ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED DEVELOPMENT OF ALLEPAD PV FOUR SOLAR PV FACILITY AND ASSOCIATED INFRASTRUCTURE ON A SITE NEAR UPINGTON, IN THE NORTHERN CAPE PROVINCE.:

AVIFAUNAL SPECIALIST IMPACT ASSESSMENT REPORT

Rufous-eared Warbler *Malcorus pectoralis*

savannah environmental

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

3Foxes Biodiversity Solutions

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EXECUTIVE SUMMARY

Allepad Solar Four is proposing the establishment of the 100MW Allepad PV Four commercial photovoltaic solar energy facilities on a portion of the Remaining Extent of Erf 5315, located approximately 11km north-west of Upington, in the Northern Cape Province. Savannah Environmental has been appointed to undertake the required application for environmental authorisation process for the above development. The development is currently in the Environmental Impact Assessment (EIA) Phase and 3Foxes Biodiversity Solutions has been appointed to provide a specialist avifaunal study of the development site as part of the EIA process.

A full field assessment over two seasons as well as a desktop review of the available avifaunal information for the area was conducted in order to identify and characterise the avifaunal features of the site. An approximate total of 145 bird species have been recorded within the broader project site, of which 71 species were observed on site during a three-day field survey both in winter (July 2018) and summer (February 2019). Only five of these species are listed as near-endemic and a further ten species as biome-restricted. There are no known Important Bird Areas (IBAs) within the vicinity of the project site, while there are also no known wetlands of significant avifaunal importance.

Nine species recorded in the broader area are red-listed, of which six species are listed as threatened, and three considered Near-Threatened. All six of the threatened species may occur within the project site, albeit in low numbers or infrequently, and include White-backed Vulture *Gyps africanus* (Critically Endangered), Martial Eagle *Polemaetus bellicosus* (Endangered), Tawny Eagle *Aquila rapax* (Endangered), Ludwig's Bustard *Neotis ludwigii* (Endangered), Lanner Falcon *Falco biarmicus* (Vulnerable), and Secretarybird *Sagittarius serpentarius* (Vulnerable). Two of these Red-listed species were recorded during the summer survey, namely, Ludwig's Bustard (3 sightings, 4 individuals) and Lanner Falcon *Falco biarmicus* (1 sighting, 1 individual). Two Near-Threatened species were also recorded, namely Karoo Korhaan (several pairs) and Kori Bustard *Ardeotis kori* (2 sightings, 3 individuals). No sensitive breeding or roosting sites of any red-listed species were observed at the site during the field survey.

The expected impacts of the proposed solar development within the project site include 1) habitat loss and fragmentation associated with sandy plains habitat of the Gordonia Duneveld vegetation type, 2) disturbance caused during the construction and maintenance phases, and 3) direct mortality of avifauna colliding with solar panels and associated power line structures, as well as electrocutions with power line infrastructure and entrapment along perimeter fencing. The species that will be the most negatively impacted by the proposed development include primarily small passerines, ground-dwelling non-passerines and large raptors and terrestrial birds that occasionally use the area for foraging. The impacts on the avifauna would normally be expected to be of medium importance, but due

to the low frequency of occurrence of priority species, the impacts are likely to be low and no high post-mitigation impacts are expected.

The primary mitigation measures required to reduce the potential impacts on priority species include 1) restrict habitat destruction and disturbance to within the footprint of the proposed development, 2) exclusion of the Kalahari Karroid Shrubland to the east of the study area from any development as this area supports resident Karoo Korhaans and nomadic Ludwig's Bustard, 3) exclusion of the linear dunes fields within the north-west portion of the study area, 4) fitment of bird diverters where necessary on all erected power lines associated with the development to reduce the possibility of collisions and electrocutions, 4) ensure that perimeter fencing along the boundaries of the development are bird (especially ground-dwelling species) and wildlife friendly.

Cumulative impacts associated with the development may be of concern due to increasing number of solar facility developments proposed for the broader Upington area. Considering that the vegetation and avifauna that occur on the property are rather typical of the Kalahari bioregion, the overall cumulative avifaunal impact of the development is, however, considered likely to be low, provided that the areas of the property beyond the project sites remain undeveloped as planned. Further, provided the development footprint for the Allepad PV Four site remains restricted to the sandy plains habitat of the Gordonia Duneveld vegetation type, and that development of the adjoining dune habitat is restricted to less than 10% of this habitat, there are no fatal flaws associated with the current layout of the development.

The Allepad PV Four site is considered to represent a broadly suitable environment for the location of the proposed solar development. Considering that the broader project site supports a typical bioregional avifaunal assemblage, and that there are no known breeding or roosting sites of red-listed priority species, there are no impacts associated with the development that are considered to be of high residual significance and which cannot be mitigated to a low level. Consequently, the development can be supported from an avifaunal perspective. It is therefore the reasoned opinion of the specialist that the Allepad PV Four project should therefore be authorised, subject to the implementation of the recommended mitigation measures.

CONTENTS

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS, AS AMENDED

Requirements of Appendix 6 – GN R326 2014 EIA Regulations, 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	6-8
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	9-10
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 3
g) an identification of any areas to be avoided, including buffers;	Section 3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 4
k) any mitigation measures for inclusion in the EMPr;	Section 5
l) any conditions for inclusion in the environmental authorisation;	Section 5
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 5
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Main Report
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Main Report
q) any other information requested by the competent authority.	
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

SHORT CV/SUMMARY OF EXPERTISE

Simon Todd

Simon Todd is Director and principal scientist at 3Foxes Biodiversity Solutions and has over 20 years of experience in biodiversity measurement, management and assessment. He has provided specialist ecological input on more than 200 different developments distributed widely across the country. This includes input on the Wind and Solar SEA (REDZ) as well as the Eskom Grid Infrastructure (EGI) SEA and Karoo Shale Gas SEA. He is on the National Vegetation Map Committee as representative of the Nama and Succulent Karoo Biomes. Simon Todd is a recognised ecological expert and is a past chairman and current deputy chair of the Arid-Zone Ecology Forum. He is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Skills & Primary Competencies

- Research & description of ecological patterns & processes in Nama Karoo, Succulent Karoo, Thicket, Arid Grassland, Fynbos and Savannah Ecosystems.
- Ecological Impacts of land use on biodiversity
- Vegetation surveys & degradation assessment & mapping
- Long-term vegetation monitoring
- Faunal surveys & assessment.
- GIS & remote sensing

Tertiary Education:

- 1992-1994 – BSc (Botany & Zoology), University of Cape Town
- 1995 – BSc Hons, Cum Laude (Zoology) University of Natal
- 1996-1997- MSc, Cum Laude (Conservation Biology) University of Cape Town

Employment History

- 2009 – Present – Sole Proprietor of Simon Todd Consulting, providing specialist ecological services for development and research.
- 2007 Present – Senior Scientist (Associate) – Plant Conservation Unit, Department of Botany, University of Cape Town.

- 2004-2007 – Senior Scientist (Contract) – Plant Conservation Unit, Department of Botany, University of Cape Town
- 2000-2004 – Specialist Scientist (Contract) - South African National Biodiversity Institute
- 1997 – 1999 – Research Scientist (Contract) – South African National Biodiversity Institute

A selection of recent work is as follows:

Strategic Environmental Assessments

Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.

Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.

Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.

Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.

Contributor – Ecological & Conservation components to SKA SEA. CSIR 2017.

Recent Specialist Ecological Studies in the Vicinity of the Current Site

- Kathu Solar PV Facility. Fauna and Flora EIA Process. Cape EAPrac 2015.
- Mogobe Solar PV Facility. Fauna and Flora EIA Process. Cape EAPrac 2015.
- Legoko Solar PV Facility. Fauna and Flora EIA Process. Cape EAPrac 2015.
- RE Capital 10 Solar Power Plant, Postmasburg. Fauna and Flora EIA Proces. Cape EAPrac 2015.
- Walk-through study of Kumba Iron Ore expansion area at Dingleton, Northern Cape. MSA Group. 2017.
- Adams PV Project – EIA process and follow-up vegetation survey. Aurora Power Solutions. 2016.
- Mamatwane Compilation Yard. Fauna and Flora EIA process. ERM. 2013.
- Olifantshoek-Emil 132kV power line, Olifantshoek. Fauna and Flora BA process. Savannah Environmental 2017.
- Gaetsewe Solar PV Facility, Kathu. Fauna and Flora EIA Process. Cape EAPrac 2018.
- Mogara Solar PV Facility, Kathu. Fauna and Flora EIA Process. Cape EAPrac 2018.
- Kathu Hyperion Solar PV Facility, Kathu. Fauna and Flora EIA Process. Cape EAPrac 2018.

Eric Herrmann

Eric Herrmann is an avifaunal specialist with over 15 years of experience in biodiversity research and conservation in the Northern Cape. He completed a B.Tech Degree in Nature Conservation (1997) at the Cape Technikon, followed by a Masters in Conservation Ecology at the University of Stellenbosch (2004). He has worked as a research assistant for the Endangered Wildlife Trust (1999-2001) in the Kgalagadi Transfrontier Park, and then for the Percy FitzPatrick Institute of African Ornithology (University of Cape Town) as project manager of a field research centre near Kimberley (2003 to 2006). In 2006 he joined

the provincial Department of Environment and Nature Conservation (DENC) in Kimberley as a faunal scientist until 2012. Since 2016 he has been working independently as an avifaunal specialist largely on wind and solar energy projects in the Western and Northern Cape.

Tertiary Education:

- 1994 - 1997 – National Diploma: Nature Conservation (cum laude), Cape Technikon
- 1998 - 1999 – B.Tech Degree: Nature Conservation (cum laude), Cape Technikon
- 2000 - 2004 – MFor: Conservation Ecology (cum Laude), University of Stellenbosch

Employment History

- 2016 - Present – Independent contractor, avifaunal specialist for renewable energy projects.
- 2006 - 2012 – Senior Conservation Scientist, Department of Environment and Nature Conservation, Kimberley.
- 2003 - 2006 – Research Assistant and Field Projects Manager, Percy Fitzpatrick Institute of African Ornithology, Cape Town
- 2001 - 2002 – Field Researcher, Deciduous Fruit Producers Trust, Stellenbosch.
- 1999 - 2001 – Research Assistant, Endangered Wildlife Trust, Johannesburg.

Recent Specialist Avifaunal Studies include the following:

- Dassieklip Wind Facility. Avifaunal post-construction monitoring. BTE Wind Pty (Ltd). 2018/19.
- Excelsior Wind Facility. Avifaunal pre-construction monitoring. BTE Wind Pty (Ltd). 2018/19.
- Kathu Hyperion Solar PV Facility, Kathu. Fauna and Flora EIA Process. Cape EAPrac 2018/19.
- Gaetsewe Solar PV Facility, Kathu. Avifaunal Scoping Report. Cape EAPrac 2018.
- Mogara Solar PV Facility, Kathu. Avifaunal Scoping Report. Cape EAPrac 2018.
- Mamre Wind Facility. Avifaunal pre-construction monitoring. Mulilo Renewable Project Developments. 2017.
- Soventix Solar PV Facility (De Aar). Avifaunal Specialist Scoping and EIA Reports. Ecoleges. 2017.
- Olifantshoek-Emil 132kV power line, Olifantshoek. Fauna and Flora BA process. Savannah Environmental 2017.
- Klondike (Vryburg) Solar PV Facility. Ecological Specialist Report for EIA. Cape EAPrac 2016.

SPECIALIST DECLARATION

I, ..Simon Todd....., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

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

Signature of the specialist: 

Name of Specialist: ____Simon Todd_____

Date: ____14 February 2019_____

SPECIALIST DECLARATION

I, ..Eric Herrmann....., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

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

Signature of the specialist: 

Name of Specialist: ____Eric Herrmann_____

Date: ____14 February 2019_____

1 INTRODUCTION

Allepad Solar Four is proposing the establishment of the 100MW Allepad PV Four commercial photovoltaic solar energy facility on a portion of the Remaining Extent of Erf 5315, located approximately 11km north-west of Upington, in the Dawid Kruiper Local Municipality, of the ZF Mgcawu District, in the Northern Cape Province. Savannah Environmental has been appointed to undertake the required application for environmental authorisation process for the above development. The development is currently in the EIA Phase and 3Foxes Biodiversity Solutions has been appointed to provide a specialist avifaunal impact assessment study of the project site as part of the EIA process.

