BASIC ASSESSMENT FOR THE PROPOSED GRID CONNECTION FOR THE AGGENEYS 2 SOLAR PV FACILITY LOCATED NEAR AGGENEYS IN THE NORTHERN CAPE:

AVIFAUNAL SPECIALIST BASIC ASSESSMENT REPORT

Red Lark *Calendulauda burra*

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

3Foxes Biodiversity Solutions

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EXECUTIVE SUMMARY

ABO Wind Aggeneys 2 PV (Pty) Ltd is proposing the establishment of the grid connection infrastructure for the Aggeneys 2 solar PV facility, located near to Aggeneys in the Northern Cape. As the grid connection infrastructure falls within the Northern Transmission Corridor and the capacity of the power line is up to 220kV, a basic assessment process is required for authorisation. Savannah Environmental has appointed 3Foxes Biodiversity Solutions to provide a specialist avifaunal Basic Assessment (BA) for the proposed grid connection infrastructure.

This specialist study details the avifaunal characteristics of the grid connection infrastructure (Alternative 1 and 2), and the possible impacts on the local avifauna. The impacts for the various phases of the development of the proposed grid connection infrastructure 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 over two seasons as well as a desktop review of the available avifaunal information for the area was conducted in order to identify and characterise the avifaunal features along the grid connection alternatives. An approximate total of 105 bird species have been recorded within the broader study area, of which 54 species were observed during the site visit in winter (June 2018) and summer (March 2019). Eight (8) of these are red-listed as Threatened while a further four (4) are Near-threatened. One species, the Vulnerable Red Lark *Calendulauda burra*, is endemic to South Africa, while fourteen (14) other species are near-endemic. Twelve species are listed as biome-restricted, and include a number of lark species in particular. The proposed grid connection infrastructure traverses the southern portion of an Important Bird Area (IBA) known as Haramoep and Black Mountain Mine. This IBA is one of only a few sites that provides protection to the globally threatened Red Lark. The IBA also supports a number of other red-listed species, while it is also important for seasonally occurring nomadic larks.

The expected impacts of the proposed grid connection infrastructure include 1) minor habitat loss associated with the Bushmanland Sandy Grassland and Bushmanland Arid Grassland vegetation types, 2) disturbance caused during the construction and maintenance phases, and 3) direct mortality of avifauna colliding with power line structures as well as electrocutions with power line infrastructure. The species that will be the most negatively impacted by the proposed development include mostly large raptors and terrestrial birds that occasionally use the area for foraging. The impacts on the avifauna would normally be expected to be of high importance, but due to the low frequency of occurrence of priority red-listed species and the wide distribution and nomadic movements of many species, the impacts are likely to be medium low and no high post-mitigation impacts are expected. The

grid connection Alternative 1 is the preferred route from an avifaunal perspective for a number of reasons, 1) it is the shortest route connecting the solar energy facility to the Aggeneis Main Transmission Substation (MTS), 2) it follows the existing Aggeneis / Aries 400kV power line which may reduce the possibility of collisions between birds and the power lines, and 3) it traverses the northern margin of the dune habitat (High sensitivity) and will therefore not impact this habitat directly.

The primary mitigation measures required to reduce the potential impacts on priority species would include 1) restrict habitat destruction and disturbance to within the footprint of the proposed grid connection development corridor, 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.

Considering that the affected area supports a typical Nama-Karoo bioregional avifaunal assemblage, and that there are no known breeding or roosting sites of red-listed priority species within the study area, and that most near-endemics and biome-restricted species have wide distribution ranges, 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 low level. Therefore, there are no fatal flaws from an avifaunal perspective that should prevent the development from proceeding.

Cumulative impacts associated with the development may be of moderate concern due to increasing number of solar facility developments and associated grid connections proposed for the broader Aggeneys area. Considering that the vegetation and avifauna that occur in the area are rather typical of the Nama-Karoo bioregion, the overall cumulative avifaunal impact of the development is, however, considered likely to be low.

Avifaunal Impact Statement:

The proposed grid connection infrastructure for the Aggeneys 2 solar PV facility 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 or roosting sites of red-listed priority species within the immediate vicinity, there are no impacts associated with the development of the power line and the collector substation that are considered to be of high residual significance and which cannot be mitigated to a low level. Consequently, it is the reasoned opinion of the specialist that the grid connection infrastructure (Alternative 1) can therefore be authorised, subject to the implementation of the recommended mitigation measures. Should this alternative not be feasible due to technical or other reasons, then Alternative 2 is considered to be acceptable but somewhat less desirable.

CONTENTS

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

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

SHORT CV/SUMMARY OF EXPERTISE

Simon Todd 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 Avifaunal Studies include the following:

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

SPECIALIST DECLARATION 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: ____8 April 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;
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- I have no vested interest in the proposed activity proceeding;
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- 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: ____Eric Herrmann_____

Date: ____8 April 2019_____

1 INTRODUCTION

ABO Wind Aggeneys 2 PV (Pty) Ltd is proposing the establishment of the grid connection infrastructure for the Aggeneys 2 solar PV facility, located near to Aggeneys in the Northern Cape. As the project development corridors fall within the Northern Transmission Corridor, a basic assessment process is required for authorisation. Savannah Environmental has appointed 3Foxes Biodiversity Solutions to provide a specialist avifaunal Basic Assessment (BA) for the proposed grid connection infrastructure.

This specialist study details the avifaunal characteristics of the grid connection alternatives and the possible impacts on the local avifauna. The impacts for the various phases of the development of the proposed grid connection infrastructure 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.

1.1 SCOPE OF STUDY

The assessment is conducted according to the 2014 EIA Regulations (Government Notice Regulation 326) 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 assessments within solar energy facilities as outlined by Birdlife South Africa.

The scope of the study includes the following activities

- a description of the avifauna that may be affected by the activity and the manner in which the avifauna may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts on the avifauna (including assessment of 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 and Construction Phase
- Operation Phase
- Decommissioning Phase

1.2 RELEVANT ASPECTS OF THE DEVELOPMENT

The grid connection infrastructure assessed in this report is considered to be the grid connection solution for the Aggeneys 2 solar PV facility and includes the development of specific infrastructure in order to enable the connection establishment. The infrastructure includes:

» A collector substation;
» A single-circuit overhead power line up to 220kV; and
» Access tracks/roads.

Two alternative corridors of up to 1km in width and up to 17km in length (known as the project development corridors) are being assessed:

» **Alternative 1:** A collector substation located adjacent to the facility substation in the south-eastern corner of the PV facility project site, as well as a single-circuit power line up to 220kV and approximately 14km in length, connecting to the Aggeneis Main Transmission Substation (MTS). This corridor is located directly adjacent and parallel to the existing Aries-Aggeneys 400kV line. This is considered to be the preferred option from a technical perspective due to the fact that the power line is shorter compared to Alternative 2.

» **Alternative 2:** A collector substation located adjacent to the facility substation within the northern portion of the PV facility project site, as well as a single-circuit power line up to 220kV and approximately 17km in length connecting to the Aggeneis MTS. This is considered to be the alternative option from a technical perspective.

