Mopane Solar Park: Phase 5

Specialist Avifauna Impact Assessment

Prepared for

Prepared by

i) Executive Summary

Kemp Operations (Pty) LTD was appointed to compile an avifauna assessment report for the proposed Mopane Photovoltaic Solar Park. The proposed development consists of 5 phases of the solar facility and associated infrastructure and a connection line between the Collector and Carmel substation for AGES Limpopo (Pty) LTD, which Voltalia South Africa (Pty) LTD appointed. Within this report we discuss the impact and mitigations of the Mopane Solar Park Phase 5. This study consisted of a desktop study, a 3-day on-site field investigation with four qualified birders/observers assessing the impacts of the proposed development on the area's avifauna and recommendations for possible mitigation.

The desktop analysis recorded 316 species (Table 5) from more than 500 full protocol cards registered during SABAP2 in the 12 pentads surrounding the proposed Mopane Solar Park and connection lines (Figure 20). The data also reveal that, on average independent of the month, one can observe 202 ± 21 species (Figure 21). Of these, 164 were confirmed during the point survey count, another 19 species were recorded during incidental recordings within the study period, and a further 70 are likely to occur (Table 5). Twenty threatened or near-threatened species were recorded in the greater region during the desktop survey, and only two were confirmed during the field survey. Approximately 38.5 % of the habitat has already been lost, and the proposed solar developments will result in an increased cumulative loss of approximately 41.8 %.

While renewable energy sources such as solar energy are important to the future development of power generation and hold great potential to alleviate the dependence on fossil fuels, they are not without their environmental risks and negative impacts. Poorly sited or designed solar power generating facilities can negatively impact birds and their habitats and the functioning of the entire ecosystem. The utilisation of detailed online databases (e.g., SABAP that have more than 500 full protocol surveying points for the area) aided a thorough site visit conducting more than 200 surveying points ourselves; I am confident in the findings of this report and the delineation through the report. The proposed Mopane Solar Park development would have a low to medium impact on the bird communities. It will cause a slight impact on the ecological process of the overall bird community. The biggest concern is the threat of the internal power lines held to threatened species and large terrestrial birds such as vultures, korhaans and herons. However, the design of the proposed internal power lines must be a type or similar structure as endorsed by the Eskom-EWT strategic Partnership on birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins et al. 2017). Bird diverters or spirals must be added to the transmission line to reduce collision risk. In addition, all the parts of the infrastructure must be nest proofed and fitted with anti-perched devices on areas that can lead to electrocution. Any exposed parts must be covered (insulated) to reduce electrocution risk. Furthermore, these power lines need to be checked quarterly to repaired any failed mitigations. Therefore, careful considerations need to be taken regarding the proposed development, as the proposed development can slightly impact the ecological process of the overall bird community. Still, if the wetland and river system can be avoided as far as possible with the mitigations mentioned above, the impact might reduce in some cases. However, the issuing authority must consider all prescribed mitigation measures and recommendations when reviewing the application.

ii) Specialist details

Report Name	**AVIFAUNA ASSESSMENT MOPANE SOLAR PARK: PHASE 5**
Reference	**Mopane Solar Park: Phase 5**
Submitted to	AGES Purpose with Passion
Report Writer	I, Ryno Kemp (SACNASP # 117462/17) declare that: • I hold higher degrees in the biological sciences, which allowed registration by the South African Council for Natural Scientific Professions (SACNASP) that sanctions us to function independently as specialist scientific consultants; • As per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, this project was our work from inception and reflected my observations and unbiased scientific interpretations exclusively, and executed to the best of my abilities; • I abide by the Code of Ethics of SACNASP; I am committed to biodiversity conservation but concomitantly recognise the need for economic development. Whereas I appreciate opportunities to learn through constructive criticism and debate, I reserve the right to form and hold my own opinion within the constraints of my training, experience and results and, therefore, will not submit willingly to the interests of other parties or change our statements to appease or unduly benefit them; • I am subcontracted as a specialist consultant for the project "Specialist Avifauna Impact Assessment – Mopane Solar Park: Phase 5, as described in this report; • I have no financial interest in the proposed development other than remuneration for the work performed; • I do not have, and will not have in the future, any vested or conflicting interests in the proposed development; • I undertake to disclose to the consultant and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006; • I reserve the right to transfer our intellectual property in this report only to the client(s) (party or company that commissioned the work) on full payment

	of the contract fee. Upon transfer of the intellectual property, we recognise that written consent from the client will be required to release any part of this report to third parties. • In addition, remuneration for services provided by me is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.  Ryno Kemp Pretoria, 24 November 2022
Disclaimer:	Even though every care is taken to ensure the accuracy of this report, faunal and environmental assessment studies are limited in scope, time and budget. To some extent discussions and proposed mitigations are made, on reasonable and informed assumptions built on *bona fide* information sources and deductive reasoning. Based on field collecting and observations, a more factual report can only be derived over several years and seasons of research to account for fluctuating environmental conditions and animal migrations. Since ecological impact studies deal with dynamic natural systems, additional information may come to light later. Therefore, the specialist cannot accept responsibility for conclusions and mitigation measures made in good faith, based on their own databases and on the information provided at the time of the directive. Although the authors exercised due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by accepting this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses that arise from or in connection with services rendered, directly or indirectly, by the authors and use of this document. Therefore, this report should be viewed and acted upon with these limitations.
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iii) Minimum report requirements

Minimum report requirements listed in the Protocol for the specialist assessment and minimum content requirements for environmental impacts on terrestrial animal species (Government Gazette 43110 20 March 2020)	
Contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae	Page 3, 108
A signed statement of independence by the specialist;	Page 4
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Page 29,85
A description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;	Page 26 - 29
A description of the mean density of observations/number of sample sites per unit área and the site inspection observations;	Page 29
A description of the assumptions made and any uncertainties or gaps in knowledge or data	Page 21
A statement of the timing and intensity of site inspection observations;	Page 29, 45
Details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;	Page 76

The online databse name, hyperlink and record accession numbers for disseminated evidence of SCC within the study área;	Page 76
Location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Page 88
A discussion on the cumulative impacts	Page 103
additional environmental impacts expected from the proposed development;	Page 93 - 101
any direct, indirect and cumulative impacts of the proposed development;	Page 93 - 101
the degree to which impacts and risks can be mitigated;	Page 93 - 101
the degree to which the impacts and risks can be reversed;	Page 93 - 101
the degree to which the impacts and risks can cause loss of irreplaceable resources;	Page 93 - 101
Impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Page 93 - 101
A reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant;	Page 104
A motivation must be provided if there were development footprints identified as per paragraph 2.2.12 above that were identified as having a “low” or médium terrestrial, animal or avian species sensitivity and that were not considered appropriate;	Page 104

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Kemp Operations (Pty) LTD was appointed to compile an avifauna assessment report for the proposed Mopane Photovoltaic Solar Park. The proposed development consists of 5 phases of the solar facility and associated infrastructure and a connection line between the Collector and Carmel substation for AGES Limpopo (Pty) LTD, which Voltalia South Africa (Pty) LTD appointed. The Mopane Photovoltaic Solar Park and the connection power line is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province (Figure 1; Table 1). The Mopane Photovoltaic Solar Park is situated on portions 12/125, 95 and RE/2/85 on Douglasdale 95IQ. However, the proposed power line 1 will transverses portions 12, 13 & 15 Blaauwbank; portions 1, 4, 5, 11 & 12 Varkenslaagte and portions 23 & 28 Doornfontein and power line 2 will transverses portions 12 Blaauwbank, portion 1 of Welverdiend, portions 1, 2, 3, 4, 5, 12, 18 and 19 Varkenslaagte and portions 23 & 28 Doornfontein located in the JB Marks Local Municipality, Dr Kenneth Kaunda District Municipality of North West Province (Figure 1).

Table 1. Basic site information

Description of affected farm portions	The remainder of farm Douglasdale 95IQ
Province	North West
District Municipality	Dr Kenneth Kaunda District Municipality
Local Municipality	JB Marks Local Municipality
Closest towns	~ 7km north west of Welverdiend
21 Digit Surveyor General codes	T0IQ00000000008500002
Type of technology	Photovoltaic facility
Structure Height	4.5 meters
Surface area to be covered (Development footprint)	182 ha
EIA footprint	182 ha
Structure orientation	North-South Orientation
Generation capacity	120MW

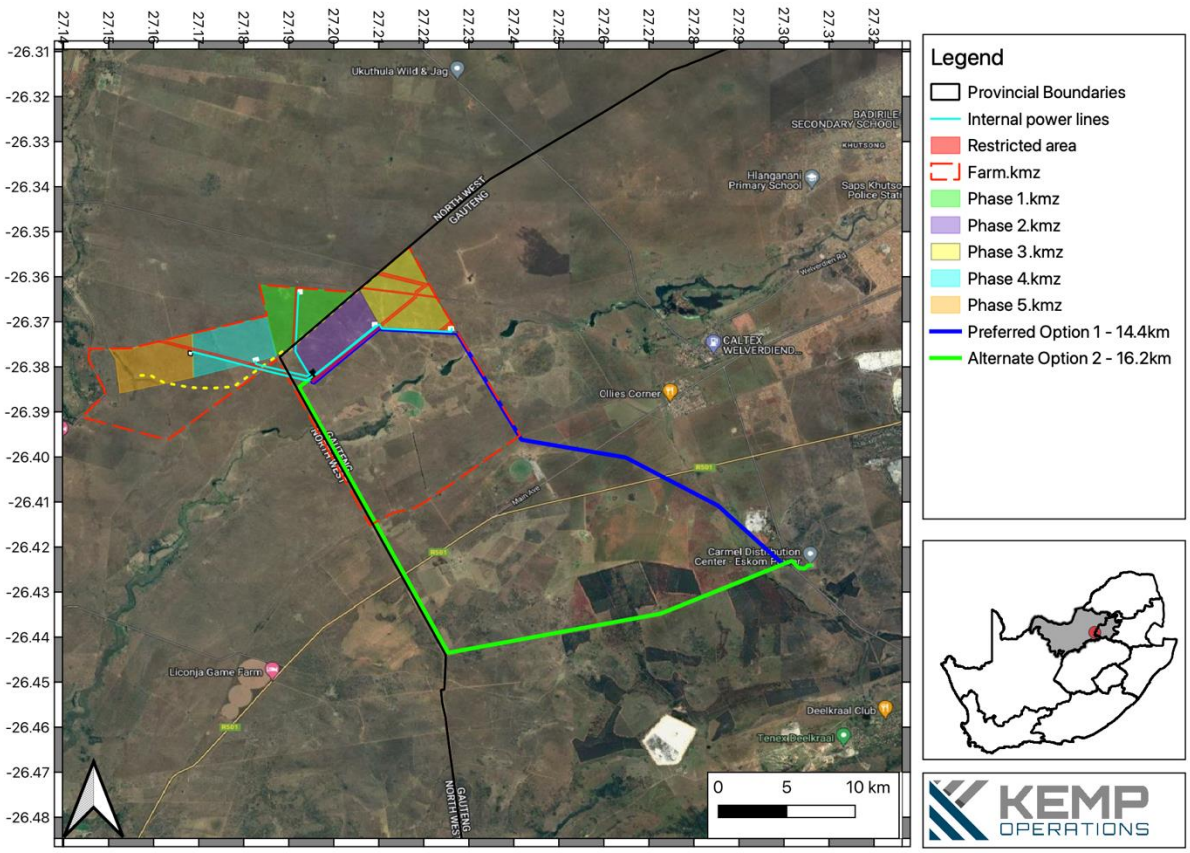

Figure 1. The Mopane Photovoltaic Solar Park and the connection power line is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

The Mopane Photovoltaic Solar Park and connection power line development consists of the installation of the following equipment for each phase:

- Phase 1 – discussed within the report Mopane Solar Park: Phase 1 (Figure 2)
    - Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
    - Mounting systems for the PV arrays will be secured in concrete foundations.
    - Internal cabling and string boxes
    - DC/AC inverters
    - Medium voltage stations hosting LV/MV power transformers
    - Medium voltage receiving stations
    - Workshops & warehouse
    - One on-site high-voltage substation and one high-voltage bushar with metering and protection devices
    - One on-site high-voltage substation power transformer, stepping up the voltage to 400kV/132kV and one high-voltage busbar with metering and protection devices.
    - Battery Energy Storage Systems (BESS), with a Maximum Export Capacity of up to

120MW and a 5-hour storage capacity of up to 1250MWh, with a footprint of up to 10ha, next to the on-site high-voltage substation, within the PV plant footprint/ fenced areas

- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access points, water supply pipelines, water treatment facilities
- Small-scale patented wastewater treatment system.

Construction phase

- Water access points, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshop & warehouses

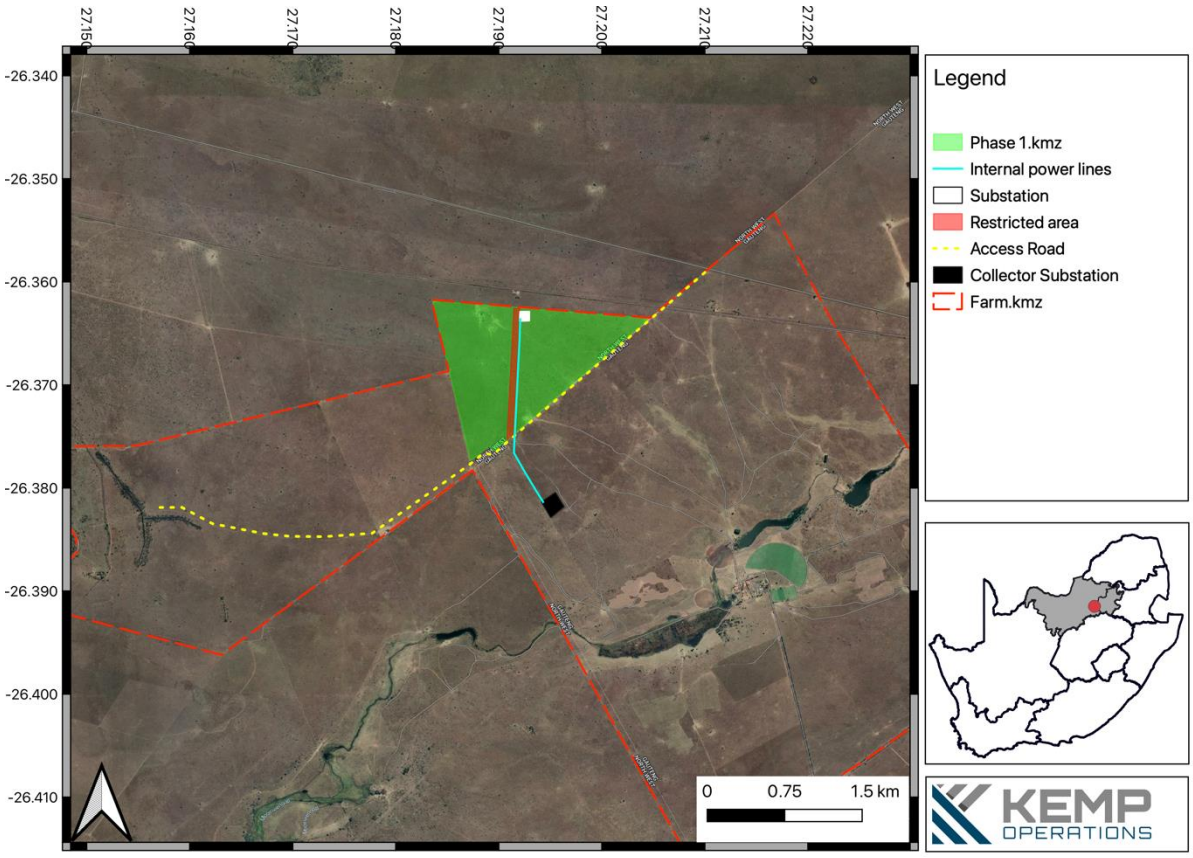

Figure 2. Phase 1 of the Mopane Photovoltaic Solar Park is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

- Phase 2 – discussed within the report Mopane Solar Park: Phase 2 (Figure 3)
    - Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
    - Mounting systems for the PV arrays will be secured in concrete foundations.
    - Internal cabling and string boxes
    - DC/AC inverters
    - Medium voltage stations hosting LV/MV power transformers
    - Medium voltage receiving stations
    - Workshops & warehouse
    - One on-site high-voltage substation and one high-voltage bushar with metering and protection devices
    - One on-site high-voltage substation power transformer, stepping up the voltage to 400kV/132kV and one high-voltage busbar with metering and protection devices.
    - Battery Energy Storage Systems (BESS), with a Maximum Export Capacity of up to 130MW and a 5-hour storage capacity of up to 1250MWh, with a footprint of up to 10ha, next to the on-site high-voltage substation, within the PV plant footprint/ fenced areas
    - Electrical system and UPS (Uninterruptible Power Supply) devices
    - Lighting system
    - Grounding system
    - Internal roads
    - Fencing of the site and alarm and video-surveillance system
    - Water access points, water supply pipelines, water treatment facilities
    - Small-scale patented wastewater treatment system.

Construction phase

- Water access points, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshop & warehouses

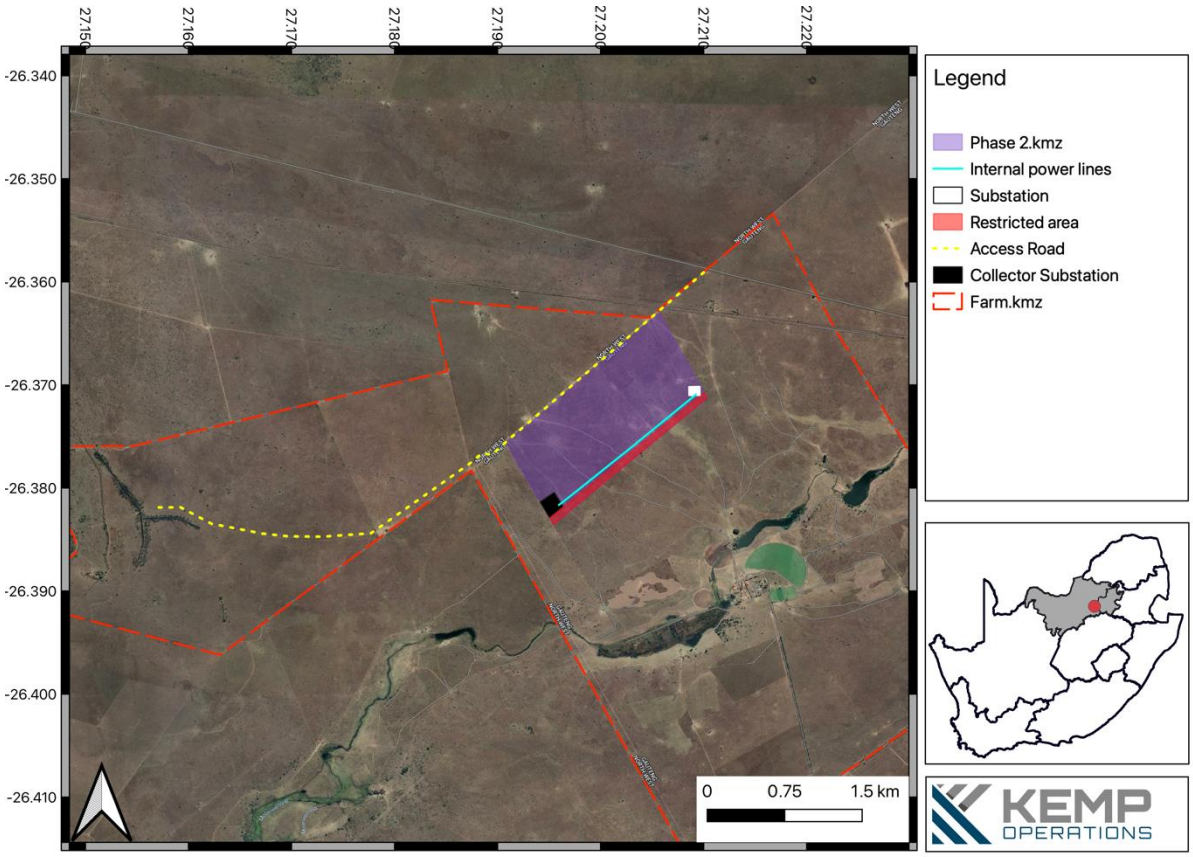

Figure 3. Phase 2 of the Mopane Photovoltaic Solar Park is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

- Phase 3 – discussed within the report Mopane Solar Park: Phase 3 (Figure 4)
    - Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
    - Mounting systems for the PV arrays will be secured in concrete foundations.
    - Internal cabling and string boxes
    - DC/AC inverters
    - Medium voltage stations hosting LV/MV power transformers
    - Medium voltage receiving stations
    - Workshops & warehouse
    - One on-site high-voltage substation and one high-voltage bushar with metering and protection devices
    - One on-site high-voltage substation power transformer, stepping up the voltage to 400kV/132kV and one high-voltage busbar with metering and protection devices.
    - Battery Energy Storage Systems (BESS), with a Maximum Export Capacity of up to 120MW and a 5-hour storage capacity of up to 1250MWh, with a footprint of up to 10ha, next to the on-site high-voltage substation, within the PV plant footprint/ fenced areas

- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access points, water supply pipelines, water treatment facilities
- Small-scale patented wastewater treatment system.

Construction phase

- Water access points, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshop & warehouses

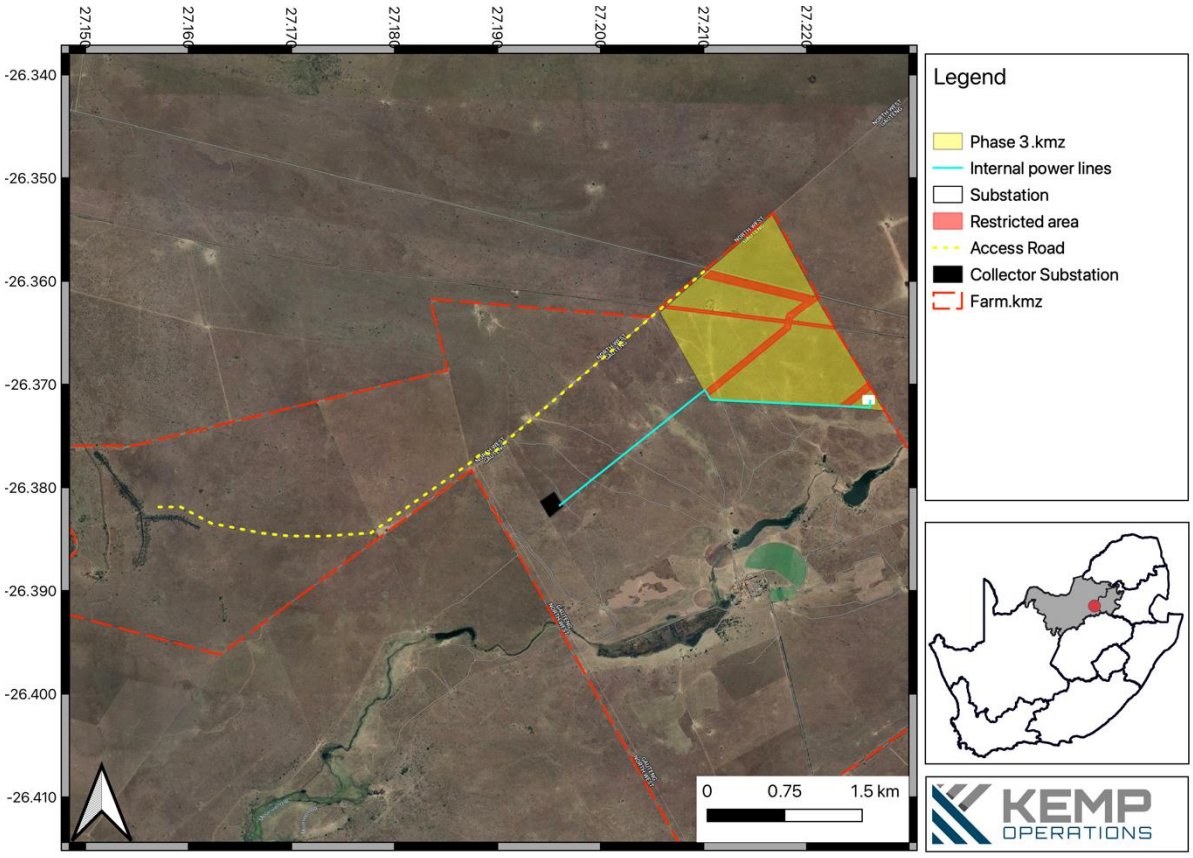

Figure 4. Phase 3 of the Mopane Photovoltaic Solar Park is situated ~ 7km north of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

- Phase 4 – discussed within the report Mopane Solar Park: Phase 4 (Figure 5)
  - Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
  - Mounting systems for the PV arrays will be secured in concrete foundations.