The purpose of the Allepad PV Four Avifaunal Specialist Report is to 1) describe the avian community and associated habitat features of the proposed PV project site, 2) to provide a an assessment of the avian sensitivity of the site, and 3) identify and assess the significance of the likely impacts on the avifauna associated with the development of the site as a solar PV facility, and 4) to provide measures to avoid, minimize and mitigate project related impacts to the avifauna. A winter (13 to 16 August 2018) and summer (1 to 3 February 2019) site visit, as well as a desktop review of the available literature for the broader project site was conducted in order to identify and characterise the local avifauna at the site. This information is used to derive an avifaunal sensitivity map that presents the ecological constraints and opportunities for development at the site. The information and sensitivity map provides an avifaunal baseline that has been used in the planning phase of the development to ensure that the potential negative avifaunal impacts associated with the development have been minimised as far as possible. Impacts are assessed for the pre-construction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed below.

1.1 SCOPE OF STUDY

The assessment is conducted according to the 2014 EIA Regulations (Government Notice Regulation 982) in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), as well as best-practice guidelines and principles for avifaunal assessment within solar energy facilities as outlined by Birdlife South Africa.

The scope of the study includes the following activities

- a description of the avifauna that may be affected by the activity and the manner in which the avifauna may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts on the

avifauna (including using direct, indirect and cumulative impacts) that have been identified

- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential impacts on the avifauna
- an assessment of the significance of direct, indirect and cumulative impacts in terms of the following criteria:
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected, and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5-15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity), or permanent
    - the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood) probable (distinct possibility), highly probable (most likely), or definite (Impact will occur regardless of any preventable measures)
    - the severity/beneficial scale indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight, or have no effect
    - the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high
    - the status which will be described as either positive, negative or neutral
    - the degree to which the impact can be reversed
    - the degree to which the impact may cause irreplaceable loss of resources
    - the degree to which the impact can be mitigated

- a description and comparative assessment of all alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
- a description of any assumptions uncertainties and gaps in knowledge
- an environmental impact statement which contains:

- a summary of the key findings of the environmental impact assessment;
- an assessment of positive and negative implications of the proposed activity;
- a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations:

- Disclose any gaps in information or assumptions made.
- Identify recommendations for mitigation measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP) for avifaunal related issues.

A description of the potential impacts of the development and recommended mitigation measures are to be provided, which will be separated into the following project phases:

- Preconstruction
- Construction
- Operational
- Decommissioning

1.2 Relevant Aspects of the Development

The development project is proposed on a portion of the Remaining Extent of Erf 5315, located approximately 11km north-west of Upington (Figure 1). The area under investigation is approximately 3 889ha in extent and comprises a single agricultural property. The project site can be accessed directly via the N10 national road which borders the southern boundary of the site. Photovoltaic (PV) technology is proposed for the generation of electricity. The solar energy facility will have a contracted capacity of up to 100MW, and will make use of either fixed-tilt, single-axis tracking, or double axis tracking PV technology. The solar energy facility will comprise the following key infrastructure components:

- Arrays of PV panels with a generation capacity of up to 100MW.
- Mounting structures to support the PV panels.
- Combiner boxes, on-site inverters (to convert the power from Direct Current (DC) to Alternating Current (AC)), and power transformers.
- An on-site substation up to 1ha in extent to facilitate the connection between the solar energy facility and the Eskom electricity grid.
- A new 132kV power line approximately 5km in length, between the on-site substation and Eskom grid connection point.

- Cabling between the project's components (to be laid underground where practical).
- Meteorological measurement station.
- Energy storage area of up to 2ha in extent.
- Access road and internal access road network.
- On-site buildings and structures, including a control building and office, ablutions and guard house.
- Perimeter security fencing, access gates and lighting.
- Temporary construction equipment camp up to 1ha in extent, including temporary site offices, parking and chemical ablution facilities.
- Temporary laydown area up to 1ha in extent, for the storage of materials during the construction and a concrete batching plant.

In terms of the grid connection, the following is proposed:

- The project will connect to the upgraded 132kV double circuit line which runs approximately 5km east of the project site, between the new Upington MTS (currently under construction approximately 15km south of the project site) and the Gordonia Distribution substation (located in Upington town).
- The grid connection will make use of a "loop in-and-loop out" configuration.
- The shortest route is along the N10 in a 300m wide corridor.

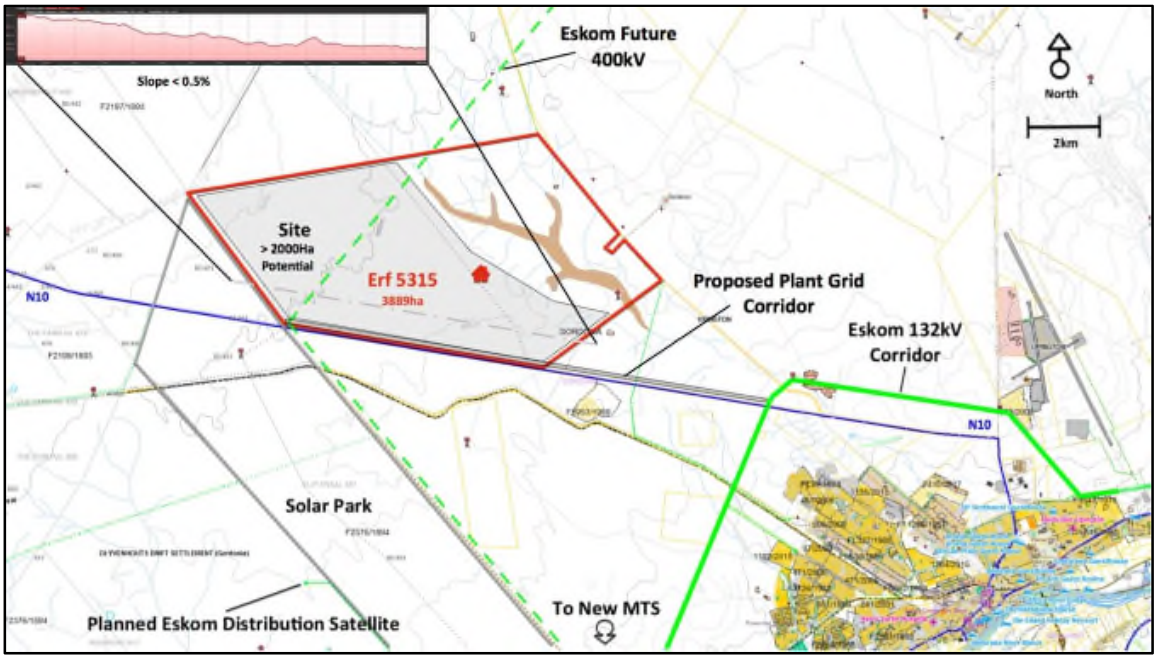

Figure 1. Locality map of the Allepad PV Four study site, illustrating the property boundary in red and the proposed power line corridor to the point of connection to the Eskom 132kV corridor.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study include the following:

- The Southern African Bird Atlas Project 1 (SABAP 1; Harrison *et al*., 1997), which obtained bird distribution data between 1987 and 1992, was consulted to determine the bird species likely to occur within the project site. The relevant quarter-degree grid cells (QDGC) that covers the site is 2821AC (35 cards, 144 species). More recent bird distribution data were also obtained from the second bird atlas project, which has been on-going since its inception in 2007 (SABAP 2; http://sabap2.adu.org.za/). SABAP2 employs a finer resolution using the pentad scale (5' latitude x 5' longitude), with the relevant pentad codes for the site being 2820_2105 (60 cards, 131 species) and 2820_2100 (7 cards, 48 species). These were consulted to determine the bird species likely to occur within the project site and the broader impact zone of the development.
- The Important Bird Areas of South Africa (IBA; Marnewick *et al*., 2015) was consulted to determine the location of the nearest IBAs to the project site.
- The data from the Coordinated Avifaunal Roadcounts (CAR; Young *et al*., 2003) were consulted to determine the location of the nearest CAR routes to the project site.
- The data from the Coordinated Waterbird Counts (CWAC; Taylor *et al*., 1999) were consulted to determine the location of the nearest CWAC sites to the project site.
- The conservation status, and biology of all species considered likely to occur within the project site were determined from Hockey *et al.* (2005) and Taylor *et al.* (2015).
- The South African National Vegetation Map (Mucina & Rutherford, 2006) was consulted in order to determine the vegetation types and their conservation status that occur within the project site.

The literature review revealed that there are no Important Bird Areas (IBAs), Coordinated Avifaunal Roadcounts (CAR) routes, or Coordinated Waterbird Counts (CWAC) wetlands in the vicinity of the broader project site.

2.2 SITE VISIT & FIELD METHODOLOGY

A site visit of three (3) days was made to the broader project site in mid-winter (15 to 17 July 2018) and summer (1 to 3 February 2019) to determine the *in situ* local avifauna and avian habitats present on site. The winter survey followed a summer (2017/18) with relatively normal rainfall, while the summer survey was preceded by poor early summer rainfall (2018/19). Hence the conditions during the summer survey were characterised by dry and hot conditions with a very poor cover of grass.

In order to survey the avifauna, line transects measuring 1km in length, were walked throughout the broader project site to ensure adequate coverage under the time constraints. A total of 35 line transects were completed throughout the day during the winter survey, and 28 transects during the mornings of the summer survey. All birds detected by sight or sound during these transect walks were recorded, as well as the number of birds per detection. These walked transects served to:

- Quantify aspects of the local avifauna (such as species diversity and abundance);
- Identify important avian features present on site (such as nesting and roosting sites);
- Confirm the presence, abundance, habitat preference and movements of priority species;
- Identify important flyways across the site; and
- Delineate any obvious, highly sensitive, no-go areas to be avoided by the development.

Prior to analysing the transect data, all records of birds that were only seen flying over the site (e.g. sandgrouse), or large flocking species attracted to focal points such as watering holes (e.g. bishop and quelea), were excluded from the database.

The proposed route of the grid connection between the proposed development and the Eskom 132kV corridor was also surveyed during the summer site visit. The length of the proposed grid corridor was sampled every 500m whereby any sensitive avifaunal habitats were identified, as well as areas where high collision rates between birds and the proposed power line could be expected.

A list was compiled of all the avifaunal species likely to occur within the broader project site, based on a combination of existing distributional data (SABAP 1 and SABAP 2) and species seen during the two seasonal site visits. A short-list of priority bird species (including nationally and/or globally threatened, rare, endemic or range-restricted bird species) which could be affected by the proposed development was also compiled. These species will subsequently be considered as adequate surrogates for the local avifauna in general, and mitigation of impacts on these species will be considered likely to accommodate any less important bird populations that may also potentially be affected.

2.3 SENSITIVITY MAPPING & ASSESSMENT

An avifaunal sensitivity map of the site was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases with mapping based on the satellite imagery of the site as well as personal knowledge of the site. This includes delineating different habitat units identified on the satellite imagery and assigning likely sensitivity values to the units based on their ecological properties, conservation value and the potential presence of avifaunal species of conservation concern.

The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with low sensitivity where there is likely to be a negligible impact on ecological processes and avifaunal biodiversity. Most development types can proceed within these areas with little ecological impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. These areas usually comprise the bulk of habitats within an area. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for avifaunal species or provide important ecological services such as water flow regulation or forage provision. Development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

2.4 Sampling Limitations and Assumptions

The current study consists of a relatively detailed field assessment (summer and winter) as well as a desktop study, which serves to significantly reduce the limitations and assumptions required for the study. However, it must be noted that there are limiting factors and these could detract from the accuracy of the predicted results:

- There is a scarcity of published, scientifically assessed information regarding the avifaunal impacts at existing SEFs. Recent studies at SEFs (all using different solar technologies) in southern California have revealed that a wide range of bird species are susceptible to morbidity and mortality at SEFs, regardless of the type of technology employed. It must however be noted, that facility related factors could influence impacts and mortality rates and as such, each SEF must be assessed individually, taking all variables into account.
- Assessment of the impacts associated with bird-SEF interactions is problematic due to: (i) limitations on the quality of information available describing the composition, abundance and movements of the local avifauna, and (ii) the lack of local, empirical data describing the known impacts of existing SEFs on birds (Jenkins, 2011). A more recent study (Venter, 2016, Visser *et al*., 2018), however, provides some preliminary data within the South African context.

