BASIC ASSESSMENT FOR THE PROPOSED KHUNAB SOLAR GRID CONNECTION ON A SITE NEAR UPINGTON, IN THE NORTHERN CAPE PROVINCE:

AVIFAUNAL SPECIALIST REPORT

Grey-backed Sparrowlark *Eremopterix verticalis*

savannah environmental

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

3Foxes Biodiversity Solutions

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EXECUTIVE SUMMARY

McTaggarts PV1 (Pty) Ltd is proposing the construction and operation of a grid connection solution for the proposed McTaggarts PV1, PV2, PV3 and Klip Punt PV1 solar PV facilities near Upington in the Northern Cape Province. The grid connection solution will connect the four solar PV facilities to the existing Upington Main Transmission Substation (MTS) through the construction of a single circuit 132 kV power line and two collector substations (each comprising of a switching station component). Savannah Environmental has been appointed to undertake the required application for environmental authorisation process for the above development. The proposed development is currently in the Basic Assessment (BA)Phase and Savannah Environmental has appointed 3Foxes Biodiversity Solutions to provide a specialist avifaunal impact study of the grid connection as part of the BA process.

This specialist study details the avifaunal characteristics of the area where one grid connection route (Preferred Option) and substations are proposed, and the possible impacts on the local avifauna. The alternative route of the grid connection corridor was not assessed as it was not technical feasible. The impacts for the various phases of the development of the proposed grid connections are assessed, including the pre-construction, construction, operation and decommissioning phases. A number of mitigation measures related to these impacts are recommended in order to reduce the likely impact of the proposed development. A draft EMPr is also provided.

A full field assessment 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. An approximate total of 150 bird species have been recorded within the project site and surrounds, of which 68 species were observed on site during a five-day field survey in October 2018 and four-day survey in April 2019. Seven avifauna species are listed as near-endemic and a further twelve species as biome-restricted. There are no known Important Bird Areas (IBAs) or wetlands of significant avifaunal importance within the vicinity of the study site (other than the Orange River located within 3km to the south).

Twelve (12) species recorded in the broader area are red-listed, of which eight (8) species are listed as Threatened, and another four (4) considered Near-Threatened. Two (2) Near-Threatened species were recorded during the site visits, namely Karoo Korhaan *Eupodotis vigorsii* (several sightings) and Kori Bustard *Ardeotis kori* (three sightings). Of the eight threatened species known from the area, the most important include White-backed Vulture *Gyps africanus* (Critically Endangered), Ludwig's Bustard *Neotis ludwigii* (Endangered), Lappet-faced Vulture (*Torgos tracheliotos*), Martial Eagle *Polemaetus bellicosus* (Endangered), Lanner Falcon *Falco biarmicus* and Secretarybird *Sagittarius serpentarius* (Vulnerable). These species are all susceptible to collisions with power lines, but particularly Ludwig's Bustard, Kori Bustard and Secretarybird. Black Stork *Ciconia nigra* (Vulnerable) and Abdim's Stork *Ciconia abdimii* (Near-Threatened) are unlikely to occur due to the

absence of suitable habitat, but may occur along the nearby Orange River where more suitable habitat exists.

The expected impacts of the proposed grid development include 1) minor habitat loss associated with plains habitat of the Kalahari Karroid Shrubland vegetation type, 2) disturbance caused during the construction and maintenance phases, and 3) direct mortality of avifauna colliding with power line structures, as well as possible electrocutions with power line infrastructure. The species that will be the most negatively impacted by the proposed development include primarily large terrestrial birds that occasionally use the area for foraging.

The impacts on the avifauna would potentially be expected to be of high importance, but due to the absence of communal roosting, breeding sites and flight paths of red-listed species and relatively low frequency of occurrence of priority species throughout the site, the impacts are likely to be medium low and no high post-mitigation impacts are expected. The preferred grid connection route is considered viable from an avifaunal perspective for the following reasons: 1) the lines are relatively short (*ca*. 13 km) and follow a relatively direct pathway towards the Upington MTS, 2) approximately half of the distance of the proposed grid line will border the transformed habitat of the proposed PV solar fields, 3) no known flight paths will be intercepted by the proposed grid connection corridor, and 4) the proposed grid connection corridor also follows an existing 400kV line for a short distance (<2 km) which may further reduce potential collision rates. There are no impacts associated with the grid connection that are considered to be of high significance and which cannot be mitigated to a medium to low level. Therefore, there are no fatal flaws from an avifaunal perspective that should prevent the development from proceeding.

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 grid connection and substations, and 2) regular monitoring of the power line to determine collision hotspots involving priority species (especially during favourable periods when nomadic species are more abundant), and 3) fitment of bird diverters where necessary on sections of the erected power lines where collisions and electrocutions risks are high.

Cumulative impacts associated with the development may be of moderate concern due to the increasing number of solar facility developments and associated grid connections proposed for the broader Upington area. Considering that the vegetation and avifauna that occur in the area 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 recommended mitigation measures are strictly implemented.

Impact statement

The proposed Khunab Solar Grid Connection corridor is considered to represent a broadly suitable environment for the location of the proposed grid connection. Considering that the broader project site supports a typical bioregional avifaunal assemblage within an extensive vegetation type, and that there are no known communal breeding, roosting sites or flight paths of red-listed priority species within close proximity, 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 grid connection can be supported from an avifaunal perspective. It is therefore the reasoned opinion of the specialist that the Khunab Solar Grid Connection project can 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;	7-9
a) a declaration that the specialist is independent in a form as may be specified by the competent authority;	10-11
b) 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 & 2.2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
c) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.2
d) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
e) 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
f) an identification of any areas to be avoided, including buffers;	Section 3
g) 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
h) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.4
i) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 4
j) any mitigation measures for inclusion in the EMPr;	Section 5 & 7
k) any conditions for inclusion in the environmental authorisation;	Section 7
l) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
m) 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
a) a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Main Report
b) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Main Report
c) 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 Pr.Sci.Nat
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Ecological Solutions for People & the Environment

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 (1999) 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 Ecological Studies in the vicinity of the current site

- Allepad Solar PV Facility, Upington. Avifaunal Specialist Report. Savannah Environmental. 2018/19.
- Aggeneys Solar PV Facility, Aggeneys. Avifaunal Specialist Report. Savannah Environmental. 2018/19.
- Gaetsewe Solar PV Facility, Kathu. Avifaunal Specialist Report. Cape EAPrac 2018.
- Mogara Solar PV Facility, Kathu. Avifaunal Specialist Report. Cape EAPrac 2018.
- Kathu Hyperion Solar PV Facility, Kathu. Avifaunal Specialist Report. Cape EAPrac 2018.

SPECIALIST DECLARATION 1

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: ____1 November 2019_____

SPECIALIST DECLARATION 2

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: ____1 November 2019_____

1 INTRODUCTION

McTaggarts PV1 (Pty) Ltd is proposing the construction and operation of a grid connection solution for the proposed McTaggarts PV1, PV2, PV3 and Klip Punt PV1 solar PV facilities near Upington in the Northern Cape Province. The grid connection solution will connect the four solar PV facilities to the Upington Main Transmission Substation (MTS) and will include the development of a single circuit 132 kV power line and two collector substations (each comprising of a switching station component). The collector substations will be known as, the Khunab Collector Substation and the Klip Punt Collector Substation. Other associated infrastructure also required for the grid connection solution, include access roads, feeder bays (inclusive of line bays, busbars, bussection and protection equipment), two switching stations, a fibre and optical ground wire (OPGW) layout, insulation and assembly structures. Savannah Environmental has been appointed to undertake the required application for environmental authorisation process for the above development. As part of the required studies, 3Foxes Biodiversity Solutions has been appointed to provide a specialist avifaunal assessment study of the grid connection corridor as part of the required application.

The purpose of the Khunab Solar Grid Connection Avifaunal Specialist Report is to 1) describe the avian ecological features of the proposed grid connection corridor, 2) to provide a preliminary assessment of the avian ecological sensitivity of the grid connection corridor, and 3) identify and assess the significance of the likely impacts on avifauna associated with the development of the grid connection corridor, and 4) to provide measures to avoid, minimize and mitigate project related impacts to the avifauna. A site visit in spring (4 to 8 October 2018) and another in late summer (9 to 12 April 2019), as well as a desktop review of the available literature for the area, 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 of the grid connection corridor. The information and sensitivity map presented here 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 can be minimised. Impacts are assessed for the pre-construction, construction, operation, and decommissioning phases of the development. A number of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which are also 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, as amended) 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 (Jenkins *et al.*, 2017).