- Internal cabling and string boxes
- DC/AC inverters
- Medium voltage stations hosting LV/MV power transformers
- Medium voltage receiving stations
- Workshops & warehouse
- One on-site high-voltage substation and one high-voltage bushar with metering and protection devices
- One on-site high-voltage substation power transformer, stepping up the voltage to 400kV/132kV and one high-voltage busbar with metering and protection devices.
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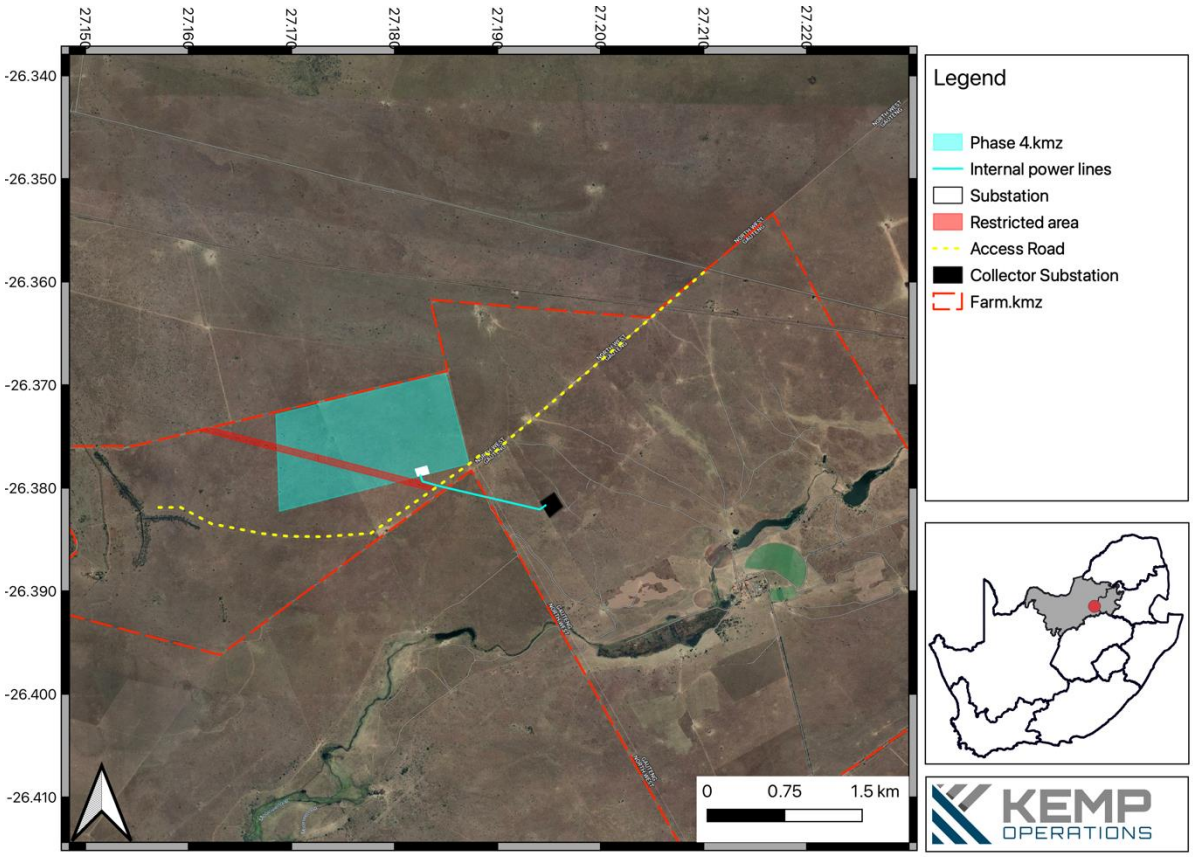

Figure 5. Phase 4 of the Mopane Photovoltaic Solar Park is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

- Phase 5 – discussed within this report 5 (Figure 6)
    - Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
    - Mounting systems for the PV arrays will be secured in concrete foundations.
    - Internal cabling and string boxes
    - DC/AC inverters
    - Medium voltage stations hosting LV/MV power transformers
    - Medium voltage receiving stations
    - Workshops & warehouse
    - One on-site high-voltage substation and one high-voltage bushar with metering and protection devices
    - One on-site high-voltage substation power transformer, stepping up the voltage to 400kV/132kV and one high-voltage busbar with metering and protection devices.
    - Battery Energy Storage Systems (BESS), with a Maximum Export Capacity of up to 120MW and a 5-hour storage capacity of up to 1250MWh, with a footprint of up to 10ha, next to the on-site high-voltage substation, within the PV plant footprint/ fenced areas

- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
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- Fencing of the site and alarm and video-surveillance system
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Construction phase

- Water access points, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshop & warehouses

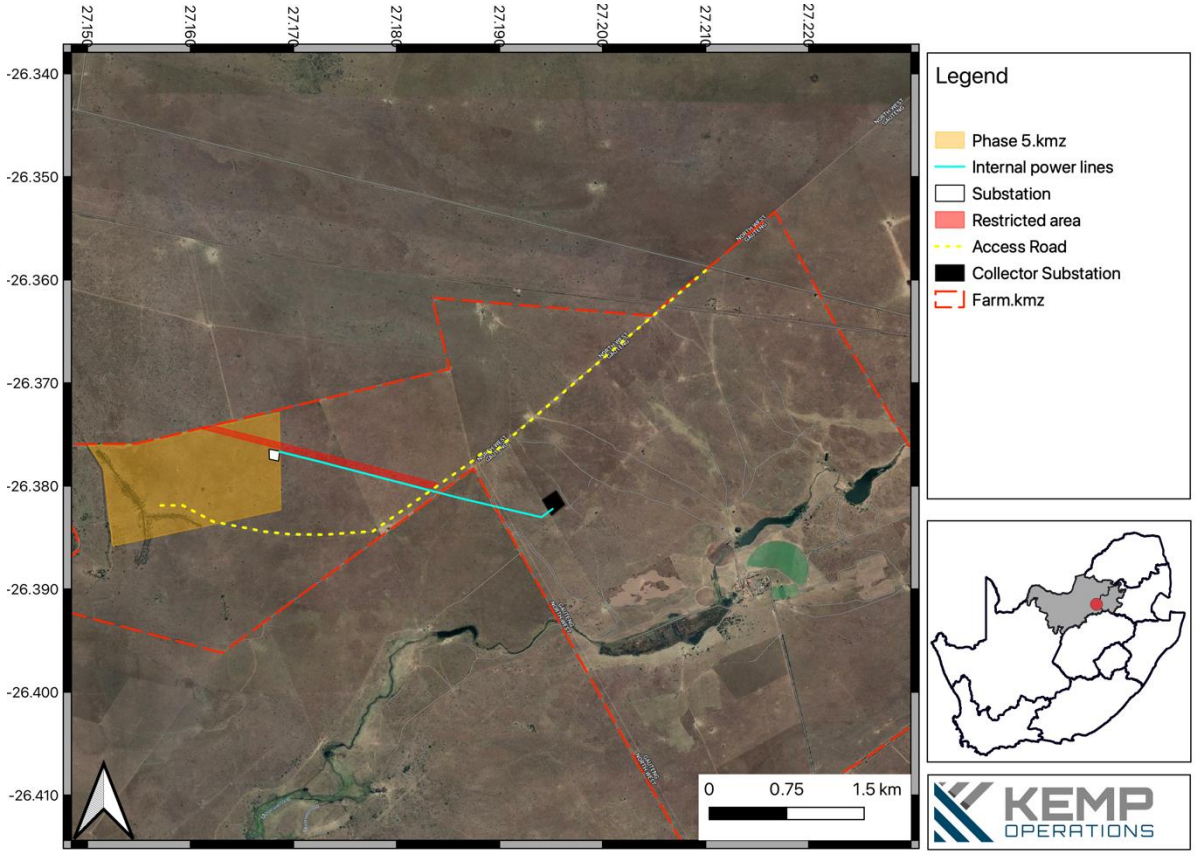


Figure 6. Phase 5 of the Mopane Photovoltaic Solar Park is situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

- Power line connection - discussed within the report Mopane Solar Park: Power line Connection (Figure 7)
  - Development and installation of a 275 kV or 400kV power line
  - Interventions on the Eskom Caramel substation

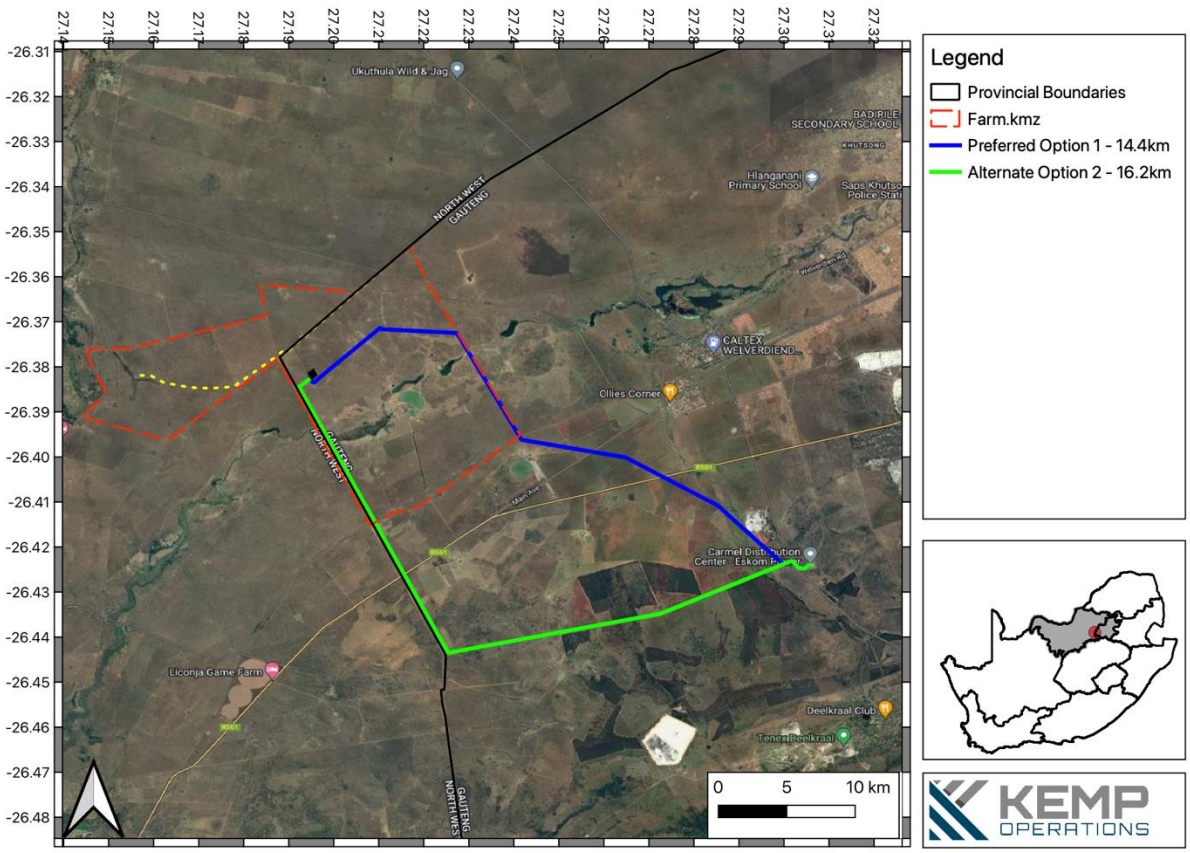


Figure 7. The proposed power line connection lines between Mopane Photovoltaic Solar Park and ESKOM Carmel substation are situated ~ 7km northwest of Welverdiend along the border between Gauteng and the North West Province. Image courtesy of Google Earth.

1.2 ASSUMPTIONS AND LIMITATIONS OF BASELINE DATA

- The environmental consultant and client received adequate background information regarding the proposed activity. It is assumed that the relevant information received is accurate and correct. Sufficient information regarding the region's avifauna was sourced from published, unpublished and online datasets.
- The findings expressed in this report are based on a three-day field survey at the end of October 2022 with four experienced birders, all with degrees and postgraduate degrees in Zoology and Ecology. The site visit was conducted at the start of the rainy season; all seasonal and nomadic movements or altitudinal migrations would likely be present during the field study. However, the information obtained from online data sources in the surrounding areas, including winter and summer observations, was deemed to fully understand the bird community's presence during each year's season.
- The assumptions made and prevalent constraints did not pose any significant negative implications for the study.
- Bird behaviour and ecology are unpredictable, like any other organisms. However, the proposed project's impact can reliably be predicted by conducting an in-depth site visit, desktop analysis, and

further research based on effects observed elsewhere. Still, it is essential to understand that specific and local factors can modify interactions between birds and humans;

- Whilst every effort is made to cover as much of the site as possible, representative sampling is completed, and by its nature, it is possible that some birds species that are present on site were not recorded during the field investigations;

1.3 OBJECTIVES AND SCOPE OF THE STUDY

The objective of this study was to carry out an avifauna assessment along and outside the footprint area of the proposed Mopane Solar Park and alternative connection power lines as described in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017). These Best Practice Guidelines were used to assess the potential impacts the proposed development may hold on the local avifauna and which mitigation actions are required to minimise or revoke these threats.

The specific aims of this study were thus:

- I used the Best Practice Guidelines for Birds & Solar Energy (Jenkins et al. 2017) and the Environmental Impact Assessment (EIA) guidelines for renewable energy projects to compile the report with the requirements listed on pages 5-6.
- Compile a species list through desktop analysis and a field investigation
    - Produce species richness analysis from the point count surveys for the proposed phase 5 and the surrounding points using EstimateS software and GraphPad Prism visual presentation.
    - Produce a detailed bird list recorded during field surveys from published data and online databases such as the South African Bird Atlas Project 2 (SABAP2).
    - Use available online databases such as SABAP2 to compile a season list as required by the Best Practice Guidelines for Birds & Solar Energy when the area is classified as regime 2.
- Identify “priority“ species of conservation concern occurring within the study area.
- Identify specific regions and avian habitats in and outside the study area that could be regarded as sensitive or which may harbour species of conservation concern,
- Identify significant bird breeding, roosting or feeding sites and possible avian flight paths or migratory routes,
- Identify potential impacts on avifauna that the proposed activity may hold,
- Determine the cumulative effect of the proposed development,
- List mitigating actions that can be implemented to limit or revoke these threats,
- Should the proposed activity be approved, make appropriate management recommendations regarding bird and habitat conservation on the site,
- Identify No-Go areas and
- Determine the surveying requirements during and post-construction, as required by the Best Practice Guidelines for Birds & Solar Energy for any Regime 2 areas.

1.4 POTENTIAL IMPACTS

The significant potential avifaunal impacts associated with the proposed development, in general, include the following:

- Displacement through habitat loss and human activity
- Collision risk with solar panels
- Collision and electrocution risk with power lines
- Disturbance during the construction and operation phase
- Electromagnetic fields
- Roosting and breeding on panels

Below, each category of impact is discussed in more detail.

1.4.1 DISPLACEMENT THROUGH HABITAT LOSS AND HUMAN ACTIVITY

Ground-disturbing activities affect various ecological processes (e.g. risk of erosion, plant invasion or secondary succession, soil density), ultimately influencing habitat quality. Avian populations require suitable habitats to remain stable over generations. However, human population growth and the associated increase in human activity (e.g. mining, agriculture, urbanisation) result in many habitats becoming fragmented and unsuitable for long-term, sustainable occupation by birds, especially among threatened species (Friesen et al. 1995; Kluza et al. 2000). The North West and Gauteng Provinces is home to several endangered species such as the vulnerable Cape Vulture. The Cape Vulture is just one of many species dependent on suitable habitats to breed and forage. However, an increase in habitat fragments has led to recent population declines in various threatened species (Taylor et al. 2015). Any development involving clearing natural vegetation risks placing additional pressure on already threatened species, and the presence of such species must be thoroughly investigated during the EIA process. Significant adverse impacts can be caused during different stages of development, e.g. the construction, operational and decommissioning phases. During the breeding season, for instance, many bird species are susceptible to human or other disturbances that can cause significant problems for reproductive success (e.g., Griffin & DeGraaf 2000; Müllner et al. 2004; Kluza; Phillips *et al.* 2005; Tewksbury *et al.* 2006).

1.4.2 COLLISION RISK WITH SOLAR PANELS

There are currently two known types of direct solar-related bird fatalities (McCrary *et al*. 1986; Hernandez *et al*. 2014; Kagan *et al*. 2014):

- Collision-related fatality—fatality resulting from the direct contact of the bird with a project structure(s). The fatality has been documented in solar projects of all technology types.
- Solar-flux-related fatal resulting from the burning/singeing effects of exposure to concentrated sunlight. Passing through the area of solar flux may result in (a) direct fatality; (b) singeing of flight feathers that cause loss of flight ability, leading to impact with other objects; or (c) impairment of flight capability to reduce the ability to forage or avoid predators, resulting in starvation or predation of the individual (Kagan *et al.* 2014). Solar-flux-related fatality has been observed only at facilities employing power tower technologies.

A study by Harvey et al. (2014a and 2014b) at the 1300 ha California Valley Solar Ranch PV conducted weekly mortality searches during two 3-month periods in 2014. They estimated that 1030 mortalities occur at this site per year. Even though they did not determine the cause of death, the risk of collisions with reflective surfaces is a proven cause of death at solar plants worldwide, making this the most likely mortality recorded at this site. The cause of death is based on opportunistic carcasses collection. Kegan et al. (2014) showed that collisions with reflective surfaces are the highest threat of any form at a solar plant.

These studies showed that collisions with reflective surfaces (impact trauma) emerge as the highest single identifiable cause of avian mortality. Another problem is that birds, especially waterbirds, mistake these large sheets of dark blue photovoltaic panels for water bodies (the so-called “lake effect”) (Kagan et al. 2014). Slight modifications of panels and design can significantly reduce the number of avian mortalities.

1.4.3 DISTURBANCE DURING THE CONSTRUCTION AND OPERATIONAL PHASE

The impact on birds is sometimes more significant during the construction phase, with increasingly higher levels of activity resulting in an increased disturbance. During the construction phase, the number of personnel and vehicles drastically increase. These activities increase the probability of other impacts, such as fuel spills and construction workers' illegal hunting of birds or mammals. For these reasons, mitigation of effects during the construction phase needs to feature prominently in the environmental management plan, and due care must be taken to avoid excessive impacts.

1.4.4 ROOSTING AND BREEDING ON PANELS

Fixed Photovoltaic panels will create nest/perching/roosting areas for various birds from small to big. One such example for the proposed site is sparrows, starlings and crows, as the panels and infrastructure can be used for a suitable breeding site.

1.4.5 COLLISION AND ELECTROCUTION RISK WITH POWER LINES

Power lines are known to impact birds through either collisions or electrocutions negatively. Power lines are categorised into transmission and distribution lines (Luzenski et al. 2016), providing elevated nesting for species such as crows. Electrocution risk can be reduced by the pole design, whereas collision risk is more difficult to mitigate for all species successfully. Collision risk poses a real threat to orders that have a high wing load (higher body mass per wing area), limiting their manoeuvrability to change direction, which puts them at higher risk of colliding with power lines (Bevanger 1998, Janss 2000), such as vultures (Cathartiformes), storks (Ciconiiformes), bustards (Druiformes), etc. (Bevanger 1995). Electrocution victims range from small species (e.g. starlings) to larger species (e.g. vultures, storks) (Bevanger 1998, Janss 2000, Mañosa 2001, Sergio et al. 2004). The pylon structure plays a considerable role in the risk of electrocution (Manosa 2001). In South Africa, storks and vultures have been severely affected by electrocution (Ledger and Annegarn 1981, Hobbs and Ledger 1986, van Rooyen 2000). Over the last two decades, more than 1530 birds have been impacted negatively by power lines in the previous two decades (VulPro, www.vulpro.com). However, more and more research has been done to reduce

the impact of this threat (Jenkins et al. 2010, 2011, 2016; Dixon et al. 2018; Hermandez- Lambrano *et al*. 2018), but still, a large portion of birds admitted to rehabilitation centres are due to power line interactions, especially vultures (Howard *et al*. 2020).

1.4.6 ELECTROMAGNETIC FIELDS

Electromagnetic fields (EMFs) are generated from power lines that negatively impact bird behaviour (Fernie and Reynolds 2005). Furthermore, EMFs can interfere with the navigation capability of migrant birds (Engels et al., 2014).

1.5 ESSENTIAL LEGISLATIVE REQUIREMENTS

The necessary application for environmental authorisation has been registered under the terms of the EIA Regulations published on 4 December 2014 under sections 24(5) and 44 of the National Environmental Management Act (NEMA, Act No. 107 of 1998). As part of the Environmental Impact Assessment process for this proposed development, several specialist surveys are required, including an avifaunal assessment which will form part of the final scoping phase of the EIA. This report thus details the modus operandi, the findings of an avifauna investigation at the proposed site, and the results of the relevant avifauna impact assessments (Table 2).

Table 2. The essential legislative requirements for assessing the impact of the proposed development on the biodiversity and the conservation of species in North West and Gauteng

Region	**Legislation**
Provincial	North-West Biodiversity Sector Plan of 2015 The North West Biodiversity Management Amendment Bill, 2017 Transvaal Nature Conservation Act GDARD Requirements for Biodiversity Assessments
National	Constitution of the Republic of South Africa (Act No. 108 of 2006) The National Environmental Management Act (NEMA) (Act No. 107 of 1998) The National Environmental Management Act (NEMA) (Act No. 107 of 1998) Section 24 , No 42946 (January 2020) The National Environmental Management Act (NEMA) (Act No. 107 of 1998) Section 24 , No 43110 (March 2020) The National Environmental Management Protected Areas Act (Act No. 57 of 2003) The National Environmental Management Biodiversity Act (Act No. 10 of 2004) The National Environmental Management: Waste Act, 2008 (Act 59 of 2008); The Environment Conservation Act (Act No. 73 of 1989) and associated EIA Regulations

	National Environmental Management Air Quality Act (No. 39 of 2004)
	National Protected Areas Expansion Strategy (NPAES)
	Environmental Conservation Act (Act No. 73 of 1983)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Biodiversity Framework (NBF, 2009)
	National Forest Act (Act No. 84 of 1998)
	National Veld and Forest Fire Act (101 of 1998)
	National Spatial Biodiversity Assessment (NSBA)
	World Heritage Convention Act (Act No. 49 of 1999)
	National Heritage Resources Act, 1999 (Act 25 of 1999)
	Municipal Systems Act (Act No. 32 of 2000)
	Alien and Invasive Species Regulations, 2014
	South Africa's National Biodiversity Strategy and Action Plan (NBSAP)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
	Sustainable Utilisation of Agricultural Resources (Draft Legislation).
	White Paper on Biodiversity
	National Water Act (NWA, 1998)
	Convention on Biological Diversity (CBD, 1993)
	The Convention on Wetlands (RAMSAR Convention, 1971)
International	The United Nations Framework Convention on Climate Change (UNFCC,1994)
	The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973)
	The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)

2 METHODS

This study consisted of a desktop study, a 3-day on-site field investigation with four qualified birders/observers (all with Zoological and Ecological degrees and postgraduate degrees) assessing the impacts of the proposed development on the area's avifauna and recommendations for possible mitigation. Furthermore, bird movements, nest and roost sites were determined, and large terrestrial species and raptors surveys were conducted as stipulated in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017).

2.1 DESKTOP STUDY

Prior to the study, various maps and satellite images (Google Earth imagery) were studied to identify unique landscape features within the study area (e.g., drainage lines, thickets, pans, wooded areas, rocky outcrops, wetlands). A detailed bird list recorded in the region of the study site was compiled using published (bird atlas reports and dissertations), unpublished literature (previous EIA reports, bird club reports, etc.) and online data sources (Table 3).

Table 3. Data sources used during the desktop study

Data/Information	Source	Description
South African Bird Atlas Project 2 (SABAP2)	University of Cape Town	It is a follow-up project from SABAP1. However, the survey scale for the current national bird atlas project (SABAP2) was reduced to the pentad grid cell, which covers 5 minutes of latitude by 5 minutes of longitude (5" X 5"). Each pentad is approximately 9 × 8 km and is a smaller survey unit, revealing more detailed and accurate bird range data.
Important Bird and Biodiversity Areas (IBA) of South Africa	Birdlife South Africa	The IBA is an international initiative to conserve important bird species and their habitats, with 12500 IBAs worldwide. South Africa has identified 112 IBAs to conserve threatened species and their habitats.
Red Data Book of Birds of Birds of South Africa, Lesotho and Swaziland	Birdlife South Africa	The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between Birdlife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI.
IUCN Red List of Threatened Species	IUCN	Established in 1964, the International Union for Conservation of Nature's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.
South African Protected Areas Database (SAPAD)	Department of Environment, Forestry and Fisheries	Spatial delineation of protected areas in South Africa. Updated quarterly

National Vegetation Map	South African National Biodiversity Institute (SANBI) (BGIS)	The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map and sample the vegetation of South Africa, Lesotho and Swaziland.
The National Screening Tool	Department of Environment, Forestry and Fisheries	The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, to screen their proposed site for any ecological sensitivity.
National Protected Areas Expansion Strategu (NPAES)	Department of Environment, Forestry and Fisheries	The National Protected Area Expansion Strategy (NPAES) provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and therefore, of high importance for biodiversity, climate resilience and freshwater protection.
Coordinated Water Bird Counts (CWAC)	University of Cape Town	The Animal Demography Unit (ADU) launched the Coordinated Water Bird Counts (CWAC) project in 1992 as part of South Africa's commitment to international waterbird conservation. The primary aim of CWAC is to act as an effective long-term waterbird monitoring tool. This is being done by means of a programme of regular mid-summer and mid-winter censuses at several wetlands. The database is located at http://cwac.birdmap.africa/index.php.