- The SABAP 1 data for the relevant quarter degree squares covering the broader project site and surrounds are now >21 years old (Harrison *et al*., 1997). However, with nearly 70 cards being submitted for the two relevant pentads that cover the broader project site during SABAP 2, relatively reliable data exist with respect to species reporting rates. In an attempt to ensure a conservative approach with regards to the species included on the final avifaunal list (Annexure 1), the species list derived from the literature was obtained from an area somewhat larger than the project site, and thus likely includes a much wider array of species than what actually occurs at the site. Aquatic species that were included on the original SABAP1 list for the area, but are largely restricted to permanent water bodies such as the nearby Orange River, were excluded from the final list compiled.
- Limited time in the field and seasonal spread means that important components of the local avifauna (i.e. important nest sites or localised areas of key habitats for rare or threatened species) could have been missed. However, the extent of the broader project site is not that large and hence been well-covered. Also, as it contains few large trees, it is highly unlikely that there are any significant nesting sites of larger species present within the affected area that would not have been detected.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 Site Context & Avifaunal Microhabitats of the Site

Broad-scale vegetation patterns influence the distribution and abundance of bird species holistically, while vegetation structure, rather than plant species composition, has a greater influence on local avifauna populations and species assemblages (Harrison *et al*., 1997). The broader project site lies within two vegetation types, the Gordonia Duneveld roughly within the western half of the broader site, and the Kalahari Karroid Shrubland to the east. These vegetation types are both classified as Least Threatened, and are predominantly (99%) untransformed. At the site the Gordonia duneveld occurs on red soils of varying depth, characterised by linear dunes to the north-west, and sandy plains to the south and south-east. This habitat supports primarily the protected trees *Acacia haematoxylon* and *Boscia albitrunca*, while the grass layer is dominated by *Stipagrostis* species and *Centropodia glauca* (Figures 2 & 3). The sandy plains of this vegetation type are dominated by *Rhigozum trichotomum* shrubs and grasses, and also support numerous patches of *Parkinsonia africana* trees (Figure 4 & 5). The Kalahari Karroid Shrubland occurs mainly within the eastern half of the site mostly on gravel plains and very shallow red soils (Figure 6). The dwarf shrubs that characterise this habitat include the following genera, *Monechma*, *Salsola*, *Hermannia* and *Zygophyllum*, amongst others, with the grass layer dominated by *Stipagrostis* species.

Figure 2. Linear dune crest of the Gordonia Duneveld, within the western half of the broader project site, with a *Boscia foetida* tree in the foreground.

Figure 3. Linear dune crest of the Gordonia Duneveld, within the western half of the broader project site, with *Acacia haematoxylon* trees.

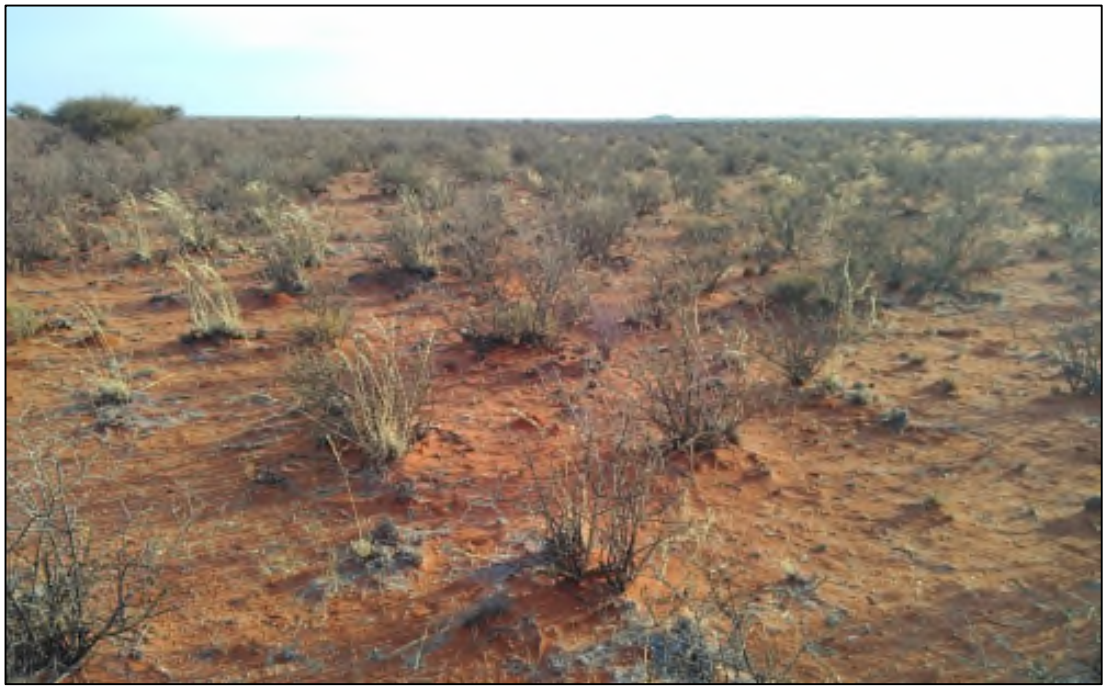

Figure 4. Sandy plains of the Gordonia Duneveld along the southern boundary of the broader project site, showing stands of *Rhigozum trichotomum* shrubs.

Figure 5. Sandy plains of the Gordonia Duneveld along the southern boundary of the broader project site, dominated by a mix of shrubs and grasses.

Figure 6. The gravel plains of the Kalahari Karroid Shrubland in the east of broader project site, dominated by a mix of dwarf shrubs and grasses.

3.2 General Avifauna

An approximate total of 145 bird species are known to occur in the broader project site and surrounds (Annexure 1), of which 71 species were recorded on site during the two seasonal field surveys. Six of these species are listed as threatened, and three are considered Near-Threatened. Only five species are considered true near-endemics to South Africa (Taylor *et al*., 2015), while ten are considered biome-restricted species (Marnewick *et al*., 2015).

The bird assemblage recorded within the site is fairly typical of the Kalahari bioregion, with elements of the Nama-Karoo. Of the 71 species recorded on site, 65 species were detected during line transects for both seasons combined. In winter, an average of 12.1±3 species were recorded per transect, with an average of 30.9±16 individual birds. In summer, 9.2±4 species were recorded per transect, with a similar average of 29.7±28 individual birds per transect. Across both seasons, small passerines species made up approximately two-thirds (60%) of the species detected, compared to non-passerines (40%).

The five near-endemic species reported for the broader project site occur with low SABAP2 reporting rates (in parentheses), and are therefore not considered common in the area, and include, Karoo Thrush *Turdus smithi* (12%), Black-eared Sparrowlark *Eremopterix australis* (4%), Fiscal Flycatcher *Sigelus silens* (2%), Black-headed Canary *Serinus alario* (2%), and Jackal Buzzard *Buteo rufofuscus* (0%). None of these species were detected during the field surveys, and can generally be considered uncommon in the area. Only five (5) of the ten

(10) biome-restricted species were recorded, which also have the highest SABAP2 reporting rates, namely, Karoo Korhaan *Eupodotis vigorsii* (73%), Sociable Weaver *Philetairus socius* (56%) and Kalahari Scrub Robin *Cercotrichas paena* (42%), Stark's Lark *Spizocorys starki* (29%) and Ludwig's Bustard (15%).

The most abundant passerine species with the highest detection rates along the line transects across both seasons were Fawn-coloured Lark *Calendulauda africanoides*, Scaly-feathered Finch *Sporopipes squamifrons*, Spike-heeled Lark *Chersomanes albofasciata* and Sociable Weaver (Table 1). Species which appeared to be stable between the seasons include Ant-eating Chat *Myrmecocichla formicivora*, Chat Flycatcher *Bradornis infuscatus*, Sabota Lark *Calendulauda sabota*, Spike-heeled Lark, Black-chested Prinia *Prinia flavicans* and Kalahari Scrub Robin. Species which were detected more frequently in winter include Bokmakierie *Telophorus zeylonus*, Lark-like Bunting *Emberiza impetuani* (nomadic), Fawn-coloured Lark, and most significantly, Rufous-eared Warbler *Malcorus pectoralis*. The latter showed a dramatic decline in detectability in summer, which could perhaps be attributed to local movements in response to rain (Hockey *et al*., 2005).

Table 1. Summary of dominant passerine species recorded along line transects walked throughout the Allepad PV project sites (including and beyond the development footprint) during the field survey in summer (n = 28) and winter (n = 35), with respect to the number of detections per species, the total number of birds detected per species, and the number of birds seen per kilometer, as a measure of relative abundance.

Species	Summer			Winter		
	No. of detections	No. of birds	Birds/km	No. of detections	No. of birds	Birds/km
Bokmakierie	7	8	0.29	20	22	0.63
Bunting, Lark-like	3	8	0.29	27	38	1.09
Canary, Yellow	11	18	0.64	20	34	0.97
Chat, Ant-eating	15	19	0.68	19	28	0.80
Eremomela, Yellow-bellied	3	4	0.14	7	10	0.29
Finch, Red-headed	4	77	2.75	2	4	0.11
Finch, Scaly-feathered	12	51	1.82	39	82	2.34
Fiscal, Southern	10	10	0.36	22	23	0.66
Flycatcher, Chat	6	8	0.29	8	11	0.31
Lark, Fawn-coloured	53	60	2.14	121	130	3.71
Lark, Grey-backed Sparrow-	19	78	2.79	14	31	0.89
Lark, Pink-billed	8	22	0.79	9	20	0.57
Lark, Sabota	6	7	0.25	5	9	0.26
Lark, Spike-heeled	27	63	2.25	42	82	2.34
Lark, Stark's	9	28	1.00	0	0	0.00
Prinia, Black-chested	21	27	0.96	28	36	1.03
Robin, Kalahari Scrub	21	22	0.79	28	30	0.86

Warbler, Chestnut-vented	2	2	0.07	4	4	0.11
Warbler, Rufous-eared	4	6	0.21	28	44	1.26
Weaver, Sociable	7	74	2.64	12	112	3.20

Species which were more apparent in summer include Grey-backed Sparrow-lark *Eremopterix verticalis*, Red-headed Finch *Amadina erythrocephala* and Stark's Lark, which were found mostly on the gravel plains habitat. Pink-billed Lark *Spizocorys conirostris* also occurred with reasonable frequency on the sandy plains habitat in both seasons, considering their irregularity as a nomadic species. Amongst the non-passerines, the three resident species of korhaans exhibited somewhat higher detectability in winter than summer (Table 2). Small to medium raptor species showed variable detectability between seasons, although both Pale Chanting Goshawk *Melierax canorus* and Pygmy Falcon *Polihierax semitorquatus* are known to be resident on the site. Raptors that are considered scarce in the area with very low SABAP2 reporting rates were also noted on occasion. During the summer survey, an adult Black-chested Snake-eagle *Circaetus pectoralis* was seen perched (once-off nocturnal roost) on a utility pole near the entrance to the property, while a Greater Kestrel was seen hunting over the gravel plains.

Table 2. Summary of non-passerines recorded along line transects walked throughout the Allepad PV project sites during the field survey in summer (n = 28) and winter (n = 35), with respect to the number of detections per species, the total number of birds detected per species, and the number of birds seen per kilometer, as a measure of relative abundance.

Species	Summer			Winter		
	No. of detections	No. of birds	Birds/km	No. of detections	No. of birds	Birds/km
Bustard, Kori	1	1	0.04	1	2	0.06
Bustard, Ludwig's	3	4	0.14	0	0	0
Courser, Double-banded	2	3	0.11	0	0	0
Falcon, Pygmy	2	3	0.11	0	0	0
Goshawk, Pale Chanting	0	0	0.00	1	1	0.03
Kestrel, Greater	1	1	0.04	0	0	0
Korhaan, Karoo	2	5	0.18	6	12	0.34
Korhaan, Northern Black	19	23	0.82	45	51	1.46
Korhaan, Red-crested	7	7	0.25	12	12	0.34
Sandgrouse, Namaqua	13	52	1.86	2	2	0.06

Certain species showed rather clear preferences for parts of the study area. Amongst the non-passerines, Karoo Korhaan *Eupodotis vigorsii*, Ludwig's Bustard *Neotis ludwigii* and Double-banded Courser *Rhinoptilus africanus* were found exclusively on the gravel plains in

the eastern side of the broader study site. Passerines that also preferred the gravel plains include Sabota and Stark's Lark, as well as Grey-backed Sparrowlark (in summer). Red-crested Korhaan *Lophotis ruficrista* were only recorded within the sandy plains habitat in the west, particularly where there were *Parkinsonia* trees. Pink-billed Lark was also only recorded on the sandy plains.