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:

- Pre-construction
- Construction
- Operational Phase
- Decommissioning Phase

1.2 RELEVANT ASPECTS OF THE DEVELOPMENT

The proposed grid connection corridor traverses three affected properties, namely, Portion 3 of McTaggarts Camp No. 453, Portion 12 of Klip Punt 452; and Olyvenhouts Drift Settlement Agricultural Holding 1080, located approximately 15km west of Upington. The entire study area and the development area are located within Focus Area 7 of the Renewable Energy Development Zones (REDZ), which is known as the Upington REDZ. Due to the location of the study area and development area within a REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN R114 as formally gazetted on 16 February 2018. A grid connection corridor which is 300m wide (which increases to ~700m at the Upington MTS) and 13km long power line is being assessed to allow for the optimisation of the grid connection and associated infrastructure to accommodate the identified environmental sensitivities. The grid connection infrastructure will be developed

within the 300m wide grid connection corridor. The height of the power line pylons will be up 32m and will be located within a servitude of up 36m and the two collector substations will step up the current from 22kV or 33kV to 132kV.

The grid connection solution will connect the four solar PV facilities to the Upington (MTS) and will include the development of a 132 kV power line and two collector substations (each comprising of switching station components). The two collector substations will be known as, the Khunab Collector Substation and the Klip Punt Collector Substation. Other associated infrastructure will also be required for the grid connection solution, including access roads, feeder bays (inclusive of line bays, busbars, bussection and protection equipment), two switching stations, a fibre and optical ground wire (OPGW) layout, insulation and assembly structures (Figure 1).

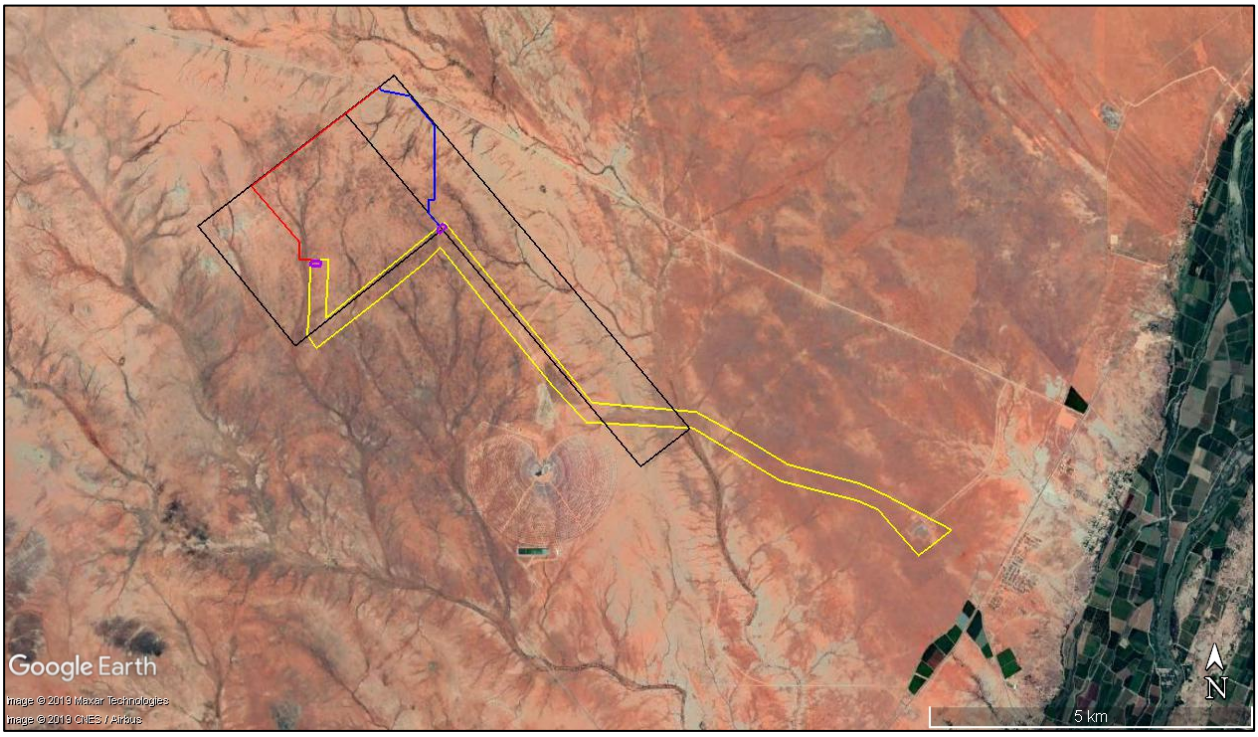

Figure 1. Layout map of the proposed Khunab Solar Grid Connection showing the power line route to the Upington MTS, as well as the two access roads and two substations.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

A full field assessment as well as a desktop review of the available avifaunal information for the study area was conducted in order to identify and characterise the avifaunal features. 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 broader project site. The relevant quarter-degree grid cell (QDGC) that covers the broader area 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 area being 2825_2100 (8 cards, 84 species) and 2830_2100 (1 card, 44 species). These were consulted to determine the bird species likely to occur within the broader project site.
- 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, endemism and biology of all species considered likely to occur within the broader 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 broader 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 project site. Though the Orange River meanders within 3km of the existing Upington MTS at the most southerly end of the proposed grid connection corridor, it is considered to be sufficiently distant enough so as not to be impacted by the project.

2.2 *SITE VISIT & FIELD METHODOLOGY*

A site visit of five days was made to the broader project site in spring (4 to 8 October 2018) and four days in late summer (9 to 12 April 2019) to determine the *in situ* local avifauna and avian habitats present on site. The timing of the spring survey corresponded with a late dry-season assessment, while the late summer survey corresponded with a late wet-season assessment when most migratory bird species are still present. Environmental conditions during the late summer survey where, however, hot and dry, with the region experiencing poor summer rains locally. The field approach was informed by the *Birds and Solar Energy Best Practice Guidelines* (Jenkins *et al*., 2017) issued by Birdlife South Africa. In terms of these guidelines, the project is seen to fall within the Regime 2 assessment protocol in terms of the extent of the site and the avifaunal sensitivity.

Linear transects measuring 1km in length were walked through the broader project site to ensure adequate coverage of the large area (±20km^2) under the time constraints, both in spring (n = 28) and late summer (n = 22) (Figure 2). All birds detected by sight or sound during these transect walks were recorded, as well as the number of birds per detection. Other variables such as time of day and weather conditions were also recorded for each transect. The relative abundance of birds (number of birds/km) was calculated for each species. 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 flight paths 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 seen flying over the site (e.g. sandgrouse) or that were seen in large flocks (bishops, queleas, weavers), were excluded from the database. This was to ensure that trends in scarcer, habitat specific species would not be masked by large fluctuations in numbers of flocking species.

In addition, a drive transect of 6.7km in length was driven on three occasions in spring and on two occasions in late summer within the broader project site, during which all birds were recorded. A second drive transect (control) of similar length, located beyond the boundaries of the project site, was completed on three occasions in both spring and late summer. A vantage point count, located in the northern central portion of the broader project site was undertaken in spring only, with a total of 12 hours of observations (four sessions of three hours) being completed.

A list was compiled of all the avifaunal species likely to occur within the broader study area, based on a combination of existing distributional data (SABAP 1 and SABAP 2) and species seen during the site visit. 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 broader study area 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 a low avifaunal sensitivity where there is likely to be a negligible impact on ecological processes and avifaunal biodiversity. Most types of development can proceed within these areas with little avifaunal impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact low. These areas usually comprise the bulk of avifaunal habitats within an area. Development within these areas can proceed with relatively little avifaunal impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high avifaunal impact is anticipated due to the high avifaunal 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 seasonal feeding areas. 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 avifaunal 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 consisted of a relatively detailed field assessment 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:

- The SABAP 1 data for the relevant quarter degree squares covering the broader project site are now >21 years old (Harrison *et al*., 1997). Further, with only nine (9) cards being submitted for the two relevant pentads that cover the broader project site during SABAP 2, there is some paucity in reliable data 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 study site, and thus likely includes a much wider array of species than what actually occurs at the site. However, 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 development area is not that large with the result that it has been well-covered and as it contains very 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

The proposed grid connection corridor lies within one vegetation type, namely the Kalahari Karroid Shrubland (Mucina & Rutherford 2006). This vegetation type is classified as Least Threatened, and is predominantly (99%) untransformed. 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. The proportion of grass increases where soils are sandy and deeper, resulting in a patch mosaic of areas with varying densities of grasses and shrub heights. Trees are absent except for the provincially protected *Boscia foetida* which occurs scattered throughout.