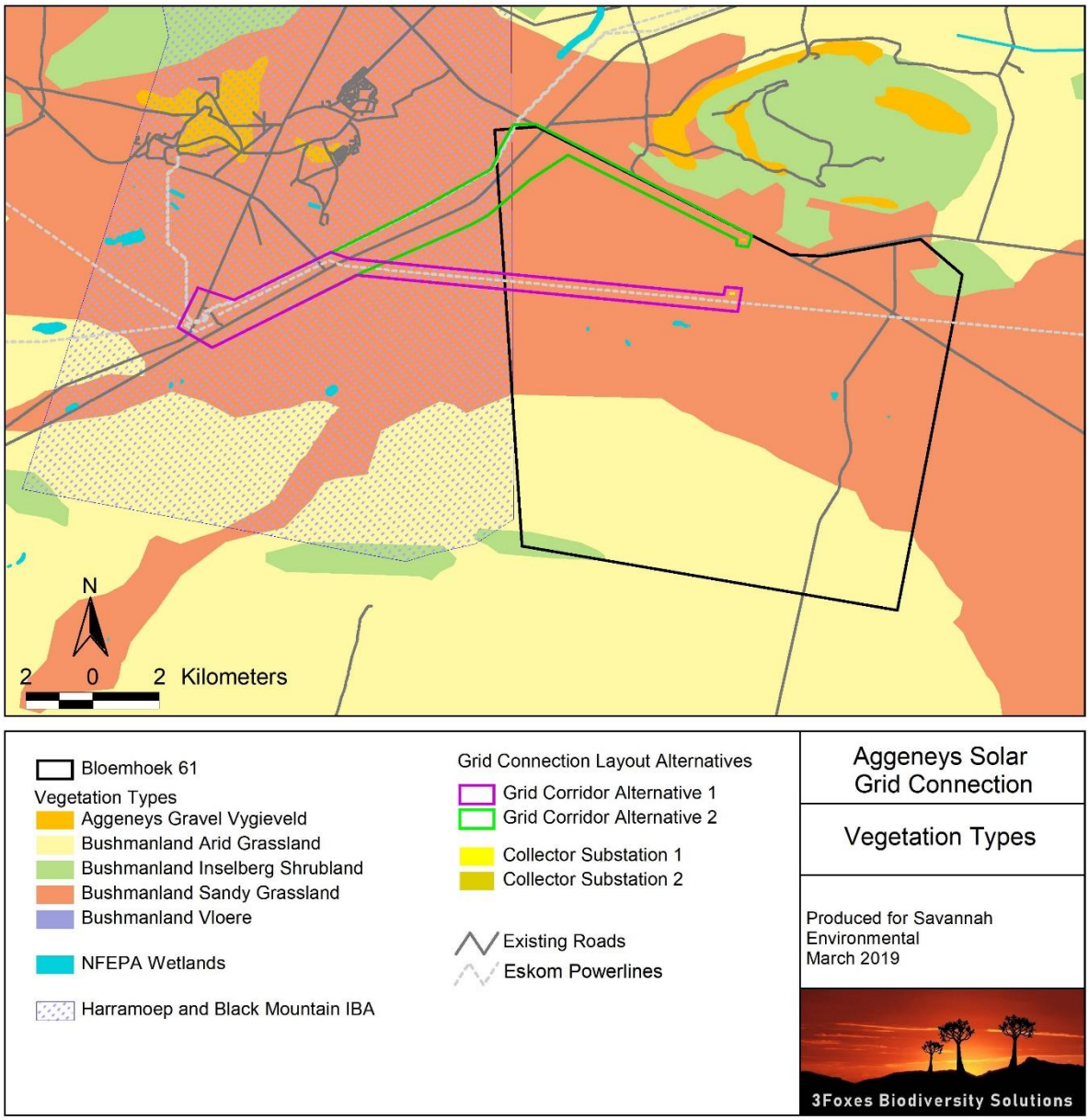

Figure 1. The layout of the Aggeneys 2 Grid Connection corridor alternatives and associated infrastructure, showing the two proposed alternatives and the vegetation of the broad area as context. The Haramoep and Black Mountain Mine Important Bird Area (IBA) which occurs in the west of the corridor alternatives is also illustrated.

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 study area. The relevant quarter-degree grid cell (QDGC) that covers the study area is 2918BD (69 cards, 159 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 study area being 2915_1855 (26 cards, 72 species), 2915_1850 (3 cards, 43 species), and 2915_1845 (7 cards, 86 species). These were consulted to determine the bird species likely to occur within the broader study area and the broader impact zone of the development.
- The Important Bird Areas of South Africa (IBA; Marnewick *et al*., 2015) was consulted to determine the location of the nearest IBAs to the study area.
- 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 study area.
- 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 study area.
- The conservation status, and biology of all species considered likely to occur within the study area 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 study area.

The literature review revealed that there is one Important Bird Area (IBA) that encompasses the study area, namely the Haramoep and Black Mountain Mine IBA. Apart from this IBA, there are no other areas of conservation concern or Coordinated Avifaunal Roadcounts (CAR) routes or Coordinated Waterbird Counts (CWAC) wetlands in the vicinity of the study area.

2.2 SITE VISIT & FIELD METHODOLOGY

The study area was visited on two occasions for three days, once in mid-winter (26 to 28 June 2018) and again in late summer (20 to 22 March 2019), to determine the *in situ* local avifauna and avian habitats present in the study area. Conditions for recording avifaunal species were considered optimal in winter, as the area had received relatively good rains during late summer, resulting in large numbers of nomadic species occupying the study area and surrounds. In contrast, the conditions during the summer survey were extremely dry and harsh owing to very poor rainfall, resulting in very low numbers of birds being recorded.

An intensive avifaunal survey was conducted within the Blomhoek 61 property which involved walking linear transects (30 transects in winter, 19 transects in summer) measuring 1km in length across the site. The number of birds seen or heard along each transect were recorded, as well as the perpendicular distance from the transect line to each bird 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. The walked transects served primarily to:

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

Apart from the fieldwork within the area in and around the solar PV facility, the development corridors were surveyed for birds during the field surveys. Additional information to inform the current study was also used where relevant, this includes avifaunal surveys that were conducted within the Black Mountain conservation area along Corridor Alternative 1 as well as surveys around Gamsberg along the Loop10 road along Alternative 2.

A list was compiled of all the avifaunal species likely to occur within the study area and the broader impact zone of the development, 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 study area was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases with mapping based on the satellite imagery of the site as well as personal knowledge of the site. This includes delineating different habitat units identified on the satellite imagery and assigning likely sensitivity values to the units based on their avifaunal value, conservation priority and the potential presence of avifaunal species of conservation concern. The avifaunal sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with low avifaunal sensitivity where there is likely to be a negligible impact on ecological processes and avifaunal biodiversity. Most development types can proceed within these areas with little ecological impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impacts are 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 impact is anticipated due to high avifaunal diversity, sensitivity or important avifaunal habitat role of the area. These areas may contain or be important habitat for avifaunal species or provide important services such as water flow regulation for wetlands or other important avifaunal habitats. 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 or nesting sites for rare/endangered species or represent other critical areas such as migration corridors. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

2.4 SAMPLING LIMITATIONS AND ASSUMPTIONS

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

- The SABAP 1 data for the relevant quarter degree squares covering the broader area are now >21 years old (Harrison *et al*., 1997). However, with over 25 cards being submitted for the relevant pentad that covers the broader area during SABAP 2, relatively reliable data exist with respect to species reporting rates. In an attempt to ensure a conservative approach with regards to the species included on the final

avifaunal list (Annexure 1), the species list derived from the literature was obtained from an area somewhat larger than the project site, and thus likely includes a much wider array of species than what actually occurs at the site.