3.3 RED-LISTED SPECIES

Red-listed species are considered fundamental to this study, because of their susceptibility to the various threats posed by solar facilities and associated infrastructures. Only six species that have been recorded in the broader project site are threatened, while a further three are listed as Near-Threatened (Table 3). The most important of these with respect to its red-listed status is the Critically Endangered White-backed Vulture *Gyps africanus*, which has been recorded in the area during SABAP2, albeit only twice (4% reporting rate). The species is thus probably only an occasional visitor to the area, with no breeding or roosting sites nearby, perhaps primarily due to the absence of suitably large *Acacia erioloba* trees.

Only two listed species were recorded during the field surveys, including a number of pairs of Karoo Korhaan (Near-Threatened) and Kori Bustard (Near-Threatened). The Karoo Korhaan were all recorded within the gravel plains habitat in the east of the broader project site, which represents the species' more preferred Karoo-like habitat type. The Kori Bustard (2 sightings, 3 individuals) were recorded within the sandy plains habitat, which represents more typical Kalahari habitat. The highly nomadic Ludwig's Bustard has a fairly high reporting rate (15%), but was only recorded during the summer survey (3 sightings, 4 individuals), primarily within the gravel plains habitat. A single observation of a Lanner Falcon *Falco biarmicus* (Vulnerable) was made of an individual hunting from a perched position on a telephone pole along the south-eastern boundary of the project site.

All other red-listed species have rather low SABAP2 reporting rates (<5%) for the area, and include Martial Eagle *Polemaetus bellicosus* (Endangered), Tawny Eagle (Endangered), Secretarybird *Sagittarius serpentarius* (Vulnerable) and Abdim's Stork *Ciconia abdimii* (Near-Threatened). The local populations of these species are, however, mostly of low to moderate importance, as these species appear to be only occasional visitors based on their low reporting rates. The broader project site and surrounds most likely serve as only part of the foraging range of occasional individuals passing through.

With respect to these red-listed species, the gravel plains habitat in the eastern portion of the broader project site, and the dunes habitat within the north, appear to be important for resident and visiting species. The presence of several individuals of Karoo Korhaan and Ludwig's Bustard on the gravel plains clearly illustrate the importance of this habitat for these species.

Table 3. Red-listed species recorded within the broader project sites and surrounds during SABAP1 (1987-1991), SABAP2 (2007 on-going) and the field survey in winter (15 to 17 July 2018) and summer (1 to 3 February 2019), ranked according to their red-list status. All species besides Abdim's Stork have been recorded during the SABAP2 period. Four species were observed during the two field surveys (marked in bold), with the most of the other species having low reporting rates (<5%).

English name	Taxonomic name	Red-list status	Estimated importance of local population	Preferred habitat	Probability of occurrence	Threats
Vulture, White-backed	*Gyps africanus*	Critically Endangered	Low	Savanna	High	Habitat loss/Disturbance Collisions/Electrocution
Bustard, Ludwig's	***Neotis ludwigii***	**Endangered**	**Moderate**	**Shrubland plains**	**Recorded**	**Habitat loss/Disturbance Collisions**
Eagle, Martial	*Polemaetus bellicosus*	Endangered	Moderate	Savanna & shrublands	High	Habitat loss/Disturbance Collisions/Electrocution
Eagle, Tawny	*Aquila rapax*	Endangered	Low	Savanna & Karoo plains	Low	Habitat loss/Disturbance Collisions/Electrocution
Falcon, Lanner	***Falco biarmicus***	**Vulnerable**	**Moderate**	**Widespread**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Secretarybird	*Sagittarius serpentarius*	Vulnerable	Low	Open savanna & grassland	Moderate	Habitat loss/Disturbance Collisions
Bustard, Kori	***Ardeotis kori***	**Near-Threatened**	**Moderate**	**Open savanna**	**Recorded**	**Habitat loss/Disturbance Collisions**
Korhaan, Karoo	***Eupodotis vigorsii***	**Near-Threatened**	**Moderate**	**Shrubland plains**	**Recorded**	**Habitat loss/Disturbance Collisions**
Stork, Abdim's	*Ciconia abdimii*	Near-threatened	Low	Grassland & savanna	Low	Collisions

During the walking transects regular scans were made to detect any large flying birds to establish the presence of flight paths across the broader project sites. Besides the predominantly terrestrial Karoo Korhaan, Ludwig's Bustard and Kori Bustard, no other red-list species were seen using the site or flying routine flight paths. This may be due to the apparent absence of communal roosting and breeding sites, and hence birds may be traversing the site on an ad hoc basis. Besides the absence of communal nest sites, no individual nests were located during the field surveys. However, it may be possible that species such as Secretarybird may use solitary *Boscia* or other tree species for nesting, which may have been missed during the surveys.

In essence, much of the avifauna within the broader project site appears fairly similar to that found across the Kalahari bioregion of the Northern Cape. The apparent lack of red-listed species in the area could be attributed to their naturally low densities and large ranges (eagles and Secretarybird), the absence of suitable habitat (Abdim's Stork) and nesting/roosting trees (White-backed Vulture). Certain species may use the project site on occasion as part of their large ranges, such as Martial Eagle, Tawny Eagle and Secretarybird. However, since the project site appears not to directly support large and healthy populations of red-listed species, the sensitivity of the site in general can be considered to be of medium significance with respect to avifauna.

3.4 CURRENT BASELINE & CUMULATIVE IMPACT

There are a large number of renewable energy developments in the Upington area, concentrated along the N14 and south of the Orange River (Figure 2). The Allepad PV Four project would potentially contribute approximately 250ha of additional habitat loss and fragmentation in the area. The significance of this impact is likely to be of a local nature only. The gravel plains and drainage system which characterises the eastern section of the broader Allepad project site is an important habitat as it supports red-listed species, while contributing to habitat heterogeneity and possibly connectivity and movement of smaller passerine species. This area will not be impacted by the development and therefore its ecological functions will be maintained. The proposed power line corridor will follow an existing telephone line and smaller power line along the N10 road, which will reduce its potential impact on collision prone species. At a broader scale, the project site is adjacent to the N10 and in relatively close proximity to Upington, with the result that the development would have a reduced impact on landscape connectivity as compared to more remote and less disturbed areas. There are also no features within the development footprint that indicate that the affected area is likely to be of broader significance for avifauna in terms of landscape connectivity and ecological process. The habitat that lies within the development footprint occurs over much of the broader area well beyond the project site. As such, development of Allepad PV Four is considered to be acceptable in terms of its contribution to cumulative impact.

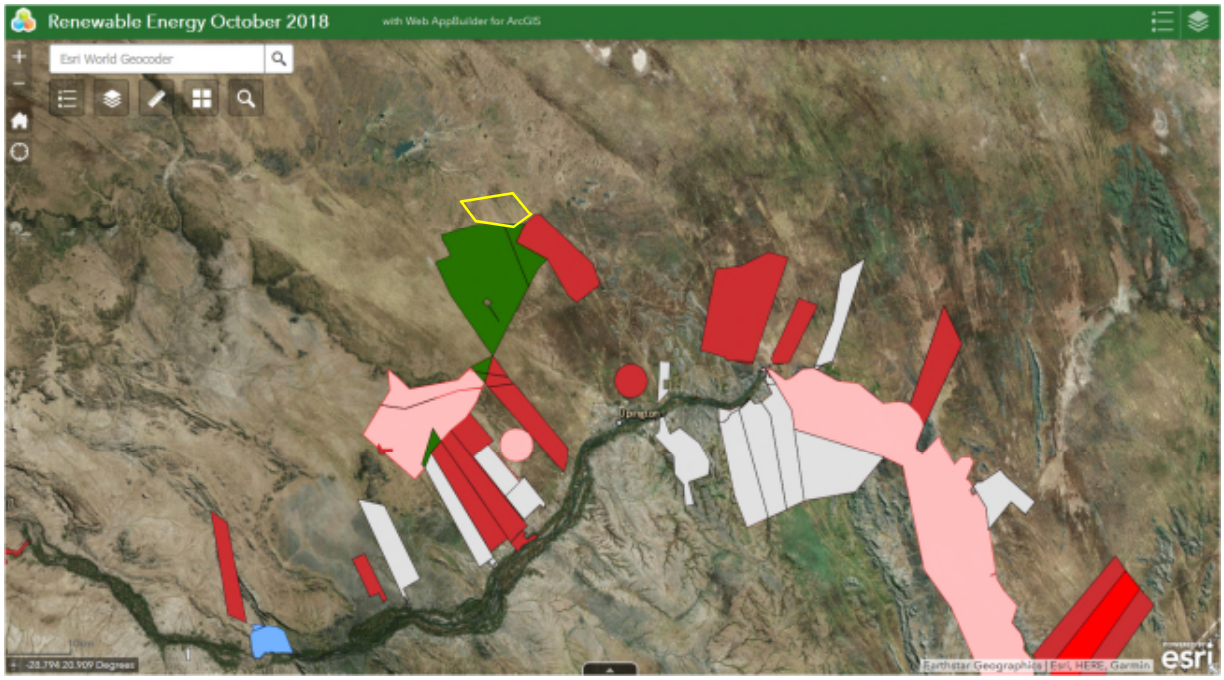

Figure 2. Map of DEA registered renewable energy applications as at October 2018, showing the Allepad PV Four project site in yellow.

3.5 AVIAN SENSITIVITY ASSESSMENT

Important avian microhabitats in the study area play an integral role within the landscape, providing nesting, foraging and reproductive benefits to the local avifauna. In order to ensure that the development does not have a long term negative impact on the local avifauna, it is important to delineate these avian microhabitats within the broader project site. To this end an avian sensitivity map (Figure 8) was generated by integrating avian microhabitats present on the site and avifaunal information collected during the winter and summer field survey.

The project site supports three main avifaunal microhabitats, which are referred to as the gravel plains, sandy plains, and dunes habitat. These three habitats have different sensitivities, due to the subtle differences in the avifaunal assemblages that they support, especially with respect to red-listed species. The gravel plains are considered to be of High Sensitivity, due firstly to the habitat diversity of the area and the fact that it supports several pairs of the Near-Threatened Karoo Korhaan (resident) and the Endangered Ludwig's Bustard (nomadic). A small section of the solar field infringes on this area. This is considered acceptable from an avifauna perspective due to the small footprint of the infringement. The drainage lines that intersect the gravel plains are considered to be of Very High Sensitivity, due to presence of localised large trees that may serve as nesting habitat

for raptors, while also providing alternative roosting and feeding areas within the area largely deprived of trees. The drainage lines also intersect the gravel plains throughout and therefore the ecological functioning of these two habitats are intertwined. The dune habitat is well represented within the bioregion, but due to the deeper soils, supports a number of protected tree species, such as the *Acacia erioloba, A. haematoxylon* and *Boscia albitrunca, B. foetida subsp. foetida.* These tree species, in turn, provide important nesting and roosting sites for birds, including large raptors. The dunes are therefore considered to be of High Sensitivity due to their importance to a wide variety of avifaunal species, while the adjoining habitat not characterised by taller dunes is considered Medium Sensitivity. The proposed development footprint traverses a single dune of Medium Sensitivity (Figure 8), which is considered acceptable with respect to the development due to the isolated location of the dune. This dune is also located adjacent the main entrance road to the development site, and therefore is unlikely to fulfil the same ecological services as the contiguous dunes fields located well beyond the development footprint. The sandy plains habitat represents the most widely distributed habitat in the region, and occurs primarily on shallower soils that do not support an extensive tree layer, besides scattered patches of *Parkinsonia Africana* throughout. This habitat is therefore regarded to be of Low Sensitivity.

There proposed grid connection traverses both of the main habitat types at Allepad, namely the sandy plains and gravel plains. There are also a number of minor features along the power line corridor, including a small rocky outcrop, a stand of *Acacia mellifera* shrubs, a stand of alien *Prosopis* trees near human habitation, a very small ephemeral pan, as well as some small sewage ponds. These features lie directly adjacent the N10 road and may attract raptors and waterbirds on occasion, although no large red-listed species are expected to be supported by these features. In particular, the small pan is considered far too insignificant in size to support either waterbirds when inundated or coursers when dry. Hence, the entire length of the power line corridor, which follows the N10 road, is considered to be of Low Sensitivity.

It is likely that development of the solar energy facility on the lower sensitivity parts of the site, such as the sandy plains habitat, would generate the lowest impacts on the avifauna, provided suitable mitigation measures are employed during construction and operation of the proposed facility. While the development would result in some habitat loss for avifauna of local significance, it will not necessarily impact negatively on red-listed avifaunal species, which appear to occur sparsely within the broader project site and primarily in adjacent habitats.