Three main avifaunal microhabitats can be distinguished, namely the plains associated with the Kalahari Karroid Shrubland (Figure 3 and 4), small drainage lines (Figure 5) and small pans (Figure 6) scattered throughout the broader study area. The plains are the dominant habitat type constituting a mix of grasses and shrubs in varying proportions, while the drainage lines and pans support a more dense woody habitat.

Figure 3. Typical plains habitat of the Kalahari Karroid Shrubland with patches of low grass cover and dwarf shrubs, which constitutes the dominant habitat type traversed by the proposed grid connection.

Figure 4. Typical plains habitat with Bushmanland Arid Grassland showing more dense grass cover and a lower density of taller shrubs. This area is towards the Helbrandleegte River.

Figure 5. The Helbrandleegte River near the proposed crossing point. The River is seen as being of significance for avifauna as it contains large trees which are used for nesting by species such as Sociable Weavers as well as various raptors.

3.2 GENERAL AVIFAUNA

An approximate total of 150 bird species are known to occur within the grid connection corridor and broader study area (Annexure 1), of which 68 species were recorded on site during the two field surveys. Eight (8) of these species are listed as threatened, and another four (4) are considered Near-Threatened. Seven species are considered true near-endemics to South Africa (BirdLife South Africa, 2018), while twelve (12) are considered biome-restricted (Marnewick *et al*., 2015).

The bird assemblage recorded within the grid connection corridor is fairly typical of the Kalahari bioregion, with elements of the Nama-Karoo. Of the 68 species recorded on site, 56 species were detected during walking transects, with 44 and 40 species recorded in spring and late summer respectively. Small passerines species made up two-thirds (36 species, 64%) of the species detected, compared to non-passerines (20 species, 36%). During walk transects in spring, an average of 8.9 species were recorded per transect with an average of 19.0 individual birds per transect (Figure 6). In late summer somewhat less species (7.6) were recorded per transect but with a similar average of 19.1 birds per transect. While the number of detections and total number of birds seen per transect were fairly similar between the two seasons, there were some marked differences in the species being detected, not only nomadic species but also species usually considered sedentary.

Species with relatively high abundance which also exhibited the most stable trends between the two seasons include Spike-heeled Lark *Chersomanes albofasciata*, Sabota Lark *Calendulauda sabota* and Chat Flycatcher *Bradornis infuscatus* (Table 1). Less abundant species with stable trends include Yellow Canary *Crithagra flaviventris*, Southern Fiscal *Lanius collaris*, Bokmakierie *Telophorus zeylonus* and Dusky Sunbird *Cinnyris fuscus* (Table 1). Primarily resident species which showed surprisingly highly variable detections between the seasons include Eastern Clapper Lark *Mirafra fasciolata*, Rufous-eared Warbler *Malcorus pectoralis*, Fawn-coloured Lark *Calendulauda africanoides*, and Black-chested Prinia *Prinia flavicans* (Table 2). The most common non-passerine, the Northern Black Korhaan *Afrotis afraoides,* also exhibited variable detections between the seasons (Table 3). These differences in detections of these species are mostly likely due to reduced vocalisations in late summer, compared to spring when most species begin to breed. Highly nomadic species which showed dramatic fluctuations between the seasons include Lark-like Bunting *Emberiza impetuani*, which was only abundant in spring, and the biome-restricted Stark's Lark *Spizocorys starki*, which was only present in good numbers in late summer (Table 2).

Table 1. Summary of small passerine and non-passerine species with fairly stable trends, recorded along line transects walked throughout the broader study area during the field survey in spring (n = 28) and late summer (n = 22), with respect to the number of detections per species, total number of birds detected per species, and number of birds seen per kilometre, as a measure of relative abundance.

Species	Spring			Summer		
	No. of detections	No. of birds	No. of birds/km	No. of detections	No. of birds	No. of birds/km
Barbet, Acacia Pied	1	1	0.04	3	3	0.14
Bokmakierie	7	10	0.36	6	7	0.32
Canary, Yellow	8	13	0.46	8	13	0.59
Chat, Ant-eating	8	13	0.46	3	4	0.18
Fiscal, Southern	6	7	0.25	6	7	0.32
Flycatcher, Chat	18	22	0.79	21	23	1.05
Lark, Black-eared Sparrow-	-	-	-	1	1	0.05
Lark, Grey-backed Sparrow-	6	12	0.43	2	19	0.86
Lark, Sabota	38	41	1.46	38	40	1.82
Lark, Spike-heeled	29	50	1.79	26	50	2.27
Penduline-tit, Cape	1	2	0.07	1	1	0.05
Robin, Kalahari Scrub	1	1	0.04	1	1	0.05
Robin, Karoo Scrub	1	1	0.04	-	-	-
Sparrow, Cape	7	11	0.39	6	12	0.55
Sunbird, Dusky	3	4	0.14	3	3	0.14

Most of the seven near-endemic species reported for the broader project site have not been recorded in the area during SABAP2, or during the field surveys. They can therefore be considered scarce in the broader area, and include, Karoo Thrush *Turdus smithi*, Fiscal Flycatcher *Sigelus silens*, Fairy Flycatcher *Stenostira scita*, Sickle-winged Chat *Cercomela sinuata*, the nomadic Black-headed Canary *Serinus alario* (0%), and Jackal Buzzard (0%). Only the highly nomadic Black-eared Sparrowlark *Eremopterix australis* has been recorded with a fair reporting rate (33%), though only one sighting was made during the late summer field survey. Karoo Thrush and Fiscal Flycatcher are both common in nearby habitats associated with the Orange River, such as riverine thickets.

Table 2. Summary of small passerines and non-passerines with variable trends, recorded along line transects walked throughout the broader study area during the field survey in spring (n = 28) and late summer (n = 22), with respect to the number of detections per species, total number of birds detected per species, and number of birds seen per kilometre, as a measure of relative abundance. The two highly nomadic species which showed significant changes in their abundance are marked with an asterix (*).

	Spring			Summer		
Species	No. of detections	No. of birds	No. of birds/km	No. of detections	No. of birds	No. of birds/km
Bishop, Southern Red	7	159	5.68	-	-	-
Bunting, Lark-like *	17	49	1.75	1	2	0.09
Chat, Familiar	-	-	-	4	4	0.18
Cisticola, Desert	4	4	0.14	-	-	-
Dove, Namaqua	16	21	0.75	-	-	-
Eremomela, Yellow-bellied	5	6	0.21	1	1	0.05
Finch, Scaly-feathered	5	13	0.46	1	1	0.05
Lark, Eastern Clapper	23	26	0.93	-	-	-
Lark, Fawn-coloured	35	38	1.36	4	5	0.23
Lark, Stark's*	-	-	-	29	114	5.18
Mousebird, White-backed	8	15	0.54	1	3	0.14
Prinia, Black-chested	14	19	0.68	3	3	0.14
Quelea, Red-billed	1	23	0.82	-	-	-
Warbler, Rufous-eared	35	43	1.54	12	15	0.68
Weaver, Sociable	1	17	0.61	4	99	4.50
Wheatear, Capped	-	-	-	9	10	0.45

Seven (7) of the 12 biome-restricted species known from the area were recorded during the field surveys, which also have some of the highest SABAP2 reporting rates (in parentheses), namely, Sociable Weaver *Philetairus socius* (100%), Karoo Korhaan *Eupodotis vigorsii* (89%), Kalahari Scrub Robin *Cercotrichas paena* (67%), Black-eared Sparrowlark (33%), Stark's Lark *Spizocorys starki* (22%), Tractrac Chat *Cercomela tractrac,* and Karoo Chat *Cercomela schlegelii* (11%). Sociable Weavers were fairly common with several of their large communal nests located on man-made structures along the western boundary of the project site, and in large *Acacia* trees to the south. Karoo Korhaan appeared to be scarce during the spring survey but were far more vocal during the late summer survey (Table 3), when several pairs were found primarily along the eastern boundary of the broader study area. The soil is more gravel-like, which this species prefers compared to sandy soils which characterise most of the site. Kalahari Scrub Robin was not common at the site, as this species prefers more wooded environments, while Karoo Long-billed Lark *Certhilauda subcoronata*, and Pale-winged Starling *Onychognathus nabouroup* prefer rocky habitats, absent at the site. Stark's Lark was common at the site during the late summer survey,

being spread out across the site in fair numbers. The species was, however, entirely absent during the spring survey, illustrating the highly nomadic tendencies of this species. Biome-restricted species which have not yet been recorded during SABAP2 include Sickle-winged Chat and the nomadic Black-headed Canary, of which the former may occur in low numbers in some years while the latter will show nomadic tendencies with variable abundances.

