, with proposed mitigation measures. The cumulative impact of the solar PV plant and 132kV power line on priority avifauna within a 50km 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.

9.5 No-Go Alternative

The no-go alternative will result in the current status quo being maintained at the proposed development site as far as the avifauna is concerned. The development site itself consist mostly of natural grassland. The no-go option would maintain the natural grassland which would be beneficial to the avifauna currently occurring there.

10 CONCLUSIONS

The proposed Wildebeestkuil 2 Solar PV Plant and 132kV Power Line 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 solar PV plant and 132kV power line on priority avifauna within a 50km 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 APPLICATION 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

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Cape Shoveler	*Anas smithii*	3.85	0
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

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Greater Striped Swallow	*Hirundo cucullata*	46.15	10
Green-winged Pytilia	*Pytilia melba*	15.38	0
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

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
Pin-tailed Whydah	*Vidua macroura*	11.54	0
Pririt Batis	*Batis pririt*	26.92	0
Rattling Cisticola	*Cisticola chiniana*	3.85	0
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

Species	Taxonomic name	Full protocol reporting rate	Ad hoc reporting rate
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
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 APPLICATION SITE

Figure 1: Typical grassland habitat at the application site.

Figure 2: High voltage lines in the application site.

Figure 3: An area of flooded grassland at the application site.

Figure 4: A water trough at the application site.

Figure 5: The habitat along the proposed grid connection alternatives.

Figure 6: Another example of the habitat along the proposed grid connection alternatives.

PROPOSED DEVELOPMENT OF THE 9.9MW WILDEBEESTKUIL 2 SOLAR PHOTOVOLTAIC (PV) PLANT, 132kV POWER LINE AND ASSOCIATED INFRASTRUCTURE NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE, MAQUASSI HILLS LOCAL MUNICIPALITY IN THE DR KENNETH KAUNDA DISTRICT MUNICIPALITY

TERMS OF REFERENCE (ToR) FOR SPECIALIST STUDIES

2 INTRODUCTION

The purpose of the Terms of Reference (ToR) 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 proposed solar photovoltaic (PV) plant and associated power line development. 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).

3 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.

4 PROJECT DESCRIPTION

4.1 Project history

The original BA process for the proposed Wildebeestkuil PV Generation (Pty) Ltd (hereafter referred to as "Wildebeestkuil PV Generation") solar photovoltaic (PV) plant was initiated in August 2016. All specialist studies were undertaken and subsequently all site sensitivities were identified. The specialist studies and draft basic assessment reports (DBARs) were completed and released for 30-day public review. The BA was however put out on hold prior to submitting the final basic assessment reports (FBARs) to the Department of Environmental Affairs (DEA). In February 2017, the proposed capacity and layout of the solar PV plant was amended, and a new connection point and associated power line corridors were assessed. However, the project was put on hold prior to submitting the application forms to the DEA or commencing with the legislated public participation process. In August of 2020, Wildebeestkuil PV Generation proposed an additional 9.9MW PV plant on the Wildebeestkuil site (now referred to as the Wildebeestkuil 1 Solar PV Plant & 132kV Power Line and Wildebeestkuil 2 Solar PV Plant & 132kV Power Line) outside of all site sensitivities that were identified in 2016, and as such specialist studies have been commissioned to assess and verify the now two (2) solar PV plants and 132kV power lines under the new Gazetted specialist protocols[7].

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[7] GOVERNMENT GAZETTE No. 43110, PROCEDURES FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING ON IDENTIFIED ENVIRONMENTAL THEMES IN TERMS OF SECTIONS 24(5)(a) AND (h) AND 44 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, WHEN APPLYING FOR ENVIRONMENTAL AUTHORISATION, 20 MARCH 2020.

In terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998, prescribe general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation, as contained in the Schedule hereto. When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements. Each protocol applies exclusively to the environmental theme identified within its scope. Multiple themes may apply to a single application for environmental authorisation, and assessments for

4.2 Project location

Wildebeestkuil PV Generation is proposing to construct a solar PV plant, 132kV power line and associated infrastructure approximately 4km east of the town of Leeudoringstad in the Maquassi Hills Local Municipality, which falls within the Dr Kenneth Kaunda District Municipality in the North West Province of South Africa (hereafter referred to as the "proposed development") (Department Ref No.: To be Allocated). The proposed development will have a total maximum generation capacity of up to approximately 9.9 megawatt (MW) and will be referred to as the Wildebeestkuil 2 Solar PV Plant and 132kV Power Line. SiVEST Environmental Division (hereafter referred to as "SiVEST") has subsequently been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the BA process for the proposed construction of the Wildebeestkuil 2 Solar PV Plant, 132kV power line and associated infrastructure. The overall objective of the solar PV plants and power lines is to generate electricity (by capturing solar energy) to feed into the national electricity grid and "wheel" the power to customers based on a power purchase agreement. Additionally, an agreement is in place to sell the energy to PowerX, who hold a National Energy Regulator of South Africa (NERSA)-issued electricity trading license which allows them to purchase energy generated from clean and renewable resources and sell it to its customers.

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

- Portion 13 of the Farm Wildebeestkuil No. 59;
- Portion 14 of the Farm Wildebeestkuil No. 59; and
- Remainder of Portion 22 of the Farm Wildebeestkuil No. 59.

The combined extent of the above-mentioned properties is approximately 115.5 hectares (ha). The proposed solar PV plant and associated infrastructure assessed as part of this BA will however only occupy a portion of the above-mentioned properties.

The power line corridor alternatives associated with each proposed solar PV plant which were assessed as part of the respective BA processes traverse the following properties:

- Portion 13 of the Farm Wildebeestkuil No. 59;
- Portion 14 of the Farm Wildebeestkuil No. 59;
- Remainder of Portion 5 of the Farm Wildebeestkuil No. 59;
- Remainder of Portion 7 of the Farm Leeuwbosch No. 44;
- Remainder of Portion 29 of the Farm Leeuwbosch No. 44;
- Remainder of Portion 22 of the Farm Wildebeestkuil No. 59;
- Portion 35 of the Farm Leeuwbosch No. 44;
- Portion 36 of the Farm Leeuwbosch No. 44;
- Portion 37 of the Farm Leeuwbosch No. 44; and
- Portion 38 of the Farm Leeuwbosch No. 44.

The proposed development is located directly west of the Harvard Substation, where the current supply of electricity for the local areas and businesses is extracted from.

4.3 Solar PV Plant Components

The key components to be constructed are listed below:

- Solar PV field (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 2.5m long and 1.2m wide and mounted on supporting structures above ground. 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.

In addition, related infrastructure required are:

- Underground cabling (≈0.8m × 0.6 wide)
- Permanent Guard House (≈876m²)
- Temporary building zone (≈2994m²)
- Switching Substation (≈2000m²)
- Internal gravel roads (≈3.5m width)
- Upgrade to existing roads; and

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these themes must be undertaken in accordance with the relevant protocol, or where no specific protocol has been prescribed, in accordance with the requirements of the EIA Regulations.

- Site fencing (≈2.1m high)

In addition to the above, the electricity generated by the proposed solar PV plant will be fed into the national electricity grid via a 132kV power line, which will connect to the Leeudoringstad Solar Plant Substation (part of a separate BA process)[8]. The proposed 132kV power line will consist of a series of towers anticipated to be located approximately 200m to 250m apart at this stage. The type of power line towers will be determined during the final design stages of the proposed development, prior to construction commencing. The height will vary based on the terrain, but will ensure minimum overhead line (OHL) line clearances with buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the proposed development.