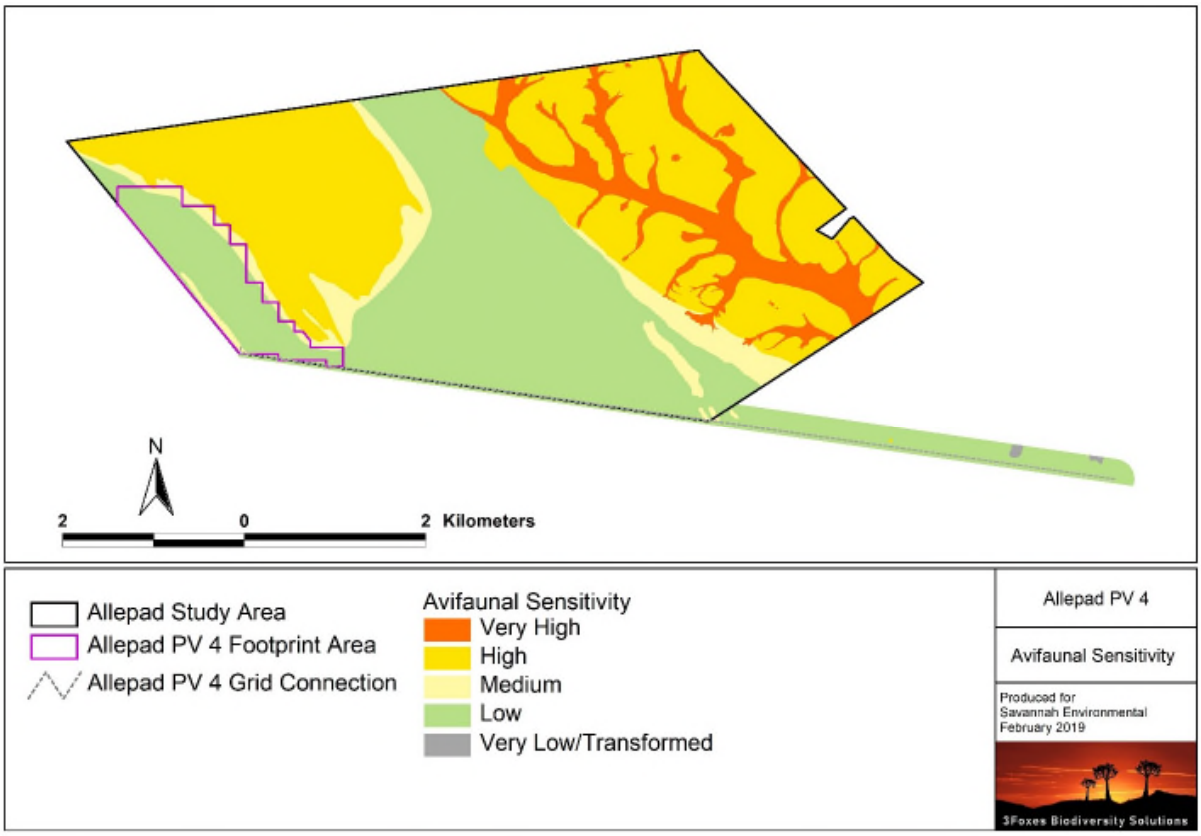

Figure 8. Avifaunal sensitivity map for the Allepad Solar project, showing the High Sensitivity gravel plains and Very High Sensitivity drainage lines in the east of the study area, and the Medium and Medium High Sensitivity dunes habitat in the west. The remaining central and southern areas constitute the sandy plains habitat with a Low Sensitivity.

4 IDENTIFICATION & NATURE OF IMPACTS

In this section, the potential impacts and associated risk factors that may be generated by the development are identified. In order to ensure that the impacts identified are broadly applicable and inclusive, all the likely or potential impacts that may be associated with the development are listed. The relevance and applicability of each potential impact to the current situation are then examined in more detail in the next section.

According to a position statement by Birdlife South Africa, the main concerns with PV facilities are the following:

- Displacement or the exclusion of nationally and/or globally threatened, rare, endemic, or range-restricted bird species from important habitats.

- Loss of habitat and disturbance of resident bird species caused by construction, operation and maintenance activities.
- Collision with the solar panels, which may be mistaken for water bodies.
- Collision and electrocution caused when perching on or flying into associated power line infrastructure.
- Habitat destruction and disturbance/exclusion of avifauna through construction (short-term) and maintenance (long-term) of new power line infrastructure.
- Habitat destruction and disturbance of birds caused by the construction and maintenance of new roads and other infrastructure.

The two main habitats on the project site represent typical vegetation of the broader area, with no features of concern present across most of these habitats. Of the nine red-listed species that are known to occur in the broader area, four (4) were seen during the site visits, while most of the five near-endemic species and ten biome-restricted species are uncommon at the project site. While the development may have an insignificant impact on these species, it will nevertheless impact on other common local bird assemblages primarily through direct habitat loss and displacement. Species are expected to be impacted to varying degrees based on their life-history strategies, abundance and general susceptibility to the threats posed by PV facilities. While habitat loss can be quantified by extent of the development footprint, there are other impacts such as direct mortalities caused by collisions with solar panels, which are still poorly understood.

Data on estimates of birds killed at solar facilities as a direct result of collisions with associated infrastructure are limited, especially in South Africa. A relatively recent study at a large solar facility in the Northern Cape (Visser, 2016, Visser *et al*., 2018) provides the first estimates of the potential impact on birds within the region, with direct mortalities amounting to 4.5 birds/MW/year. This short term study also concluded, however, that there was no significant association with collision-related mortality at that study site, and that further studies were required. Most injuries that were recorded were related to species such as francolin colliding with the underside of PV panels, and korhaans becoming entrapped along the perimeter fencing, between the mesh and electrical strands (Visser, 2016). A PV solar facility in the United States is reported to result in the deaths of 0.5 birds/MW/year as a direct result of the collisions with infrastructure (Walston *et al*., 2016).

4.1 Identification of Potential Impacts and Damaging Activities

In this section each of the potential impacts on avifauna associated with the development is explored in more detail with reference to the features and characteristics of the site and the likelihood that each impact would occur given the characteristics of the site and the extent and nature of the development. 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 SEFs can have negative impacts on not only vulnerable species and habitats, but also on entire ecosystem functioning. These impacts are extremely variable, differing from site to site, and are dependent on numerous contributing factors which include the design and specifications of the development, the importance and sensitivity of avian microhabitats present on site and the diversity and abundance of the local avifauna.

Potential avifaunal impacts resulting from the development of Allepad PV Four would stem from a variety of different activities and risk factors associated with the pre-construction, construction and operational phases of the project including the following:

Pre-construction Phase

- Human presence and uncontrolled access to the site may result in negative impacts on the avifauna through disturbance and specimen abstraction due to poaching and uncontrolled collection of all fauna and flora for traditional medicine or other purpose.
- Site clearing and exploration activities for site establishment may have a negative impact on avifauna if this is not conducted in a sensitive manner.

Construction Phase

- Vegetation clearing for the solar field, access roads, site fencing and associated infrastructure will impact the local avifauna directly through habitat loss. Vegetation clearing will therefore lead potentially to the loss of avifaunal species, habitats and ecosystems as birds are displaced from their habitat.
- Presence and operation of construction machinery on site. This will create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
- Increased human presence can lead to poaching, illegal fauna collecting (especially larger avifaunal species) and other forms of disturbance such as fire.

Operational Phase

- The operation of the facility will generate minor disturbances which may deter some avifauna from the project site, especially red-listed avifaunal species which are less tolerant of disturbances. Such indirect impacts are still largely understudied and poorly understood, but preliminary data suggest that bird communities can be altered by solar PV facilities (DeVault *et al*., 2014, Smith & Dwyer, 2016).
- Mortality among the local avifauna may result due to direct collisions with solar panels (Kagan *et al*., 2014) or entrapment along the fenced boundaries of the facility (Visser, 2016).

- The areas inside the facility will require management and if this is not done appropriately, it could impact adjacent intact areas through erosion, alien plant invasion and contamination from pollutants, herbicides or pesticides.
- The associated overhead power lines will pose a risk to avifauna susceptible to collisions and electrocution with power line infrastructure (Lehman *et al*., 2007, Jenkins *et al*., 2010).

Cumulative Impacts

- The loss of unprotected vegetation types on a cumulative basis from the broader area may impact avifauna, as habitat loss is a major contributor to declines in avifauna (Birdlife International, 2018). The aggregation of numerous SEFs in a region has the potential to compound environmental impacts, and because this impact has been mostly understudied, it should be considered during the early stages of land use planning (Moore-O'Leary *et al*., 2017).
- Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for avifauna and impair their ability to respond to environmental fluctuations. This is particularly a concern with regards to species and ecosystems with limited geographical distributions (Rudman *et al.*, 2017).
- The erection of new power line corridors can also have a cumulative impact, which may only become discernable over many years. However, where new power lines follow the same route as existing lines, the potential impacts can be reduced.

Project specific impacts on particular groups of avifauna are as follows:

Habitat loss and disturbance of small passerines

For the smaller passerine species the most important impacts will involve displacement from the area encompassed by the development footprint as a result of habitat destruction. While numerous species will be impacted, all of these species have large distribution ranges and will therefore only experience population declines on the project site, and not regionally or nationally. Some of the most abundant species which will be impacted, and which are also common in neighbouring habitats, include Yellow Canary *Crithagra flaviventris*, Rufous-eared Warbler, Black-chested Prinia, Spike-heeled Lark, Kalahari Scrub Robin, Sociable Weaver, Scaly-feathered Finch, and Fawn-coloured Lark. Less abundant species which will also be impacted, but are still common elsewhere, include Pink-billed Lark, Ant-eating Chat, and Chat Flycatcher. The loss of habitat will be permanent while disturbance may be continuous during the operational phase of the solar facility. Other impacts such as disturbances caused by reflective panels and grid connecting power lines are not likely to have any appreciable impact on these small species. The impacts in general can be expected to be minimal as these smaller species are far less susceptible to the associated impacts than larger species.

Habitat loss, disturbance and collision risk of medium terrestrial birds and raptors

Small to medium-sized non-passerines that may be impacted to some extent due to habitat loss and displacement include resident raptors such as Pale Chanting Goshawk, and the ground-dwelling Namaqua Sandgrouse *Pterocles namaqua*, Northern Black Korhaan, and Red-crested Korhaan. The latter three species are particularly common at the broader project site. These species may also be susceptible to collisions with associated infrastructure such as the PV panels and power lines, but this is not expected to have a major impact on most of these species. Northern Black Korhaan and Red-crested Korhaan, may, however, be at more risk based on the recent research (Visser, 2016).

Habitat loss, disturbance and collision risk of large terrestrial birds and raptors

The group of primary concern is the medium to large non-passerines, which include the large terrestrial birds and diurnal raptors. Many of these are also red-listed, such as White-backed Vulture, Martial eagle, Secretarybird and Lanner Falcon. While most of these are considered uncommon to scarce in the broader project site, they may occur on occasion (e.g. a Lanner Falcon was recorded on the project site during the summer survey, while none of the other species have yet been recorded). Besides the loss of habitat that these species will experience, disturbances during construction and maintenance of the facility is also expected to have a negative impact. In addition, most of these species are also highly susceptible to collisions with power lines owing to reduced ability to see the power lines and reduced manoeuvrability in flight to avoid collisions (Martin & Shaw, 2010; Jenkins *et al.*, 2010). All large terrestrial birds, including the red-listed species, are killed in substantial numbers by existing and newly erected power lines in the country (Jenkins *et al.*, 2010; Jenkin *et al*., 2011; Shaw, 2013). An additional threat faced by the large raptors is electrocution when perched or attempting to perch on power line structures (Lehman *et al*., 2007).

5 ASSESSMENT OF IMPACTS

The various identified avifaunal impacts are assessed below for the different phases of the development.

5.1 ALLEPAD PV FOUR DEVELOPMENT

The following is an assessment of the Allepad PV Four Development, for the planning, construction and operational phase of the development. The construction phase will result in the direct loss of habitat due to clearing of vegetation and avifaunal microhabitats for the

solar fields, road infrastructure, perimeter fencing, auxiliary buildings and associated infrastructure. Disturbances will be caused by increased traffic of vehicles, and particularly heavy machinery used for clearing vegetation and road construction. During the operational phase the impacts that can be expected to include direct bird mortalities through collisions with PV panels and entrapment along perimeter fencing, and disturbances in the form of vehicular and personnel traffic during maintenance of solar fields and other infrastructure. Night lighting may also disturb nocturnal birds, those attracted to the facility to prey on insects drawn to lights, and those flying over the facility at night.