Differences in species composition between the three avifaunal microhabitats were subtle. The drainage lines and pans support denser vegetation than the plains and hence were characterised by higher occurrences of species preferring wooded habitats. Mousebirds, Karoo Scrub Robins, Dusky Sunbird, Black-chested Prinia and Acacia Pied Barbet, in particular, were more frequently encountered in these habitats than the plains. In contrast, the numerous lark species recorded at the site were generally associated with the more sparsely vegetated open plains. Other species were more cosmopolitan in their use of the habitats, such as Chat Flycatcher, Southern Fiscal, Ant-eating Chat, and Yellow Canary.

Table 3. Summary of medium to large non-passerines, recorded along line transects throughout the broader study area during spring (n = 28) and late summer (n = 22), with respect to the number of detections per species, total number of birds detected per species, and number of birds seen per kilometre, as a measure of relative abundance.

Species	Spring			Summer		
	No. of detections	No. of birds	No. of birds/km	No. of detections	No. of birds	No. of birds/km
Bustard, Kori	-	-	-	1	1	0.05
Courser, Double-banded	1	1	0.04	4	6	0.27
Goshawk, Pale Chanting	1	1	0.04	1	1	0.05
Kestrel, Rock	-	-	-	1	1	0.05
Korhaan, Karoo	1	1	0.04	9	17	0.77
Korhaan, Northern Black	47	53	1.89	24	27	1.23
Sandgrouse, Namaqua	3	13	0.46	3	5	0.23
Vulture, White-backed	-	-	-	1	2	0.09

Based on drive transect surveys during both seasons combined, a number of the larger non-passerine species, including red-listed species, appeared to be detected with greater frequency along the control site transect compared to the transect within the broader study area (Figure 7). Only Northern Black Korhaan and Double-banded Courser were more regularly encountered within the broader study area. This may possibly suggest that conditions beyond the broader study area are more favourable for most of these species, though care should be taken to not interpret these differences as significant.

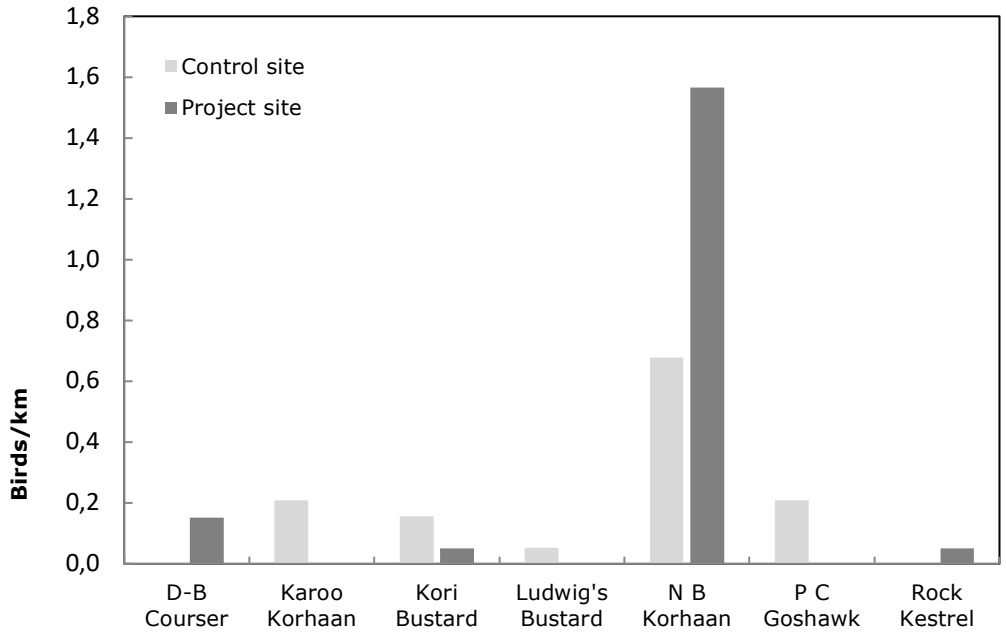

Figure 7. The primary medium to large sized non-passerines detected along drive transects within the broader study area (n=5) and neighbouring control site (n=6) during the combined spring and late summer seasons.

3.3 RED-LISTED SPECIES

Red-listed species are considered fundamental to this study, because of their susceptibility to power lines and associated infrastructures. Five (5) of the eight (8) threatened species known from the broader study area were recorded during the field surveys, and a further two (2) of the four (4) Near-Threatened species (Table 4). One species (Tawny Eagle *Aquila rapax*) has not been recorded in the area during SABAP surveys, but is known to occur on occasion based on local knowledge.

The most important of the red-listed species is the Critically Endangered White-backed Vulture *Gyps africanus*, which was recorded on two separate days during the late summer site visit. At least two immature birds were seen on each occasion, soaring at varying heights across the grid connection corridor, presumably searching for food. The broader study area is currently being used for cattle ranching, and hence vultures may occasionally pass by during foraging forays. There are no breeding or roosting sites nearby, primarily due to the absence of suitably large *Acacia erioloba* trees, and hence the species is considered only as an occasional visitor, corroborated by its infrequent presence in the area based on SABAP records. Similarly, the Endangered Lappet-faced Vulture *Torgos tracheliotos,* which was seen on one occasion (one individual) together with two White-backed Vultures, is most likely also only an occasional visitor to the area. The Martial Eagle

Polemaetus bellicosus (Endangered) is also an important species, as two individuals were recorded on separate occasions in close proximity to the broader study area, one adult and one immature bird, both perched on utility poles. The species most likely breeds on a large pylon in the broader area, and is thus most likely a resident. However, considering that there are no suitable pylons or trees for nesting within the broader study area itself, the species is not likely to be impacted directly by the proposed grid connection infrastructure. These species will therefore most likely only be impacted indirectly by the temporary loss of a portion of their normal foraging ranges during the construction phase of the grid connection infrastructure. Although not recorded during SABAP2, the nomadic Ludwig's Bustard has been recorded by local knowledge, and one sighting was made during the late summer survey, suggesting the species does occur during favourable conditions. Due to its nomadic behaviour, the species will most likely not be impacted by minor habitat loss associated with the grid connection corridor, but rather through collisions with power lines. The Tawny Eagle (Endangered) is only known from the area based on local knowledge, but probably only occurs on rare occasions as this species favours more wooded savannas, and can thus be considered to be rare to uncommon visitor.

The two Near-Threatened species that were recorded during the field surveys include Karoo Korhaan (several sightings) and Kori Bustard (3 sightings, 5 individuals). The Karoo Korhaan were recorded along the eastern boundary of the broader study area were gravel plains predominate, their preferred habitat. The Kori Bustard were recorded both within the gid connect corridor and beyond the boundaries of the broader study area. Both Secretary bird *Sagittarius serpentarius* (Vulnerable) and Lanner Falcon *Falco biarmicus* (Vulnerable) have a relatively moderate SABAP2 reporting rate of 22% and are therefore very likely to occur in the area fairly frequently. One Lanner Falcon was seen perched on a pylon a few kilometres south of the broader study area, so may occasionally frequent the grid connection corridor during hunting forays. A pair of Secretarybird previously nested in the area near to the existing Khi Solar One CSP facility prior to its construction, but no sightings were made during the site visits. All other red-listed species have rather low SABAP2 reporting rates (<5%) for the area, and include Black Stork *Ciconia nigra* (Vulnerable), Pallid Harrier *Circus macrourus* (Near-Threatened), 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 very occasional visitors based on their low reporting rates. The project site and surrounds do not provide essential breeding or feeding habitat to these species. The stork species, in particular, would most likely frequent more suitable habitats closer to the Orange River.

During the walking transects, regular scans were made to detect any large flying birds to establish the presence of flight paths across the broader study area. Besides the two sightings of vultures made during these scans, the additional 12 hours of observations from the vantage point revealed only one Pale Chanting Goshawk *Melierax canorus* in flight over

the area. This bird was seen soaring at a low to moderate height (<200 m), for a period of a few minutes. Besides the predominantly terrestrial Karoo Korhaan 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 of raptors and other larger species of concern were located during the field survey. However, it may be possible that species such as the Secretarybird may use solitary *Boscia* or other tree species for nesting, which may have been missed during the site visits. Although given the relatively limited extent of the site and the open nature of the study area, this seems unlikely.