Coordinated Avifaunal Roadcounts (CAR)	University of Cape Town	The Coordinated Avifaunal Road counts (CAR) were pioneered in July 1993 in a point Cape Bird Club/ADU project to monitor the population of two threatened species: Blue Crane (*Anthropoides paradiseus*) and Denham's Bustard (*Neotis denhamii*). Presently it monitors 36 species of large terrestrial birds along 350 fixed routes covering 19,000km using a standardised method.

2.2 FIELD SURVEY

A detailed field survey was carried out from 28 to 30 October 2022 (the start of the wet season). However, based on the National Screening Tool (https://screening.environment.gov.za/screeningtool/#/pages/welcome), the proposed animal species theme sensitivity site is classified as medium sensitivity due to the following species (*Tyto capensis* and *Eupodotis senegalensis*) and the avian theme sensitivity is classified as high sensitivity due being within 20 km of known vulture supplementary feeding site. A field survey aid in filling in any information gaps identified from pilot investigations and published data. Bird communities were surveyed on the proposed Mapone Solar Park Phase 5 and surrounding environments using point counts as stipulated in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017). QGIS was used to create random points on the proposed Solar Park and surrounding areas, which were located using a GPS. Fifty-seven random points were plotted on the proposed Mapone Solar Park (Phase 1 – 11 points; Phase 2 – 11 points; Phase 3 – 12 points; Phase 4 – 11 points & Phase 5 – 12 points) with a minimum distance apart of 250m and another 45 points along the proposed power lines with a minimum distance of 500m apart. In addition, another 33 alternative points were surveyed (Figure 8). See Appendix A for the point count raw data.

Each solar park and power line point was visited twice during the morning survey (06:30-10:30) or the afternoon survey (14:30 - 18:30). The alternative points were only surveyed once. Surveys were restricted to early mornings and late afternoons to avoid midday air temperatures known to reduce bird activity (Kemp et al. 2020). During the survey, two observers were used. Upon arrival at the survey point, the observer waited 2 minutes before the start of the 10-minute survey as stipulated in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017).

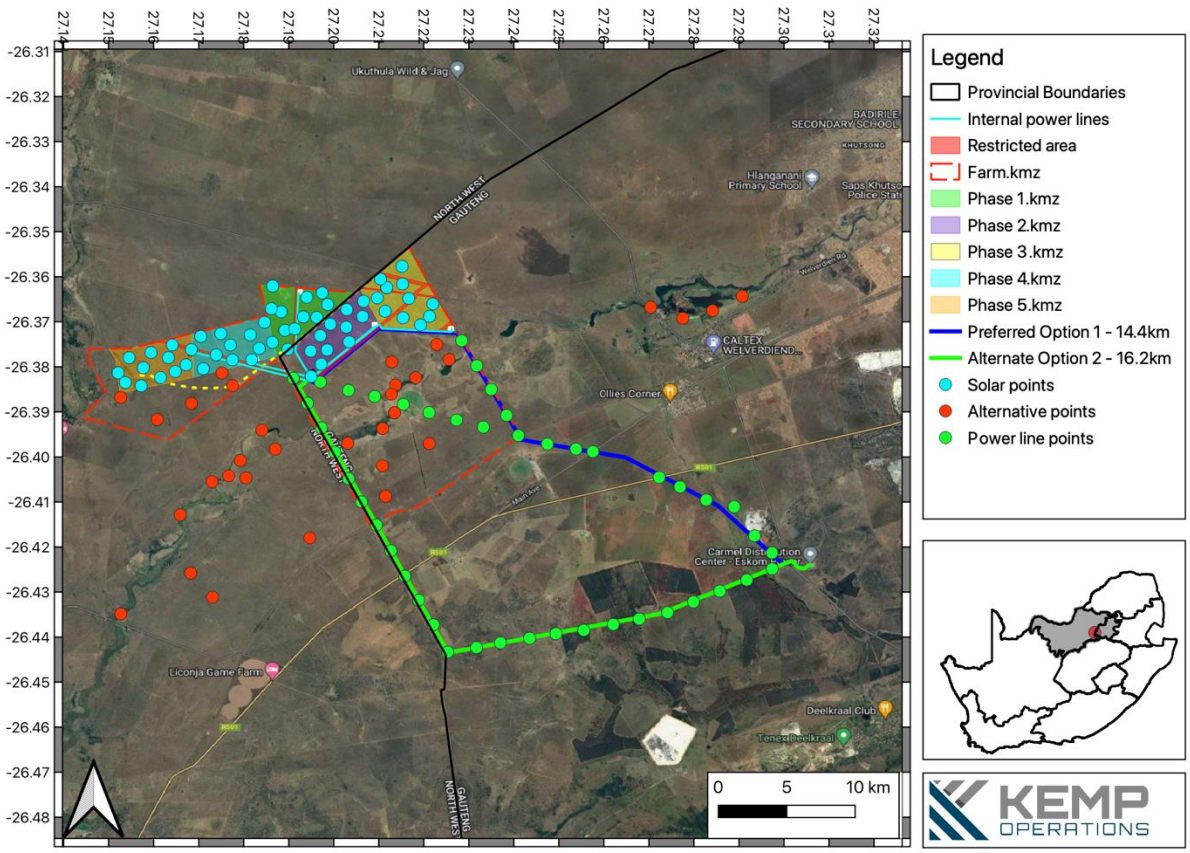


Figure 8. Hundred and thirty-five points were plotted on and outside the proposed Mapone development to better understand the bird assemblage. Image courtesy of Google Earth.

3 RESULTS

3.1 DESKTOP ASSESSMENT

3.1.1 Protected Areas

The Gauteng and North West Province of South Africa contain various small privately-owned and government-owned nature reserves and protected environments along the Magaliesberg. The proposed Mopane Solar Park Phase 5 development does not fall into a protected area (Figure 9). However, the proposed development is surrounded by several privately owned nature reserves (Boskop Dam Nature reserve, Abe Bailey Nature Reserve).

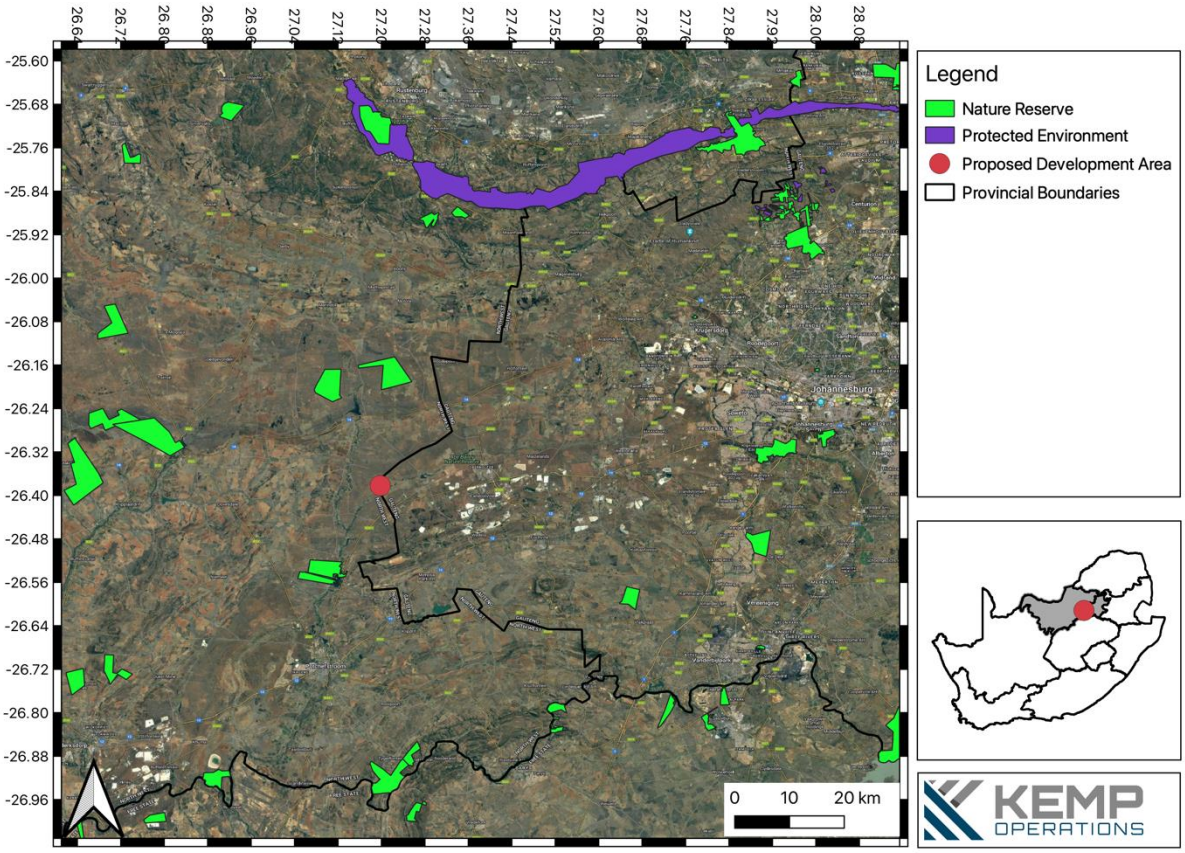


Figure 9. Conservation status of the area surrounding the proposed development (red) on the border of the Gauteng and North West Province. Data obtained from South Africa National Land Cover (SANLC) 2018. Image courtesy of Google Earth.

3.1.2 National Protected Areas Expansion Strategy

National Protected Areas Expansion Strategy (NPAES) (DFFE, 2021b) – The National Protected Area Expansion Strategy (NPAES) provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and are, therefore, highly important for biodiversity, climate resilience and freshwater protection. Figure 10 illustrates that the proposed development of phase 5 of the Mopane Solar Park falls within a Priority Focus Area.

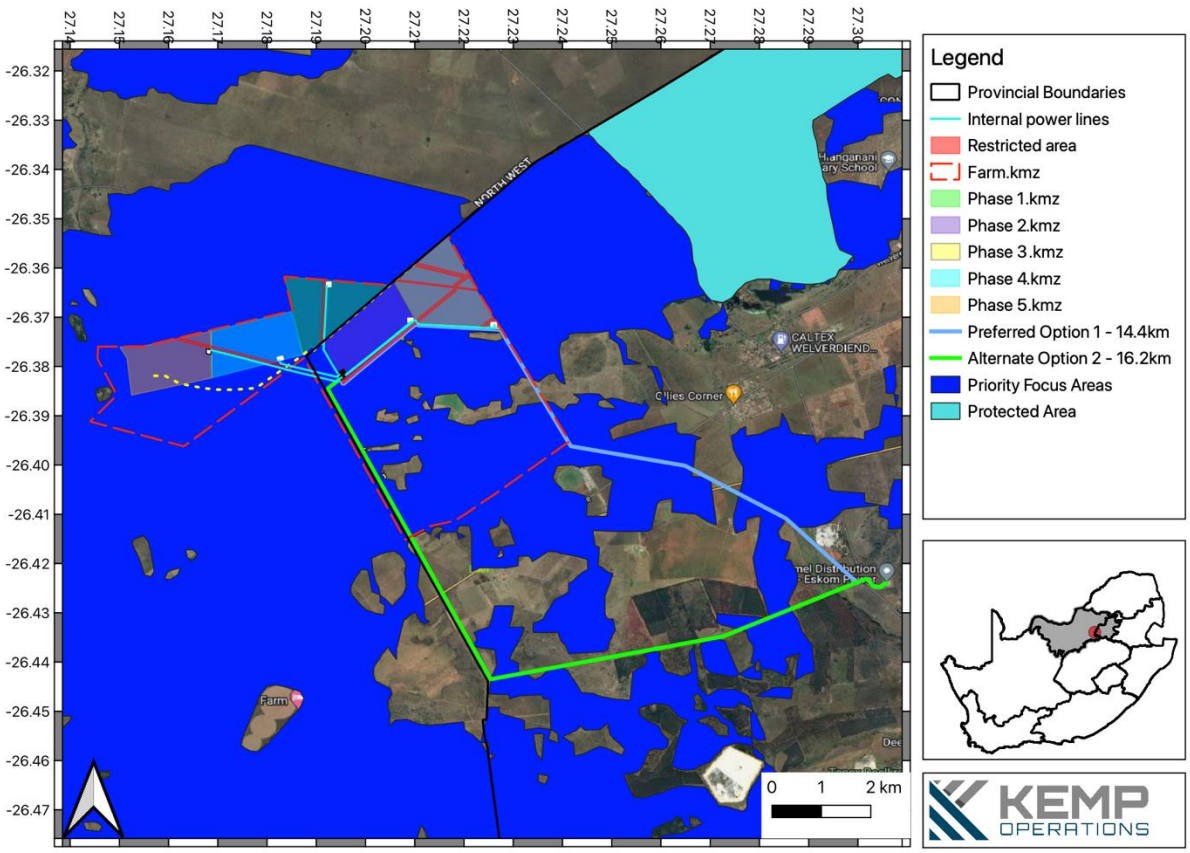


Figure 10. National Protected Areas Expansion Strategy status of the area surrounding the proposed development on the border of the Gauteng and North West Province. Image courtesy of Google Earth.

3.1.3 Critical Biodiversity Area

The North West and Gauteng Department of Environment and Nature Conservation has developed a Critical Biodiversity Area Map which identifies biodiversity priority areas for the province, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole. Figure 11 illustrates that the proposed development of phase 5 of the Mopane Solar Park falls within Critical Biodiversity Area 2.

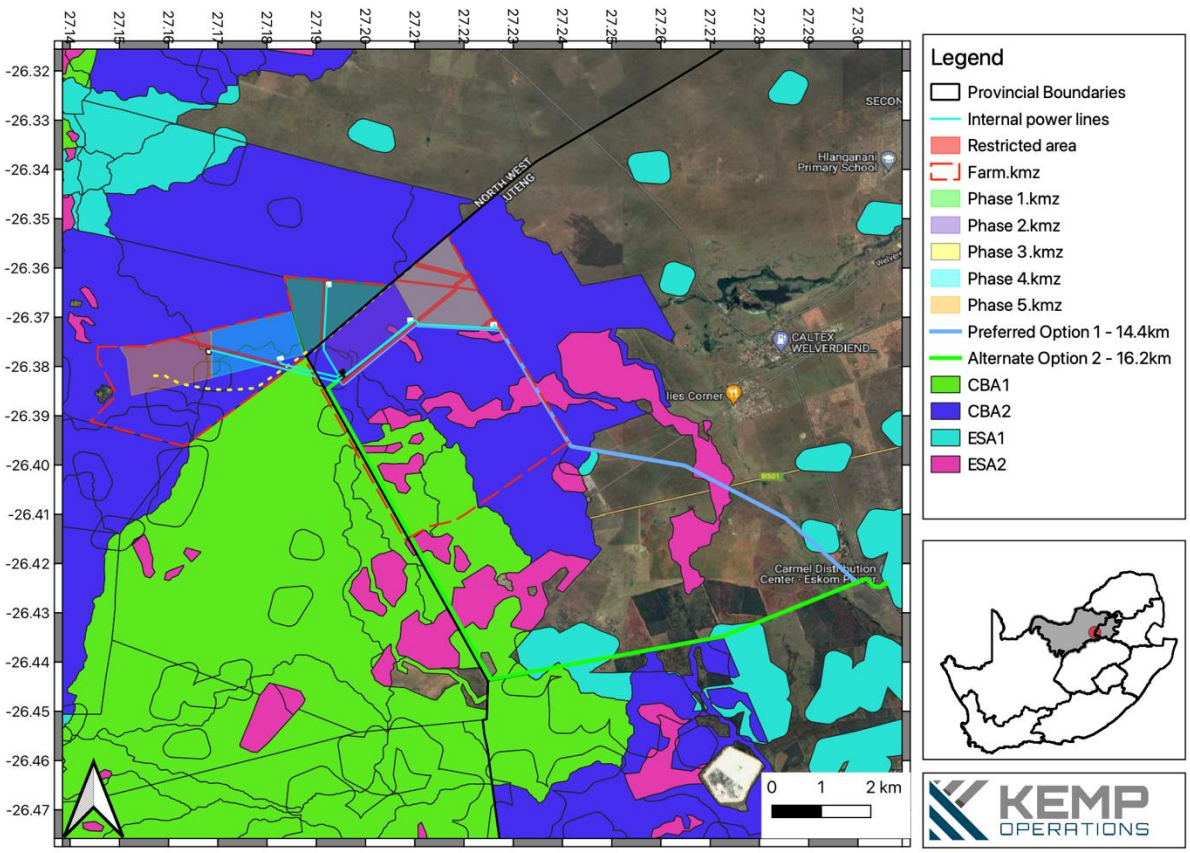


Figure 11. North West Biodiversity Sector Plan status of the area surrounding the proposed development on the border of the Gauteng and North West Province. Image courtesy of Google Earth.

3.1.4 Important Biodiversity Areas

The proposed development is not located within an IBA, but the closest is the Magaliesberg IBA, located North of the proposed development (Figure 12). This IBA is home to a huge variety of bird species and home to two Cape Vulture (*Gyps coprotheres*) colonies with ~300-400 active breeding pairs (Hirschauer et al. 2021). In addition, the African Grass Owl (*Typo capensis*) and Secretarybird (*Sagittarius serpentarius*) are regularly recorded within the area. However, the area is also important for other reptiles, mammals and amphibians.

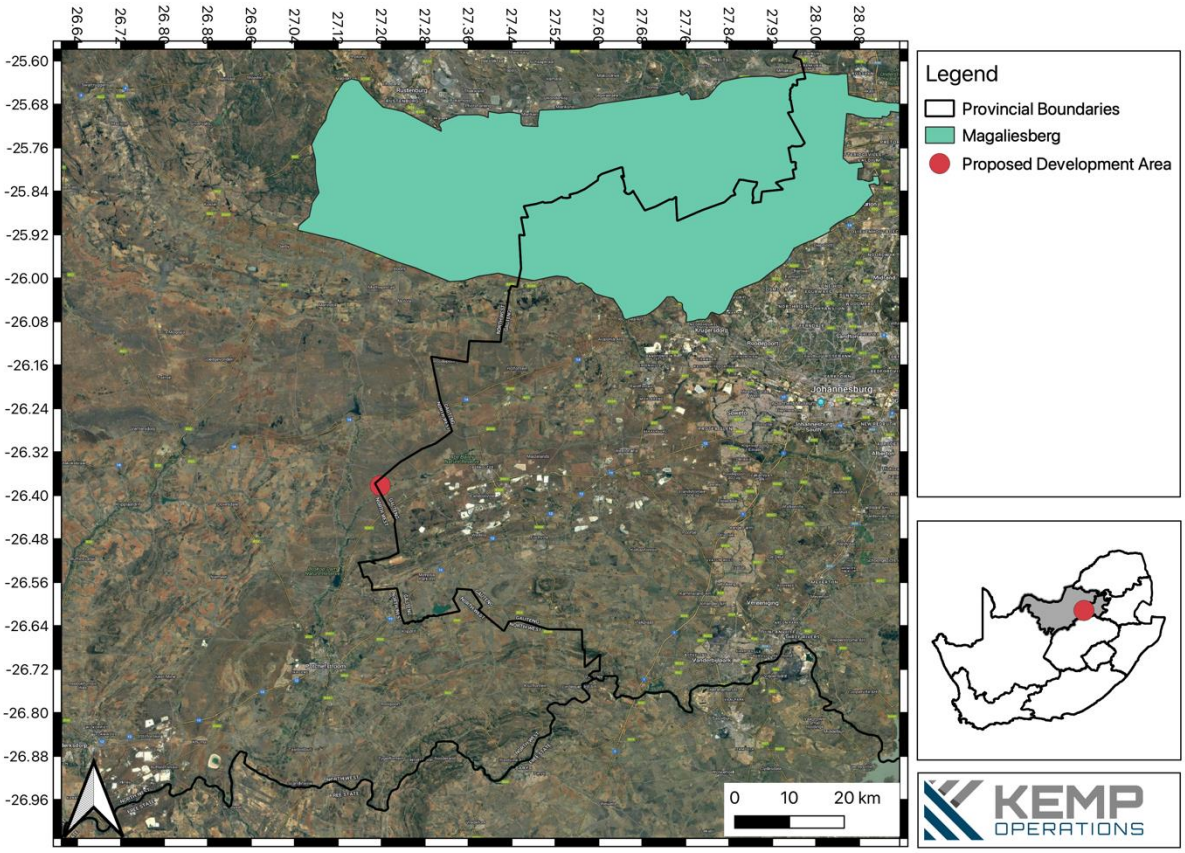


Figure 12. Important Biodiversity Areas (IBAs) status of the area surrounding the proposed development (red) on the border of the Gauteng and North West Province. Data obtained from Birdlife South Africa. Image courtesy of Google Earth.

3.1.5 Coordinated Water Bird Counts

Three CWAC sites (Abe Bailey Nature Reserve: Mooi Rivier Loop 1, Abe Bailey Nature Reserve: Mooi Rivier Loop 2, Abe Bailey Nature Reserve: Mooi Rivier Loop 3) can be found just outside the footprint of the proposed development (Figure 13). Collectively 81 water bird species have been found at these sites. Table 4 lists the various species recorded at each site and their abundance.

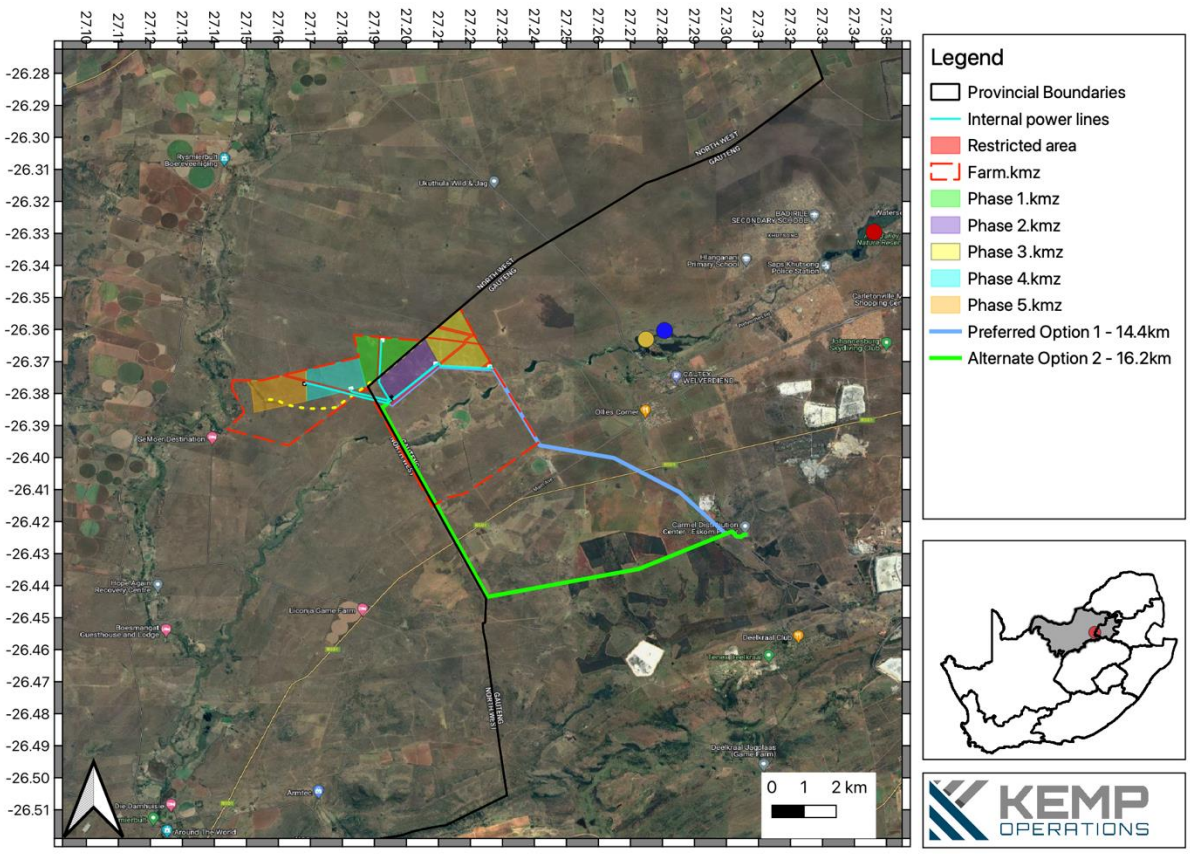


Figure 13. Map representing Coordinated Water Bird Counts (CWAC) sites (circles) in relation to the proposed development.