5.1.1 Planning & Construction Phase

Impact Nature: Direct Avifaunal Impacts During Construction – habitat loss and disturbance due to vegetation clearing		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low to Moderate (5)
Probability	Definite (5)	Definite (5)
Significance	Medium (45)	Medium (40)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	This impact cannot be well mitigated because the loss of habitat is unavoidable and is a definite outcome of the development.	
Mitigation	• The use of laydown areas within the footprint of the development should be used where feasible, to avoid habitat loss and disturbance to adjoining areas. • All building waste produced during the construction phase should be removed from the development site and be disposed of at a designated waste management facility. Similarly, all liquid wastes should be contained in appropriately sealed vessels/ponds within the footprint of the development, and be disposed of at a designated waste management facility after use. Any liquid and chemical spills should be dealt with accordingly to avoid contamination of the environment. • Pre-construction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to, and awareness about not harming or hunting ground-dwelling species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of	

	superstition. • This induction should also include awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • All construction vehicles should adhere to a low speed limit (40km/h on site) to avoid collisions with susceptible species such nocturnal and crepuscular species (e.g. nightjars, thick-knees and owls) which sometimes forage or rest along roads. • Any avifauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. • Reservoirs or ponds (evaporative or other) should be covered with fine mesh or other exclusion material in order to exclude and prevent birds from accessing potentially contaminated water contained therein. • If holes or trenches need to be dug, these should not be left open for extended periods of time as ground-dwelling avifauna or their flightless young may fall in and become trapped in them. Holes should only be dug when they are required and should be used and filled shortly thereafter. • No construction activity should occur near to active raptor nests should these be discovered prior to or during the construction phase. If there are active nests near construction areas, these should be reported to ECO and should be monitored until the birds have finished nesting and the fledglings left the nest. • The fence around the facility should be designed with potential impacts on avifauna in mind, following recommendation by Visser (2016). This includes the location and positioning of the electrified strands in relation to the fence as it has been shown that avifauna may become trapped in the gap between these two components of the fence (Visser, 2016).
Cumulative Impacts	The development will contribute to cumulative impacts on avifaunal habitat loss and transformation in the area.
Residual Risks	As the loss of currently intact habitat is an unavoidable consequence of the development, the habitat loss associated with the development remains a residual impact even after mitigation and avoidance of more sensitive areas. The sensitivity of the affected habitat is however low and the overall residual impact on avifaunal habitat loss remains low.

5.1.2 Operational Phase Impacts

Impact Nature: Avifaunal Impacts due to operational activities – collisions with PV panels, entrapment along perimeter fencing, and disturbance due to traffic and night lighting		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low to Moderate (5)	Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (27)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	Yes to a large degree, but it may be more difficult to prevent collisions and impacts related to the perimeter fence.	
Mitigation	• All incidents of collision with panels should be recorded as meticulously as possible, including data related to the species involved, the exact location of collisions within the facility, and suspected cause of death. Post-construction monitoring with the aid of video surveillance should be considered, as this will contribute towards understanding bird interactions with solar panels. • If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects. The use of lighting at night should be kept to a minimum, so as not to unnecessarily attract invertebrates to the solar facility and possibly their avian predators, and to minimise disturbance to birds flying over the facility at night. • If birds nest on the infrastructure of the facility and cannot be tolerated due to operational risks of fire, electrical shorts, soiling of panels or other concerns, birds should be prevented from accessing nesting sites by using mesh or other manner of excluding them. Birds should not be shot, poisoned or harmed as this is not an effective control method and has negative ecological consequences. Birds with eggs or nestlings should be allowed to fledge their young before nests are removed. • If there are any persistent problems with avifauna, then an avifaunal specialist should be consulted for advice on further mitigation. • Any movements by vehicle and personnel should be limited to	

	within the footprint of solar field and other associated infrastructure, especially during routine maintenance procedures. • Reservoirs or ponds (evaporative or other) should be covered with fine mesh or other exclusion material in order to exclude and prevent birds from accessing potentially contaminated water contained therein. • All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such nocturnal and crepuscular species (e.g. nightjars, thick-knees and owls) which sometimes forage or rest on roads at night. • Maintenance of the perimeter fencing must ensure that it fulfils the guidelines suggested by Visser (2016), to minimise impacts to korhaans susceptible to entrapment between the fencing and electrical components of perimeter fencing.
Cumulative Impacts	The development will contribute to cumulative impacts on avifaunal habitat loss and transformation in the area, as well as minor disturbances (traffic and night lighting).
Residual Risks	Although high rates of mortality due to collisions has not been recorded in South Africa, there is some risk that this may occur in addition to some likely mortality associated with the perimeter fencing.

5.2 GRID CONNECTION

The following is an assessment of the Grid Connection for the Allepad PV Four Development, for the planning and construction and operational phases of the development. The construction phase will result in the direct loss of habitat due to clearing of vegetation and avifaunal microhabitats along the power line corridor. Disturbances will be caused by increased traffic of vehicles along the power line corridor during construction. Potential collisions and electrocutions along the power line corridor may contribute to the cumulative impacts of the project.

5.2.1 Planning & Construction Phase

Impact Nature: Direct Avifaunal Impacts During Construction – habitat loss and disturbance		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low to Moderate (5)
Probability	High Likely (4)	Probable (3)

Significance	Medium (36)	Low (24)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	Although there will be some habitat loss that cannot be well mitigated, impacts on avifauna will be transient and of low magnitude during construction.	
Mitigation	• Prior to construction, the design and layout of any proposed power lines must be endorsed by members of the Eskom-EWT Strategic Partnership, taking into account the mitigation guidelines recommended by Birdlife South Africa (Jenkins *et al*., 2017; Jenkins *et al*., 2016). • Only power lines structures that are considered safe for birds should be erected to avoid the electrocutions of birds (particularly large raptors) perching or attempting to perch. Where necessary, deterrent devices such as bird guards should be mounted on relevant parts of the pylons to further reduce the possibility of electrocutions. • The route that the power line will follow should be the shortest distance possible across an area where collisions are expected to be minimal, or follow existing power lines (as with this project), and be marked with bird diverters to make the lines as visible as possible to collision-susceptible species. Recommended bird diverters such as brightly coloured 'aviation' balls, thickened wire spirals, or flapping devices that increase the visibility of the lines should be fitted where considered necessary (collision hot-spots). • The potential to 'stagger' the position of the power line pylons in relation to existing telephone or power line poles/pylons should be investigated, as this may assist in increasing the visibility of power lines to large flying birds such as bustards, which may regularly fly through the area. • All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting or hunting ground-dwelling species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of superstition. • Any avifauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. • All vehicles (construction or other) accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular	

	species (e.g. nightjars, thick-knees and owls) which sometimes forage or rest on roads, especially at night. • If holes or trenches need to be dug for pylons, these should not be left open for extended periods of time as ground-dwelling avifauna or their flightless young may become entrapped therein. Holes should only be dug when they are required and should be used and filled shortly thereafter.
Cumulative Impacts	The development will contribute to cumulative impacts on avifaunal habitat loss, as well as collision risk with power line infrastructure in the area.
Residual Risks	The loss of habitat associated with the grid connection corridor is an unavoidable consequence of the power line construction, and remains a residual impact even after mitigation and avoidance of more sensitive areas. The sensitivity of the affected habitat is however mostly low and the overall residual impact on avifaunal habitat loss remains low. Although the use of power line structures that are considered safe for large birds will contribute to reducing the potential impacts of the power line, future collisions with power line will remain a risk. This can be reduced further by 'staggering' the pylons in relation to existing pylons during construction, so that the profile of the power line will be more visible to flying birds.

5.2.2 Operational Phase

Impact Nature: Direct Avifaunal Impacts During Operation – collisions, electrocution and disturbance		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	High Likely (4)	Probable (3)
Significance	Medium (44)	Low (27)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	To a large extent although bird flappers and other bird diverters are not 100% effective and so there would still be some residual impact.	
Mitigation	• Regular monitoring of power lines should be undertaken to detect bird carcasses, to enable the identification of any areas of high impact to be marked with bird diverters. • Any movements by vehicle and personnel should be limited to	

	within the footprint of the power line corridor and other associated infrastructure, especially during routine maintenance procedures. • Any raptor nests that are discovered on the power line structures should be reported to the ECO, while utmost care should be taken to not disturb these nests during routine maintenance procedures. • Minor features along the proposed route include the following, a stand of *Acacia mellifera* shrubs, a stand of alien *Prosopis* trees near human habitation, a small rocky outcrop and some small sewage ponds. These may attract raptors and waterbirds on occasion, although no large red-listed species are expected to be attracted to these features. Areas where the power line should be fitted with bird flight diverters to reduce collision risk should be identified post-construction through searches for bird carcasses along the power line, and particularly in the vicinity of the above mentioned features.
Cumulative Impacts	The development will contribute to cumulative impacts on avifaunal habitat loss as well as collision and electrocution risk with power line infrastructure in the area.
Residual Risks	Deterrent devices such as bird guards to reduce electrocutions, and flight diverters to reduce the risk of collisions with power lines are not 100% effective and some residual impact is likely to occur.

5.3 DECOMMISSIONING PHASE

The decommissioning phase will result in disturbance and loss of avifaunal microhabitats due to removal and clearing of the solar field and associated infrastructure. Disturbances will be caused by increased traffic of vehicles, and particularly heavy machinery used for clearing the infrastructure.

Impact Nature: Avifaunal impacts due to decommissioning activities – disturbance due to traffic and presence of personnel.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (4)	Low to Moderate (3)
Probability	Definite (5)	Definite (5)
Significance	Medium (35)	Medium (30)
Status	Negative	Negative

Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	Disturbance impact can be mitigated to an extent as it will be transient and have no long term impact.	
Mitigation	• All infrastructure should be removed from the development site and disposed of in the appropriate manner. • All waste produced during decommissioning must be disposed of at a designated waste management facility. • Environmental induction for all personnel on site to ensure that basic environmental principles are adhered to, and awareness about not harming or hunting ground-dwelling species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of superstition. • This induction should also include awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated decommissioning areas. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed in undisturbed natural areas outside of the decommissioning area. • All construction vehicles should adhere to a low speed limit (40km/h on site) to avoid collisions with susceptible species such nocturnal and crepuscular species (e.g. nightjars, thick-knees and owls) which sometimes forage or rest along roads. • Any avifauna threatened by the activities should be removed to safety by the ECO or appropriately qualified environmental officer. • If holes or trenches need to be dug, these should not be left open for extended periods of time as ground-dwelling avifauna or their flightless young may become entrapped in them. Holes should only be dug when they are required and should be used and filled shortly thereafter. • No activity should occur near to active raptor nests should these be discovered prior to or during the decommissioning phase. If there are active nests near the decommissioning areas, these should be reported to the ECO and should be monitored until the birds have finished nesting and the fledglings left the nest.	
Cumulative Impacts	There are no cumulative impacts associated with the decommissioning of the project site.	
Residual Risks	Disturbance during the decommissioning phase is an unavoidable consequence, but will have low residual impact with implementation of the mitigations. The sensitivity of the affected habitat is however low and the overall residual impact on avifaunal habitat loss remains low.	

5.4 CUMULATIVE IMPACTS

The following are the cumulative impacts that are assessed as being a likely consequence of the development of the Allepad Solar PV Four Development. These are assessed in context of the extent of the current site, other developments in the area as well as general habitat loss and transformation resulting from other activities in the area. The potential long-term impact of the grid connection during the operational phase of the project is also considered a cumulative impact.

Impact Nature: Impact on avifaunal habitats, migration routes and nesting areas due to cumulative loss and fragmentation of habitat, as well collisions and electrocutions along the grid connection.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low to Moderate (5)
Probability	Improbable (2)	Probable (3)
Significance	Low (18)	Medium (33)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated	To some degree, but the majority of the long-term impact results from the presence of the facility and other developments in the area which cannot be well mitigated.	

Mitigation:

- Minimise the development footprint as far as possible. A cover of indigenous grasses should be encouraged and maintained within the facility. This prevents the invasion of weeds and is the easiest to manage in the long-term. Furthermore, the grasses can be maintained low through livestock (sheep) grazing which is being successfully used at existing PV facilities. This will assist in maintaining natural vegetative cover which may support avifaunal population, as opposed to complete clearing of all vegetation.
- The facility should be fenced off in a manner which allows small fauna to pass through the facility, but that does not result in ground-dwelling avifauna (e.g. bustards, korhaan, thick-knees, coursers) being trapped and electrocuted along the boundary fences (Venter, 2016). In practical terms this means that the facility should be fenced-off to include only the developed areas and should include as little undeveloped ground or natural veld as possible. In addition, there should not be electrified ground-strands present within 30cm of the ground and the electrified strands

should be located on the inside of the fence and not the outside. Furthermore, the fence should be a single layer fence and not a double fence with a large gap between. Images of suitable fencing types from existing PV facilities are available on request.