In essence, much of the avifauna of the broader study area appears fairly similar to that found across the Kalahari and Nama-Karoo bioregions of the Northern Cape. The absence of communal or solitary roosting and nesting sites for red-listed species at the broader project site ensures that no species are at immediate risk. Although a relatively high proportion of near-endemic and biome-restricted species occur at the site, many of these have wide ranges or are highly nomadic within the bioregion. A number of species are using the area primarily for foraging as part of their normally large home ranges and are therefore not likely to be significantly impacted by the temporary loss of a portion of foraging habitat during construction of the grid connection infrastructure. Large tracks of suitable habitat remain in the broader study area, particularly to the north of the grid connection corridor. Species which clearly use the broader study area as part of their foraging ranges include White-backed Vulture, Lappet-faced Vulture, Martial Eagle, Tawny Eagle, Lanner Falcon, and Secretarybird. However, at least two Near-Threatened species, namely Karoo Korhaan and Kori Bustard, are likely to be temporarily displaced from the site as these species are strictly ground-dwelling foragers. These species do however have very wide national ranges and therefore their regional and national populations will not be impacted. In essence, the sensitivity of the area in general can therefore be considered to be of medium significance with respect to avifauna.

Table 4. Red-listed species recorded in the broader study area during SABAP1 (1987-1991), SABAP2 (2007 on-going) and the spring (4 to 8 October 2018) and late summer (9 to 12 April 2019) site visit, ranked according to their red-list status. All species besides White-backed Vulture, Ludwig's Bustard and Tawny Eagle have been recorded during the SABAP2 period. Seven species were observed during the two site visits (marked in bold).

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**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Vulture, Lappet-faced	***Torgos tracheliotos***	**Endangered**	**Low**	**Savanna**	**Recorded**	**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**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Eagle, Tawny	*Aquila rapax*	Endangered	Low	Savanna & Karoo plains	High	Habitat loss/Disturbance Collisions/Electrocution
Falcon, Lanner	***Falco biarmicus***	**Vulnerable**	**Moderate**	**Widespread**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Secretarybird	*Sagittarius serpentarius*	Vulnerable	Moderate	Open savanna & grassland	High	Habitat loss/Disturbance Collisions
Stork, Black	*Ciconia nigra*	Vulnerable	Low	Water bodies	Low	Collisions
Bustard, Kori	***Ardeotis kori***	**Near-Threatened**	**Moderate**	**Open savanna**	**Recorded**	**Habitat loss/Disturbance Collisions**
Harrier, Pallid	Circus macrourus	Near-Threatened	Low	Grassland & floodplains	Low	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

3.4 CURRENT BASELINE & CUMULATIVE IMPACT

There are a large number of proposed and approved solar energy developments with the associated grid connection infrastructure in the Upington area, concentrated mainly between the N14 and N10 roads. The potential for cumulative impact of solar energy development with the associated grid connection infrastructure in the area is therefore a potential concern. The total estimated direct footprint of the existing approved projects is estimated at as much as 9000ha, should all proposed projects in the area be established. These are largely concentrated within the plains habitat of the Kalahari Karroid Shrubland and the Gordonia Duneveld vegetation types, which are widespread habitats with relatively low avifaunal diversity. As these vegetation types are rather extensive, the loss of portions of these habitats due to grid connection infrastructure is not significant regionally. The major concern would be with respect to the impacts on landscape connectivity more locally. The location of the current proposed grid connection adjacent to the proposed Khunab solar PV projects as well as the presence of an existing power line along some of the route are certainly mitigating circumstances which would serve to reduce the cumulative impact associated with the current development. This will also reduce the potential for collisions with large raptors and terrestrial birds (e.g. bustards) since the grid connection corridor will mostly be traversing adjacent to solar fields. The contribution of the current grid connection project at approximately 13 km in length is considered relatively low and would result in a low additional contribution to cumulative impact in the area and as such is considered acceptable.

3.5 AVIAN SENSITIVITY ASSESSMENT

Important avian microhabitats 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 site visits.

The broader study area supports three main avifaunal microhabitats, which are referred to as the plains, drainage lines, and small pans. These three habitats have marginally different sensitivities, due to the subtle differences in the avifaunal assemblages that they support. The plains habitat supports a mosaic of open gravel to sandy plains traversed by drainage lines, contributing to the habitat diversity of the area. The plains support the Near-Threatened Karoo Korhaan (primarily along the eastern boundary of the broader study area) and Kori Bustard, and the Endangered Ludwig's Bustard in favourable years. The plains habitat also supports numerous protected trees, *B. foetida subsp. foetida,* and is therefore considered to be of Medium Sensitivity and Medium-High sensitivity in areas where Karoo Korhaan are abundant. The drainage lines and small pans are a restricted habitat within the

broader study area, and due to the denser vegetation they support, can be considered to be of High Sensitivity even though red-listed species may not be directly associated with these habitats. The development of the grid connection infrastructure within the corridor on the lower sensitivity parts of the site, will generate low impacts on the avifauna, provided suitable mitigation measures are employed during construction and operation of the proposed project. The construction phase of the development would result in the temporary displacement of avifauna of local significance, such as Karoo Korhaan and Kori Bustard. Other species appear to occur too sparsely to be negatively impacted by disturbance during the construction phase.

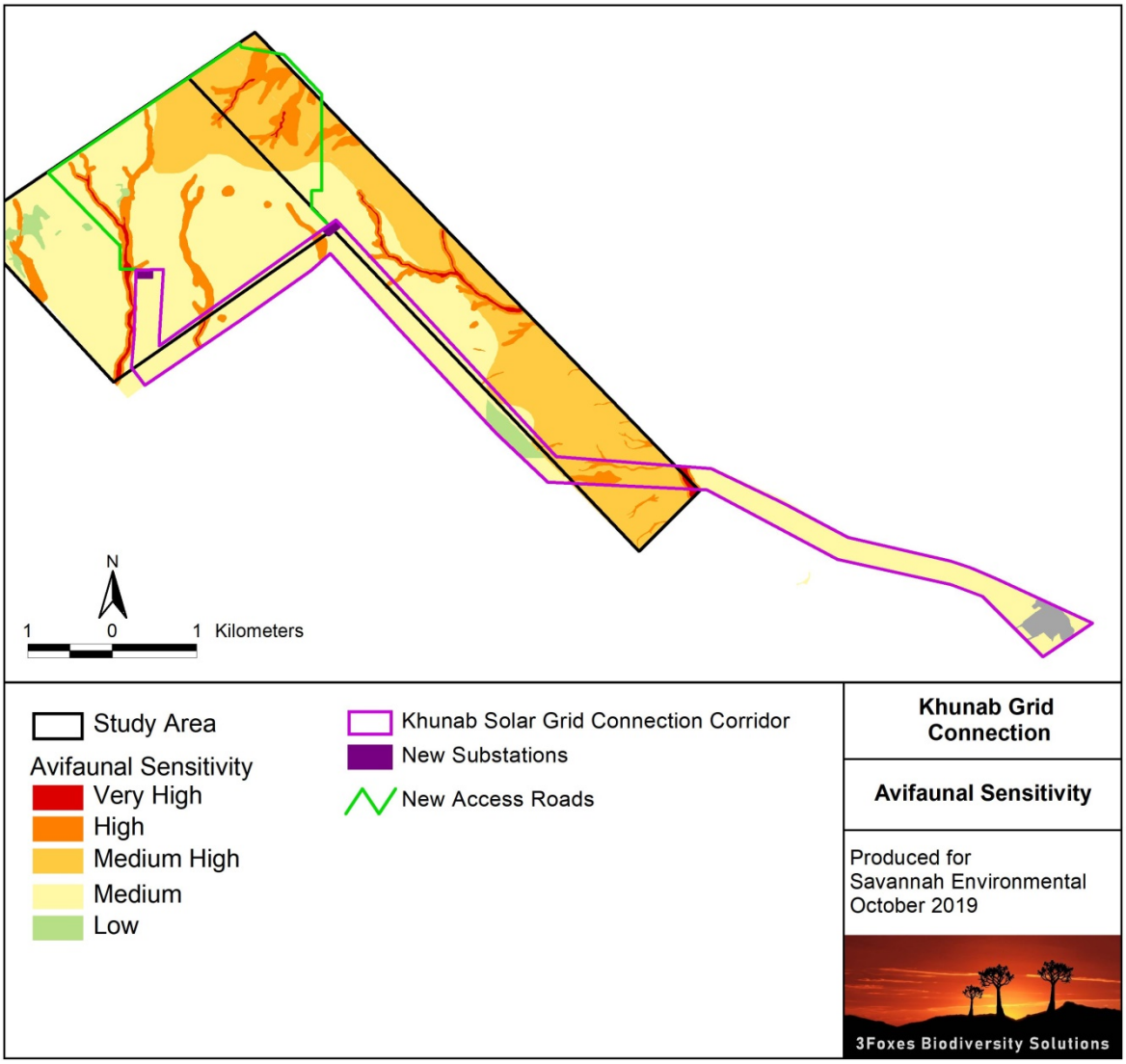

Figure 8. Avifaunal sensitivity map for the Khunab Grid Conenction corridor as well as the adjacent Khunab site where the Khunab PV projects would be located.