Table 4. The species recorded at the CWAC sites and their abundance

Common name	Taxonomic name	Abe Bailey Nature Reserve		
		Mooi Rivier Loop 1	Mooi Rivier Loop 2	Mooi Rivier Loop 3
Grebe, Great Crested	Podiceps cristatus	4.23	0	1.33
Grebe, Black-necked	Podiceps nigricollis	0	0	2
Grebe, Little	Tachybaptus ruficollis	16.08	6.6	20.56
Cormorant, White-breasted	Phalacrocorax lucidus	5.31	1.38	3.94
Cormorant, Reed	Microcarbo africanus	33.86	4.21	14.22
Darter, African	Anhinga rufa	7.61	1.82	11.29
Heron, Grey	Ardea cinerea	2.52	1.14	2.75
Heron, Black-headed	Ardea melanocephala	4.44	7	3.27
Heron, Goliath	Ardea goliath	2.47	1.29	1.36
Heron, Purple	Ardea purpurea	5.49	1.6	2.26
Egret, Great	Ardea alba	2.07	1	4.8
Egret, Little	Egretta garzetta	3.15	1	2.45
Egret, Intermediate	Ardea intermedia	2.33	0	5.5
Egret, Western Cattle	Bubulcus ibis	74.88	5.47	80
Heron, Squacco	Ardeola ralloides	8.77	4.33	4.36
Heron, Striated	Butorides striata	1	0	1
Heron, Black	Egretta ardesiaca	8	1.63	7.5
Bittern, Little	Ixobrychus minutus	2.17	1	2
Heron, Black-crowned Night	Nycticorax nycticorax	1.92	1	2.11
Hamerkop	Scopus umbretta	1.5	0	0
Stork, Yellow-billed	Mycteria ibis	1.55	1	1.5
Stork, White	Ciconia ciconia	1	0	0
Ibis, African Sacred	Threskiornis aethiopicus	9	3	5.45
Ibis, Glossy	Plegadis falcinellus	32.68	3.68	13.18
Ibis, Hadada	Bostrychia hagedash	5.3	1.82	2.09
Spoonbill, African	Platalea alba	6.2	2.11	5.34
Flamingo, Greater	Phoenicopterus roseus	69.47	55.63	131.7
Flamingo, Lesser	Phoeniconaias minor	48.75	37.33	53.17
Goose, Spur-winged	Plectropterus gambensis	15.98	3.69	7.19
Goose, Egyptian	Alopochen aegyptiaca	13.41	4.48	7.93
Shelduck, South African	Tadorna cana	71.22	13.31	31.35
Duck, Knob-billed	Sarkidiornis melanotos	2	0	1
Shoveler, Cape	Spatula smithii	15.4	5.63	14.47
Duck, African Black	Anas sparsa	3.5	2.67	4.2
Duck, Yellow-billed	Anas undulata	125.14	12.03	31.82
Teal, Red-billed	Anas erythrorhyncha	71.51	13.15	47.18
Teal, Cape	Anas capensis	5.7	2.33	4.43
Teal, Blue-billed	Spatula hottentota	24.51	5.16	12.57
Duck, White-faced Whistling	Dendrocygna viduata	57.74	22.1	27.76

Duck, Fulvous Whistling	Dendrocygna bicolor	11.2	2	8.25
Pochard, Southern	Netta erythrophthalma	13.54	6.47	5.4
Duck, White-backed	Thalassornis leuconotus	15	0	0
Eagle, African Fish	Haliaeetus vocifer	1	1	1.2
Harrier, Western Marsh	Circus aeruginosus	1	1	0
Harrier, African Marsh	Circus ranivorus	1.18	0	1.33
Harrier, Pallid	Circus macrourus	1	0	0
Osprey, Western	Pandion haliaetus	1	0	0
Rail, African	Rallus caerulescens	3.06	1.75	1.64
Crake, African	Crecopsis egregia	1	0	0
Crake, Spotted	Porzana porzana	1	0	1
Crake, Black	Zapornia flavirostra	5.44	1.33	1.69
Flufftail, Red-chested	Sarothrura rufa	0	0	1
Swamphen, African	Porphyrio madagascariensis	9.55	1.95	2.32
Moorhen, Common	Gallinula chloropus	108.42	4.26	11.38
Coot, Red-knobbed	Fulica cristata	277.91	97.05	174.64
Painted-snipe, Greater	Rostratula benghalensis	0	0	1
Plover, Kittlitz's	Charadrius pecuarius	2	0	2.11
Plover, Three-banded	Charadrius tricollaris	5.12	2.17	2.78
Lapwing, Blacksmith	Vanellus armatus	32.71	3.21	9.42
Lapwing, African Wattled	Vanellus senegallus	1	0	4
Snipe, African	Gallinago nigripennis	5.4	2	3.93
Sandpiper, Curlew	Calidris ferruginea	9.67	1	1
Stint, Little	Calidris minuta	15.57	38	24.29
Ruff	Calidris pugnax	35.88	18.75	41.3
Sandpiper, Common	Actitis hypoleucos	2	3	4
Sandpiper, Marsh	Tringa stagnatilis	5	1	2.5
Greenshank, Common	Tringa nebularia	2.22	0	1.13
Sandpiper, Wood	Tringa glareola	3	2.4	3.29
Avocet, Pied	Recurvirostra avosetta	26.93	10.69	25.52
Stilt, Black-winged	Himantopus himantopus	14.59	5.12	13.94
Gull, Grey-headed	Chroicocephalus cirrocephalus	14.8	2.5	9.25
Tern, White-winged	Chlidonias leucopterus	2.4	0	5
Tern, Whiskered	Chlidonias hybrida	19.18	3.67	6.6
Owl, African Grass	Tyto capensis	1	0	1
Owl, Marsh	Asio capensis	1	0	0
Kingfisher, Pied	Ceryle rudis	2.05	1.25	1
Kingfisher, Giant	Megaceryle maxima	1.33	0	0

Kingfisher, Malachite	Corythornis cristatus	1.57	2	1
Wagtail, African Pied	Motacilla aguimp	11	0	0
Wagtail, Cape	Motacilla capensis	6.03	1.44	2.9
Wagtail, Western Yellow	Motacilla flava	0	0	2

3.1.6 Coordinated Avifaunal Road Counts

Figure 14 illustrates the location of CAR routes in relation to the proposed development footprint. The closest CAR route is ~72km circling the proposed development footprint. Unfortunately, no recent data was obtained from route GC03.

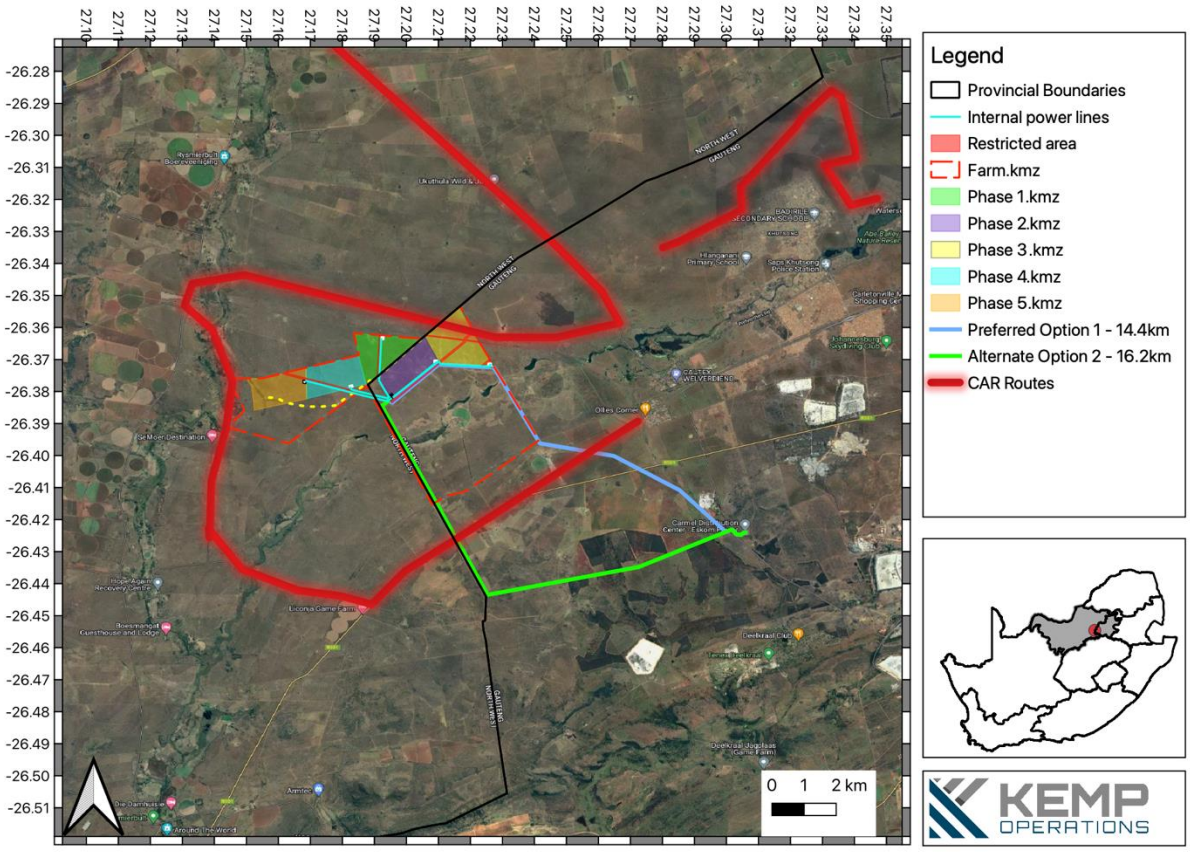


Figure 14. Map illustrating Coordinated Avifaunal Roadcounts (CAR) routes in relation to the proposed development footprint

3.1.7 South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the National Biodiversity Assessment (NBA) 2018. The ecosystem threat status (ETS) of ecosystem types is based on the extent to which each river ecosystem type has been altered from its natural condition. Ecosystem types are categorised as Critical Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Concern (LC). Critically Endangered, EN and VU ecosystem types are collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al.,*

2019). Both the Wetland and River system outside the proposed Development of Phase 5 of the Mopnane Solar Park is classified as CR.

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and are envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEMBA) biodiversity goals (Nel *et al.,* 2011).

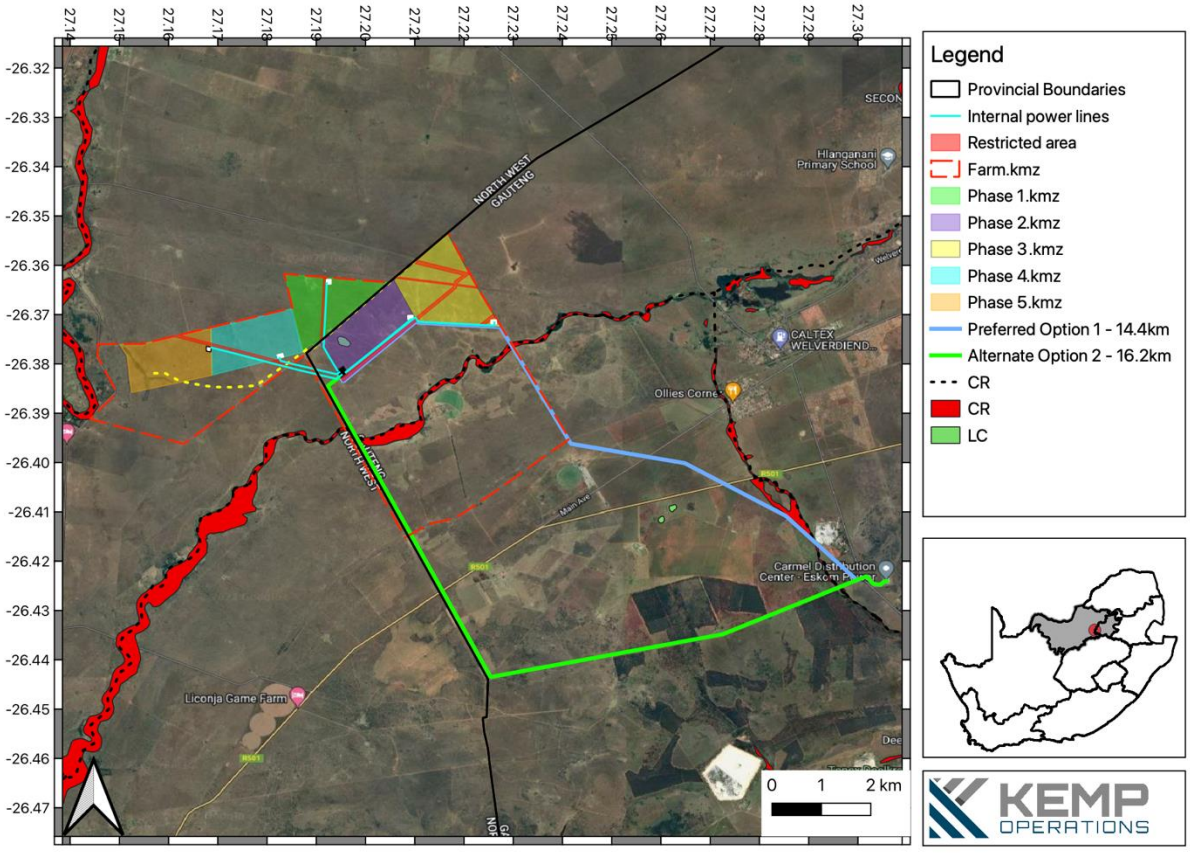


Figure 15. Map illustrating the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) ecosystem threat status (ETS) in relation to the proposed development footprint

3.1.8 Strategic Transmission Corridors (EGI)

On 16 February 2018, minister Edna Molewa published Government Notice No. 113 in Government Gazette No. 41445, which identified 5 strategic transmission corridors important for the planning of electricity transmission and distribution infrastructure as well as the procedure to be followed when applying for environmental authorisation for electricity transmission and distribution expansion when occurring in these corridors. On 29 April 2021, Minister Barbara Dallas Creecy published Government Notice No. 383 in Government Gazette No. 44504, which expanded the eastern and western transmission corridors and gave notice of the applicability of the application procedures identified in Government Notice No. 113 to these expanded corridors. More information on this can be obtained from https://egis.environment.gov.za/egi.

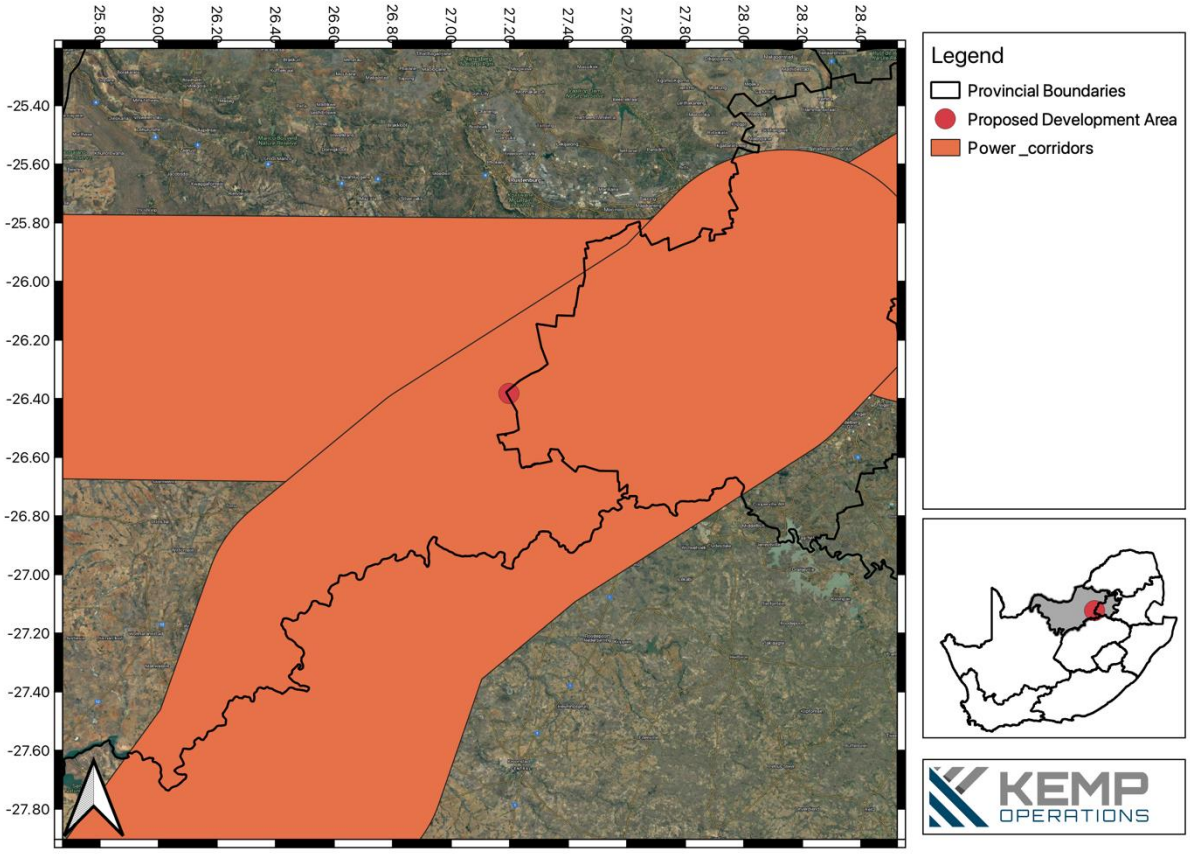


Figure 16. The project area in relation to the strategic transmission corridors

3.1.9 Renewable Energy Zones

In 2018 Government Notice No 114 in Government Gazette No 41445 was published, where 8 renewable energy development zones important for developing large-scale wind and solar photovoltaic facilities were identified. In 2021 an additional 3 sites were included. The REDZs were identified by undertaking Strategic Environmental Assessments. Figure 17 illustrates that the proposed development of phase 5 of the Mopane Solar Park falls outside these REDZ.

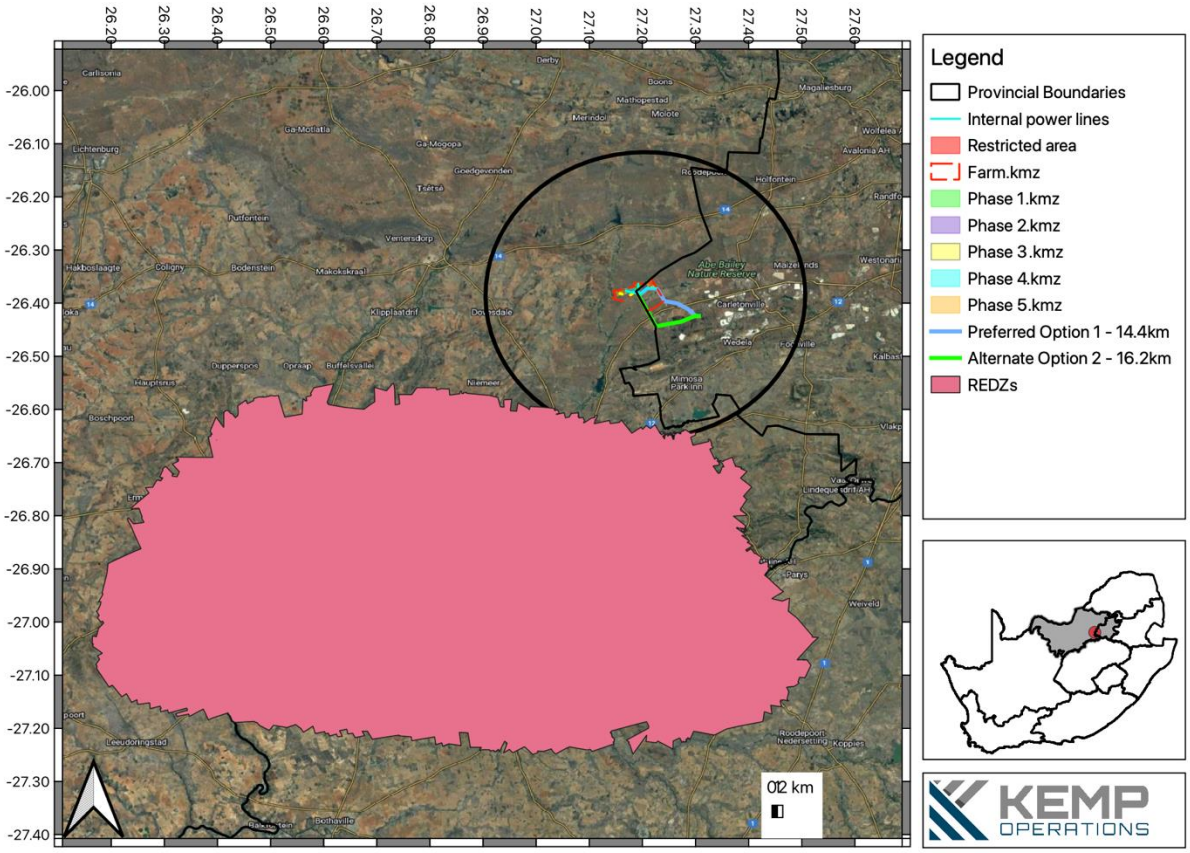


Figure 17. The Project area in relation to the Renewable Energy Development Zone dataset

3.1.10 Vegetation and Landforms

According to Mucina and Rutherford (2006), the proposed Mopane Solar Park and Mopane Power line Connection line falls within the Carletonville Dolomite Grassland (Figure 18). A fine-scale 2018 Land-Use map was generated from South Africa National Land-Cover (SANLC) 2018, suggesting that most of the proposed Mopane Solar Parks are classified as natural grassland and the proposed Mopane Power line Connection line land cross natural grasslands, crops and herbaceous wetlands (Figure 19).

Carletonville Dolomite Grasslands (Gh15) are predominantly found in the North West Province, in the regions around Potchefstroom, Ventersdorp and Carletonville. Carletonville Dolomite Grasslands occur on slightly undulating plains, which are typically intersected by rocky chert ridges. They are species rich and, according to Mucina and Rutherford (2006), dominated by many plant species.

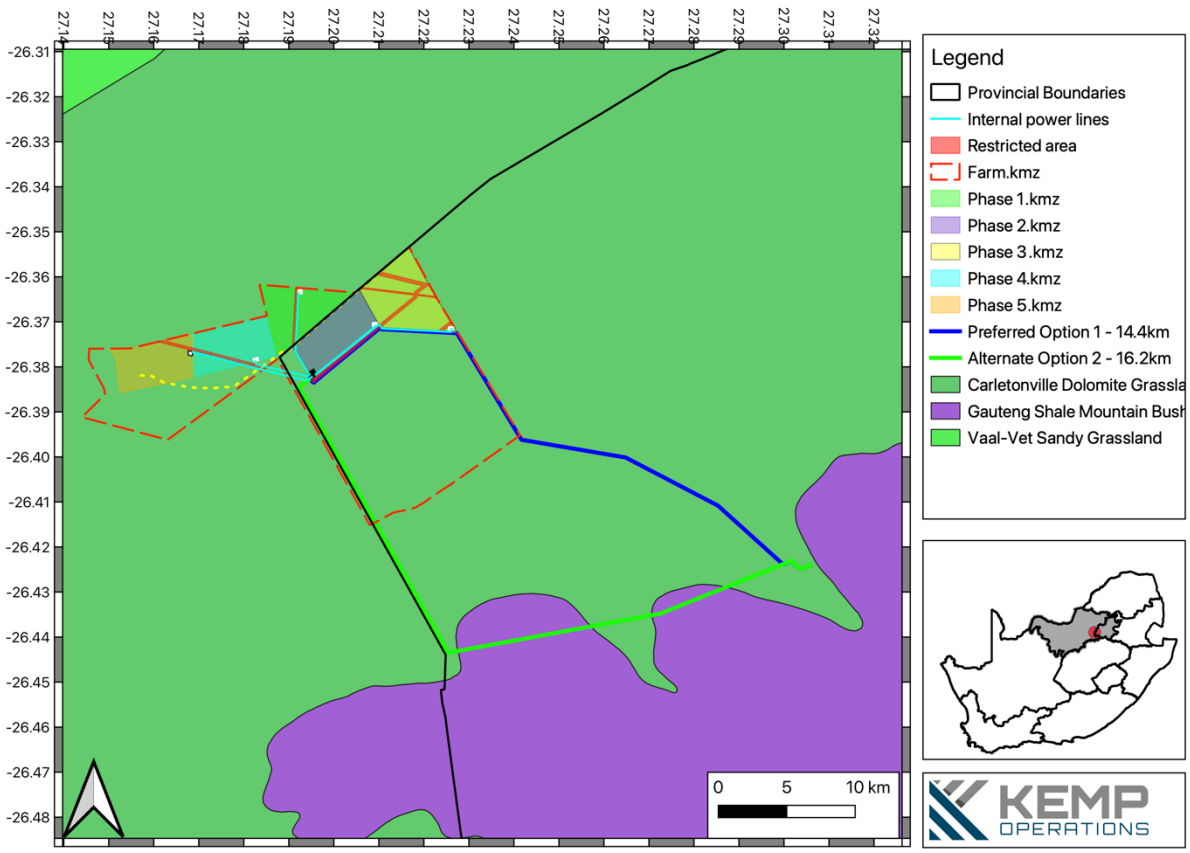


Figure 18. A map extracted from Mucina & Rutherford (2006) shows the proposed Solar Park and Connection lines in an area dominated by Carletonville Dolomite Grassland.