- 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 study area is not that large and hence has been well-covered. Also, as it contains few large trees, it is highly unlikely that there are any significant nesting sites of larger species present within the affected area that would not have been detected.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 Context & Avifaunal Microhabitats of the Study Area

The vegetation of the study area lies within the range to two vegetation types, namely Bushmanland Sandy Grassland and Bushmanland Arid Grassland (Figure 1). According to Mucina & Rutherford (2006), the power line footprint and collector substation options are restricted to Bushmanland Sandy Grassland. However, the latest revision of Vegmap (2017, Unpublished) is more accurate and has the majority of the affected area classified as Bushmanland Arid Grassland and only the dune system of the Koa River is still considered to be Bushmanland Sandy Grassland. Bushmanland Arid Grassland is the second most extensive vegetation type in South Africa, and extends from Aggeneys eastwards to Prieska. Due to the aridity of this vegetation type, it has not been significantly impacted by intensive agriculture with only 1% being transformed. The soils of this vegetation type are mostly shallow (<300mm deep), red-yellow apedal (without structure) and freely drained. Grasses such as *Stipagrostis* and *Aristida* species dominate the vegetation, while small trees such as *Acacia mellifera* subsp. *detinens* and *Boscia foetida* occur. Along large parts of Corridor Alternative 1 as well as to the south of the Aggeneys 2 solar PV facility footprint, the vegetation comprises Bushmanland Sandy Grassland, characterised by deep red sands (>300mm), forming dunes in places. Dominant grasses include *Stipagrostis* and *Schmidtia*, with conspicuous shrubs such as *Rhigozum trichotomum.* This vegetation type represents the primary habitat of the endemic and Vulnerable Red Lark that occurs within the area.

Two avifaunal microhabitats were identified within the affected area, and are directly associated with the two main vegetation types. The Bushmanland Arid Grassland vegetation type represents the plains habitat (Figure 2, Figure 3), while the Bushmanland Sandy Grassland represents the dune habitat (Figure 4). The Bushmanland Sandy Grassland habitat is restricted to the central section of Corridor Alternative 1, while the plains habitat occurs across the rest of the affected area. Although not within the project development corridors, the inselbergs represent the Bushmanland Inselberg Shrubland vegetation type, but are an important feature for avifauna in the area as they provide a different vegetation

and habitat structure for avifauna and also nesting sites for large raptors such as Verreaux's Eagle *Aquila verreauxii*.

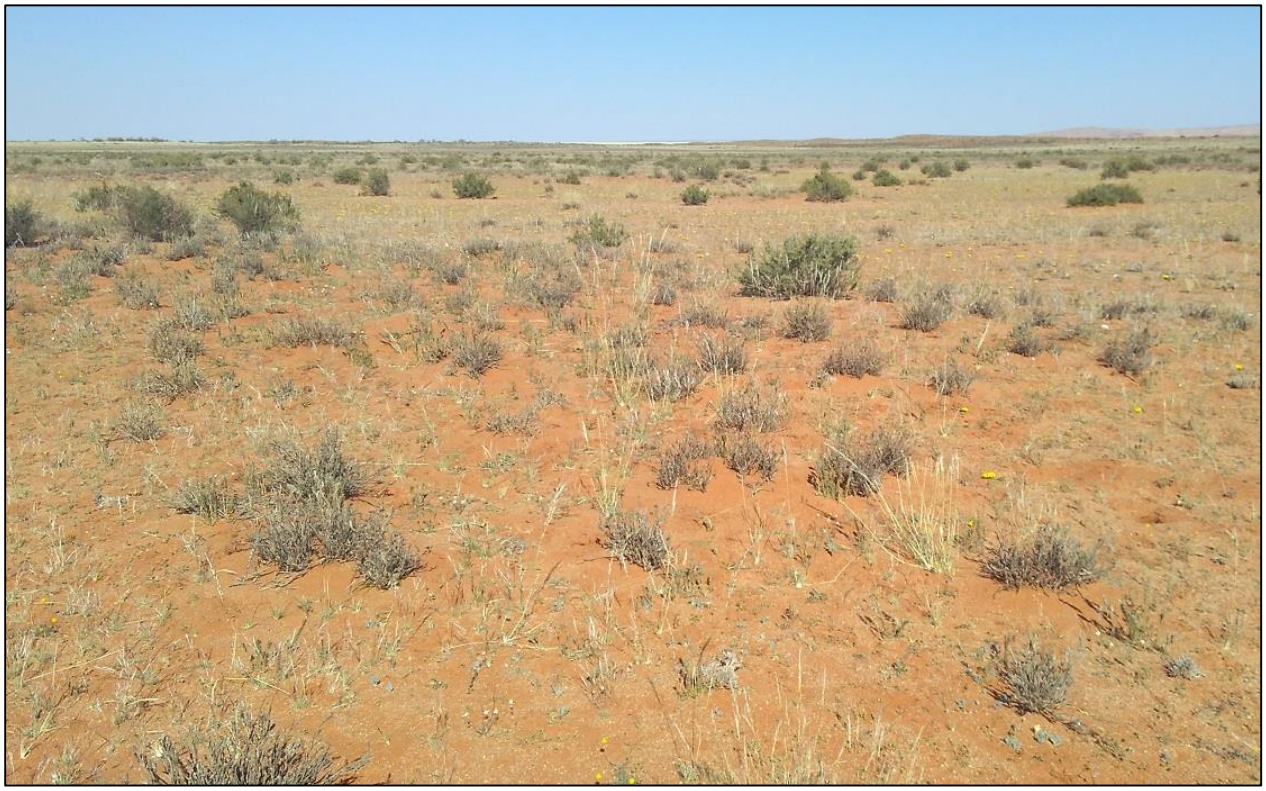

Figure 2. The whole of Corridor Alternative 2 lies within the plains habitat within the Bushmanland Arid Grassland vegetation type, pictured here within the Aggeneys 2 solar PV facility footprint area and showing the typical habitat that would be affected by the on-site substation.

Figure 3. Looking down Corridor Alternative 2 towards the Eskom Aggeneis MTS, showing the typical plains habitat in this section of the route, as well as the large number of power lines already present in the vicinity of the existing substation.

Figure 4. The dune habitat lies within the Bushmanland Sandy Grassland vegetation type, which lies mostly in the west of the study area. This is the primary habitat for the endemic and Vulnerable Red Lark.

Figure 5. Sandy grassland dominated by *Stipagrostis brevifolia* along Corridor Alternative 1 near the N9.

3.2 General Avifauna

The bird assemblage recorded within the study area is typical of the Nama-Karoo bioregion. An approximate total of 105 bird species have been recorded within the broader study area, of which 54 species were observed during the two site visits. Eight of these are red-listed while a further four are Near-threatened. One species (Red Lark) is endemic to South Africa, while fourteen species are near-endemic. Twelve species are listed as biome-restricted, which include a number of lark species in particular. Numerous others that have been recorded are arid-zone species, which follow either resident or nomadic life strategies.

A total of 38 bird species were recorded during the transect surveys during both seasons, with 31 and 28 species recorded in winter and summer respectively. Small passerines species made up the majority (ca. 70%) of the species detected, compared to non-passerines. Significantly more species and birds were detected in winter compared to summer (Figure 6), with total bird abundance being five times greater. The good veld conditions that prevailed during winter (June 2018) resulted in numerous nomadic species being attracted to the area, whereas the arid conditions in late summer (March 2019) resulted in many of these species being almost entirely absent. This illustrates the extremes

in bird abundances that occur depending on local conditions and the corresponding response by nomadic bird species.