4 IDENTIFICATION & NATURE OF IMPACTS

In this section, the potential impacts and associated risk factors that may be generated by the proposed grid connection 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 grid connections related to PV facilities are the following:

- Collision and electrocution caused when perching on or flying into 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 habitat on the site represents typical vegetation of the broader area, with no features of concern which are expected to be severely impacted by the proposed grid connection. Of the twelve red-listed species that are known to occur in the broader area, seven were seen during the site visit, while most of the near-endemic species and biome-restricted species occur throughout much of the vegetation type. While the development may have an insignificant impact on most of the species, it may nevertheless impact some of the larger terrestrial birds and diurnal raptors through direct collisions with the power line cables and electrocution. Species are expected to be impacted to varying degrees based on their life-history strategies, abundance and general susceptibility to the threats posed by power lines, as well as the type of pylons/towers constructed and appropriate marking of power cables with bird diverters.

4.1 IDENTIFICATION OF POTENTIAL IMPACTS AND DAMAGING ACTIVITIES

In this section each of the potential impacts on avifauna associated with the construction and operation of the grid connection are 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. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed.

Potential avifaunal impacts resulting from the development of the Khunab Solar Grid Connection 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 poaching and uncontrolled collection of fauna and flora for traditional medicine or other purpose.
- Site clearing, and exploration activities for the grid connection may have a negative impact on avifaunal biodiversity if this is not conducted in a sensitive manner.

Construction Phase

- Vegetation clearing for the grid connection 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.
- Increased human presence can lead to poaching, illegal fauna collecting and other forms of disturbance such as fire.

Operational Phase

- The operation of the grid connection infrastructure will generate minor disturbance which may deter some avifauna from the area, especially red-listed avifaunal species which are less tolerant of disturbances.
- Mortality among the local avifauna may result due to direct collisions with power lines and electrocution with power line infrastructure (Lehman *et al*., 2007, Jenkins *et al*., 2010).

Cumulative Impacts

- The development of the grid connection infrastructure will contribute to cumulative impacts in the area and may potentially affect the ability to meet future conservation targets. However, the total footprint of the development would be less than 10ha, which is not considered to be a highly significant impact. It is however assessed as there are numerous other facilities and associated grid connections in the area and the cumulative impact of numerous power lines may generate a more significant impact overall.
- Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora 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). However, the expected habitat transformation for the proposed grid connection is minimal.

- The erection of new power line corridors can also have a cumulative impact, which may only become discernible 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 temporary displacement from the area encompassed by the grid connection footprint as a result of minor habitat destruction and disturbance. While numerous species will be impacted, all of these species have large distribution ranges and due to the temporary nature of the impact, will therefore experience insignificant population declines in the area, and not regionally or nationally. Some of the most abundant species which may be impacted, and which are also common in neighbouring habitats, include primarily Spike-heeled Lark, Sabota Lark, Fawn-coloured Lark, Eastern Clapper Lark, Rufous-eared Warbler, Chat Flycatcher, and Black-chested Prinia, amongst others. The loss of habitat and disturbance will not be permanent during the operational phase of the grid connection infrastructure. The impacts in general can be expected to be minimal as these smaller species are far less susceptible to the associated impacts of power lines than larger-bodied 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 terrestrial Namaqua Sandgrouse *Pterocles namaqua*, Northern Black Korhaan, Double-banded Courser *Rhinoptilus africanus*, and most importantly the Near-Threatened Karoo Korhaan. While some of these species may be susceptible to collisions with power lines, this is not expected to have a major impact on most of these species. Their smaller size and hence better maneuverability, as well as sedentary lifestyle and knowledge of their environs, ensures that they have a much lower probability of colliding with power lines (Shaw 2013).

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, Lappet-faced Vulture, Martial eagle, Tawny Eagle, Secretarybird, and the Near-Threatened Kori Bustard. Most of these species are 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; Jenkin *et al*., 2011; Shaw, 2013). However, the only species which are highly susceptible include Ludwig's Bustard, Kori Bustard and Secretarybird (Jenkins *et al.*, 2010). An additional threat faced by the large raptors is electrocution when perched or attempting to perch on power line structures (Lehman *et al*., 2007), but this depends largely on the type of pylons or towers used. Electrocutions can further be avoided to a large extent by employing suitable mitigation methods. Disturbances during construction of the grid connection is also expected to have a negative impact by temporarily displacing birds from foraging habitat. Hence it is essential that all impact mitigations are employed to ensure minimal potential disturbance and mortalities.

5 ASSESSMENT OF IMPACTS

The various identified avifaunal impacts are assessed below for the proposed grid development. It is important to note that this is contingent on the layout as provided and any changes to the layout or project description would potentially invalidate the assessment.

5.1 KHUNAB SOLAR GRID CONNECTION

The following is an assessment of the Khunab Solar Grid Connection, for the planning and construction and operational phases of the development. The construction phase will result in limited direct loss of habitat due to some clearing of vegetation and avifaunal microhabitats along the grid connection corridor. Disturbances will be caused by increased traffic of vehicles along the corridor during construction. Potential collisions and electrocutions along the power line will be potential impacts during the operational phase, but may also contribute to the cumulative impacts of the project. The decommissioning phase of the project will also result in limited loss of habitat due to disturbance of vegetation and avifaunal microhabitats along the grid connection corridor. Disturbances will also be caused by increased traffic of vehicles along the grid connection corridor during the decommissioning phase.

5.1.1 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 (5)	Low to Moderate (4)
Probability	Highly likely (4)	Probable (3)

Significance	Medium (32)	Low (21)
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	• Pre-construction walk-through of the power line route to identify areas of avifaunal sensitivity and where bird diverters should be attached. • Prior to construction, the design and layout of 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). • 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, and should traverse transformed habitats such as solar fields 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). • Impact near to important habitats such as at the major drainage lines traversed by the grid connection corridor, that may serve as breeding sites for large raptors should, be minimised. • 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 terrestrial species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of superstition. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • 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. • Any avifauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. • If lights are to be used at night for ensuring that infrastructure on site is lit, 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. • 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. • 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 the ECO and should be monitored until the birds have finished nesting and the fledglings have left the nest. • If holes or trenches need to be dug for pylons, these should not be left open for extended periods of time as terrestrial 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 Khunab Solar Grid Connection development will contribute to cumulative impacts on avifaunal habitat loss (minimal) and fragmentation, 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 total residual impact of habitat loss would however be 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 lines will remain a risk. This can be reduced further by 'staggering' the pylons in relation to existing pylons during construction, rather than aligning the pylons of adjacent power lines, so that the profile of the combined power lines will be more visible to flying birds.

*5.1.2 **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	Highly Likely (4)	Probable (3)
Significance	Medium (44)	Low (27)
Status	Negative	Negative
Reversibility	Medium	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 in reducing bird collisions and electrocutions, and hence 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 potential 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 grid connection corridor and associated infrastructure, especially during routine maintenance. • 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. • Impact near to important habitats such as stands of large trees, particularly in major drainage lines, that may be breeding sites for large raptors should be minimised.
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.

5.1.3 Decommissioning Phase Impacts

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 – some habitat disturbance/loss and 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	Highly Likely (4)	High Likely (4)
Significance	Low (28)	Low (24)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	The 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 terrestrial species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of fear or superstition. • This induction should also include awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, and 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 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 terrestrial 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. • All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.
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. Although the sensitivity of the affected habitat ranges from Medium to Very High, the overall residual impact on avifaunal habitat loss remains low as the habitat can be readily rehabilitated due to small footprint of the pylon infrastructure.