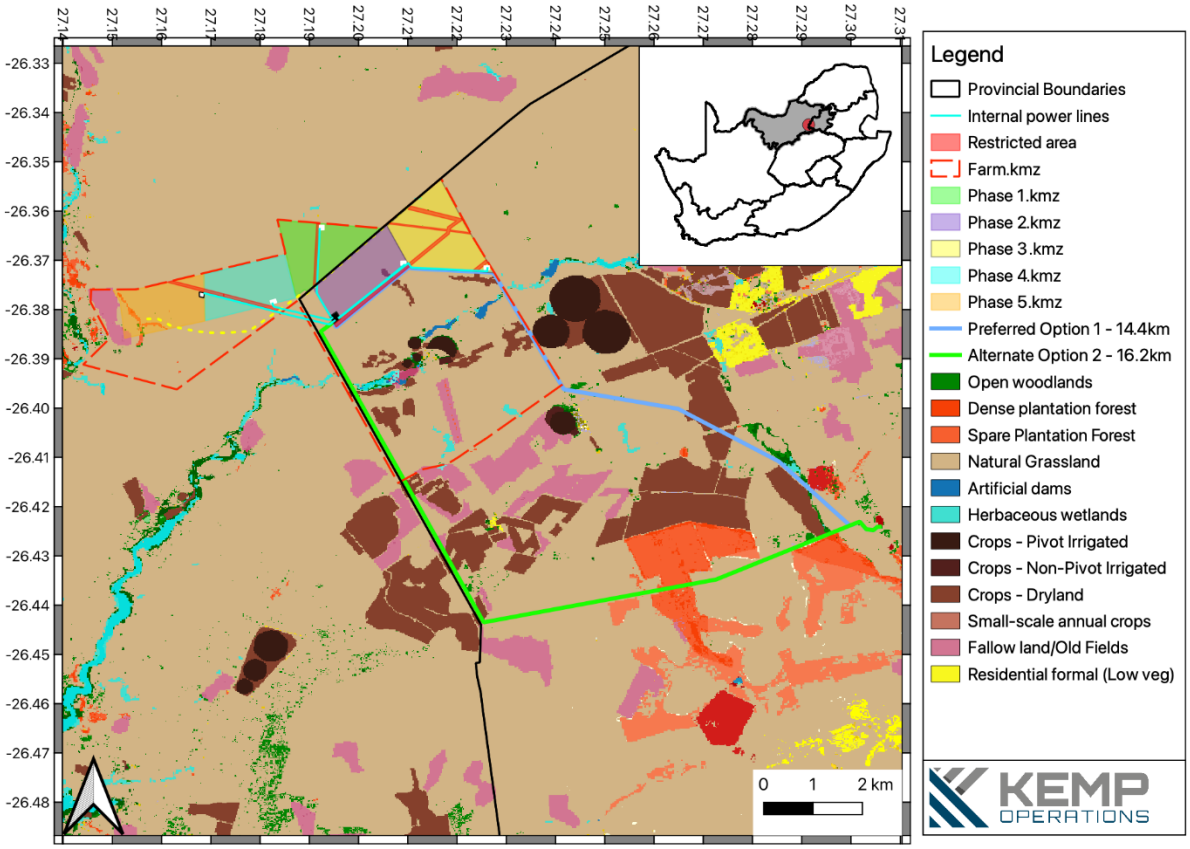


Figure 19. The vegetation classification for the proposed Solar Park and connection lines are based on the South Africa National Land Cover (SANLC) 2018. It is classified as natural grassland, and the proposed Mopane Power line Connection line land across natural grasslands, crops and herbaceous wetlands

3.1.11 Expected Avifauna

The desktop analysis recorded a total of 316 species (Table 5) from more than 500 full protocol cards recorded during SABAP2 in the 12 pentads surrounding the proposed Mopane Solar Park and connection lines (Figure 20). The data also reveal that, on average independent of the month, one can observe 202 ± 21 species (Figure 21). Twenty threatened or near-threatened species were recorded in the greater region during the desktop survey (Table 6).

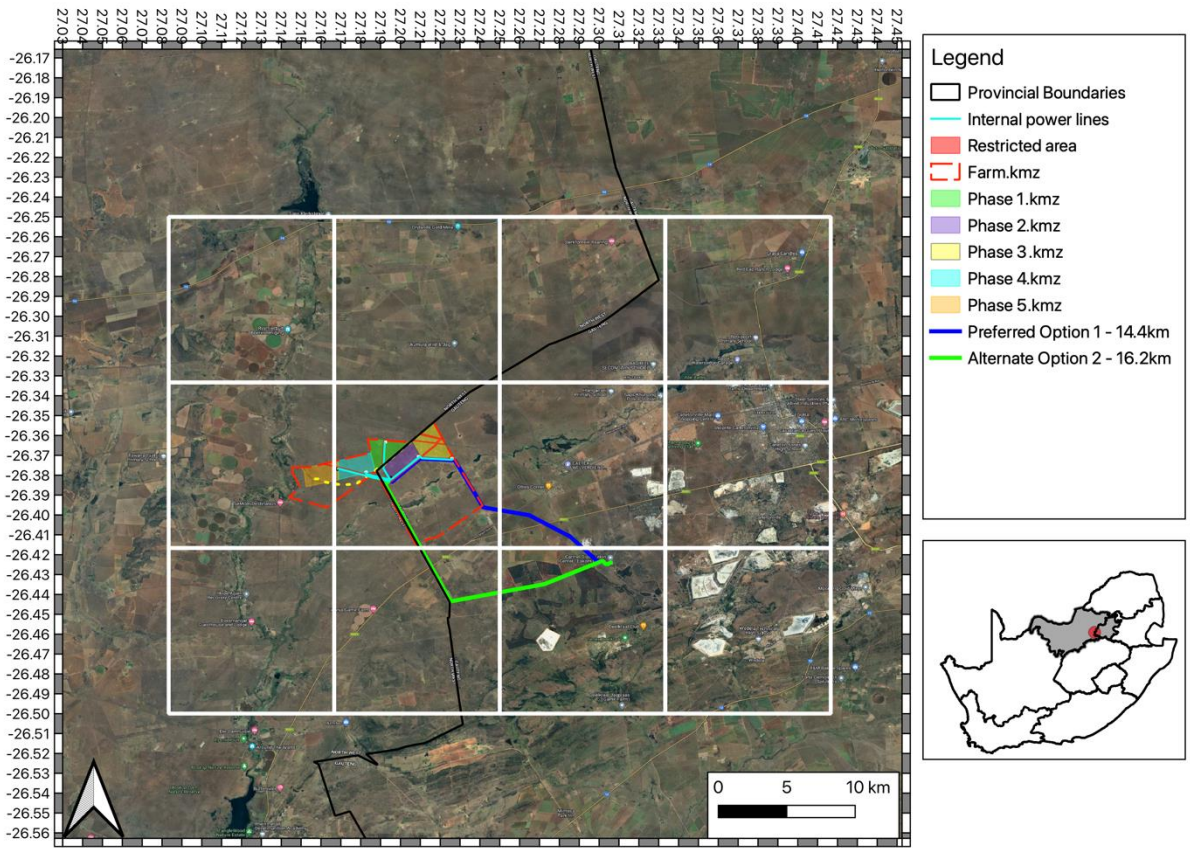


Figure 20. For a more comprehensive desktop analysis, a satellite image shows the 12 South African Bird Atlas Project 2 pentads surrounding the proposed development area. Image courtesy of Google Earth.

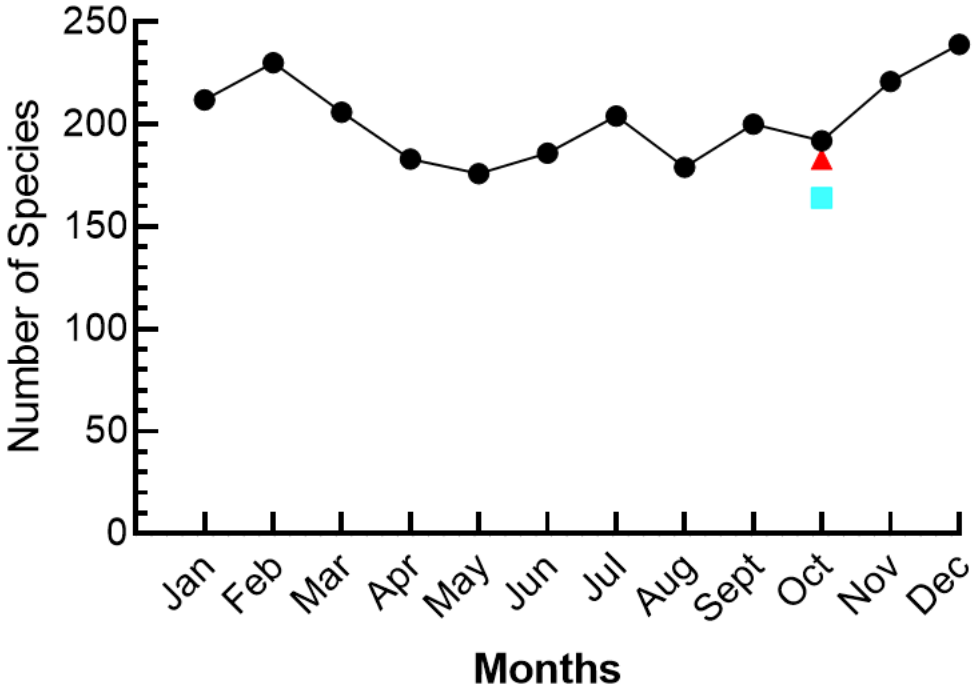
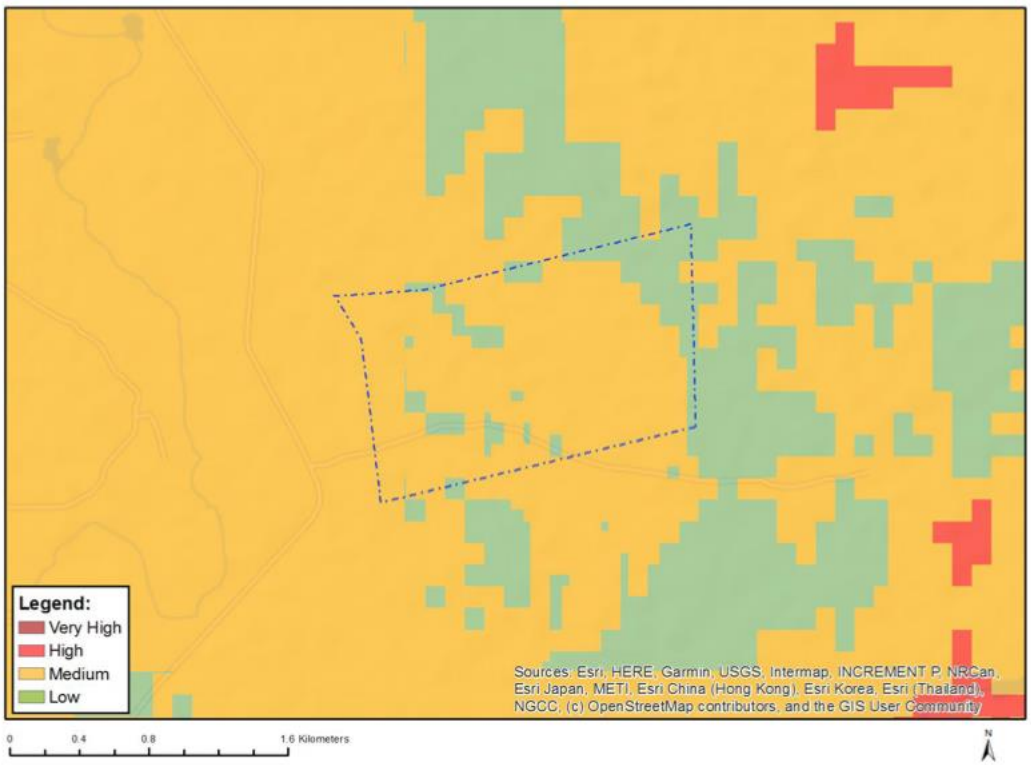


Figure 21. The number of species that have been recorded each month of the year.

3.1.12 Site Ecological Importance (SEI)

As indicated by the screening tool report for the project areas, the animal species theme sensitivity was derived from being medium sensitivity (Figure 22) due to *Typo capensis* and *Eupodotis senegalensis*. As indicated by the screening tool report for the project areas, the avian sensitivity theme was derived from high sensitivity (Figure 23) due to being within 20km of a known Vulture restaurant. As indicated by the screening tool report for the project areas, the terrestrial biodiversity theme of sensitivity was derived from very high sensitivity (Figure 24) due to it being a CBA 2 and part of the Protected Areas Expansion Strategy.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Aves-Tyto capensis
Medium	Aves-Eupodotis senegalensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis

Figure 22. Animal species Sensitivity

MAP OF RELATIVE AVIAN THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	within 20 km of known Cape Vulturerestuarants sites

Figure 23. Avian species Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 2
Very High	Protected Areas Expansion Strategy

Figure 24. Terrestrial Species Sensitivity

Table 5. Bird species were recorded in the area considered for the desktop survey (see Figure 20). The current global (IUCN 2021) and regional (Taylor et al. 2015) red data status ("RD" column) of each red-listed species is provided (NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered), and the likelihood of each species occurring at the greater surveyed area of the proposed Mopane Solar Park and the connection power line is rated as Confirmed, Likely and Unlikely. The table also provides insight into the bird species occurring at the proposed site for each month of the year with a high (Green), medium (Orange) and low (Red) report rate for each month.

Common Name	Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Likelihood	(Regional, Global)	Endemic
Apalis, Bar-throated	Apalis thoracica	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Avocet, Pied	Recurvirostra avosetta	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Babbler, Arrow-marked	Turdoides jardineii		1					1		1		1		Unlikely		
Barbet, Acacia Pied	Tricholaema leucomelas	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Barbet, Black-collared	Lybius torquatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Barbet, Crested	Trachyphonus vaillantii	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Batis, Chinspot	Batis molitor		1	1	1	1	1	1		1	1	1	1	Confirmed		
Bee-eater, Blue-cheeked	Merops persicus	1											1	Unlikely		

Bee-eater, European	Merops apiaster	1	1	1	1						1	1	1	Confirmed		
Bee-eater, Little	Merops pusillus	1	1	1		1	1	1	1	1		1	1	Confirmed		
Bee-eater, Swallow-tailed	Merops hirundineus							1						Unlikely		
Bee-eater, White-fronted	Merops bullockoides		1	1	1	1	1	1	1	1		1	1	Likely		
Bishop, Southern Red	Euplectes orix	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Bishop, Yellow-crowned	Euplectes afer	1	1	1	1	1	1	1		1	1	1	1	Likely		
Bittern, Little	Ixobrychus minutus	1	1	1	1		1	1	1	1	1	1	1	Confirmed		
Bokmakierie	Telophorus zeylonus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Boubou, Southern	Laniarius ferrugineus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Brubru	Nilaus afer	1		1	1	1	1	1		1	1	1	1	Confirmed		
Bulbul, African Red-eyed	Pycnonotus nigricans	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Bulbul, Dark-capped	Pycnonotus tricolor	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Bunting, Cape	Emberiza capensis						1	1					1	Confirmed		
Bunting, Cinnamon-breasted	Emberiza tahapisi	1	1	1	1	1	1	1	1			1	1	Confirmed		
Bunting, Golden-breasted	Emberiza flaviventris													Confirmed		
Buttonquail, Common (Kurrichane)	Turnix sylvaticus		1									1	1	Likely		
Buzzard, Common (Steppe)	Buteo buteo	1	1	1								1	1	Confirmed		
Buzzard, European Honey	Pernis apivorus	1	1											Unlikely		
Buzzard, Jackal	Buteo rufofuscus	1												Unlikely		NE
Canary, Black-throated	Crithagra atrogularis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Canary, Yellow	Crithagra flaviventris	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Canary, Yellow-fronted	Crithagra mozambica	1	1		1	1		1	1	1	1	1	1	Confirmed		

Chat, Ant-eating	Myrmecocichla formicivora	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Chat, Familiar	Oenanthe familiaris	1		1	1	1	1	1	1	1	1	1	1	Confirmed		
Chat, Mocking Cliff	Thamnolaea cinnamomeiventris					1	1	1						Unlikely		
Cisticola, Cloud	Cisticola textrix	1	1	1		1	1	1	1	1	1	1	1	Confirmed		NE
Cisticola, Desert	Cisticola aridulus	1	1	1	1		1	1			1	1	1	Confirmed		
Cisticola, Lazy	Cisticola aberrans												1	Unlikely		
Cisticola, Levaillant's	Cisticola tinniens	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Cisticola, Rattling	Cisticola chiniana		1	1	1								1	Confirmed		
Cisticola, Wailing	Cisticola lais	1	1				1	1		1	1	1	1	Confirmed		
Cisticola, Wing-snapping	Cisticola ayresii	1											1	Confirmed		
Cisticola, Zitting	Cisticola juncidis	1	1	1	1	1	1	1	1		1	1	1	Confirmed		
Coot, Red-knobbed	Fulica cristata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Cormorant, Reed	Microcarbo africanus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Cormorant, White-breasted	Phalacrocorax lucidus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Coucal, Burchell's	Centropus burchellii	1	1	1	1	1		1		1	1	1	1	Confirmed		
Courser, Double-banded	Rhinoptilus africanus							1						Likely		
Courser, Temminck's	Cursorius temminckii	1					1	1	1	1	1			Likely		
Crake, African	Crecopsis egregia		1	1										Likely		
Crake, Black	Zapornia flavirostra	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Crake, Corn	Crex crex												1	Likely		
Crombec, Long-billed	Sylvietta rufescens	1	1	1	1	1	1	1	1	1		1	1	Unlikely		
Crow, Pied	Corvus albus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Cuckoo, Black	Cuculus clamosus											1	1	Unlikely		
Cuckoo, Diederik	Chrysococcyx caprius	1	1	1	1	1					1	1	1	Confirmed		
Cuckoo, Jacobin	Clamator jacobinus												1	Unlikely		

Cuckoo, Klaas's	Chrysococcyx klaas	1	1										Unlikely		
Cuckoo, Red-chested	Cuculus solitarius	1	1		1						1	1	1	Confirmed		
Cuckooshrike, Black	Campephaga flava											1		Confirmed		
Darter, African	Anhinga rufa	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Dove, Cape Turtle (Ring-necked)	Streptopelia capicola	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Dove, Laughing	Spilopelia senegalensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Dove, Namaqua	Oena capensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Dove, Red-eyed	Streptopelia semitorquata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Dove, Rock	Columba livia	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Drongo, Fork-tailed	Dicrurus adsimilis									1				Confirmed		
Duck, African Black	Anas sparsa	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Duck, Fulvous Whistling	Dendrocygna bicolor	1	1						1	1			1	Likely		

Duck, Knob-billed	Sarkidiornis melanotos							1				1		Confirmed	
Duck, Maccoa	Oxyura maccoa			1										Likely	NT, EN
Duck, White-faced Whistling	Dendrocygna viduata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Duck, Yellow-billed	Anas undulata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Eagle, African Fish	Haliaeetus vocifer	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Eagle, Black-chested Snake	Circaetus pectoralis	1	1	1				1	1	1	1	1	1	Confirmed	
Eagle, Brown Snake	Circaetus cinereus	1										1	1	Likely	
Eagle, Verreaux's	Aquila verreauxii				1	1	1	1	1					Unlikely	VU, LC
Egret, Great	Ardea alba	1	1	1			1	1	1	1	1	1	1	Confirmed	
Egret, Little	Egretta garzetta	1	1	1	1	1	1	1		1	1	1	1	Confirmed	
Egret, Western Cattle	Bubulcus ibis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Egret, Yellow-billed (Intermediate)	Ardea intermedia		1	1				1		1	1	1	1	Likely	

Falcon, Amur	Falco amurensis	1	1	1	1								1	Likely	
Falcon, Lanner	Falco biarmicus	1						1						Unlikely	VU, LC
Falcon, Peregrine	Falco peregrinus		1									1		Unlikely	
Falcon, Red-footed	Falco vespertinus	1												Likely	NT, VU
Finch, Cut-throat	Amadina fasciata					1								Likely	
Finch, Red-headed	Amadina erythrocephala	1	1	1	1	1	1	1	1	1	1	1	1	Likely	
Firefinch, African	Lagonosticta rubricata		1	1			1	1	1	1	1	1	1	Confirmed	
Firefinch, Jameson's	Lagonosticta rhodopareia		1	1	1	1	1	1	1	1		1	1	Likely	
Firefinch, Red-billed	Lagonosticta senegala		1	1		1	1	1		1	1	1	1	Likely	
Fiscal, Southern	Lanius collaris	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Flamingo, Greater	Phoenicopterus roseus	1	1	1	1	1	1	1	1	1	1	1	1	Likely	NT, LC
Flamingo, Lesser	Phoeniconaias minor		1				1	1	1	1	1	1	1	Likely	NT, NT
Flufftail, Red-chested	Sarothrura rufa	1	1		1			1	1		1	1	1	Likely	

Flycatcher, African Paradise	Terpsiphone viridis	1	1	1	1						1	1	1	Likely		
Flycatcher, Fairy	Stenostira scita		1			1	1			1				Likely		NE
Flycatcher, Fiscal	Melaenornis silens	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		NE
Flycatcher, Marico	Melaenornis mariquensis						1				1	1	1	Unlikely		
Flycatcher, Spotted	Muscicapa striata	1	1	1								1	1	Likely		
Francolin, Coqui	Peliperdix coqui		1			1	1	1		1	1	1	1	Confirmed		
Francolin, Crested	Dendroperdix sephaena		1										1	Confirmed		
Francolin, Orange River	Scleroptila gutturalis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Go-away-bird, Grey	Crinifer concolor		1	1									1	Likely		
Goose, Egyptian	Alopochen aegyptiaca	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Goose, Spur-winged	Plectropterus gambensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Goshawk, Gabar	Micronisus gabar									1				Unlikely		
Goshawk, Pale Chanting	Melierax canorus			1			1						1	Unlikely		
Grassbird, Cape	Sphenoeacus afer								1			1		Likely		NE
Grebe, Great Crested	Podiceps cristatus	1	1		1			1	1	1	1	1		Likely		
Grebe, Little	Tachybaptus ruficollis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Greenshank, Common	Tringa nebularia	1	1		1	1		1	1	1	1	1	1	Confirmed		
Guineafowl, Helmeted	Numida meleagris	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Gull, Grey-headed	Chroicocephalus cirrocephalus		1	1			1	1	1	1	1	1		Unlikely		
Hamerkop	Scopus umbretta	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Harrier, African Marsh	Circus ranivorus	1	1	1	1	1	1	1	1	1	1	1	1	Likely	EN, LC	
Harrier, Montagu's	Circus pygargus												1	Unlikely		
Harrier, Pallid	Circus macrourus		1									1	1	Unlikely	NT, NT	

Harrier, Western Marsh	Circus aeruginosus												1	Unlikely	
Hawk, African Cuckoo	Aviceda cuculoides	1										1		Unlikely	
Heron, Black	Egretta ardesiaca	1	1	1	1		1	1	1	1	1	1	1	Confirmed	
Heron, Black-crowned Night	Nycticorax nycticorax	1	1			1	1	1	1	1	1	1	1	Confirmed	
Heron, Black-headed	Ardea melanocephala	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Heron, Goliath	Ardea goliath	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Heron, Green-backed (Striated)	Butorides striata	1	1				1			1	1	1	1	Unlikely	
Heron, Grey	Ardea cinerea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Heron, Purple	Ardea purpurea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Heron, Squacco	Ardeola ralloides	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Honeybird, Brown-backed	Prodotiscus regulus									1			1	Unlikely	
Honeyguide, Greater	Indicator indicator			1			1					1		Confirmed	
Honeyguide, Lesser	Indicator minor	1	1	1	1		1	1	1	1	1	1	1	Confirmed	