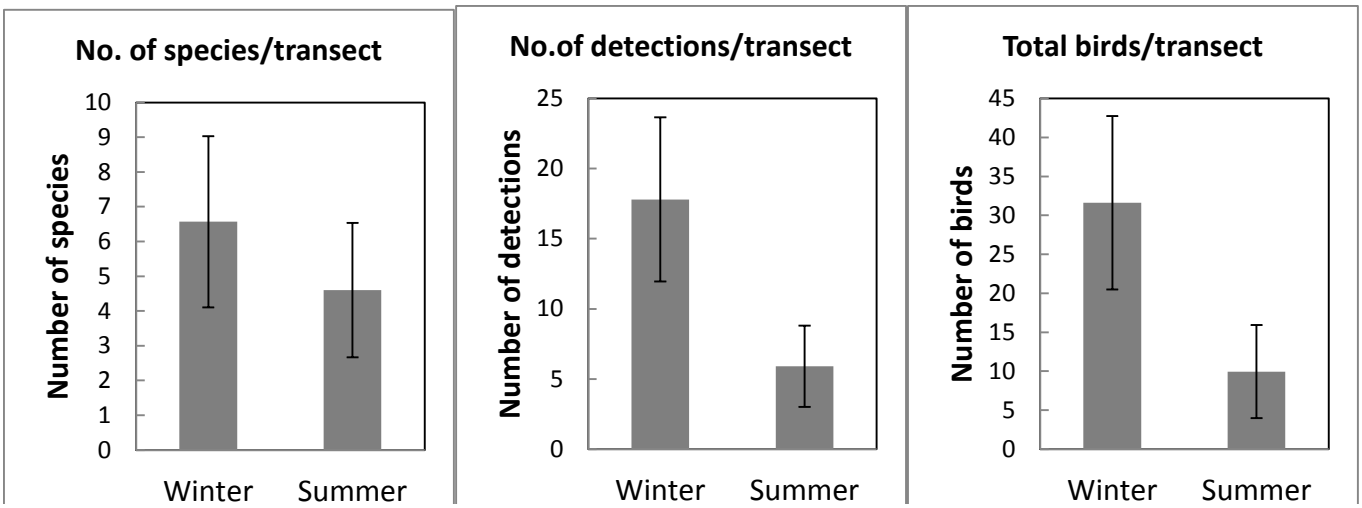

Figure 6. Comparison of transect observations during the field surveys in winter (n = 30 transects) and summer (n = 19 transects) at the study area, with respect to number of species seen per transect, the number of detections per transect, and the total number of birds seen per transect. Standard deviation bars are included.

The four most abundant species recorded during the transect surveys in winter were all highly nomadic passerine species, of which the most abundant was Grey-backed Sparrow-lark *Eremopterix verticalis*, with 10.8 birds/km being detected (Table 1). These highly nomadic species are known to respond to rainfall events (Dean 2000), becoming entirely absent again during unfavourably dry periods as witnessed in the study area. The second and third most abundant species were Lark-like Bunting *Emberiza impetuani* and Stark's Lark *Spizocorys starki*, with 4.5 and 4.1 birds/km, respectively. The fourth most abundant species was the Black-eared Sparrow-lark *Eremopterix australis*, with 2.8 birds/km detected. All these species exhibited dramatically reduced numbers during the summer survey (Table 1).

Table 1. Summary of dominant passerine species recorded along line transects walked in the study area during the field survey in winter (n = 30) and summer (n = 19), with respect to the number of detections per species, the total number of birds detected per species, and the number of birds seen per kilometre, as a measure of relative abundance.

Species	Winter			Summer		
	No. of detections	No. of birds	Birds/km	No. of detections	No. of birds	Birds/km
Bunting, Lark-like	76	135	4.50	3	3	0.16
Chat, Ant-eating	6	7	0.23	7	12	0.63
Chat, Karoo	-	-	-	7	10	0.53
Chat, Tractrac	6	7	0.23	6	7	0.37
Flycatcher, Chat	16	20	0.67	13	15	0.79
Lark, Black-eared Sparrow-	51	84	2.80	1	5	0.26
Lark, Cape Clapper	11	11	0.37	-	-	
Lark, Grey-backed Sparrow-	157	323	10.77	12	20	1.05
Lark, Red	14	16	0.53	12	13	0.68
Lark, Spike-heeled	31	51	1.70	6	14	0.74
Lark, Stark's	71	122	4.07	2	3	0.16
Warbler, Rufous-eared	10	14	0.47	6	6	0.32

Species which were mostly resident in the area and which did exhibit drastic changes in abundance include Spike-heeled Lark *Chersomanes albofasciata*, Ant-eating *Myrmecocichla formicivora*, Tractrac Chat *Cercomela tractrac*, Rufous-eared warbler *Malcorus pectoralis*, Chat Flycatcher *Bradornis infuscatus*, and Red Lark. The Red Lark was detected at a rate of 0.53 birds/km in winter and 0.68 birds/km in summer, although considering that it was only recorded in the dune habitat and not within the plains habitat where most of the transects were walked, this relative abundance is rather unrepresentative of the species. In winter Red Larks were recorded on six (6) of the 30 transects, with a total of 16 sightings, and exclusively within the dune habitat and adjacent sandy flats characterised by red sands, tall grasses, and interspersed tall shrubs. In summer, Red Larks were recorded on seven (7) of the 19 transects (12 sightings), all within the same dune habitat as in winter. This suggests that the species is indeed common within the dune habitat, but mainly absent from the plains habitat of the study area.

Other red-listed passerine species that have been recorded in the greater area, but only during the SABAP 1 atlas period, include the Sclater's Lark *Spizocorys sclateri* and African Rock Pipit *Anthus crenatus.* Neither species were recorded during the site visits, nor have they been detected during SABAP 2. Sclater's Lark prefers quartz or stony gravel plains which are coarser than the sandy plains of the study area. African Rock Pipit prefers more mountainous terrain and would most likely be restricted to the neighbouring Gamsberg inselberg, if it is present in the area. Both species are therefore unlikely to occur in the

study area based on their habitat preferences, which is corroborated by the absence of SABAP 2 sightings for both these species within the pentads that covers the study area.

Of the 12 species listed as biome-restricted, only three species occur in the study area throughout the year in good numbers, including the Red Lark, Sociable Weaver *Philetairus socius* and Tractrac Chat. Species such as Karoo Long-billed Lark *Certhilauda subcoronata*, Pale-winged Starling *Onychognathus nabouroup*, and Karoo Chat *Cercomela schlegelii* are mostly marginal to the site, being recorded more frequently in the Bushmanland Arid Grassland. Species such as Ludwig's Bustard *Neotis ludwigii*, Black-eared Sparrowlark, Black-headed Canary *Serinus alario* and Stark's Lark are nomadic and therefore only occur in good numbers when conditions are favourable.

Table 2. Summary of non-passerines recorded along line transects in the study area during the field survey in winter (n = 30) and summer (n = 19), 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	Winter			Summer		
	No. of detections	No. of birds	Birds/km	No. of detections	No. of birds	Birds/km
Bustard, Ludwig's	2	2	0.07	-	-	-
Courser, Burchell's	-	-	-	1	3	0.16
Courser, Double-banded	1	2	0.07	-	-	-
Dove, Namaqua	9	20	0.67	-	-	-
Eagle, Black-chested Snake	-	-	-	1	1	0.05
Eagle, Martial	1	1	0.03	1	1	0.05
Eagle, Verreaux's	1	1	0.03	-	-	-
Kestrel, Greater	4	6	0.20	2	3	0.16
Korhaan, Karoo	-	-	-	1	2	0.11
Korhaan, Northern Black	13	14	0.47	5	6	0.32
Sandgrouse, Namaqua	9	15	0.50	7	39	2.05

Amongst the non-passerines, only Namaqua Sandgrouse *Pterocles namaqua*, Northern Black Korhaan *Afrotis afraoides* and Greater Kestrel *Falco rupicoloides* were detected with similar frequency across the seasons, whereas other species were present in only one season (Table 2). For example, Namaqua Dove *Oena capensis* and Ludwig's Bustard were present only in winter. Rates of detection for other species were far too low to make meaningful deductions regarding seasonal changes.