- Increased probability of bird collisions and electrocutions with new power lines may contribute to the cumulative impacts of the proposed development. However, considering that the proposed power line corridor follows an existing telephone line and small power line (132kV), on opposite sides of the N10 road, the potential impacts are not considered significantly accumulative (refer to assessment of grid connection impacts).

6 CONCLUSION & RECOMMENDATIONS

The current study is based on two seasons of detailed field assessment of the proposed development area. Consequently, the impact assessment and sensitivity map presented herein are based on detailed on-site information and as such have a relatively high degree of confidence and are considered reliable and comprehensive.

The project site lies within the Kalahari bioregion with elements of the Nama-Karoo, and supports a fairly typical avifaunal assemblage expected for the area. Although six threatened and three Near-Threatened species are known to occur within the broader project area, most of these are not common in the area and probably occur in low numbers. The gravel plains habitat which characterises the area to the east of the PV1 footprint is considered to be High Sensitivity and unsuitable for development, but would not be impacted by the current development. The vegetation of the sandy plains habitat which is the target of the current development, supports few species or features of concern, such as nesting or roosting sites of red-listed species. Impacts on avifauna with the development of this particular habitat will likely to be low and no high post-mitigation impacts are likely.

The expected impacts of the proposed solar development area will include the following, 1) habitat loss and fragmentation associated with the sandy plains of the Gordonia Duneveld vegetation type, 2) disturbance and displacement caused during the construction and maintenance phases, and 3) possible direct mortality of avifauna colliding with solar panels and associated power line structures, as well as electrocutions with power line infrastructure, 4) possible direct mortality of ground-dwelling birds with electrified perimeter fencing, and 5) a cumulative habitat loss at a broader scale from renewable energy developments in the broader area. Habitat loss and disturbance during the construction phase of the development will impact mostly small passerine species and medium-sized non-passerines, with consequences restricted to the local area only. Impacts related to collisions with PV panels and associated infrastructure (such as fencing) will impact mostly medium-sized non-passerines (e.g. korhaans, thick-knees and possibly sandgrouse) if not properly mitigated. Red-listed species will be impacted by the loss of foraging habitat and disturbances, and potentially by collisions and electrocutions with power line infrastructure. However, given the extensive national ranges of these species, the impact of the development on habitat loss for these species would be local and minimal, and a long-term impact unlikely.

Several mitigation measures can be implemented during the construction and maintenance phase of the proposed development to reduce the impacts on the avifauna. During the construction phase, mitigation measures may assist in reducing displacement and disturbance by restricting habitat loss and disturbance to within the footprint of the development within the lower sensitivity habitat types and especially the open sandy plains.

Impacts associated with the power line, such as collisions and electrocutions, should be mitigated where necessary through regular monitoring to determine high risk areas where bird diverters (e.g. bird flappers) should be located along the power line route. With the implementation of the mitigation measures, the impact of the development can be reduced to an acceptable level and as such there are no fatal flaws associated with the development that should prevent it from proceeding.

Cumulative impacts in the area are a concern due to the proliferation of solar energy development in the greater Upington area. In terms of habitat loss, the affected Gordonia Duneveld vegetation type is still approximately 90% intact, while it has an extensive range within the bioregion. The transformation and loss of 250 ha of this habitat is not considered highly significant. In terms of potential losses to landscape connectivity, the site is not considered to lie within an area that is considered a likely avifaunal movement corridor or along an important avifaunal habitat gradient. The proposed grid connection will following two existing utility lines, which will contribute to reducing the potential impact on birds through collisions. As such, the overall cumulative impact of the development is considered likely to be low.

Avifaunal Impact Statement:

The Allepad PV1 site is considered to represent a broadly suitable environment for the location of the proposed solar development. Considering that the study area supports a typical bioregional avifaunal assemblage, and that there are no known breeding or roosting sites of red-listed priority species, there are no impacts associated with the development that are considered to be of high residual significance and which cannot be mitigated to a low level. Consequently, the development can be supported from an avifaunal perspective. It is therefore the reasoned opinion of the specialist that the Allepad PV Four project should therefore be authorised, subject to the implementation of the recommended mitigation measures.

7 ACTIVITIES FOR INCLUSION IN DRAFT EMPR

An Environmental Management Programme (EMPr) provides a link between the predicted impacts and mitigation measures recommended within the EIA and the implementation and operational activities of a project. As the construction and operation of the Allepad Solar Four development may impact the environment, activities which pose a threat should be managed and mitigated so that unnecessary or preventable environmental impacts do not result. The primary objective of the EMPr is to detail actions required to address the impacts identified in the EIA during the establishment, operation and rehabilitation of the proposed infrastructure. The EMPr provides an elaboration of how to implement the mitigation measures documented in the EIA. As such the purpose of the EMPr can be outlined as follows:

- To outline mitigation measures and environmental specifications which are required to be implemented for the planning, establishment, rehabilitation and operation/maintenance phases of the project in order to minimise and manage the extent of environmental impacts.
- To ensure that the establishment and operation phases of the solar facility do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- To identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- To propose mechanisms for monitoring compliance, and preventing long-term or permanent environmental degradation.
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation that were not considered in the EIA process

Below are the ecologically-orientated measures that should be implemented as part of the EMPr for the development to reduce the significance or extent of the above impacts. The measures below do not exactly match with the impacts that have been identified, as certain mitigation measures, such as limiting the loss of vegetation may be effective at combating several other impacts.

7.1 CONSTRUCTION PHASE ACTIVITIES

Objective: Limit disturbance and loss of avifaunal microhabitats during construction			
Project component/s	All infrastructure and activities which result in disturbance and loss of intact vegetation: » Vegetation clearing for establishment of solar field » Vegetation clearing for construction camps & other temporary infrastructure. » Vegetation clearing for access roads. » Human presence. » Operation of heavy machinery.		
Potential Impact	Disturbance and loss of avifaunal microhabitats, leading to displacement and loss of resident avifaunal species.		
Activity/risk source	» Clearing for solar field and infrastructure construction » Clearing for laydown areas and construction camps. » Clearing for construction of access roads. » Presence of construction crews. » Operation of heavy vehicles. » Birds drinking from reservoirs or ponds containing contaminated water.		
Mitigation: Target/Objective	» Low footprint and low impact on avifaunal habitats. » Low disturbance of avifauna during construction. » Low disturbance and impact on red-listed avifaunal species.		
Mitigation: Action/control		Responsibility	Timeframe
» Pre-construction environmental induction for all construction personnel regarding basic environmental principles.		ECO	Pre-construction
» The use of laydown areas within the footprint of the development should be used where feasible, to avoid habitat loss and disturbance to adjoining			

areas. » All construction vehicles should adhere to clearly defined and demarcated roads. » All construction vehicles should adhere to a low speed limit (40km/h on site) to avoid collisions with susceptible species such nocturnal and crepuscular species, as well as reduce dust. » Reservoirs or ponds (evaporative or other) should be covered with fine mesh or other exclusion material in order to exclude and prevent birds from accessing potentially contaminated water contained therein. » The fence around the facility should be designed to be bird friendly, to prevent entrapment and electrocutions of ground-dwelling birds. In practical terms this means that the perimeter fence of the facility should only include the developed areas and as little undeveloped ground or natural veld as possible. All electrified strands should be located on the inside of the fence and not the outside, while there should be no electrified ground-strands present within a 30cm height from the ground. Furthermore, the fence should be a single-layer fence and not a double fence with a large space between, which can cause ground-dwelling birds to become entrapped between these. » If holes or trenches are to be dug, these should not be left open for extended periods of time as ground-dwelling avifauna may become entrapped therein. » No construction activity should occur near to active raptor nests should these be discovered prior to or during the construction phase.	Contractor	Construction
» ECO to monitor and enforce ban on hunting and collecting of avifauna or their products (e.g.	ECO	Construction

eggs). » Any avifauna threatened or injured by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. » If there are active nests near construction areas, these should be reported to ECO and should be monitored until the birds have finished nesting and the fledglings have left the nest.			
Performance Indicator	» Avifaunal microhabitat loss restricted to infrastructure footprint. » Low disturbance and impact on red-listed avifaunal species. » Avifauna do not have access to water contained in reservoirs or ponds used on site. » Low mortality of avifauna due to construction machinery and activities. » No disturbance of breeding raptors (i.e. no nest abandonment due to disturbance). » No poaching or collecting of avifauna or their products (e.g. eggs) by construction personnel. » Removal to safety of entrapped/injured avifauna encountered during construction.		
Monitoring	ECO to monitor construction to ensure that: » Vegetation is cleared only within footprint areas during construction. » Perimeter fencing is constructed in a manner that is considered bird friendly, especially with respect to ground-dwelling birds. » Reservoirs and/or ponds on site are covered with mesh to exclude birds from any potentially contaminated water. » No birds or eggs are disturbed or removed by construction personnel. » Any raptor nests (especially of red-listed species) discovered on site or nearby, are monitored weekly until the post-fledging period.		

7.2 OPERATION PHASE ACTIVITIES

OBJECTIVE: Limit direct and indirect impacts and disturbances of avifauna during operation			
Project component/s	All activities which result in disturbance of avifauna, including: » Avifaunal collisions with PV panels » Human presence » Vehicle traffic		
Potential Impact	» Mortality and disturbance of avifauna within and beyond the footprint of the facility due to collisions with solar panels, presence of personnel and vehicle traffic.		
Activity/risk source	» Avifaunal collisions with PV panels. » Presence of operational phase personnel. » Presence of personnel during solar field, road and fence maintenance activities. » Birds drinking from reservoirs or ponds containing contaminated water. » Birds entrapped along perimeter fencing.		
Mitigation: Target/Objective	Low disturbance and impact of avifauna and low collision rates of avifauna with PV panels and power line during operation.		
Mitigation: Action/control		Responsibility	Timeframe
» All incidents of collision with PV panels should be recorded as meticulously as possible, including data related to the species involved, the exact location of collisions within the facility, and suspected cause of death. » Post-construction monitoring with the aid of video surveillance should be considered, as this will contribute towards understanding bird interactions with solar panels, in accordance with suggestions made by Visser (2016).		ECO	Operation
» Maintenance of the perimeter fencing must ensure that it fulfils the guidelines (Visser, 2016) to minimise impacts on species susceptible to			

entrapment. » The power line should be monitored on a regular basis to determine potential areas of high collision rates, especially involving red-listed species (e.g. Ludwig's Bustard). Bird diverters should be fitted to the power line in areas where high collisions rates are detected. » Any movements by vehicle and personnel should be limited to within the footprint of solar field and other associated infrastructure, especially during routine maintenance procedures. » All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such nocturnal and crepuscular species. » Reservoirs or ponds (evaporative or other) should be covered with fine mesh or other exclusion material in order to exclude and prevent birds from accessing potentially contaminated water contained therein. » If birds nesting on infrastructure cannot be tolerated due to operational risks, birds should be prevented from accessing nesting sites using exclusion methods. An avifaunal specialist should be consulted for advice on further mitigation if problems persist. » All night-lighting should use low-UV type lights (such as most LEDs), which do not attract insects, and be directed downwards.	Contractors	Operation
Performance Indicator	» No disturbance of breeding raptors (i.e. no nest abandonment due to disturbance). » No disturbance of red-listed avifaunal species perched or foraging in the vicinity of the solar field. » No poaching or collecting of avifauna or their products (e.g.	

	eggs) by maintenance personnel. » Removal to safety of entrapped/injured avifauna encountered during routine maintenance. » Avifauna do not have access to water contained in reservoirs or ponds used on site. » Low impact on nocturnal and crepuscular species along roads. » Low impact on large raptors and terrestrial birds (e.g. bustards) along the power line corridor.
Monitoring	ECO to monitor operational phase to ensure that: » No birds or eggs are disturbed or removed by maintenance personnel. » Perimeter fencing is maintained in manner that ensures it is bird friendly, with respect to ground-dwelling species. » Any raptor nests (especially of red-listed species) discovered on site or nearby, are monitored weekly until the post-fledging period. » Power line infrastructure and corridor is monitored weekly to determine potential areas of collisions and electrocutions. » Reservoirs and/or ponds on site are covered with mesh to exclude birds from any potentially contaminated water.