Hoopoe, African	Upupa africana	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Hornbill, African Grey	Lophoceros nasutus			1					1					Unlikely		
Ibis, African Sacred	Threskiornis aethiopicus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Ibis, Glossy	Plegadis falcinellus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Ibis, Hadeda (Hadada)	Bostrychia hagedash	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Indigobird, Dusky	Vidua funerea			1										Unlikely		
Indigobird, Purple	Vidua purpurascens	1	1							1				Likely		
Indigobird, Village	Vidua chalybeata	1												Unlikely		
Jacana, African	Actophilornis africanus				1			1						Unlikely		
Kestrel, Greater	Falco rupicoloides	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Kestrel, Lesser	Falco naumanni		1	1										Confirmed		
Kestrel, Rock	Falco rupicolus		1	1				1	1				1	Likely		
Kingfisher, Brown-hooded	Halcyon albiventris		1	1					1	1			1	Likely		

Kingfisher, Giant	Megaceryle maxima	1	1		1	1		1	1		1		1	Likely		
Kingfisher, Half-collared	Alcedo semitorquata			1										Likely	NT, LC	
Kingfisher, Malachite	Corythornis cristatus	1	1	1	1	1	1	1	1		1	1	1	Confirmed		
Kingfisher, Pied	Ceryle rudis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Kite, Black-winged	Elanus caeruleus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Korhaan, Northern Black	Afrotis afraoides	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lapwing, African Wattled	Vanellus senegallus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lapwing, Blacksmith	Vanellus armatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lapwing, Crowned	Vanellus coronatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lark, Chestnut-backed Sparrow-	Eremopterix leucotis		1	1	1	1		1	1		1			Likely		

Lark, Eastern Clapper	Mirafra fasciolata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lark, Eastern Long-billed	Certhilauda semitorquata							1						Unlikely		SLS
Lark, Melodious	Mirafra cheniana	1		1			1	1					1	Likely		NE
Lark, Pink-billed	Spizocorys conirostris						1		1					Confirmed		
Lark, Red-capped	Calandrella cinerea	1		1		1	1	1	1	1	1	1	1	Likely		
Lark, Rufous-naped	Mirafra africana	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Lark, Sabota	Calendulauda sabota	1		1	1	1	1	1		1		1	1	Confirmed		
Lark, Spike-heeled	Chersomanes albofasciata	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Longclaw, Cape	Macronyx capensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Mannikin, Bronze	Spermestes cucullata					1		1						Likely		
Martin, Banded	Riparia cincta	1	1	1	1	1				1	1	1	1	Confirmed		

Martin, Brown-throated	Riparia paludicola	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Martin, Common House	Delichon urbicum	1	1	1								1	1	Unlikely		
Martin, Rock	Ptyonoprogne fuligula		1				1	1	1	1		1	1	Likely		
Martin, Sand	Riparia riparia	1		1	1				1				1	Likely		
Moorhen, Common	Gallinula chloropus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Mousebird, Red-faced	Urocolius indicus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Mousebird, Speckled	Colius striatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Mousebird, White-backed	Colius colius	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Myna, Common	Acridotheres tristis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Neddicky	Cisticola fulvicapilla	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Nightjar, Fiery-necked	Caprimulgus pectoralis			1										Confirmed		

Oriole, Black-headed	Oriolus larvatus	1					1	1				1	1	Unlikely		
Osprey, Western	Pandion haliaetus	1	1		1	1	1			1	1	1	1	Likely		
Ostrich, Common	Struthio camelus	1					1	1	1		1	1		Confirmed		
Owl, African Grass	Tyto capensis									1				Likely	VU, LC	
Owl, Marsh	Asio capensis		1				1	1	1	1			1	Likely		
Owl, Spotted Eagle-	Bubo africanus		1							1	1	1		Confirmed		
Owl, Western Barn	Tyto alba		1	1	1			1		1			1	Confirmed		
Owlet, Pearl-spotted	Glaucidium perlatum													Confirmed		
Parakeet, Rose-ringed	Psittacula krameri		1					1						Unlikely		
Peafowl, Indian	Pavo cristatus		1			1	1							Unlikely		
Petronia, Yellow-throated	Gymnoris superciliaris	1	1										1	Unlikely		
Pigeon, African Green	Treron calvus											1		Unlikely		

Pigeon, African Olive	Columba arquatrix	1										1	Unlikely		
Pigeon, Speckled	Columba guinea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Pipit, African	Anthus cinnamomeus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Pipit, Buffy	Anthus vaalensis	1		1		1	1	1	1	1		1		Confirmed		
Pipit, Nicholson's	Anthus nicholsoni					1		1				1	1	Confirmed		
Pipit, Plain-backed	Anthus leucophrys	1	1				1	1	1	1	1	1		Confirmed		
Plover, Common Ringed	Charadrius hiaticula												1	Unlikely		
Plover, Kittlitz's	Charadrius pecuarius		1		1	1	1	1	1		1			Likely		
Plover, Three-banded	Charadrius tricollaris	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Pochard, Southern	Netta erythrophthalma	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Pratincole, Black-winged	Glareola nordmanni		1										1	Unlikely	NT, NT	
Prinia, Black-chested	Prinia flavicans	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Prinia, Tawny-flanked	Prinia subflava	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Puffback, Black-backed	Dryoscopus cubla	1		1					1			1	1	Likely		
Pytilia, Green-winged	Pytilia melba			1		1	1		1	1				Confirmed		
Quail, Common	Coturnix coturnix	1										1	1	Unlikely		
Quailfinch	Ortygospiza atricollis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Quelea, Red-billed	Quelea quelea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Rail, African	Rallus caerulescens	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Robin-chat, Cape	Cossypha caffra	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Robin-chat, White-throated	Cossypha humeralis	1												Unlikely		
Robin, Kalahari Scrub	Cercotrichas paena	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Roller, European	Coracias garrulus	1												Unlikely	NT, LC	
Ruff	Calidris pugnax	1	1	1	1	1		1	1	1	1	1	1	Confirmed		

Sandgrouse, Namaqua	Pterocles namaqua			1					1					Unlikely		
Sandpiper, Common	Actitis hypoleucos		1	1								1		Likely		
Sandpiper, Curlew	Calidris ferruginea		1	1						1	1			Unlikely	LC, NT	
Sandpiper, Marsh	Tringa stagnatilis	1	1					1	1	1	1	1	1	Confirmed		
Sandpiper, Wood	Tringa glareola	1	1	1	1			1	1	1	1	1	1	Confirmed		
Scimitarbill, Common	Rhinopomastus cyanomelas		1		1	1	1	1		1			1	Likely		
Secretarybird	Sagittarius serpentarius						1	1		1	1	1	1	Likely	VU, EN	
Seedeater, Streaky-headed	Crithagra gularis	1	1	1	1	1	1	1		1	1	1	1	Confirmed		
Shelduck, South African	Tadorna cana	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Shoveler, Cape	Spatula smithii	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Shrike, Crimson-breasted	Laniarius atrococcineus			1		1	1		1	1			1	Likely		

Shrike, Lesser Grey	Lanius minor	1	1	1	1							1	1	Likely		
Shrike, Red-backed	Lanius collurio	1	1	1							1	1	1	Likely		
Snipe, African	Gallinago nigripennis	1	1		1	1	1	1	1	1	1	1	1	Confirmed		
Sparrow-weaver, White-browed	Plocepasser mahali	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Sparrow, Cape	Passer melanurus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Sparrow, House	Passer domesticus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Sparrow, Southern Grey-headed	Passer diffusus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Sparrowhawk, Black	Accipiter melanoleucus		1	1					1	1	1	1		Confirmed		
Sparrowhawk, Little	Accipiter minullus						1							Unlikely		
Sparrowhawk, Ovambo	Accipiter ovampensis			1	1		1	1						Confirmed		
Spoonbill, African	Platalea alba	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Spurfowl, Natal	Pternistis natalensis					1	1	1					1	Confirmed		
Spurfowl, Swainson's	Pternistis swainsonii	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Starling, Cape Glossy (Cape)	Lamprotornis nitens	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Starling, Pied	Lamprotornis bicolor	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		SLS
Starling, Red-winged	Onychognathus morio							1						Unlikely		
Starling, Violet-backed	Cinnyricinclus leucogaster												1	Confirmed		
Starling, Wattled	Creatophora cinerea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Stilt, Black-winged	Himantopus himantopus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Stint, Little	Calidris minuta	1	1	1	1				1	1	1	1	1	Confirmed		
Stonechat, African	Saxicola torquatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Stork, Abdim's	Ciconia abdimii		1						1			1		Unlikely	NT, LC	
Stork, White	Ciconia ciconia							1				1	1	Unlikely		
Stork, Yellow-billed	Mycteria ibis	1	1	1	1	1				1	1	1	1	Confirmed	EN, LC	

Sunbird, Amethyst	Chalcomitra amethystina	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Sunbird, Greater Double-collared	Cinnyris afer				1									Unlikely		SLS
Sunbird, Malachite	Nectarinia famosa		1											Unlikely		
Sunbird, Marico	Cinnyris mariquensis				1							1		Unlikely		
Sunbird, White-bellied	Cinnyris talatala	1	1	1	1	1	1	1		1	1	1	1	Confirmed		
Swallow, Barn	Hirundo rustica	1	1	1	1	1				1	1	1	1	Confirmed		
Swallow, Greater Striped	Cecropis cucullata	1	1	1	1	1	1			1	1	1	1	Confirmed		
Swallow, Lesser Striped	Cecropis abyssinica								1			1	1	Confirmed		
Swallow, Pearl-breasted	Hirundo dimidiata			1										Confirmed		
Swallow, Red-breasted	Cecropis semirufa		1										1	Confirmed		

Swallow, South African Cliff	Petrochelidon spilodera	1	1	1	1	1		1	1	1	1	1	1	Confirmed		BNE
Swallow, White-throated	Hirundo albigularis	1	1	1	1	1			1	1	1	1	1	Confirmed		
Swamphen, African (Purple)	Porphyrio madagascariensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Swift, African Black	Apus barbatus		1	1					1				1	Confirmed		
Swift, African Palm	Cypsiurus parvus	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Swift, Common	Apus apus												1	Unlikely		
Swift, Horus	Apus horus				1					1	1	1		Likely		
Swift, Little	Apus affinis	1	1	1	1	1		1	1	1	1	1	1	Confirmed		
Swift, White-rumped	Apus caffer	1	1	1	1	1			1	1	1	1	1	Confirmed		
Tchagra, Black-crowned	Tchagra senegalus									1		1	1	Likely		
Tchagra, Brown-crowned	Tchagra australis	1	1	1	1	1	1	1		1	1	1	1	Confirmed		

Teal, Blue-billed	Spatula hottentota	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Teal, Cape	Anas capensis	1	1		1	1	1	1	1	1	1	1	1	Confirmed		
Teal, Red-billed	Anas erythrorhyncha	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Tern, Caspian	Hydroprogne caspia										1		1	Likely	VU, LC	
Tern, Whiskered	Chlidonias hybrida	1	1	1	1	1	1	1		1	1	1	1	Confirmed		
Tern, White-winged	Chlidonias leucopterus		1									1	1	Unlikely		
Thick-knee, Spotted	Burhinus capensis	1	1				1	1	1	1	1	1	1	Confirmed		
Thrush, Groundscraper	Turdus litsitsirupa	1	1	1	1			1			1		1	Likely		
Thrush, Karoo	Turdus smithi	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		NE
Thrush, Kurrichane	Turdus libonyana		1		1			1				1	1	Confirmed		
Thrush, Short-toed Rock	Monticola brevipes				1									Unlikely		
Tit, Ashy	Melaniparus cinerascens	1			1	1	1	1		1	1		1	Unlikely		
Vulture, Cape	Gyps coprotheres		1	1	1		1	1	1			1	1	Confirmed	EN, VU	

Vulture, White-backed	Gyps africanus		1										Unlikely	CR, CR	
Wagtail, African Pied	Motacilla aguimp							1					Unlikely		
Wagtail, Cape	Motacilla capensis	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Wagtail, Western Yellow	Motacilla flava	1											Unlikely		
Warbler, African Reed	Acrocephalus baeticatus	1	1	1	1	1		1		1	1	1	1	Confirmed	
Warbler, Chestnut-vented	Curruca subcoerulea	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Warbler, Garden	Sylvia borin		1	1									Unlikely		
Warbler, Great Reed	Acrocephalus arundinaceus	1	1	1						1	1		1	Likely	
Warbler, Icterine	Hippolais icterina										1	1		Likely	
Warbler, Lesser Swamp	Acrocephalus gracilirostris	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	
Warbler, Little Rush	Bradypterus baboecala	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed	

Warbler, Marsh	Acrocephalus palustris	1	1	1						1	1	1	1	Unlikely		
Warbler, Sedge	Acrocephalus schoenobaenus	1	1		1							1		Unlikely		
Warbler, Willow	Phylloscopus trochilus	1	1	1	1						1	1	1	Likely		
Waxbill, Black-faced	Brunhilda erythronotos	1		1		1								Unlikely		
Waxbill, Blue	Uraeginthus angolensis	1	1	1	1	1	1	1	1	1		1	1	Confirmed		
Waxbill, Common	Estrilda astrild	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Waxbill, Orange-breasted	Amandava subflava	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Waxbill, Violet-eared	Granatina granatina		1	1	1	1	1							Likely		
Weaver, Cape	Ploceus capensis				1					1		1	1	Likely		NE
Weaver, Scaly-feathered	Sporopipes squamifrons	1	1	1		1	1	1	1	1			1	Confirmed		
Weaver, Southern Masked	Ploceus velatus	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		

Weaver, Thick-billed	Amblyospiza albifrons	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Wheatear, Capped	Oenanthe pileata	1				1	1	1	1	1	1	1	1	Confirmed		
Wheatear, Mountain	Myrmecocichla monticola	1	1	1			1	1	1	1	1	1	1	Confirmed		
White-eye, Cape	Zosterops virens	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		NE
White-eye, Orange River	Zosterops pallidus	1	1	1			1	1		1	1			Likely		
Whitethroat, Common	Curruca communis	1	1											Unlikely		
Whydah, Long-tailed Paradise	Vidua paradisaea		1							1			1	Unlikely		
Whydah, Pin-tailed	Vidua macroura	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Whydah, Shaft-tailed	Vidua regia	1												Likely		
Widowbird, Long-tailed	Euplectes progne	1	1	1	1	1	1	1	1	1	1	1	1	Confirmed		
Widowbird, Red-collared	Euplectes ardens	1	1	1	1	1	1	1	1	1	1	1	1	Very likely		

Widowbird, White-winged	Euplectes albonotatus	1	1	1	1	1	1	1	1	1	1	1	1	Very likely		
Wood-hoopoe, Green	Phoeniculus purpureus	1	1	1	1	1	1	1	1	1	1	1	1	Likely		
Woodpecker, Cardinal	Dendropicos fuscescens		1	1		1	1	1	1	1		1		Confirmed		
Woodpecker, Golden-tailed	Campethera abingoni	1		1		1	1			1			1	Likely		
Wryneck, Red-throated	Jynx ruficollis	1	1		1	1	1	1	1	1	1	1	1	Confirmed		

Table 6. Red-listed species, both Regional (Taylor et al. 2015) and Global (according to IUCN 2021), whose possible presence at the proposed Mopane Solar Park Phase 5 development site was evaluated during the assessment process. NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered Indicates species listed as Protected ("PR"), Vulnerable ("VU"), Endangered ('EN") or Critically Endangered ("CR").

Common Name	Species	(Regional, Global)	Likelihood
Vulture, White-backed	Gyps africanus	CR, CR	Unlikely to occur at the site due to low reporting rates. However, they might use the power lines as roosting sites and, therefore, cannot exclude the threat of the proposed power line for this threatened species.

Harrier, African Marsh	Circus ranivorus	EN, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks, especially Phase 5, but are at risk of collision and electrocution of internal and connection power lines.
Stork, Yellow-billed	Mycteria ibis	EN, LC	Confirmed within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks, especially Phase 5, but are at risk of collision and electrocution of internal and connection power lines.
Vulture, Cape	Gyps coprotheres	EN, VU	Confirmed at the site. They utilise surrounding power lines as roosting sites and are at risk of increased collision and electrocution of internal and connection power lines.
Sandpiper, Curlew	Calidris ferruginea	LC, NT	Unlikely to occur at the site due to low reporting rates and not at risk to the proposed Solar PV Park and power line development.
Duck, Maccoa	Oxyura maccoa	NT, EN	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks, especially Phase 5, but are at risk of collision and electrocution of internal and connection power lines.
Kingfisher, Half-collared	Alcedo semitorquata	NT, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks or at risk to collision and electrocution of internal and connection power lines.
Stork, Abdim's	Ciconia abdimii	NT, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks especially Phase 5, but are at risk to collision and electrocution of internal and connection power lines.

Roller, European	Coracias garrulus	NT, LC	Unlikely to occur at the site due to low reporting rates and not at risk to the proposed Solar PV Park and power line development.
Flamingo, Greater	Phoenicopterus roseus	NT, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks especially Phase 5, but are at risk to collision and electrocution of internal and connection power lines.
Harrier, Pallid	Circus macrourus	NT, NT	Unlikely to occur at the site due to low reporting rates. If they were supposed to be observed they would occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks especially Phase 5, but are at risk to collision and electrocution of internal and connection power lines.
Pratincole, Black-winged	Glareola nordmanni	NT, NT	Unlikely to occur at the site due to low reporting rates and not at risk to the proposed Solar PV Park and power line development.
Flamingo, Lesser	Phoeniconaias minor	NT, NT	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks especially Phase 5, but are at risk to collision and electrocution of internal and connection power lines.
Falcon, Red-footed	Falco vespertinus	NT, VU	Likely to occur on site. However, they might use the power lines as roosting sites and therefore cannot exclude the threat of the proposed power line for this threatened species.
Secretarybird	Sagittarius serpentarius	VU, EN	Likely to use the grasslands as foraging ground and therefore would lead to a loss of suitable habitat and they are at risk to collision and electrocution of internal and connection power lines.

Eagle, Verreaux's	Aquila verreauxii	VU, LC	Unlikely to occur at the site due to low reporting rates. However, they might use the power lines as roosting sites and therefore cannot exclude the threat of the proposed power line for this threatened species.
Falcon, Lanner	Falco biarmicus	VU, LC	Unlikely to occur at the site due to low reporting rates. However, they might use the power lines as roosting sites and therefore cannot exclude the threat of the proposed power line for this threatened species.
Tern, Caspian	Hydroprogne caspia	VU, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks or at risk to collision and electrocution of internal and connection power lines.
Owl, African Grass	Tyto capensis	VU, LC	Likely to occur within the wetlands and river system outside the footprint of the proposed Solar Park Footprint but within the connection power line footprint. Very unlikely to be influenced by the Solar PV Parks or at risk to collision and electrocution of internal and connection power lines.

3.2 FIELD ASSESSMENT

3.2.1 Land uses and infrastructure in and around the survey site

Grassland habitats include dry terrestrial grassland (Figure 25-27), moist grassland (wetland; Figure 28-30) east of the proposed Mopane Solar Parks and crossing the proposed connection power line at multiple occasions and artificial plantations along the connection power line route.

3.2.1.1 Natural Grasslands

Terrestrial grasslands are classified as secondary grasslands (Figure 25-26) as the property is used primary for cattle. Several species are common in disturbed grassland, including the thatching grass *Hyparrhenia hirta* and various *Eragrostis* species. In less disturbed grassland, *Themeda triandra,* amongst others is abundant. Furthermore, larger shrubs and power lines (Figure 27) are also found across the proposed development.

Figure 25. Terrestrial grasslands within the proposed development footprint.

Figure 26. Terrestrial grasslands within the proposed development footprint.

Figure 27. Presence of larger shrubs and electrical infrastructure within the proposed development footprint.

3.2.1.2 Water Resources

Moist grassland habitats are mainly found along the unnamed tributary to the Mooirivierloop. The unnamed tributary to the Mooirivierloop is characterised by a fairly broad river corridor/floodplain and dams Figure 28-30.

Figure 28. Moist grassland habitats are mainly found along the Mooirivierloop with power line.

Figure 29. Moist grassland habitats are mainly found along the Mooirivierloop.

Figure 30. Dam along the mooirivierloop.

3.2.1.3 Woody trees and Plantations

Woody and alien trees are abundant along the proposed power line. *Eucalyptus* sp*., Acacia dealbata* and *Acacia mearnsii* are the most common taxa, and typically dominate in areas displaying drier soils (Figure 31-32).

Figure 31. Woody and alien trees are abundant along the proposed connection power line.

Figure 32. Alien trees are abundant along the proposed connection power line.

3.2.2 Avifauna Species

The desktop analysis recorded 316 species (Table 5) from more than 500 full protocol cards registered during SABAP2 in the 12 pentads surrounding the proposed Mopane Solar Park and connection lines (Figure 20). The data also reveal that, on average independent of the month, one can observe 202 ± 21 species (Figure 21). Of these, 164 were confirmed during the point survey count, another 19 species were recorded during incidental recordings within the study period, and a further 70 are likely to occur (Table 5). Furthermore, the species richness analysis in Estimate S confirmed that the proposed Mopane Solar Park and Connection power line would hold ~186 ± 8 species based on the species accumulation curve (Figure 35). Furthermore, the species accumulation curve suggested adequate sampling for the proposed area was reached and therefore did not require further sampling. In addition, the sampling was conducted at the beginning of the wet season when migrator species had returned. Only two species recorded during the field survey have not been recorded here previously, suggesting that the number of species within the area has been saturated and could make accurate conclusions from the desktop analysis. Therefore, it would not make sense to repeat the survey during the winter months as suggested in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017).

Species confirmed include grassland species (e.g., Spike-heeled Lark, Cloud Cisticola, Capped Wheatear, etc.). Furthermore, the field survey also observed endemic or near-endemic species in South Africa, such as Cape Sparrow, Fiscal Flycatcher, Sabota Lark, etc. (Table 5). Twenty threatened or near-threatened species were recorded in the greater region during the desktop survey, and only two were confirmed during the field survey. However, the proposed Mopane Solar Park development and the connecting power line pose a significant threat regarding habitat loss, collisions and electrocution with the infrastructure. The threats to each species are discussed in more detail in Table 6.

Figure 33. Purple Heron (Ardea purpurea) flying over a point

Figure 34. Two Cape Vultures (Gyps coprotheres) roosting on overhead transmission lines.

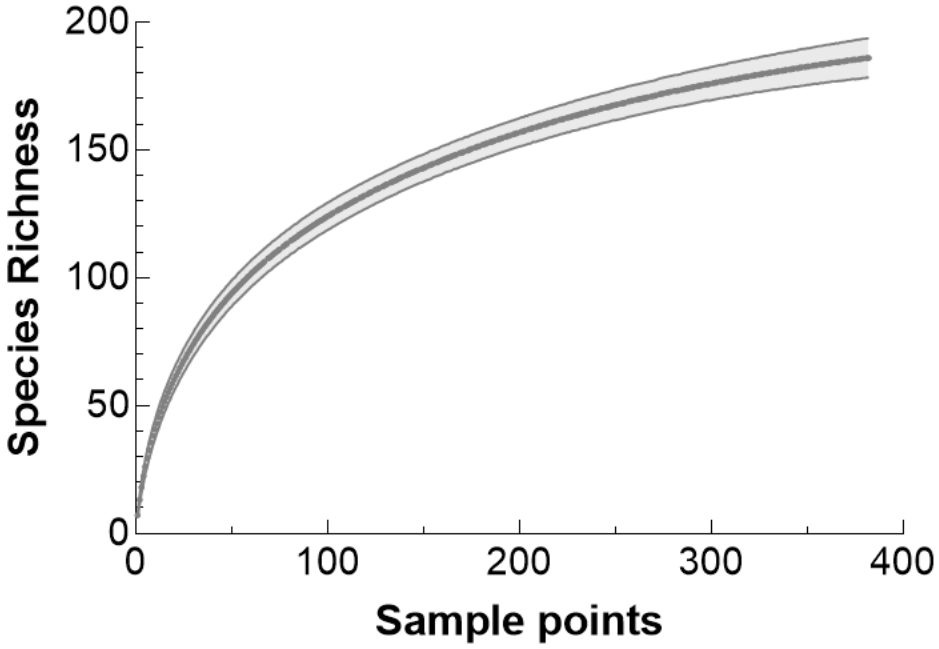


Figure 35. Species accumulation curve for all the points surveyed. The species accumulation curve estimates that the proposed power line habitat holds 186 ± 8 species.