For the purpose of this BA, corridors between approximately 60m and 150m wide were assessed for the proposed power line corridor route alternatives (see **Section 4** below). This is to allow for flexibility to route the power lines within the assessed corridors. As such, the selected preferred power lines will be routed within the assessed corridors. The final servitudes will be routed within the power line corridors, and it expected that the servitude swill not exceed 32m.

Once fully developed, the intention is to generate electricity (by capturing solar energy) to feed into the national electricity grid and “wheel” the power to customers based on a power purchase agreement. Additionally, an agreement is in place to sell the energy to PowerX, who hold a NERSA-issued electricity trading license which allows them to purchase energy generated from clean and renewable resources and sell it to its customers.

The construction phase will be between 12 and 24 months and the operational lifespan will be approximately 20 years, depending on the length of the power purchase agreement with the relevant off taker.

5 BA ALTERNATIVES

5.1 Location alternatives

No site alternatives for the proposed developments are being considered as the placement of solar PV installations and power lines is dependent on several factors, all of which are favourable at the proposed site location. This included land availability and topography, environmental sensitivities, distance to the national grid, solar resource site accessibility and current land use.

5.2 Technology alternatives

No other activity / technology alternatives are being considered. Renewable energy development in South Africa is highly desirable from a social, environmental and development point of view. Based on the flat terrain, the climatic conditions and current land use being agricultural, it was determined that the proposed site would be best-suited for a solar PV plant and associated power line, instead of any other type of renewable energy technology. It is generally preferred to install wind energy facilities (WEFs) on elevated ground. In addition, concentrated solar power (CSP) installations are not feasible because they have a high water requirement and the project site is located in a relatively arid area. There is also not enough rainfall in the area to justify a hydro-electric plant. Therefore, the only feasible technology alternative on this site is solar PV with associated power line, and as such this is the only technology alternative being considered.

5.3 Layout alternatives

No design or layout alternatives for the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) are being considered or assessed as part of the current BA process. Design and layout alternatives were considered and assessed as part of a previous BA process that was never completed, and as such the PV development area, Switching Substation, Guard house and Temporary Building Zone (and all other associated infrastructure) have been placed to avoid site sensitivities identified as part of a previous BA process as well as the current BA process. Specialist studies were originally undertaken in 2016 and all current layouts and/or positions being proposed were selected based on the environmental sensitivities identified as part of these studies in 2016. All specialist studies which were undertaken in 2016 were however updated in 2020 (including ground-truthing, where required) to focus on the impacts of the layout being proposed as part of the current project. The results of the updated specialist assessments have informed the layout being proposed as part of the current BA process. The proposed layout has therefore been informed by the identified environmental sensitive and/or “no-go” areas.

Three (3) power line corridor route alternatives for the proposed 132kV power line were however identified and assessed by the respective specialists as part of the current BA process. These alternatives essentially provide for different power line route alignments contained within an assessment corridor. The power line corridor route

[8] Proposed Leeudoringstad Solar Plant Substation part of separate BA process and will be authorised under a separate EA.

alternatives were informed by the identified environmental sensitive and/or “no-go” areas. The various power line corridor alternatives are described in **Section 5.10** below.

5.4 The operational aspects of the activity

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

5.5 ‘No-go’ alternative

The “no-go” alternative is the option of not fulfilling the proposed project. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report. Implementing the “no-go” option would entail no development.

The “no-go” option is a feasible option; however, this would prevent the Wildebeestkuil 2 Solar PV Plant & 132kV Power Line 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 and 132kV power line (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 50km 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, 132kV power line and associated infrastructure in the proposed project area and the status quo would proceed.

6.10 Comparative Assessment of Alternatives

As mentioned, layout alternatives, which subsequently informed the area for the potential erection of PV panels for the proposed solar PV plant, were identified and comparatively assessed as part of the BA process undertaken in 2016. Specialist studies were originally undertaken in 2016 and all current layouts and/or positions being proposed were selected based on the environmental sensitivities identified as part of these studies in 2016. All specialist studies which were undertaken in 2016 were however updated in 2020 (including ground-truthing, where required) to focus on the impacts of the layout being proposed as part of the current project. The results of the updated specialist assessments have informed the layout being proposed as part of the current BA process.