5.1.4 Cumulative Impacts

The following are the cumulative impacts that are assessed as being a likely consequence of the development of the Khunab Solar Grid Connection. 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 (dealt with specifically under Operational Impacts).		
	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	Impacts can be mitigated to some degree, but the majority of the long-term impact results from the presence of the grid connection and other developments in the area which cannot be well mitigated.	
Mitigation: • Initiate increased monitoring along the grid connection during periods when numbers of large nomadic species (e.g. Ludwig's Bustard) are highest, to determine any areas along the power lines where there are potentially high collision rates. Such areas should be fitted with bird diverters to reduce collisions rates. • Ensure that suitable avifaunal and ecological corridors within the broader study area are identified and maintained, whereby connectivity between areas of higher conservation value are preserved.		

6 CONCLUSION & RECOMMENDATIONS

The grid connection corridor lies within the Kalahari bioregion and supports a fairly typical avifaunal assemblage expected for the area. The diversity and density of birds is generally low, but may increase during favourable years when large numbers of nomadic species occupy the area. Eight (8) threatened and four (4) Near-Threatened species are known to occur within the broader study area, of which at least two terrestrial species (Karoo Korhaan, Kori Bustard) are common while others appear to occur more infrequently. The proposed Khunab Solar Grid Connection corridor route traverses open plains and drainage

lines, which are considered to be of Medium and High avifaunal sensitivity respectively. The area appears to support few species or features of concern, such as communal nesting or roosting sites of red-listed species, while there are also not known flight paths. Impacts on avifauna within the grid connection corridor are likely to be medium-low and no high post-mitigation impacts are likely.

The expected impacts of the proposed grid connection will include the following: 1) some habitat loss and fragmentation associated with the Kalahari Karroid Shrubland, 2) limited disturbance and displacement caused during the construction and maintenance phases, and 3) direct mortality of avifauna colliding with the power lines, as well as possible electrocutions with power line infrastructure, and 4) cumulative habitat loss at a broader scale from renewable energy developments in the area. Mostly large non-passerine species, many of which are red-listed, may be impacted by the minor and temporary loss of foraging habitat and disturbances, and potential collisions with the power line structures and electrocutions. However, given the extensive national ranges of these species, the impact of the development minimal and a long-term impact unlikely provided mitigation measures are taken.

Several mitigation measures can be implemented during the construction and operational phase of the proposed grid connection to reduce the impacts on the avifauna. During the construction phase, displacement and disturbance of avifauna can be reduced by restricting habitat loss and disturbance strictly to within the footprint of the development corridor. During the operational phase regular monitoring along the grid connection must be undertaken to identify areas of potential high collision risks. Monitoring intensity should be increased during periods when large nomadic species (e.g. Ludwig's Bustards in particular) are more common in the area, to establish any potential areas with high collision risk. With the implementation of the mitigation measures, the impact of the proposed grid connection 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 Upington area. In terms of habitat loss, the affected Kalahari Karroid Shrubland vegetation type is still approximately 90% intact, while it has an extensive range within the bioregion. 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 ecological gradient, and as such, the overall cumulative impact of the development is considered likely to be low.

The proposed route is therefore considered favourable. There are no known impacts associated with the development that are considered to be of high significance and which cannot be mitigated to a low level. Therefore, based on the results of this assessment, there are no reasons to indicate that the grid connection should not be authorised.

Avifaunal Impact Statement:

The proposed Khunab Solar Grid Development mostly traverses widespread habitat which supports a typical bioregional avifaunal assemblage with a relatively low species diversity and abundance in most years. Considering that there are no known breeding, roosting sites or major flight paths of red-listed priority species within the immediate vicinity, there are no impacts associated with the development of the Khunab Solar Grid Connection that are considered to be of high residual significance and which cannot be mitigated to a low level. Consequently, it is therefore the reasoned opinion of the specialist that the Khunab Solar Grid Connection can 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 Khunab Solar Grid Connection 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 grid connection 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, 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 the establishment of the grid connection corridor » 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	» Habitat transformation during construction. » Presence of construction crews. » Operation of heavy vehicles.	
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. » Where holes or trenches are to be dug, these should not be left open for extended periods of time as terrestrial 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. eggs).	ECO	Construction

» 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 footprint of the grid connection corridor. » Low disturbance and impact on red-listed avifaunal species. » 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 or nestlings) 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. » 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 the operation phase	
Project component/s	All activities which result in disturbance of avifauna, including: » Avifaunal collisions with power line » Avifaunal electrocutions with power line components » Human presence » Vehicle traffic
Potential Impact	» Mortality and disturbance of avifauna within the footprint of the grid connection corridor due to collisions with power lines and electrocutions, and disturbance due to presence of personnel and vehicle traffic.
Activity/risk source	» Avifaunal collisions with power lines and electrocutions. » Presence of operational phase personnel. » Presence of personnel during power line maintenance activities.
Mitigation:	Low disturbance and impact of avifauna, and low collision and

Target/Objective	electrocution rates of avifauna with power line infrastructure during operational phase.		
Mitigation: Action/control		Responsibility	Timeframe
» All incidents of collision with power line and electrocution should be recorded as meticulously as possible, including data related to the species involved, the exact location of each incident along the grid connection corridor, and suspected cause of death (collision or electrocution).		ECO	Operation
» 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 grid connection corridor 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 as nocturnal and crepuscular species. » 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.		Contractors	Operation
Performance Indicator	» Low mortality rates of avifauna due to collisions with power line and electrocutions. » 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 grid connection corridor. » No poaching or collecting of avifauna or their products (e.g. eggs or nestlings) 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	Annual monitoring for compliance during the operational phase. All avifaunal mortality incidents related to collisions and electrocutions or other causes to be noted.

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 the power line 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 the power line and other grid connection 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 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 grid connection corridor should be used where feasible, to avoid habitat loss and disturbance to adjoining areas. » The removal and clearing of the power line 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	Contractor	Decommissioning

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 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 and nestlings). » 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 a minimum within the grid connection corridor. » Low disturbance of avifauna within the grid connection corridor and adjacent areas.
Monitoring	ECO to monitor decommissioning activities 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 broader Khunab project site and surrounds, including records from SABAP1, SABAP2 and the two site visits, and includes red-list status (Taylor *et al.*, 2015), regional endemism (BirdLife South Africa, 2018), and SABAP2 reporting rates (based on nine cards). Species with a zero reporting rate were only recorded during SABAP1 and not SABAP2. Species highlighted in bold text were recorded during the site visit in spring (4 to 8 October 2018) and late summer (9 to 12 April 2019). Species with an asterix (*) are biome-restricted (Taylor *et al*., 2015).

Species name	Taxonomic name	Red-list Status	Regional Endemism	Reporting Rate (%)
Barbet, Acacia Pied	***Tricholaema leucomelas***			**44.4**
Batis, Pririt	***Batis pririt***			**22.2**
Bee-eater, European	*Merops apiaster*			22.2
Bee-eater, Swallow-tailed	*Merops hirundineus*			0.0
Bishop, Southern Red	***Euplectes orix***			**77.8**
Bokmakierie	***Telophorus zeylonus***			**77.8**
Brubru	*Nilaus afer*			0.0
Bulbul, African Red-eyed	*Pycnonotus nigricans*			11.1
Bunting, Lark-like	***Emberiza impetuani***			**88.9**
Bustard, Kori	***Ardeotis kori***	**Near-Threatened**		**22.2**
Bustard, Ludwig's*	***Neotis ludwigii***	**Endangered**		
Buzzard, Jackal	*Buteo rufofuscus*		Near-endemic	0.0
Buzzard, Steppe	*Buteo vulpinus*			11.1
Canary, Black-headed*	*Serinus alario*		Near-endemic	0.0
Canary, Black-throated	*Crithagra atrogularis*			0.0