3.2.3 Flight Path, Migratory Routes and Nest Sites

Observing and monitoring flight paths and nesting sites of SCC and/or priority species are important in ascertaining habitat sensitivity and evaluating the impact risk significance of any proposed development. Flight analysis is also important for species that exhibit movement between roosting and foraging sites to prevent the risk of collision with infrastructure. A very condensed version of flight path analysis was done to determine if there is a general direction for most birds on site. This section must be interpreted cautiously based on the limited time spent on this component. Outside the Mooirivierloop, no flight paths were observed, but within the Mooirivierloop system, they use the river as their flight path (Figure 36). No nest sites of SCC were recorded during the field assessment.

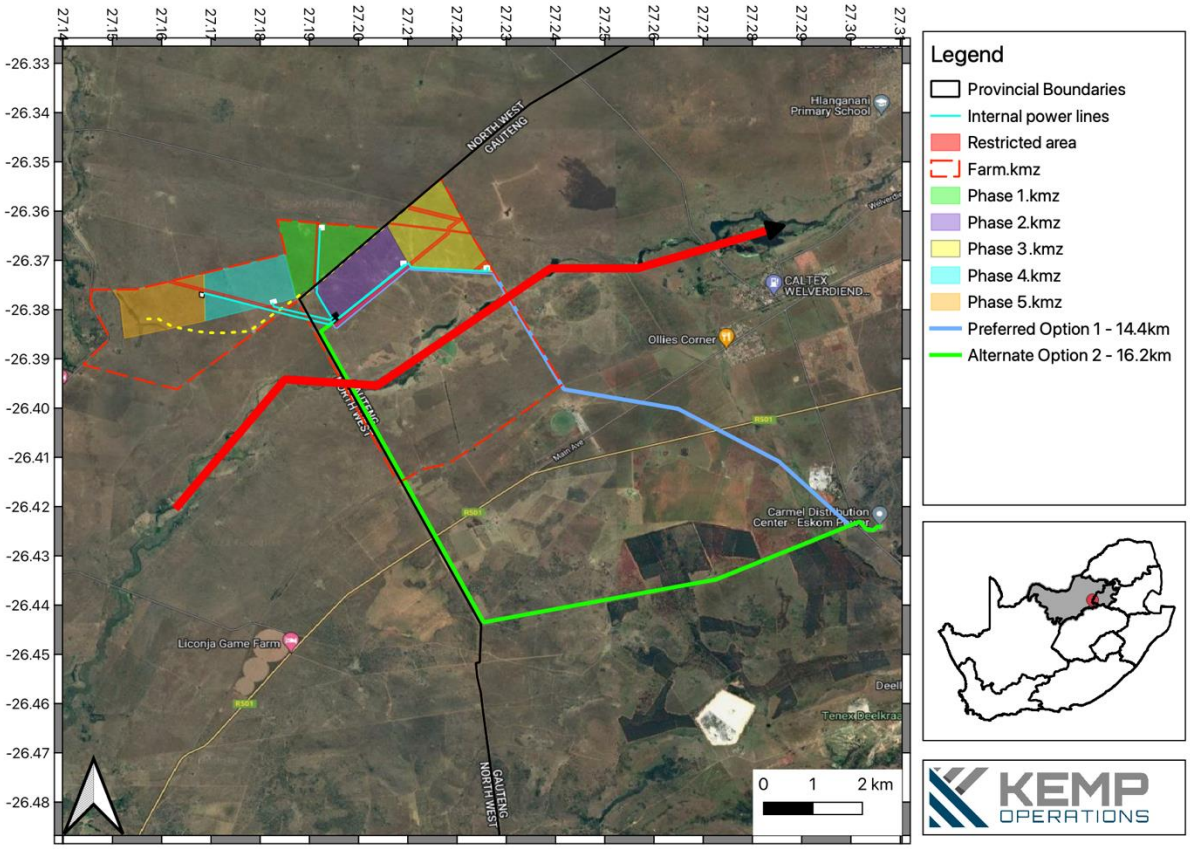


Figure 36. Flight path observed during the field investigation.

3.2.4 Site Ecological Importance (SEI)

All habitats within the assessment area of the proposed project were allocated a sensitivity or SEI category (Table 7). The SEI of the proposed development within an avifauna context was based on the field results and desktop information. The SEI of the habitat types delineated is illustrated in Figure 37. The water resources were given a very high rating based on the increased likelihood of the water sources supporting SCCs. No nests of the SCCs were observed in the project area, and therefore only a medium rating was given to the natural grassland habitat. However, this habitat still has the potential to support other SCC, such as the Secretarybird.

Table 7. SEI Summary of habitat types delineated within field assessment area of project area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Water Resources	High Confirmed or highly likely occurrence of CR, EN, VU species.	High Only minor current negative ecological impacts with no signs of major past disturbance and good	**High**	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50%	**Very High**

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
	Presence of Rare species	rehabilitation potential.		of the original species composition and functionality	
Grassland	Medium Confirmed or highly likely occurrence of populations of NT species	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	**Medium**	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	**Medium**
Transformed	Very Low No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.	Very Low Several major current negative ecological impacts.	**Low**	Very High Habitat that can recover rapidly	**Low**

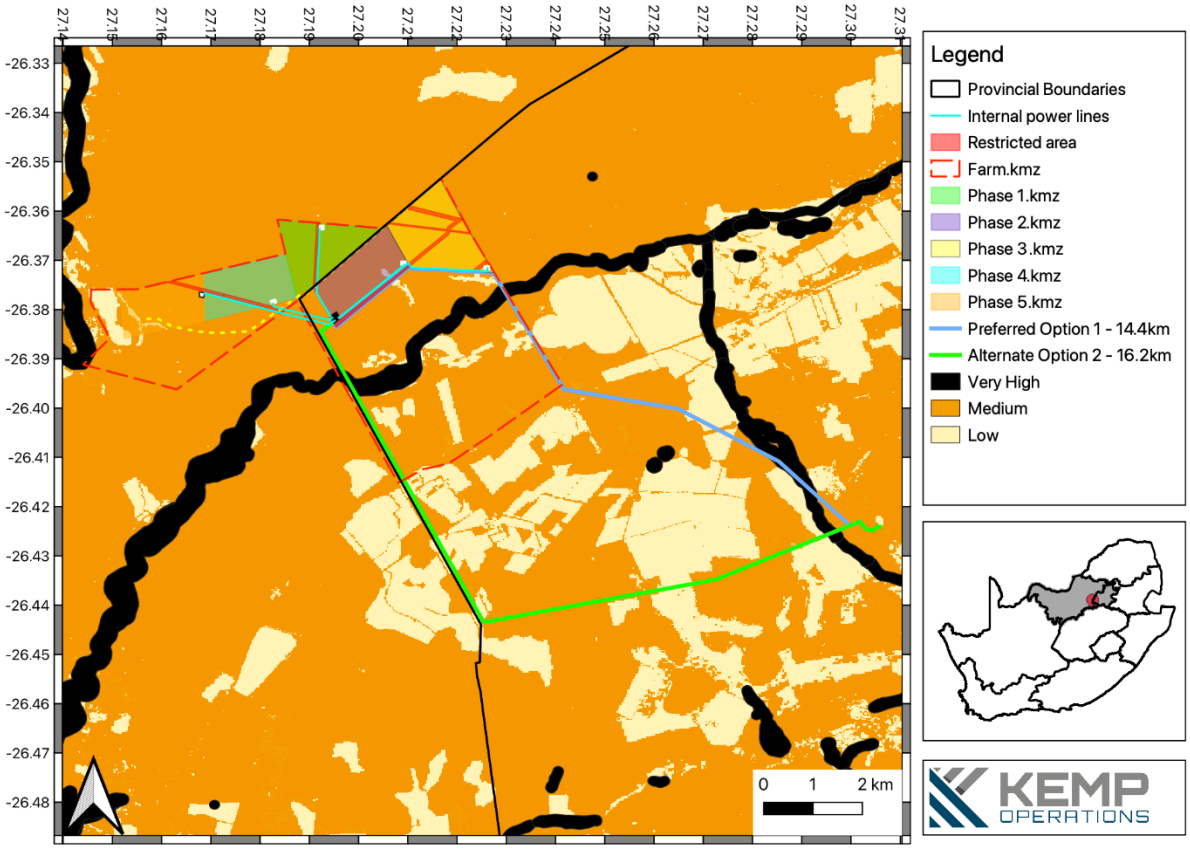


***Figure 37*. Map illustrating the SEI within the wider área of the proposed development**

***Table 8.* Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities**

Site Ecological Importance	Interpretation in relation to proposed development activities
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

4 DISCUSSION: IMPACT ASSESSMENT AND MITIGATION RECOMMENDATIONS

The impacts of the proposed development were evaluated against the data captured during both the desktop and field investigation. The effect can be explained through direct, indirect and cumulative impacts.

- Direct impacts – Impacts that result from project activities or operational decisions that can be predicted based on planned activities and knowledge of local biodiversities, such as habitat loss under the project footprint, habitat fragmentation due to project infrastructure and species disturbance or mortality as a result of project operations.
- Indirect impacts – Impacts induced by, or 'by-products' of, project activities within a project's area of influence.
- Cumulative impacts – Impacts that result from the successive, incremental and/or combined effects of existing, planned and/or reasonably anticipated future human activities combined with project development impacts.

4.1 PRESENT IMPACTS ON AVIFAUNA

Considering that anthropogenic activities and influences are present within the landscape, there are several negative impacts on biodiversity, including avifauna. These include:

- Existing energy infrastructure;
- Noise pollution, especially from the train and transmission lines;
- Invasive Alien Plants;
- Livestock agriculture; and
- Fences and associated infrastructure.

4.2 ALTERNATIVES CONSIDERED

No alternative locations were determined for the proposed Solar Parks. However, one can always utilise the low-sensitivity areas closer to the substation that consists of plantations and agricultural land.

4.3 METHODOLOGY OF IMPACT ASSESSMENT

The following section assesses the likely impacts on the avifauna due to the proposed Mopane Solar Park Phase 5 Development on the EIA guideline for renewable energy projects (Department of Environmental Affairs 2015) and the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017). The impacts have been quantified and evaluated according to an Impact Assessment Methodology shown in Tables 9, 10 and 11. This qualitative assessment method has been adapted from that of Warner and Preston (1974) and Morris and Therivel (1995) to measure the level of impact on the avifauna before and after mitigation.

Table 9. Criteria are used to measure the level of impact

Magnitude	
Small and will have no effect on the environment	0
Minor and will not result in an impact on the ecological processes	2
Low and will cause a slight impact on the ecological processes	4

Moderate and will result in the ecological process continuing but in a modified way	6
High (processes are altered to the extent that they temporarily cease)	8
Very high and results in complete (irreversible) destruction of the ecology	10
Scale	
Localised (At localised scale and less than 10 hectares in scale)	1
Localised (At localised scale between 10 and 100 hectares in scale)	2
Entire study area (The proposed site and its environs e.g. neighbouring areas)	3
Beyond Municipal boundaries	4
Provincial-level	5
Duration	
Very short (0 - 1 year)	1
Short (1 - 5 years)	2
Medium term (5 - 15 years)	3
Long term (>15 years)	4
Permanent	5
Probability	
Highly improbable (<20% chance of occurring)	1
Improbable (20 - 40% chance of occurring)	2
Probable (40% - 70% chance of occurring)	3
Highly probable (>70% - 90% chance of occurring)	4
Definite (>90% chance of occurring)	5
Risk= (Scale+Duration+Magnitude) x Probability	

Table 10. The risk matrix indicates the scale of impact calculated using the above equation.

CONSEQUENCE (Scale + Duration + Magnitude)

PROBABILIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

Low	<30	Where this impact would not have a direct influence on the decision to developin the area
Medium	30 - 60	Where the impact could influence the decision to develop in the area unless itis effectively mitigated
High	>60	Where the impact must influence the decision process to develop inthe area
Confidence of assessment		
Low	The degree of confidence in predictions based on available information, judgement andspecialist's knowledge	
Medium		
High		

4.4 GENERAL IMPACTS

The remainder of the farm, Douglasdale 95IQ, is located within JB Marks Local Municipality, Dr Kenneth Kauda District Municipality, North West Province. However, the potential occurrence of some threatened species at the proposed site is always of deep concern. As part of the risk assessment process, it is essential to identify any possible mitigating actions or circumstances that may soften or eliminate the potential impacts. Alterations to the design of the infrastructure to improve its "bird safety" character can be suggested, or the consideration of environmental mitigation, such as the nature of the proposed project about the surrounding landscape.

In broad terms, the impacts of the proposed development are as follows:

- Displacement through habitat loss and human activity (Table 12)
- Disturbance during the construction phase (Table 13)
- Disturbance during the operations phase (Table 14)
- Collision risk with Solar Panels (Table 15)
- Collision risk with internal power lines (Table 16)
- Electrocution risk with internal power lines (Table 17)
- Electromagnetic fields (Table 18)
- Roosting and breeding on panels (Table 19)

4.5 SPECIFIC IMPACTS AND MITIGATION RECOMMENDATIONS

4.5.1 DISPLACEMENT THROUGH HABITAT LOSS AND HUMAN ACTIVITY

Table 12. Impact assessment – Habitat destruction – Displacement through habitat loss and human activity

Nature: Habitats will be lost in areas cleared for the construction of the development.

Impacts

During the construction phase of the proposed Mopane Solar Park: Phase 5, we will see permanent habitat destruction and displacement due to the extensive space requirements of the proposed Solar Park development. Clearing for construction across the entire proposed area will impact the threatened, endemic, resident species' breeding, foraging behaviour and roosting activities at the proposed development site.

It is improbable that any of the priority species will be permanently displaced or affected by the habitat transformation that will take place for the proposed development.

	Without mitigation		**With mitigation**	
Scale	Entire Study area	3	Entire Study area	3
Duration	Permanent	5	Long term	4
Magnitude	Very high and results in complete (irreversible) destruction of the ecology	10	Low	6
Probability	Highly Probable	4	Probable	3
Significance	**High**	**72**	**Medium**	**39**
Status	Negative		Negative	
Reversibility	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation

- All construction and maintenance activities must be carried out according to the generally accepted environmental best practice guidelines. The temporal and spatial footprint of the development should be kept to a minimum.
- Boundaries need to be marked before the start of the construction.
- Clearing should occur between May-August outside the breeding season to avoid the destruction of any breeding birds.
- Solar Panels must be mounted on pile driven or screw foundations to reduce the negative impact on natural soil functioning.
- Indigenous vegetation to be maintained under the Solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al. 2017)
- The area, where vegetation has been cleared, must be revegetated with local indigenous plant species.
- The cleared area needs to be monitored to avoid the establishment of invasive plant species.

- Any bird nests found during construction must be reported to the ECO. Should any nests be found in the area, a qualified avifaunal specialist must be consulted to advise on the correct actions to be taken before the project can continue. - The above measures must be covered in a site-specific EMP and controlled by an ECO.
Outcome: The proposed development will lead to habitat loss and the displacement of various bird species, However it will most likely not lead to the displacement of any priority species..

4.5.2 DISTURBANCE DURING THE CONSTRUCTION PHASE

Table 13. Impact assessment – Disturbance during the construction phase

Nature: Habitats will be lost in areas cleared for the construction of the development.

Impacts

During the construction phase of the proposed Mopane PV Solar Park: Phase 5 development, continued disturbance will occur due to increased human activity and mechanical equipment, negatively impacting birds' breeding activities and community structure in the surrounding areas of the solar park. Avian species with small territories are more susceptible to these disturbances.

	Without mitigation		**With mitigation**	
Scale	Entire study area	3	Entire study area	3
Duration	Short	2	Short	2
Magnitude	Moderate	6	Low and will cause a slight impact on the ecological processes	4
Probability	Highly Probable	4	Probable	3
Significance	**Medium**	**44**	**Low**	**27**
Reversibility	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation

- All construction and maintenance activities must be carried out according to the generally accepted environmental best practice. The temporal and spatial footprint of the development should be kept to a minimum.
- Construction should occur outside the breeding season. It is strongly suggested that this phase be carried out during the winter months (May-August).
- Contractors should not be accommodated on-site, and when contractors stay on-site, it should be within the development footprint. Movement outside this development footprint must be restricted.
- Driving must take place on the proposed access road, and a speed limit of 30km/h must be implemented.
- All personnel should undergo environmental induction regarding avifauna and particular awareness about not harming, collecting or hunting terrestrial species (e.g., korhaans, francolins, vultures, etc.)
- Any bird nests found during construction must be reported to the ECO. Should any nests be found in the area, a qualified avifaunal specialist must be consulted to advise on the correct actions to be taken before the project can continue.
- The above measures must be covered in a site-specific EMP and controlled by an ECO.

Outcome: The impact of the construction phase is largely unavoidable but can be mitigated with the mitigation mentioned above. The effect during the construction phase is anticipated to be of moderate significance as it is a largely temporary threat. Still, it can be reduced to low significance should the necessary threat preventative steps be implemented.

4.5.3 DISTURBANCE DURING THE OPERATION PHASE

Table 14. Impact assessment – Disturbance during the operations phase

Nature: Disturbance during the operations phase

Impacts

During the operational phase, lights are required to light the proposed Mopane PV Solar Park: Phase 5 for security reasons. However, it will result in disorientated birds flying over the site at night or drawing birds to insect prey with the risk of collisions with infrastructure. In addition, defecation on the solar panels could lower the panels' efficiency. Furthermore, birds using PV infrastructure for nesting could cause various maintenance issues and threats to the birds themselves.

	Without mitigation		**With mitigation**	
Scale	Entire study area	3	Entire study area	3
Duration	Permanent	5	Permanent	5
Magnitude	High	8	Moderate	6
Probability	Probable	3	Improbable	2

Significance	**Medium**	**48**	**Low**	**28**
Reversibility	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation

- The use of lighting at night should be kept to a minimum. Furthermore, a red light needs to be used to avoid the attraction of invertebrates and their avian predators to the solar facility. In addition, this will minimise the disturbance to birds flying over the facility at night.
- Low- UV type lights orientated downwards should be used
- Single bird and mammal-friendly fences should be used as stipulated in the Birdlife Guidelines
- Regular cleaning and maintenance activities should prevent defecation on panels before becoming a problem. Eco-friendly bird deterring devices could prevent large birds from perching on panel structures.
- As the site is considered a medium risk area during construction and post-construction, monitoring by an avifaunal specialist should be conducted for approximately two years. In addition, all incidents should be recorded as meticulously as possible using suitable scientific protocols.
- If any nest construction starts on the panels, the nest should be removed immediately to avoid any electrical shorts and operational risks of fire.
- If there are any persistent problems with avifauna, then an avifaunal specialist should be consulted for advice on further mitigations.
- Driving must take place on the proposed access road, and a speed limit of 30km/h must be implemented.
- Any bird nests found during the construction period must be reported to the ECO.
- The above measures must be covered in a site-specific EMP and controlled by an ECO.

Outcome: The impact assessment found threat of disturbance to birds during the operational phase to be moderate significance. Implementing above mitigations, the threat of disturbance will probably be of low significance.

4.5.4 COLLISION RISK WITH SOLAR PANELS

Table 15. Impact assessment – Collision risk with solar panels

Nature: Avifaunal species get disorientated by the reflected light.

Impacts

Large areas of the proposed site can increase the risk of reflected light from panels and can be a potential threat to aerial hunters (e.g. Lanner Falcon). Waterbirds might mistake PV solar panels for a water source and attempt to land on panels resulting in injuries or deaths when PV Solar Parks are close to large water bodies and are known as the “lake effect”. However, this theory has not yet been disputed or approved. Lights at the PV facility need to be kept to a minimum to minimise the disorientation of night-flying birds.

	Without mitigation		**With mitigation**	
Scale	Entire study area	3	Entire study area	3

Duration	Permanent	5	Permanent	5
Magnitude	Low and will cause a slight impact on ecological processes	4	Low and will cause a slight impact on ecological processes	2
Probability	Probable	3	Improbable	2
Significance	**Medium**	**36**	**Low**	**20**
Reversibility	Low		Moderate	
Can impacts be mitigated?	Yes			

Mitigation

- Structural elements or markings can be incorporated into the design that may break up the reflection.
- Increase the spacing between panels to avoid the "lake effect". However, this will increase the surface area of the site.
- Low UV type lights orientated downwards should be used
- Panels should be tilted towards the vertical when not in use.
- Place rotary solar panels instead of fixed panels should be implemented to avoid suitable pearching locations for aerial raptors.
- ECO's should be trained in collecting collision information.
- During construction and post-construction, monitoring by an avifaunal specialist should be conducted for approximately two years. In addition, all incidents should be recorded as meticulously as possible using suitable scientific protocols.

Outcome: The impact of this threat is largely unknown, and therefore, it is expected that the impact is of medium significance, but with proper mitigation in place, the impact can be considered as low significance.

4.5.5 COLLISION RISK WITH THE INTERNAL POWER LINE

Table 16. Impact assessment – Collision risk with the internal power line

Nature: Negative interaction with power lines in terms of collisions

Impacts

Collisions are the most significant single threat posed by transmission power lines to birds in southern Africa (Van Rooyen 2004). Due to limited manoeuvrability, large terrestrial birds and vultures are most susceptible and impacted by transmission lines, making it difficult to avoid colliding with power lines. In this particular case, Bustards, Cape Vultures, Herons and other large terrestrial birds are at risk of increased power line collisions as they have been observed within the vicinity of the proposed development.

	Without mitigation		**With mitigation**	
Scale	Localised	2	Localised	2
Duration	Permanent	5	Permanent	5

Magnitude	Moderate	6	Low and will cause a slight impact on ecological processes	2
Probability	Probable	3	Probable	2
Significance	**Moderate**	**39**	**Low**	**18**
Reversibility	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation

- The power line route should be the shortest between the Solar Park and the collector substation.
- Even though these power lines are less likely to cause power line collisions, placing the internal power lines underground should be considered to remove the threat from the scenario, as the priority species are highly vulnerable to negative power line interactions.
- Suppose the power lines can't be placed underground. In that case, the design and layout of any proposed power lines within the PV facility must be endorsed by members of the Eskom-EWT Strategic Partnership, considering the mitigation guidelines (Smit 2012; Jenkins et al. 2016).
- Recommended bird diverters such as brightly coloured "aviation" balls, flapping devices, luminescent light emission reflector devices, or solar-powered night deterrents for nocturnal birds should be installed. It is proven that bird collision can be reduced by 50-60%, but it is still not incident-proof. Therefore, I suggest the underground power line to remove this threat.
- Post-construction monitoring by an avifaunal specialist should be conducted for approximately two years as described in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017) should be considered

Outcome: The impact assessment found the threat of collision with power line infrastructure to be of moderate significance, but implementing the above mitigations will reduce to low significance. However, the design of the proposed internal power lines must be a type or similar structure as endorsed by the Eskom-EWT strategic Partnership on birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins et al. 2017). Bird diverters or spirals must be added to the transmission line to reduce collision risk. In addition, all the parts of the infrastructure must be nest proofed and fitted with anti-perched devices on areas that can lead to electrocution. Any exposed parts must be covered (insulated) to reduce electrocution risk. Furthermore, these power lines need to be checked quarterly to repaired any failed mitigations.

4.5.6 ELECTROCUTION RISK WITH INTERNAL POWER LINES

Table 17. Impact assessment – Electrocution risk with internal power lines

Nature: Negative interaction with power lines in terms of electrocution

Impacts

As for collisions, it is known that electrocution is a significant cause of mortality for a variety of large bird species, such as vultures, korhaans and other large terrestrial birds in South Africa (Van Rooyen and Ledger 1999, Howard et al. 2021). Electrocution is usually associated with distribution lines but still occurs on transmission lines.

	Without mitigation		**With mitigation**	
Scale	Localised	2	Localised	2
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	6	Low and will cause a slight impact on ecological processes	2
Probability	Probable	3	Probable	2
Significance	**Moderate**	**39**	**Low**	**18**
Reversibility	Low		Low	
Can impacts be mitigated?	Yes and can be eliminated by placing all the lines underground			

Mitigation

- The power line route should be the shortest between the Solar Park and the collector substation.
- Suppose the power lines can't be placed underground. In that case, the design and layout of any proposed power lines within the PV facility must be endorsed by members of the Eskom-EWT Strategic Partnership, considering the mitigation guidelines (Smit 2012; Jenkins et al. 2016).
- High-risk perching surfaces should be fitted with bird and perch guards as deterrents (Hunting 2002). Only power line structures considered safe for birds may be erected to avoid the electrocution of birds perching or attempting to perch. The power line is recommended to be placed underground to remove this threat.
- Recommended bird diverters such as brightly coloured "aviation" balls, flapping devices, luminescent light emission reflector devices, or solar-powered night deterrents for nocturnal birds should be installed. It is proven that bird collision can be reduced by 50-60%, but it is still not incident proof. Therefore, more mitigations needs to be implemented than what is suggested by the Eskom-EWT strategic partnership.
- Post-construction monitoring by an avifaunal specialist should be conducted for approximately two years as described in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017) should be considered.