3.3 RED-LISTED SPECIES

Red-listed species are considered fundamental to this study, because of their susceptibility to the threats posed by power lines, substations and associated infrastructure. A total of nine red-listed non-passerine species have been reported for the area during SABAP 1 and the SABAP 2 period. Of these, seven are listed as threatened and two as Near-Threatened (Table 3). The most important of these include Martial Eagle *Polemaetus bellicosus* (Endangered), Ludwig's Bustard (Endangered), Verreaux's Eagle *Aquila verreauxii* (Vulnerable) and Secretarybird *Sagittarius serpentarius* (Vulnerable), all of which are considered to have local populations of moderate importance. These species are considered prone to collisions with power line structures, and hence may be susceptible to increased developments in the area that involve the erection of power lines. Ludwig's Bustard and Martial Eagle were both seen foraging within the study area, while Verreaux's Eagle was seen directly adjacent to the site. An adult Martial Eagle was also seen roosting on the pylon structures of the existing power line that traverses the study area during both the winter and summer field survey. Two separate Martial Eagle nests are located on pylons to the west and east of the study area (Figure 7). The nest in the west of the study area is located on the 400kV power lines that fall within the Alternative 2 corridor. A Secretarybird nest is also known from the study area, and is located some 1.5km south from the Alternative 1 grid connection corridor.

Figure 7. Location of two Martial Eagle nests (orange markers) and one Secretarybird nest (blue marker) in relation to the two proposed grid connections, Alternative 1 (black) and Alternative 2 (Blue).

Other red-listed species that may occur in the study area, and that are prone to collisions with powerlines, include (with SABAP2 reporting rates in parentheses) the Near-Threatened

Kori Bustard *Ardeotis kori* (0%) and Karoo Korhaan *Eupodotis vigorsii* (15.4%). Kori Bustard were not recorded during the site visits and is probably scarce in the area, while Karoo Korhaan was recorded once, and will mostly likely be restricted to the plains habitat in the east of the study area. The species is considered to be scarce in the study area as it is generally readily detected in other areas. Other red-listed species that are not prone to collisions, include, the Vulnerable Lanner Falcon *Falco biarmicus* (3.9%), the near-endemic and Endangered Black Harrier *Circus maurus* (0%), and the Vulnerable Burchell's Courser *Cursorius rufus* (3.9%). Only Burchell's Courser was recorded once during the site visits, and will most likely only occur in the plains habitat or the ecotone between the plains and dune habitat.

During the walking transects regular scans were made to detect any large flying birds to establish the presence of flight paths across the study area. Large raptors that have been seen foraging over the study area include Martial Eagle (two occasions), Black-chested Snake-eagle (one occasion) and Verreaux's Eagle (one occasion). No other red-list species were seen using the study area 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 study area on an ad hoc basis. Besides the absence of communal nest sites, no individual nests were located during the field surveys other than the two Martial Eagle nests and the Secretarybird nest (Figure 5).

The Haramoep and Black Mountain Mine IBA (Important Bird Area) occurs in the western half of both corridor alternatives. Besides this IBA, no Coordinated Avifaunal Roadcounts (CAR) routes, or Coordinated Waterbird Counts (CWAC) wetlands occur in the vicinity of the study area. The presence of the Haramoep and Black Mountain Mine IBA, however, highlights the need to investigate the cumulative impact of grid connection infrastructure in the broader study area, as this IBA's potential connectivity with other IBAs to the south should not be compromised by expansions of grid connections and additional solar energy projects. Marnewick *et al.* (2015) points out that the particular threats facing this IBA include overgrazing by livestock and subsequent habitat degradation, mining, climate change, and additional power and transmission lines from the solar energy facilities to substations.

In essence, much of the avifauna within the study area appears similar to that found across the Nama-Karoo bioregion of the Northern Cape. 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. The only passerine species of particular concern is the Red Lark, which occupies much of the red dune habitat of the study area. While a fair number of red-listed species also occur, most of these also have wide ranges across much of the bioregion and beyond. Some species, such as the large eagles and bustard, may use the area on occasion as part of their large ranges. However, since the study area appears not to directly support communally nesting red-listed species, the

sensitivity of the study area in general can be considered to be of medium significance with respect to avifauna.

Table 3. Red-listed species recorded in the broader study area during SABAP1 (1987-1992), SABAP2 (2007 on-going) and the mid-winter (26 to 28 June 2018) and late summer (20 to 22 March 2019) site visit, ranked according to their red-list status. Of the twelve species that have been recorded during the two bird atlasing periods, six species were recorded during the two field surveys.

English name	Taxonomic name	Red-list status	Regional endemism	Estimated importance of local population	Preferred habitat	Probability of occurrence	Threats
Bustard, Ludwig's	***Neotis ludwigii***	**Endangered**	**-**	**Low**	**Semi-arid shrublands**	**Recorded**	**Habitat loss/Disturbance Collisions**
Eagle, Martial	***Polemaetus bellicosus***	**Endangered**	**-**	**Moderate**	**Savanna & shrublands**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Harrier, Black	*Circus maurus*	Endangered	Near-endemic	Low	Fynbos, Karoo & grassland	Low	Habitat loss/Disturbance/Collisions
Courser, Burchell's	***Cursorius rufus***	**Vulnerable**	**-**	**Low**	**Shrubland plains**	**Recorded**	**Habitat loss/Disturbance**
Red Lark	***Calendulauda burra***	**Vulnerable**	**Endemic**	**High**	**Red dunes & sandy plains**	**Recorded**	**Habitat loss, degradation & fragmentation**
Eagle, Verreaux's	***Aquila verreauxii***	**Vulnerable**	**-**	**Moderate**	**Mountainous and rocky areas**	**Recorded**	**Habitat loss/Disturbance Collisions/Electrocution**
Falcon, Lanner	*Falco biarmicus*	Vulnerable	-	Low	Widespread	High	Habitat loss/Disturbance Collisions/Electrocution
Secretarybird	*Sagittarius serpentarius*	Vulnerable	-	Low	Open savanna & grassland	Moderate	Habitat loss/Disturbance Collisions
Sclater's Lark	*Spizocorys sclateri*	Near-threatened	Near-endemic	Low	Quartz gravel or stony plains	Low	Habitat loss, degradation & fragmentation
Karoo Korhaan	***Eupodotis vigorsii***	**Near-threatened**	**-**	**Low**	**Karoo shrubland**	**Recorded**	**Habitat loss/Disturbance Collisions**
Bustard, Kori	*Ardeotis kori*	Near-threatened	-	Low	Open savanna	Low	Habitat loss/Disturbance Collisions
African Rock Pipit	*Anthus crenatus*	Near-threatened	-	Low	Arid koppies & mountains	Low	Habitat loss, degradation & fragmentation