As the positions of the proposed PV development area, 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.

Three (3) power line corridor route alternatives for the proposed 132kV power line were however identified and assessed by the respective specialists as part of the current BA process. These alternatives essentially provide for different power line route alignments contained within an assessment corridor. The power line corridor route alternatives were informed by the identified environmental sensitive and/or “no-go” areas. The various power line corridor route alternatives are described below.

1) Power Line Corridor Option 1:
This involves an overhead power line which will run north of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as “preferred” for the Leeudoringstad Solar Plant Substation site[9]. The Leeudoringstad Solar Plant Substation site alternatives are situated

[9] 132kV power line corridor route associated with solar PV plant intrinsically linked to Leeudoringstad Solar Plant Substation site (part of separate on-going BA process). Leeudoringstad Solar Plant Substation site chosen as “preferred” by respective specialists as part of that separate BA process therefore informed connection point for power line corridor being proposed as part of this BA application.

approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

2) Power Line Corridor Option 2A:
This involves an overhead power line which will run south of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as "preferred" for the Leeudoringstad Solar Plant Substation site[9]. The Leeudoringstad Solar Plant Substation site alternatives are situated approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

3) Power Line Corridor Option 2B:
This involves an underground power line which will run south of the R502, from the switching substation located within the Wildebeestkuil 2 Solar PV Plant application site (namely Portion 14 of the Farm Wildebeestkuil No. 59) to either Option 1 or Option 2 of the Leeudoringstad Solar Plant Substation, depending on the alternative chosen as "preferred" for the Leeudoringstad Solar Plant Substation site[9]. The Leeudoringstad Solar Plant Substation site alternatives are situated approximately 2km to the north-east of the Wildebeestkuil 2 Solar PV Plant application site, within Portion 37 of the Farm Leeuwbosch No. 44.

The specialist is therefore also to undertake comparative assessment for the above-mentioned power line corridor alternatives as per the table provided by SiVEST.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
Power Line Corridor Route Alternative		
Option 1		
Option 2A		
Option 2B		

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 7** below).

8 GENERAL SUBMISSION REQUIREMENTS

Please ensure that your specialist report includes the following:

- A detailed description of the study's methodology; indication of the locations and descriptions of the development footprint, and all other associated infrastructures that they have assessed and are recommending for authorisations;

- Provide a detailed description of all limitations to the studies. All specialist studies must be conducted in the correct season and providing that as a limitation will not be allowed;
- All specialist studies must be final, and provide detailed / practical mitigation measures for the preferred alternative and recommendations, and must not recommend further studies to be completed post EA;
- Should a specialist recommend specific mitigation measures, these must be clearly indicated;
- Regarding cumulative impacts:
    - Clearly defined cumulative impacts and where possible the size of the identified impact must be quantified and indicated, i.e. hectares of cumulatively transformed land.
    - A detailed process flow to indicate how the specialist's recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project.
    - Identified cumulative impacts associated with the proposed development must be rated with the significance rating methodology used in the process.
    - The significance rating must also inform the need and desirability of the proposed development.
    - A cumulative impact environmental statement on whether the proposed development must proceed.
- The report must in line with the DEA Screening Tool Specialist Theme Protocols (As gazetted 20 March 2020) if they apply. If they do not, the report must be written in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended);
- 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;
- Please note that the Department considers a "no-go" area, as an area where no development of any infrastructure is allowed; therefore, no development of associated infrastructure is allowed in the "no-go" areas;
- Should the specialist definition of "no-go" area differ from the Departments definition; this must be clearly indicated. The specialist must also indicate the "no-go" area's buffer if applicable;
- 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, SiVEST 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, SiVEST will require the original graphic in .jpg format for inclusion in our submission; and
- ***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.