Canary, White-throated	*Crithagra albogularis*			22.2
Canary, Yellow	***Crithagra flaviventris***			**66.7**
Chat, Anteating	***Myrmecocichla formicivora***			**55.6**
Chat, Familiar	***Cercomela familiaris***			**55.6**
Chat, Karoo*	***Cercomela schlegelii***			**11.1**
Chat, Sickle-winged*	*Cercomela sinuata*		Near-endemic	0.0
Chat, Tractrac*	***Cercomela tractrac***			**0.0**
Cisticola, Desert	***Cisticola aridulus***			**44.4**
Cisticola, Grey-backed	*Cisticola subruficapilla*			0.0
Cisticola, Zitting	*Cisticola juncidis*			11.1
Courser, Double-banded	***Rhinoptilus africanus***			**55.6**
Crombec, Long-billed	***Sylvietta rufescens***			**22.2**
Crow, Pied	***Corvus albus***			**88.9**
Cuckoo, Diderick	*Chrysococcyx caprius*			11.1
Dove, Ringed-necked	***Streptopelia capicola***			**44.4**
Dove, Laughing	***Streptopelia senegalensis***			**55.6**
Dove, Namaqua	***Oena capensis***			**88.9**
Dove, Red-eyed	*Streptopelia semitorquata*			0.0
Drongo, Fork-tailed	*Dicrurus adsimilis*			0.0
Eagle, African Fish	*Haliaeetus vocifer*			11.1
Eagle, Booted	*Aquila pennatus*			11.1
Eagle, Martial	***Polemaetus bellicosus***	**Endangered**		**0.0**
Egret, Western Cattle	*Bubulcus ibis*			11.1
Eremomela, Yellow-bellied	***Eremomela icteropygialis***			**55.6**
Falcon, Lanner	***Falco biarmicus***	**Vulnerable**		**22.2**
Falcon, Pygmy	*Polihierax semitorquatus*			11.1
Finch, Red-headed	***Amadina erythrocephala***			**11.1**
Finch, Scaly-feathered	***Sporopipes squamifrons***			**66.7**
Firefinch, Red-billed	*Lagonosticta senegala*			0.0
Fiscal, Southern	***Lanius collaris***			**66.7**
Flycatcher, Chat	***Bradornis infuscatus***			**66.7**
Flycatcher, Fairy	*Stenostira scita*		Near-endemic	0.0
Flycatcher, Fiscal	*Sigelus silens*		Near-endemic	0.0
Flycatcher, Spotted	*Muscicapa striata*			0.0
Goose, Egyptian	***Alopochen aegyptiacus***			**66.7**
Goshawk, Pale Chanting	***Melierax canorus***			**77.8**
Greenshank, Common	*Tringa nebularia*			0.0
Guineafowl, Helmeted	*Numida meleagris*			0.0
Harrier, Pallid	*Circus macrourus*	Near-Threatened		11.1

Heron, Black-headed	*Ardea melanocephala*			11.1
Honeyguide, Lesser	*Indicator minor*			0.0
Hoopoe, African	*Upupa africana*			0.0
Ibis, African Sacred	*Threskiornis aethiopicus*			0.0
Ibis, Hadeda	***Bostrychia hagedash***			**44.4**
Kestrel, Greater	*Falco rupicoloides*			33.3
Kestrel, Rock	***Falco rupicolus***			**33.3**
Kingfisher, Striped	*Halcyon chelicuti*			0.0
Kite, Black-shouldered	*Elanus caeruleus*			0.0
Kite, Yellow-billed	*Milvus aegyptius*			0.0
Korhaan, Karoo*	***Eupodotis vigorsii***	**Near-Threatened**		**88.9**
Korhaan, Northern Black	***Afrotis afraoides***			**100.0**
Lapwing, Blacksmith	***Vanellus armatus***			**55.6**
Lapwing, Crowned	***Vanellus coronatus***			**22.2**
Lark, Black-eared Sparrow-*	***Eremopterix australis***		**Near-endemic**	**33.3**
Lark, Grey-backed Sparrow-	***Eremopterix verticalis***			**66.7**
Lark, Eastern Clapper	***Mirafra fasciolata***			**66.7**
Lark, Fawn-coloured	***Calendulauda africanoides***			**88.9**
Lark, Karoo Long-billed*	*Certhilauda subcoronata*			0.0
Lark, Red-capped	*Calandrella cinerea*			0.0
Lark, Sabota	***Calendulauda sabota***			**66.7**
Lark, Spike-heeled	***Chersomanes albofasciata***			**100.0**
Lark, Stark's*	***Spizocorys starki***			**22.2**
Lovebird, Rosy-faced	*Agapornis roseicollis*			0.0
Martin, Brown-throated	*Riparia paludicola*			0.0
Martin, Rock	***Hirundo fuligula***			**44.4**
Mousebird, Red-faced	***Urocolius indicus***			**33.3**
Mousebird, White-backed	***Colius colius***			**11.1**
Oriole, Eurasian Golden	*Oriolus oriolus*			0.0
Owl, Spotted Eagle-	*Bubo africanus*			11.1
Owl, Western Barn	*Tyto alba*			0.0
Owlet, Pearl-spotted	*Glaucidium perlatum*			0.0
Penduline-tit, Cape	***Anthoscopus minutus***			**11.1**
Pigeon, Speckled	***Columba guinea***			**33.3**
Pipit, African	*Anthus cinnamomeus*			11.1
Plover, Kittlitz's	*Charadrius pecuarius*			0.0
Plover, Three-banded	*Charadrius tricollaris*			22.2
Prinia, Black-chested	***Prinia flavicans***			**100.0**
Quail, Common	*Coturnix coturnix*			11.1

Quelea, Red-billed	***Quelea quelea***		**100.0**
Reed-warbler, African	*Acrocephalus baeticatus*		0.0
Robin, Kalahari Shrub*	***Cercotrichas paena***		**66.7**
Robin, Karoo Scrub	***Cercotrichas coryphoeus***		**22.2**
Robin-chat, Cape	*Cossypha caffra*		0.0
Rock-thrush, Short-toed	*Monticola brevipes*		0.0
Ruff	*Philomachus pugnax*		0.0
Sandgrouse, Namaqua	***Pterocles namaqua***		**100.0**
Sandpiper, Common	*Actitis hypoleucos*		0.0
Sandpiper, Curlew	*Calidris ferruginea*		0.0
Sandpiper, Marsh	*Tringa stagnatilis*		0.0
Sandpiper, Wood	*Tringa glareola*		0.0
Scimitarbill, Common	*Rhinopomastus cyanomelas*		0.0
Secretarybird	*Sagittarius serpentarius*	Vulnerable	22.2
Shelduck, South African	***Tadorna cana***		**33.3**
Shikra	*Accipiter badius*		0.0
Shrike, Lesser Grey	*Lanius minor*		11.1
Shrike, Red-backed	*Lanius collurio*		0.0
Sparrow, Cape	***Passer melanurus***		**66.7**
Sparrow, House	*Passer domesticus*		11.1
Sparrow-weaver, White-browed	***Plocepasser mahali***		**33.3**
Starling, Cape Glossy	*Lamprotornis nitens*		0.0
Starling, Pale-winged*	*Onychognathus nabouroup*		0.0
Starling, Wattled	*Creatophora cinerea*		0.0
Stilt, Black-winged	*Himantopus himantopus*		33.3
Stint, Little	*Calidris minuta*		0.0
Stork, Abdim's	*Ciconia abdimii*	Near-Threatened	0.0
Stork, Black	*Ciconia nigra*	Vulnerable	0.0
Sunbird, Dusky	***Cinnyris fuscus***		**77.8**
Swallow, Barn	***Hirundo rustica***		**33.3**
Swallow, Greater Striped	***Cecropis cucullata***		**11.1**
Swallow, Pearl-breasted	***Hirundo dimidiate***		
Swallow, White-throated	*Hirundo albigularis*		11.1
Swift, African Palm	***Cypsiurus parvus***		**11.1**
Swift, Alpine	***Tachymarptis melba***		**0.0**
Swift, Common	*Apus apus*		11.1
Swift, Little	***Apus affinis***		**66.7**
Swift, White-rumped	*Apus caffer*		0.0
Teal, Cape	*Anas capensis*		0.0

Teal, Red-billed	*Anas erythrorhyncha*			11.1
Thick-knee, Spotted	*Burhinus capensis*			0.0
Thrush, Karoo	*Turdus smithi*		Near-endemic	0.0
Tit-Babbler, Chestnut-vented	***Sylvia subcaerulea***			**66.7**
Tit, Ashy	*Parus cinerascens*			0.0
Vulture, White-backed	***Gyps africanus***	**Critically Endangered**		
Wagtail, Cape	*Motacilla capensis*			22.2
Warbler, Icterine	*Hippolais icterina*			0.0
Warbler, Rufous-eared	***Malcorus pectoralis***			**100.0**
Waxbill, Common	*Estrilda astrild*			0.0
Weaver, Sociable*	***Philetairus socius***			**100.0**
Weaver, Southern Masked	***Ploceus velatus***			**55.6**
Wheatear, Capped	***Oenanthe pileata***			**44.4**
Wheatear, Mountain	***Oenanthe monticola***			**0.0**
White-eye, Orange River	*Zosterops pallidus*			0.0
Whydah, Pin-tailed	*Vidua macroura*			0.0
Woodpecker, Cardinal	*Dendropicos fuscescens*			0.0
Woodpecker, Golden-tailed	*Campethera abingoni*			0.0