3.4 CURRENT BASELINE & CUMULATIVE IMPACT

There are a number of proposed and approved solar energy developments in the Aggeneys area, concentrated mainly along the N14 road. The potential for cumulative impact of grid connection infrastructure in the area is therefore a potential concern given the large number of different proposed renewable energy developments in the area and the status of the area as a REDZ and EGI Transmission Corridor. Although there are currently few preferred bidders, the projects are concentrated around the Aggeneys area and in the longer-term a node of development is likely to occur in this area (**Error! Reference source not found.**8). 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. This is largely concentrated within the plains habitat of the Bushmanland Arid Grassland vegetation type, which is a widespread habitat with relatively low avifaunal diversity. As Bushmanland Arid Grassland is one of the most extensive vegetation types in South Africa, the loss of 9000ha of this vegetation type is not significant regionally and the major concern would be with respect to the impacts on landscape connectivity more locally. The location of the current grid connection infrastructure adjacent to existing power lines (Corridor Alternative 1 - preferred) and the Loop 10 and N14 roads (Corridor Alternative 2 – acceptable) is certainly a mitigating circumstance which would serve to reduce the cumulative impact associated with the development. This will also reduce the potential for collisions with large raptors and terrestrial birds (e.g. bustards) since the grid will mostly be following existing power lines. The footprint within the Bushmanland Sandy Grassland habitat (High sensitivity), is low should therefore have minimal negative impact on the Red Lark or its distribution within the area. The major corridors of the area, such as the Koa River valley directly south of Corridor Alternative 1 and the mountain chain north of the study area, would not be impacted by the grid connection infrastructure and are also still largely free from development impact more generally. As the broader area is still largely free from solar energy developments, the capacity of the area to support development is still considered generally quite high. Given the broad-scale over which most ecological processes in this area operate, the current levels of habitat fragmentation are still considered low and not a threat to ecological processes and avifauna in the area. The contribution of the proposed grid connection at approximately 17 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.

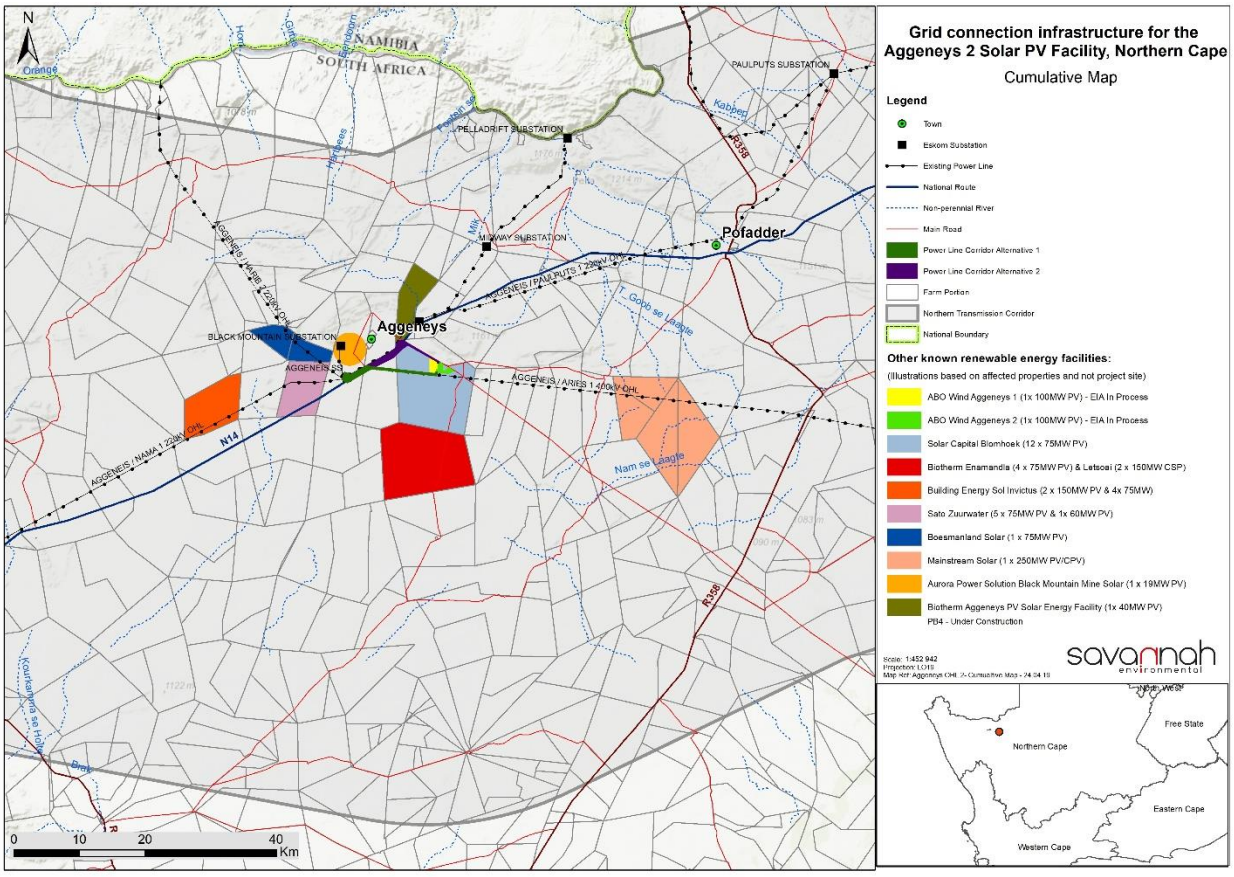

Figure 8. Map of renewable energy development facilities as well as current applications for the wider area. It is important to note that the map indicates the affected properties and not the extent of the facilities themselves.

3.5 AVIAN SENSITIVITY ASSESSMENT

Important avian microhabitats in the study area play an integral role within the landscape, providing nesting, foraging and reproductive benefits to the local avifauna. In order to ensure that the grid connection does not have a long term negative impact on the local avifauna, it is important to delineate these avian microhabitats and features within the development corridors. To this end an avian sensitivity map (Figure 9) was generated by integrating avian microhabitats present in the affected area and avifaunal information collected during the site visits.

The dune habitat to the restricted to the central section of Corrisor Alternative 1 is considered to be of High sensitivity, as this supports a healthy resident population of the Vulnerable Red Lark. The species is mainly susceptible to impacts associated with habitat transformation and degradation (Taylor *et al.*, 2015). The plains habitat along the remainder of Corridor Alternative 1 as well as the whole of Alternative 2 and both collector substation sites do not currently appear to support any Red Larks based on the field

surveys, and since it is a widely distributed habitat, it is considered to have a Low sensitivity. There are parts of the plains habitat along both Corridor Alternatives as well as around the Aggeneis substation that are considered to be of Medium sensitivity due to the presence of greater structural diversity (presence of *Boscia* trees), presence of previously used raptor nests in *Boscia* trees, and traversing minor drainage lines.

There are no highly sensitive habitats within the study area that are considered a no-go from an avifaunal perspective. However, the Alternative 1 is considered the preferred alternative as it is the shortest route to the Aggeneis MTS, and only traverses the northern margin of the dune habitat along an existing power line corridor. It is therefore expected to have the least impact, considering that the Alternative 2 route is longer and will only run parallel with an existing power line along the N14 road for the final portion of the route. It is therefore likely that the Alternative 1 would generate the least impact on avifauna, provided suitable mitigation measures are employed during construction and operation of the grid connection infrastructure. The difference in impact between the two options is however small and both are considered potentially acceptable.