7.3 DECOMMISSIONING PHASE ACTIVITIES

Objective: Limit disturbance and loss of avifaunal microhabitats during decommissioning.	
Project component/s	All infrastructure and activities which result in transformation and loss of intact or rehabilitated avifauna microhabitats: » Removal and clearing of solar field and other infrastructure. » Removal and clearing of camps & other temporary infrastructure. » Removal of access roads.
Potential Impact	Disturbance and loss of avifaunal microhabitats, leading to displacement and loss of resident avifaunal species.

Activity/risk source	» Clearing and removal of solar field and other infrastructure. » Clearing and removal of camps and other temporary infrastructure. » Removal of access roads. » Presence of decommissioning crews. » Operation of heavy vehicles.
Mitigation: Target/Objective	» Low disturbance and low impact on avifauna and avifaunal habitats. » Low disturbance and impact on red-listed avifaunal species.

Mitigation: Action/control	Responsibility	Timeframe
» The use of laydown areas within the footprint of the development should be used where feasible, to avoid habitat loss and disturbance to adjoining areas » The removal and clearing of the solar field and other associated infrastructure (buildings, reservoirs, ponds, fencing etc) should be done in such a manner that does not cause destruction and pollution of rehabilitated habitats on site or adjoining natural areas. » All vehicles should adhere to clearly defined and demarcated roads. » All vehicles on site should adhere to a low speed limit (40km/h) to avoid collisions with susceptible species such nocturnal and crepuscular species, as well as reduce dust. » If holes or trenches are to be dug, these should not be left open for extended periods of time as ground-dwelling avifauna may become entrapped therein. » No decommissioning activity should occur near to active raptor nests, should these be discovered prior to or during the	Contractor	Decommissioning

decommissioning phase.		
» Environmental induction for all personnel regarding basic environmental principles. » ECO to monitor and enforce ban on hunting and collecting of avifauna or their products (e.g. eggs). » Any avifauna threatened or injured by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.	ECO	Decommissioning

Performance Indicator	» Avifaunal microhabitat loss restricted to infrastructure footprint. » Low disturbance of avifauna within footprint and adjacent areas.
Monitoring	ECO to monitor construction to ensure that: » Vegetation clearing is limited as far as possible within footprint and adjoining areas during decommissioning. » No birds or eggs are disturbed or removed by personnel. » Any raptor nests (especially of red-listed species) discovered on site or nearby, are monitored weekly to ensure zero disturbances.

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9 ANNEX 1. LIST OF AVIFAUNA

A consolidated avifaunal list for the Allepad PV Four project site and surrounds, including records from SABAP1, SABAP2 and the site visits (winter and summer), and includes red-list status (Taylor *et al.*, 2015), regional endemism (Taylor *et al.*, 2015), and SABAP2 reporting rates (based on 52 cards). Species with a zero reporting rate were only recorded during SABAP1 and not SABAP2. Species highlighted in bold text were recorded during the winter (15 to 17 July 2018) and summer (1 to 3 Feb 2019) site visit.

Species name	Taxonomic name	Red-list Status	Regional Endemism	Reporting Rate (%)
Barbet, Acacia Pied	***Tricholaema leucomelas***			**92**
Barbet, Crested	*Trachyphonus vaillantii*			4
Batis, Pririt	***Batis pririt***			**31**
Bee-eater, European	***Merops apiaster***			**10**
Bee-eater, Swallow-tailed	***Merops hirundineus***			**42**
Bishop, Southern Red	***Euplectes orix***			**27**
Bokmakierie	***Telophorus zeylonus***			**81**
Brubru	*Nilaus afer*			2
Bulbul, African Red-eyed	***Pycnonotus nigricans***			**83**
Bunting, Lark-like	***Emberiza impetuani***			**85**
Bustard, Kori	***Ardeotis kori***	**Near-Threatened**		**4**
Bustard, Ludwig's	***Neotis ludwigii***	**Endangered**		**15**
Buzzard, Jackal	*Buteo rufofuscus*		Near-Endemic	0
Buzzard, Steppe	*Buteo vulpinus*			6
Canary, Black-headed	*Serinus alario*		Near-Endemic	2
Canary, Black-throated	***Crithagra atrogularis***			**15**
Canary, White-throated	*Crithagra albogularis*			6
Canary, Yellow	***Crithagra flaviventris***			**65**
Chat, Ant-eating	***Myrmecocichla formicivora***			**35**
Chat, Familiar	***Cercomela familiaris***			**10**
Chat, Karoo	*Cercomela schlegelii*			4
Cisticola, Desert	*Cisticola aridulus*			25
Cisticola, Grey-backed	*Cisticola subruficapilla*			0
Cisticola, Zitting	*Cisticola juncidis*			2
Courser, Double-banded	***Rhinoptilus africanus***			**27**
Crombec, Long-billed	*Sylvietta rufescens*			4
Crow, Pied	***Corvus albus***			**65**
Cuckoo, Diderick	*Chrysococcyx caprius*			19
Cuckoo, Jacobin	*Clamator jacobinus*			10
Dove, Laughing	***Streptopelia senegalensis***			**100**

Dove, Namaqua	***Oena capensis***			**79**
Drongo, Fork-tailed	*Dicrurus adsimilis*			4
Eagle, African Fish	*Haliaeetus vocifer*			2
Eagle, Booted	*Aquila pennatus*			2
Eagle, Martial	*Polemaetus bellicosus*	Endangered		2
Eagle, Tawny	*Aquila rapax*	Endangered		0
Egret, Western Cattle	*Bubulcus ibis*			6
Eremomela, Yellow-bellied	***Eremomela icteropygialis***			**52**
Falcon, Lanner	***Falco biarmicus***	**Vulnerable**		**6**
Falcon, Pygmy	***Polihierax semitorquatus***			**8**
Finch, Red-headed	***Amadina erythrocephala***			**29**
Finch, Scaly-feathered	***Sporopipes squamifrons***			**75**
Firefinch, Red-billed	*Lagonosticta senegala*			0
Fiscal, Southern	***Lanius collaris***			**100**
Flycatcher, Chat	***Bradornis infuscatus***			**71**
Flycatcher, Fiscal	*Sigelus silens*		Near-Endemic	2
Flycatcher, Marico	*Bradornis mariquensis*			4
Flycatcher, Spotted	*Muscicapa striata*			2
Goose, Egyptian	***Alopochen aegyptiacus***			**35**
Goshawk, Gabar	*Melierax gabar*			2
Goshawk, Pale Chanting	***Melierax canorus***			**19**
Guineafowl, Helmeted	*Numida meleagris*			10
Heron, Black-headed	*Ardea melanocephala*			2
Honeyguide, Lesser	*Indicator minor*			0
Hoopoe, African	*Upupa africana*			4
Hornbill, Southern Yellow-billed	*Tockus leucomelas*			15
Ibis, Hadeda	***Bostrychia hagedash***			**54**
Kestrel, Greater	***Falco rupicoloides***			**2**
Kestrel, Rock	*Falco rupicolus*			13
Kingfisher, Brown-hooded	*Halcyon albiventris*			2
Kingfisher, Giant	*Megaceryle maximus*			2
Kite, Black-winged	*Elanus caeruleus*			4
Kite, Yellow-billed	*Milvus aegyptius*			2
Korhaan, Karoo	***Eupodotis vigorsii***	**Near-Threatened**		**73**
Korhaan, Northern Black	***Afrotis afraoides***			**94**
Korhaan, Red-crested	***Lophotis ruficrista***			**6**
Lapwing, Blacksmith	*Vanellus armatus*			23
Lapwing, Crowned	***Vanellus coronatus***			**88**
Lark, Black-eared Sparrow-	***Eremopterix australis***		**Near-Endemic**	**4**
Lark, Eastern Clapper	***Mirafra fasciolata***			**37**
Lark, Fawn-coloured	***Calendulauda africanoides***			**71**

Lark, Grey-backed Sparrow-	***Eremopterix verticalis***		**56**
Lark, Karoo Long-billed	*Certhilauda subcoronata*		0
Lark, Pink-billed	***Spizocorys conirostris***		**13**
Lark, Red-capped	***Calandrella cinerea***		**4**
Lark, Sabota	***Calendulauda sabota***		**44**
Lark, Spike-heeled	***Chersomanes albofasciata***		**65**
Lark, Stark's	***Spizocorys starki***		**29**
Lovebird, Rosy-faced	*Agapornis roseicollis*		0
Martin, Brown-throated	*Riparia paludicola*		0
Martin, Rock	***Hirundo fuligula***		**73**
Mousebird, Red-faced	*Urocolius indicus*		42
Mousebird, White-backed	***Colius colius***		**88**
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*		10
Oriole, Eurasian Golden	*Oriolus oriolus*		0
Ostrich, Common	*Struthio camelus*		2
Owl, Spotted Eagle-	*Bubo africanus*		13
Owl, Western Barn	*Tyto alba*		35
Owlet, Pearl-spotted	*Glaucidium perlatum*		0
Penduline-tit, Cape	***Anthoscopus minutus***		**10**
Pigeon, Speckled	***Columba guinea***		**62**
Pipit, African	*Anthus cinnamomeus*		8
Plover, Three-banded	*Charadrius tricollaris*		15
Prinia, Black-chested	***Prinia flavicans***		**85**
Quail, Common	*Coturnix coturnix*		6
Quelea, Red-billed	***Quelea quelea***		**37**
Robin, Kalahari Scrub	***Cercotrichas paena***		**42**
Robin, Karoo Scrub	***Cercotrichas coryphoeus***		**6**
Sandgrouse, Namaqua	***Pterocles namaqua***		**85**
Scimitarbill, Common	*Rhinopomastus cyanomelas*		2
Secretarybird	*Sagittarius serpentarius*	Vulnerable	2
Shelduck, South African	***Tadorna cana***		**15**
Shrike, Lesser Grey	*Lanius minor*		4
Shrike, Red-backed	*Lanius collurio*		0
Snake-eagle, Black-chested	***Circaetus pectoralis***		**2**
Sparrow, Cape	***Passer melanurus***		**96**
Sparrow, House	***Passer domesticus***		**77**
Sparrow, Southern Grey-headed	*Passer diffusus*		3
Sparrow-weaver, White-browed	***Plocepasser mahali***		**97**
Starling, Cape Glossy	*Lamprotornis nitens*		2
Starling, Pale-winged	*Onychognathus nabouroup*		0
Starling, Pied	*Spreo bicolor*		2

Starling, Wattled	*Creatophora cinerea*			19
Stilt, Black-winged	*Himantopus himantopus*			2
Stork, Abdim's	*Ciconia abdimii*	Near-Threatened		0
Sunbird, Dusky	***Cinnyris fuscus***			**40**
Swallow, Barn	***Hirundo rustica***			**44**
Swallow, Greater Striped	***Cecropis cucullata***			**42**
Swallow, South African Cliff	*Petrochelidon spilodera*			4
Swallow, White-throated	*Hirundo albigularis*			15
Swift, African Palm	***Cypsiurus parvus***			**81**
Swift, Alpine	*Tachymarptis melba*			2
Swift, Bradfield's	***Apus bradfieldi***			**4**
Swift, Common	***Apus apus***			**27**
Swift, Little	***Apus affinis***			**56**
Swift, White-rumped	*Apus caffer*			2
Thick-knee, Spotted	***Burhinus capensis***			**46**
Thrush, Karoo	*Turdus smithi*		Near-Endemic	12
Tit, Ashy	***Parus cinerascens***			**4**
Turtle-dove, Cape	***Streptopelia capicola***			**94**
Vulture, White-backed	*Gyps africanus*	Critically Endangered		4
Wagtail, African Pied	*Motacilla aguimp*			0
Wagtail, Cape	*Motacilla capensis*			12
Warbler, African Reed	*Acrocephalus baeticatus*			0
Warbler, Chestnut-vented	***Sylvia subcaeruleum***			**37**
Warbler, Icterine	*Hippolais icterina*			0
Warbler, Lesser Lesser	*Acrocephalus gracilirostris*			0
Warbler, Rufous-eared	***Malcorus pectoralis***			**71**
Warbler, Willow	*Phylloscopus trochilus*			2
Waxbill, Common	*Estrilda astrild*			2
Weaver, Sociable	***Philetairus socius***			**56**
Weaver, Southern Masked	***Ploceus velatus***			**87**
Wheatear, Capped	*Oenanthe pileata*			25
Wheatear, Mountain	*Oenanthe monticola*			13
White-eye, Orange River	*Zosterops pallidus*			4
Whydah, Pin-tailed	*Vidua macroura*			2
Woodpecker, Cardinal	*Dendropicos fuscescens*			2
Woodpecker, Golden-tailed	*Campethera abingoni*			0