Outcome: The impact assessment found the threat of collision with power line infrastructure to be of moderate significance, but implementing the above mitigations will reduce to low significance. However, the design of the proposed internal power lines must be a type or similar structure as endorsed by the Eskom-EWT strategic Partnership on birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins et al. 2017). Bird diverters or spirals must be added to the transmission line to reduce collision risk. In addition, all the parts of the infrastructure must be nest proofed and fitted with anti-perched devices on areas that can

lead to electrocution. Any exposed parts must be covered (insulated) to reduce electrocution risk. Furthermore, these power lines need to be checked quarterly to repaired any failed mitigations.

4.5.7 ELCTROMAGNECTIC FIELDS

Table 18. Impact assessment – Electromagnetic fields

Nature: There is some evidence that the electromagnetic fields generated by power lines have adverse effects on avian breeding, as well as the ability of migrants to navigate				
	Without mitigation		**With mitigation**	
Scale	Entire study period	3	Entire study period	3
Duration	Permanent	5	Permanent	5
Magnitude	Low and will cause a slight impact on the ecological processes	4	Low and will cause a slight impact on the ecological processes	4
Probability	Improbable	2	Improbable	2
Significance	**Low**	**24**	**Low**	**24**
Reversibility	Low		Low	
Can impacts be mitigated?	No			
Mitigation - None is necessary beyond installing insulators and shielding following Eskom's standard guidelines for best practice (Fernie *et al*. 2000).				
Outcome: The impact can be considered low. However, it will contribute to widespread EMFs generated by electrical infrastructure. Evidence of negative impact is limited, and therefore, mitigations are limited.				

4.5.8 ROOSTING AND BREEDING ON PANELS

Table 19. Impact assessment – Roosting and breeding on panels

Nature: Photovoltaic panels fixed towards one angle could create a problem. The fixed panels will create nest/perching/roosting areas for various birds from small to big. For example, sparrows and crows can potentially use it as a suitable breeding site.				
	Without mitigation		**With mitigation**	
Scale	Entire study period	3	Entire study period	3
Duration	Long term	4	Long term	4
Magnitude	Minor and will not result in an impact on the ecological processes	2	Small and will not affect the environment	0

Probability	Improbable	2	Improbable	2
Significance	**Low**	**18**	**Low**	**14**
Reversibility	Moderate		Moderate	
Can impacts be mitigated?	Yes			
Mitigation: - Nest building will not likely be a concern during the construction phase. - Place rotary solar panels instead of fixed panels should be implemented to avoid any nest construction. Alternatively, panels should be checked weekly to remove any early nest construction. - Any bird nests found on the panels must be reported to the ECO. - The above measures must be covered in a site-specific EMP and controlled by an ECO.				
Outcome: Continue to remove any nest from panels. However, it needs to be reported to the ECO.				

4.6 UNPLANNED EVENTS

As discussed above, the planned activities will have anticipated impacts; however, unplanned events may occur on any project, which could lead to potential impacts that will require appropriate management. In Table 20, I summarise the findings of an unplanned event assessment conducted from a terrestrial ecology perspective. Not all potential random events may be captured herein. This process must be managed throughout all phases and according to events that are likely to occur.

***Table 20*. Summary of unplanned events, potential impacts and mitigations**

Unplanned Event	Potential Impact	Mitigation
Spills into the surrounding environment	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on, and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural savannah.	An appropriate fire management plan needs to be compiled and implemented.
Erosion caused by water runoff from the surface	Erosion on the side of the roads and cleared areas.	A storm water management plan must be compiled and implemented.

4.7 CUMULATIVE IMPACTS

Cumulative impacts are assessed within the context of the extent of the proposed development within a 30 km radius in relation to general habitat loss and disturbance resulting from other anthropogenic activities in the area. The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. This section describes the potential cumulative impacts of the project on the local and regional avifauna community.

Localised cumulative impacts include those from operations that are close enough to potentially cause additive effects on the local environment or any sensitive receivers (such as nearby large road networks, other solar PV facilities, and power infrastructure, agricultural loss). Long-term cumulative impacts associated with the site development activities can lead to the loss of endemic and threatened species, including natural habitat and vegetation types, and these impacts can even lead to the degradation of conserved areas such as the adjacent game parks and reserves.

The total area within the 30 km buffer around the project area amounts to 30,000 ha, but when considering the transformation (11539 ha) that has taken place within this radius, 18461 ha of intact habitat remains according to the 2018 National Biodiversity Assessment. Therefore, the area within 30 km of the project has experienced approximately 38.5% % loss of natural habitat. Considering this context, the project footprint for Phase 1 is 185 ha (according to the provided layout), Phase 2 is 197ha, Phase 3 is 246 ha, Phase 4 182 ha and Phase 5 is 179ha in the 30 km region measuring a maximum of 17472 ha, which includes the project area (as per the latest South African Renewable Energy EIA Application Database). This means that the total amount of remaining habitat lost as a result of solar projects in the region amounts to 41.8% (the sum of all related developments as a percentage of the total remaining habitat). Table 21. Table outlines the calculation procedure for the spatial assessment of cumulative impacts.

Table 21. Table Loss of habitat within a 30 km radius of the project

	Total Habitat (ha)	**Total Loss (ha)**	**Tot. Remaining Habitat (ha) (Remnants)**	**Total Historical Loss**	**Similar Projects (ha)**	**Tot. Remaining Habitat (ha)**	**Cumulative Habitat Lost**
Approximate Solar development cumulative effects (Spatial)	30,000	11539	18461	**38.5 %**	989	17472	**41.8 %**

Approximately, 38.5 % of the habitat has already been lost, and as discussed above the proposed solar developments will result in a cumulative loss of approximately 41.8 % from only similar developments (Solar,

approved and in process). This means that the careful spatial management and planning of the entire region must be a priority, and existing large infrastructure projects must be carefully monitored over the long term.

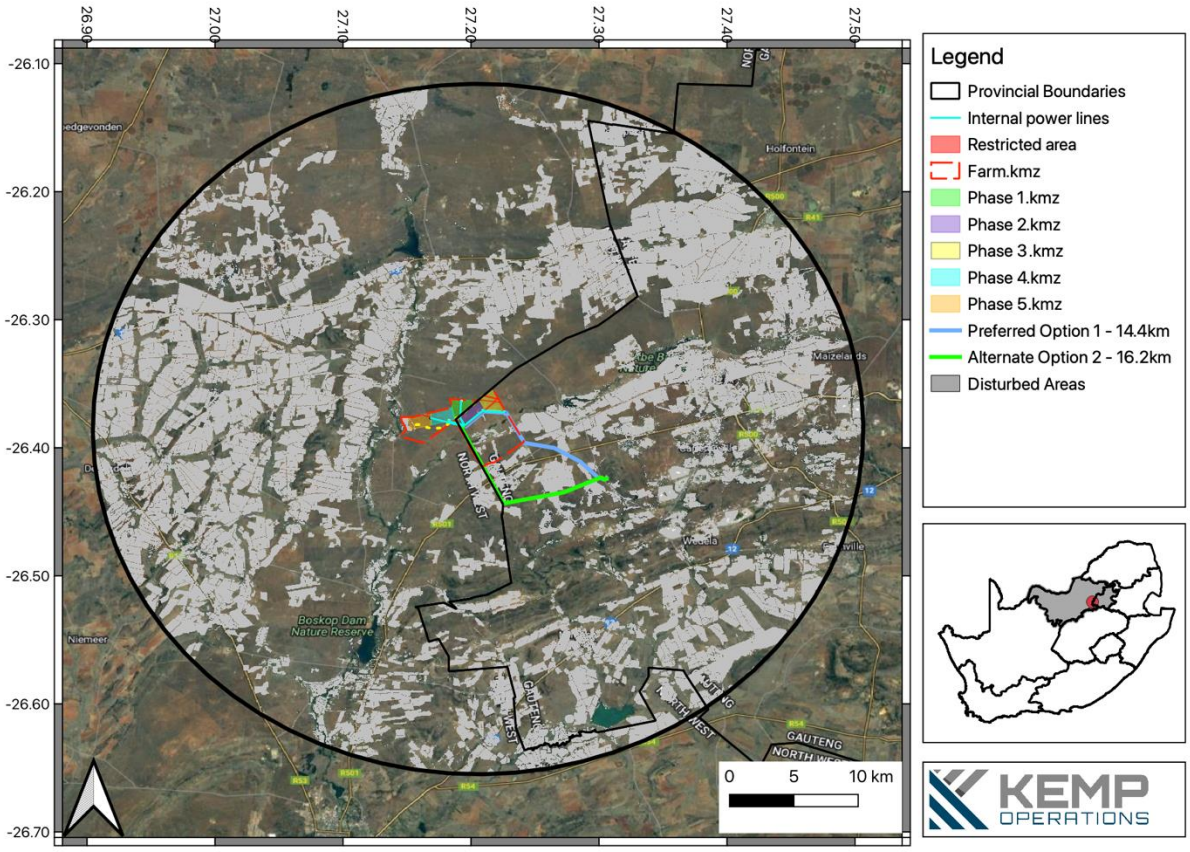


Figure 38. *Cumulative Effect*

5 CONCLUSIONS AND RECOMMENDATIONS

While renewable energy sources such as solar energy are important to the future development of power generation and hold great potential to alleviate the dependence on fossil fuels, they are not without their environmental risks and negative impacts. Poorly sited or designed solar power generating facilities can negatively impact birds and their habitats and the functioning of the entire ecosystem.

The assessment of impacts identified by Birdlife SA as significant for PV developments has revealed that most of these impacts fall within the low to moderate-risk category. As most threats to birds and other wildlife posed by PV facilities are poorly understood, the Mopane Solar Parks, if endorsed, have the potential to provide an ideal platform for monitoring the impact of Solar Parks on the avifaunal communities in grasslands close to wetlands and a river system. Birds within these systems usually stick to them but can occasionally fly between these systems, which increases the risk of a negative interaction with the Solar Park. The Solar Parks might have a negligible effect on the overall bird community, as more than 38% of the landscape has already undergone some anthropogenic disturbance, and even the proposed area is used for grazing livestock. However, the biggest threat will come from the overhead power lines between the Solar Park and the substation (Discussed in a separate report). The proposed development allows institutions to conduct valuable and relevant research into threats posed to avifauna by PV facilities and how to avoid these threats, especially to high-priority species, as described in the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017).

The utilisation of detailed online databases (e.g., SABAP that have more than 500 full protocol surveying points for the area) aided a thorough site visit conducting more than 200 surveying points ourselves; I am confident in the findings of this report and the delineation through the report. The proposed Mopane Solar Park development would have a low to medium impact on the bird communities. It will cause a slight impact on the ecological process of the overall bird community. The biggest concern is the threat of the internal power lines held to threatened species and large terrestrial birds such as vultures, korhaans and herons. However, the design of the proposed internal power lines must be a type or similar structure as endorsed by the Eskom-EWT strategic Partnership on birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins et al. 2017). Bird diverters or spirals must be added to the transmission line to reduce collision risk. In addition, all the parts of the infrastructure must be nest proofed and fitted with anti-perched devices on areas that can lead to electrocution. Any exposed parts must be covered (insulated) to reduce electrocution risk. Furthermore, these power lines need to be checked quarterly to repaired any failed mitigations. Therefore, careful considerations need to be taken regarding the proposed development, as the proposed development can slightly impact the ecological process of the overall bird community. Still, if the wetland and river system can be avoided as far as possible with the mitigations mentioned above, the impact might reduce in some cases. However, the issuing authority must consider all prescribed mitigation measures and recommendations when reviewing the application.

6 POST-CONSTRUCTION MONITORING METHODOLOGY AT EACH SITE

According to the Best Practice Guidelines Birds & Solar Energy (Jenkins et al. 2017), under the medium sensitivity of the proposed development, a post-construction survey will be conducted with two survey periods approximately 6 months apart during the austral summer and winter each year for a minimum of 2-3 years. This allows us to make more comprehensive assessments of the impact of solar farms on avifaunal. Each survey will consist of multiple site visits (3-4 days), conducting various point transects during each visit. Transects will be conducted on the proposed solar area and potentially surrounding areas. This is required based on the Birds and

Solar Energy Best Practice Guidelines by Jenkins *et al*. (2017). Points were spatially placed to cover all habitat features at each site as described by Leddy *et al*. (1999) and Bibby *et al*. (2000). This analysis will consider possible observer biases, detectability, time of day, weather condition and activity. Furthermore, these points will be walked during cooler periods of the day (*e.g*., early mornings and late afternoons). As described in the Birds and Solar Energy Best Practice Guidelines the species, number, and distance will be recorded with a range finder (e.g., 0-10m,11-50m,51-200m, >200m).

In addition, I will conduct dedicated road counts to observe large terrestrial birds as described in the Birds and Solar Energy Best Practice Guidelines. From these road surveys, I will record any breeding pairs, nest/breeding areas that will undergo further monitoring and any information on the flight patterns of large Raptors. Furthermore, powerlines and solar parks will be walked and surveyed to record any fatalities during each survey. The study design is subject to change if the contract is provided to Kemp Operations

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8 CURRICULUM VITAE

GENERAL INFORMATION					
Surname:	Kemp			**First names:**	Ryno
Title:	Mr				
Date of birth:	09 October 1991	**Gender:**	Male	**Citizenship:**	South African
E-mail address:	rynokemp0510@gmail.com			**Phone number:**	0832733488
Institution most recently affiliated with:	- VulPro - Kemp operations (Pty) Ltd				
Position:	- Research Manager - Avifaunal/Ecologist Specialist – (Professional Natural Scientist)				
Postal Address:	Primary Address: 20 Glen Avenue, Equestria, Pretoria, 0184 Secondary Address: 35 Yellowwood Road, Ruitevlei, Sedgefield, Western Cape				
Driver's Licence	Code 8 driver's license				

ACADEMIC QUALIFICATIONS OBTAINED				
Degree/ Diploma	**Field of study**	**HE Institution**	**Year Obtained**	**DISTINCTIONS**
BSc (Degree)	Zoology	University of Pretoria	2015	
BSc (Honours)	Zoology – Winter heterothermy in Ground woodpeckers	University of Pretoria	2016	
PhD (Doctoral)	Zoology	University of Pretoria	Expect to submit in 2022	
Certificate	Environmental Law and Liabilities for the Regulated Community (Short Course)	University of South Africa	2020	*

RESEARCH / RELEVANT WORK EXPERIENCE TO DATE (IF APPLICABLE)		
Name of institution	**Capacity and/or type of work**	**Period**
University of Pretoria	Field assistant to various postgraduate students under Prof Andrew E. McKechnie. I gained valuable data collection skills.	2013-2020
University of Pretoria	Field assistant to various postgraduate students under Prof Rudi van Aarde. I gained valuable experience in understanding how to assess bird communities within various landscapes.	2014 & 2016
University of Pretoria	My BSc (Hons) research investigated the thermoregulation ability in free-ranging Ground Woodpeckers during cold winter months. I gained valuable experience in data collection, data-analysis (R-software), and improved my writing during my Honours degree.	2016
University of Pretoria	My PhD research investigates the impacts of climate change on threatened arid-zone Red lark (*Calendulauda burra*) using a mechanistic model. I gained valuable skills during my data collection. I learned more about coding in R and using ArcGIS as it forms part of the data analysis during my chapters of my PhD thesis: - Physiological data (data-analysis: R-software) - Field metabolic rate (data-analysis: R-software) - Behavioural and body mass data (data-analysis: R-software)	2017- submitted

	- Home range data to estimate the population size of the Red Lark on Black Mountain Mine conservation area (data-analysis: R-software & ArcGIS) - Other animal-specific data (R-software with an endotherm model to assess the impact of climate change) - Environmental data (NicheMapper [R-software] to model suitable micro-climates)	
SACNASP	Pr. Sci. Nat.	117462/17
VulPro	Head of Research and Fieldwork	February 2020 - Present
CONSULTING EXPERIENCE TO DATE SINCE 2018 (Avifaunal assessment = 9; Faunal assessments = 2) Below is the last 10 jobs		
COMPANY	**PROJECT DETAILS**	**DATE**
GNES	Faunal Assessment: Vredekloof development	2022
GNEC	Faunal Assessment: Schoongezicht development	2022
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Lichtenburg Solar Park	2022
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Ivydale residential development	2022
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Malu Pork Unit	2022
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Virginia Powerline Development	2021
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Virginia Solar Park	2021
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: Stellar Solar Project	2021
AGES Limpopo (Pty) LTD	Specialist avifaunal impact Assessment: New Hope Solar Project	2021

RESEARCH OUTPUT

Publications in peer-reviewed / refereed journals [11]

- Hirschauer MT, Hannweg CG, **Kemp R** & Wolter K. (2022) VulPro: An overview of Africa's Vulture Conservation Centre. Vulture News
- Kane A, Monadjem A, Bildstein K, Botha A, Bracebridge C, Buechley ER, Buij R, Davies JP, Diekmann M, Downs C, Farwig N, Galligan T, Kaltenecker G, Kelly C, **Kemp R**, Kolberg H, MacKenzie M, Mendelsohn J, Mgumba M, Nathan R, Nicholas A, Ogada D, Pfeiffer MB, Phipps WL, Pretorius M, Rösner S, Schabo DG, Spiegel O, Thompson LJ, Venter JA, Virani M, Wolter K, Kendall C (*2022*) Size doesn't matter, it's how

you use it: Using continent-wide variation in ranging behaviour of vultures to assess the feasibility of Vulture Safe Zones in Africa. Conservation Biology

- Czenze ZJ, Freeman MT, **Kemp R**, van Jaarsveld B, Wolf BO & McKechnie AE. (2021) Gular flutter provides the basis for efficient evaporative cooling and pronounced heat tolerance in an eagle-owl, a thick-knee and a sandgrouse from the southern Africa arid zone. Frontiers in Ecology and Evolution
- Curk T, Scacco M, Safi K, Wikelski M, **Kemp R** & Wolter K. (2021) Severe differences in movement associated with tagging method used in the African Cape vulture.
- van Jaarsveld B, Bennett NC, **Kemp R**, Czenze ZJ & McKechnie AE. (2021). Heat tolerance in desert rodents is correlated with microclimate at inter- and intraspecific levels. Journal of Experimental Biology
- van Jaarsveld B, Bennett NC, **Kemp R**, Czenze ZJ & McKechnie AE. (2021) How hornbills handle the heat: sex-specific thermoregulation in the Southern Yellow-billed Hornbill. Journal of Experimental Biology
- **Kemp R,** Freeman MT, van Jaarsveld B, Czenze ZJ, Conradie SR & McKechnie AE. (2020) Sublethal fitness costs of chronic exposure to hot weather vary between sexes in a threatened desert lark. EMU
- Czenze ZJ, **Kemp R**, van Jaarsveld B, Freeman MT, Smit B, Wolf BO & McKechnie AE. (2020). Regularly-drinking desert birds have a greater capacity for evaporative cooling and higher heat tolerance limits than non-drinking species. Journal of Functional Ecology
- Lund J, Bolopo D, Thompson RL, Elliott DL, Arnot LF, **Kemp R**, Lowney AM & McKechnie AE. (2020) Winter thermoregulation in free-ranging pygmy falcons in the Kalahari Desert. Journal of Ornithology
- **Kemp R**, McKechnie AE (2019) Thermal physiology of a range-restricted desert lark. Journal of Comparative Physiology B 189:131-141
- **Kemp R**, Noakes MJ, McKechnie AE (2017) Thermoregulation in free-ranging ground woodpeckers *Geocolaptes olivaceus*: no evidence of torpor. J Avian Biol 48:1287–1294

Publications in peer-reviewed / refereed journals (submitted) [2]

- Aspenström S*, **Kemp R***, Howard A, Hannweg, CG, Chetty K, Briers RA & Wolter K. (***Accepted***) The threat of power lines on two African Vulture species. (* joint co-first authors)
- Francisco CP, Murgatroyd M; Allan DG, Farwig N, **Kemp R;** Krüger S, Maude G, Mendelsohn J; Rösner S, Schabo DG, Tate G, Wolter K & Amar A. (***Accepted***) A spatially explicit encounter risk model for the Cape Vulture Gyps coprotheres to guide wind energy development. Ecological applications
- Conradie SR, Kearney MR, Wolf BO, Cunningham SJ, Freeman MT, **Kemp R**, McKechnie AE. (**Submitted**) An evaluation of a biophysical model predicting avian thermoregulation in the heat.

Publications in peer-reviewed / refereed journals (in prep) [6]

- **Kemp R,** Freeman MT, Colyn R, Lee ATK, Ryan P & McKechnie AE. (***In Prep***) Population status of the Red Lark in the Black Mountain Mine Conservation Area.
- Casey J, **Kemp R**, Hannweg CG, Hirschauer MT, Naidoo V & Wolter K. (***In Prep***) Lead poisoning may not contribute to power line collisions amongst African Vultures.

- **Kemp R** & McKechnie AE. (***In Prep***) The effect of climate change on the water and energy budget of the threatened arid-zone Red Lark (*Calendulauda burra*) of South Africa
- MacLeod N., **Kemp R.,** Hannweg CG., Wolter K., Warren B. and Keith Mark. (In Prep) Examing the foraging ranges and behaviours of two African vultures in Gauteng and North-West Provinces of South Africa.
- McKechnie, AE., **Kemp, R.,** Freeman, MT., Wolter, K. & Naidoo, V. (In Prep) The impact of lead exposure on the thermoregulatory capacity of Pied Crows.

Technical/policy reports [10 – only showing the last 10]

- **Kemp. R. 2022.** Faunal Impact Assessment: Vredekloof development. Prepared for GNEC.
- **Kemp. R.** & Engelbrecht. D. **2022.** Faunal Impact Assessment: Schoongezicht development. Prepared for GNEC.
- **Kemp. R.** & Engelbrecht. D. **2022.** Specialist avifaunal Impact Assessment: Lichtenburg PV Solar Park Projects. Prepared for AGES Limpopo.
- **Kemp. R.** & Engelbrecht. D. **2022.** Specialist avifaunal Impact Assessment: Ivydale residential development. Prepared for AGES Limpopo.
- Kemp. R. 2022. Specialist avifaunal Impact Assessment: Proposed Malu Pork Unit. Prepared for AGES Limpopo.
- Grosel. J & **Kemp. R. 2021.** Specialist avifaunal Impact Assessment: Proposed Virginia Power Line Development. Prepared for AGES Limpopo.
- Grosel. J & **Kemp. R. 2021.** Specialist avifaunal Impact Assessment: Proposed Virginia Solar Park. Prepared for AGES Limpopo.
- **Kemp. R.** & Engelbrecht. D. **2021.** Specialist avifaunal Impact Assessment: Proposed Stellar Solar Park. Prepared for AGES Limpopo.
- **Kemp. R. 2021.** Specialist avifaunal Impact Assessment: Proposed New Hope Solar Park. Prepared for AGES Limpopo.

OTHER SCHOLARLY, RESEARCH-BASED CONTRIBUTIONS

Participation in conferences, workshops, and short courses

- Biophysical Field Methods Course – Pinshow B, Scott Turner and Marias E. Theoretical Section (online from February – Augustus 2017) and field component (at Gobabeb from 22 June – 6 July 2017)
- **Kemp R**, Noakes MJ, McKechnie AE. (2018) Thermoregulation in free-ranging ground woodpeckers Geocolaptes olivaceus: no evidence of torpor. 27th International Ornithological Congress – Vancouver. Speed Talk.
- **Kemp R**, Freeman MT, van Jaarsveld B, Czenze ZJ & McKechnie AE. (2019) The cost of hot weather on the body condition and activity budget of the threatened arid-zone Red Lark (*Calendulauda burra*). 39th Zoological Society of Southern Africa Congress. Oral Presentation.

- van Jaarsveld B, Bennett NC, **Kemp R**, Czenze ZJ & McKechnie AE. (2019) How hornbills handle the heat: sex-specific differences in evaporative cooling in the Southern Yellow-billed Hornbill. 39th Zoological Society of Southern Africa Congress. Oral Presentation.
- van Jaarsveld B, Bennett NC, **Kemp R**, Czenze ZJ & McKechnie AE. (2019) How hornbills handle the heat: sex-specific differences in evaporative cooling in the Southern Yellow-billed Hornbill. Australasian Ornithological Conference. Poster Presentation

Reference

Prof Andrew E. McKechnie – Postgraduate supervisor - aemckechnie@gmail.com

- Honours
- Masters (Upgraded to PhD September 2018)
- PhD
- Mentor as an avifaunal specialist

Dr Derek Engelbrecht - faunagalore@gmail.com

- Mentor as an avifaunal and faunal specialist

Marc Trevor Freeman - marcfreeman78@gmail.com

- Postgraduate colleague also under the supervision of Prof Andrew McKechnie

Kerri Wolter

- Employer at VulPro.