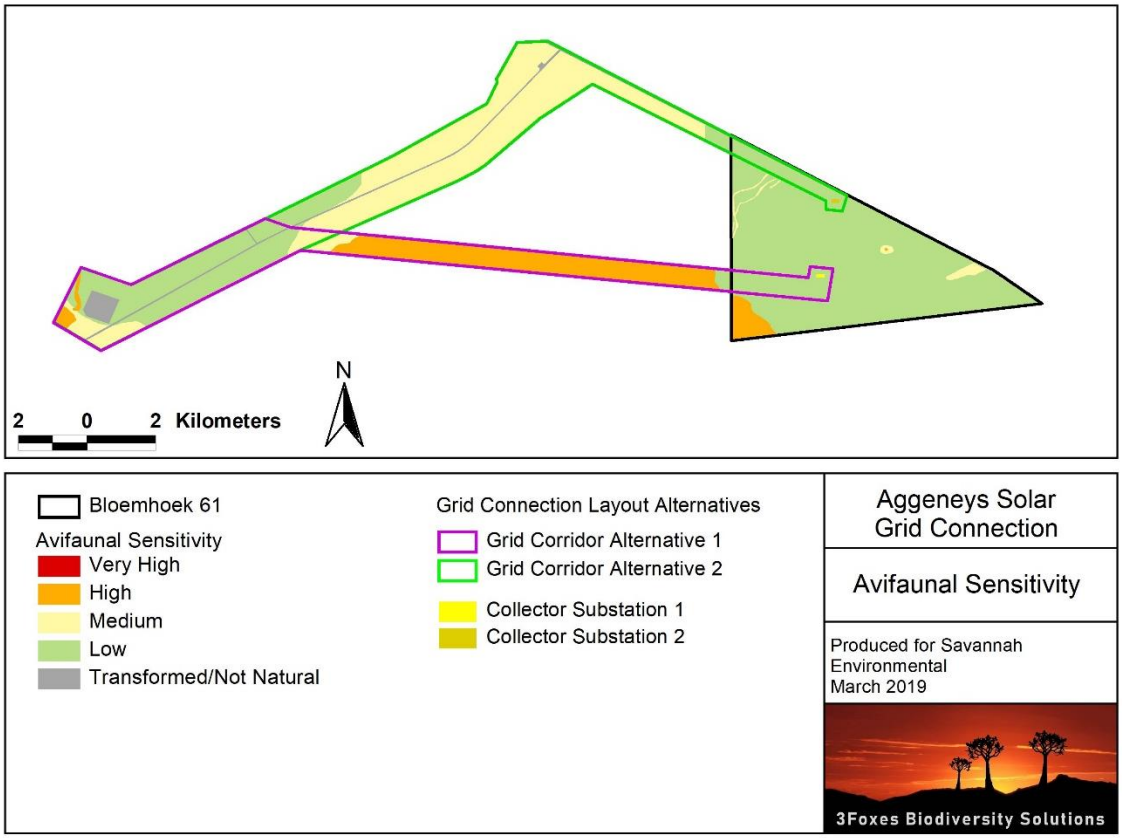

Figure 9. Avifaunal sensitivity map for the grid connection development corridors. Much of the corridors is considered Low or Medium Sensitivity, and although Alternative 1 passes through the northern portion of the dune habitat considered to be High Sensitivity, the potential impact on avifauna is considered to be less than Alternative 2.

4 IDENTIFICATION & NATURE OF IMPACTS

In this section, the potential impacts and associated risk factors that may be generated by the proposed grid connection infrastructure 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.

4.1 IDENTIFICATION OF POTENTIAL IMPACTS AND DAMAGING ACTIVITIES

In this section each of the potential impacts on avifauna associated with the development of the Aggeneys 2 grid connection infrastructure is explored in more detail with reference to the features and characteristics of the area 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 Aggeneys 2 grid connection infrastructure 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 final grid connection servitude may result in negative impacts on the avifauna through disturbance and specimen abstraction due to poaching and uncontrolled collection of all fauna and flora for traditional medicine or other purpose.
- Site clearing and exploration activities for grid connection establishment may have a negative impact on avifauna if this is not conducted in a sensitive manner.

Construction Phase

- Vegetation clearing for the pylons and access roads 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 in the vicinity of the grid connection servitude. This will create a physical impact as well as generate noise, pollution and other forms of disturbance in the vicinity of the grid connection servitude.
- Increased human presence can lead to poaching, illegal fauna collecting (especially larger avifaunal species) and other forms of disturbance such as fire.

Operation Phase

- The operation of the grid connection infrastructure will generate minor disturbances which may deter some avifauna from the grid connection infrastructure, 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 Haramoep and Black Mountain IBA as well as the more general ability to meet future conservation targets. However, the total footprint of the grid connection infrastructure would be less than 10ha, which is not considered to be a highly significant impact on the IBA and affected habitat types. 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 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 avifauna and impair their ability to respond to environmental fluctuations. This is particularly a concern with regards to species and ecosystems with limited geographical distributions (Rudman *et al.*, 2017).
- The erection of new power lines 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 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 that will be impacted, and which are also common in neighbouring habitats, include Red Lark, Spike-heeled Lark, Rufous-eared Warbler, Chat Flycatcher, Tractrac Chat, and Karoo Chat. The loss of habitat and disturbance will be largely restricted to the construction phase and long-term impacts during the operation phase of the grid connection would be restricted largely to a small amount of habitat loss. 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 and disturbance 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 Greater Kestrel *Falco rupicoloides*, and the ground-dwelling Namaqua Sandgrouse*,* and Double-banded Courser *Rhinoptilus africanus*. While these species may be susceptible to collisions with power lines and substations, this is not expected to have a major impact on most of these species.

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 Martial eagle, Ludwig's Bustard, Verreaux's Eagle, Secretarybird and Karoo Korhaan. Besides the loss of foraging habitat that these species will experience, disturbances during construction of the grid connection is also expected to have a negative impact. Most of these species are also highly susceptible to collisions with power lines owing to reduced ability to see the power lines and reduced manoeuvrability in flight to avoid collisions (Martin & Shaw, 2010; Jenkins *et al.*, 2010). All large terrestrial birds, including the red-listed species, are killed in substantial numbers by existing and newly erected power lines in the country (Jenkins *et al.*, 2010; Jenkin *et al*., 2011; Shaw, 2013). An additional threat faced by the large raptors is electrocution when perched or attempting to perch on power line structures (Lehman *et al*., 2007).

5 ASSESSMENT OF IMPACTS

The various identified avifaunal impacts are assessed below for the different phases of the proposed grid connection infrastructure. It is important to note that this is contingent on

the project development corridors as provided and any changes to the corridors or project description would potentially invalidate the assessment.

5.1 AGGENEYS GRID CONNECTION

The following is an assessment of the grid connection infrastructure for the Aggeneys 2 solar PV facility, for the planning and construction, operation and decommissioning phases of the grid connection infrastructure. The construction phase will result in limited direct loss of habitat due to clearing of vegetation and avifaunal microhabitats along the corridor. Disturbances will be caused by increased traffic of vehicles along the corridor during construction. Potential collisions and electrocutions along the corridor will be potential impacts during the operational phase, but may also contribute to the cumulative impacts of the grid connection infrastructure. The decommissioning phase of the grid connection infrastructure will also result in limited loss of habitat due to disturbance of vegetation and avifaunal microhabitats along the corridor. Disturbances will also be caused by increased traffic of vehicles along the corridor during the decommissioning phase.

5.1.1 Planning & Construction Phase Impacts

Impact Nature: Direct avifaunal impacts during construction – habitat loss and disturbance				
	Alternative 1		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)	Short-term (2)	Short-term (2)
Magnitude	Moderate (5)	Moderate (5)	Moderate (6)	Moderate (5)
Probability	High Likely (4)	Probable (3)	High Likely (4)	Probable (3)
Significance	Moderate (32)	Low (24)	Moderate (36)	Low (30)
Status	Negative	Negative	Negative	Negative
Reversibility	High	High	High	High
Irreplaceable loss of resources	Low	Low	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 such as raptor nests in the proximity of the line route. • Prior to construction, the design and layout of any proposed power			

	line and substation infrastructure must be endorsed by members of the Eskom-EWT Strategic Partnership, taking into account the mitigation guidelines recommended by Birdlife South Africa (Jenkins *et al*., 2017; Jenkins *et al*., 2016). • Only power lines structures that are considered safe for birds should be erected to avoid the electrocutions of birds (particularly large raptors) perching or attempting to perch. Where necessary, deterrent devices such as bird guards should be mounted on relevant parts of the pylons to further reduce the possibility of electrocutions. • The route that the power line will follow should be the shortest distance possible across an area where collisions are expected to be minimal, or follow existing power lines (as with this project), and be marked with bird diverters to make the lines as visible as possible to collision-susceptible species. Recommended bird diverters such as brightly coloured 'aviation' balls, thickened wire spirals, or flapping devices that increase the visibility of the lines should be fitted where considered necessary (collision hot-spots). • The potential to 'stagger' the position of the power line pylons in relation to existing telephone or power line poles/pylons should be investigated, as this may assist in increasing the visibility of power lines to large flying birds such as bustards, which may regularly fly through the area. • All personnel should undergo environmental induction with regard to avifauna and in particular awareness about not harming, collecting or hunting ground-dwelling species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of superstition. • This induction should also include awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas etc. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • The use of laydown areas within the footprint of the project development corridor should be used where feasible, to avoid habitat loss and disturbance to adjoining areas. • All building waste produced during the construction phase should be removed from the development corridor and be disposed of at a designated waste management facility. Similarly, all liquid wastes should be contained in appropriately sealed vessels/ponds within the footprint of the development, and be disposed of at a designated waste management facility after use. Any liquid and chemical spills should be dealt with accordingly to avoid contamination of the environment. 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 substation and possibly their avian predators, and to minimise disturbance to birds flying over the facility at night. • 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 active raptor nests should these be discovered prior to or during the construction phase. If active nests are discovered 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 cables or pylons, these should not be left open for extended periods of time as ground-dwelling avifauna or their flightless young may become entrapped therein. Holes should only be dug when they are required and should be used and filled shortly thereafter.
Cumulative Impacts	The development will contribute to cumulative impacts on avifaunal habitat loss, as well as collision risk with power line and substation 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. Although the sensitivity of the affected habitat is High for the dune habitat, the overall residual impact on avifaunal habitat loss remains low due to the small footprint of pylons and collector substation, while the power line will not pose a threat to the Red Lark. Although the use of power line structures that are considered safe for large birds will contribute to reducing the potential impacts of the power line, future collisions with power line will remain a risk. This can be reduced further by 'staggering' the pylons in relation to existing pylons during construction, so that the profile of the power line will be more visible to flying birds.

5.1.2 Operational Phase Impacts

Impact Nature: Direct avifaunal impacts during operation – collisions, electrocution and disturbance				
	Alternative 1		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)	Long-term (4)	Long-term (4)
Magnitude	Moderate (5)	Low (4)	Moderate (6)	Low (4)
Probability	High Likely (4)	Probable (3)	High Likely (4)	Probable (3)
Significance	Moderate (40)	Low (27)	Moderate (44)	Low (27)
Status	Negative	Negative	Negative	Negative
Reversibility	High/Medium	High	High/ Medium	High
Irreplaceable loss of resources	Low	Low	Low	Low
Can impacts be mitigated?	To a large extent although bird flappers and other bird diverters are not 100% effective and so there would still be some residual impact.			
Mitigation	• Regular monitoring of power lines should be undertaken to detect bird carcasses, to enable the identification of any areas of high impact to be marked with bird diverters. • Any movements by vehicle and personnel should be limited to within the footprint of the power line corridor and other associated infrastructure, especially during routine maintenance procedures. • Any raptor nests that are discovered on the power line structures should be reported to the ECO, while utmost care should be taken to not disturb these nests during routine maintenance procedures.			
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 and substations are not 100% effective and some residual impact is likely to occur.			

5.1.3 Decommissioning Phase Impacts

The decommissioning phase will result in some disturbance and loss of avifaunal microhabitats due to removal and clearing of pylons, substation areas 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.				
	Alternative 1		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)	Short-term (2)	Short-term (2)
Magnitude	Moderate (4)	Low to Moderate (3)	Moderate (4)	Low to Moderate (3)
Probability	Definite (5)	Definite (5)	Definite (5)	Definite (5)
Significance	Medium (35)	Medium (30)	Medium (35)	Medium (30)
Status	Negative	Negative	Negative	Negative
Reversibility	Moderate	Moderate	Moderate	Moderate
Irreplaceable loss of resources	Low	Low	Low	Low
Can impacts be mitigated?	Disturbance impact can be mitigated to an extent as it will be transient and have no long term impact.			
Mitigation	• All infrastructure should be removed from the development corridor and disposed of in the appropriate manner. • All waste produced during decommissioning must be disposed of at a designated waste management facility. • Environmental induction for all personnel on site to ensure that basic environmental principles are adhered to, and awareness about not harming or hunting ground-dwelling species (e.g. bustards, korhaans, thick-knees and coursers), and owls, which are often persecuted out of superstition. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed in undisturbed natural areas outside of the decommissioning area. • All construction vehicles should adhere to a low speed limit (40km/h on site) to avoid collisions with susceptible species such nocturnal and crepuscular species (e.g. nightjars, thick-knees and owls) which sometimes forage or rest along roads. • Any avifauna threatened by the activities should be removed to safety by the ECO or appropriately qualified environmental officer. • If holes or trenches need to be dug, these should not be left open for extended periods of time as ground-dwelling avifauna or their flightless young may become entrapped in them. Holes should only be dug when they are required and should be used and filled shortly			

	thereafter. • No activity should occur near to active raptor nests should these be discovered prior to or during the decommissioning phase. If active nests are discovered 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 grid connection.
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 Low to 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 Aggeneys 2 grid connection infrastructure. These are assessed in context of the extent of the current area, 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 infrastructure during the operational phase of the project is also considered a cumulative impact.

Impact Nature: Impact on the Haramoep and Black Mountain IBA as well as avifaunal habitats, migration routes and nesting areas due to cumulative loss and fragmentation of habitat, as well collisions and electrocutions along the grid connection corridor.

	Alternative 1		**Alternative 2**	
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**	**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)	Local (1)	Local (2)
Duration	Long-term (4)	Long-term (4)	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Moderate (5)	Low (4)	Moderate (6)
Probability	Improbable (2)	Probable (3)	Improbable (2)	Probable (3)

Significance	Low (18)	Medium (33)	Low (18)	Medium (33)
Status	Negative	Negative	Negative	Negative
Reversibility	Moderate	Moderate	Moderate	Moderate
Irreplaceable loss of resources	Low	Low	Low	Low
Can impacts be mitigated	To some degree, but the majority of the long-term impact results from the presence of the power line and other developments in the area which cannot be well-mitigated.			

Mitigation:

- Increased probability of bird collisions and electrocutions with new power lines may contribute to the cumulative impacts of the proposed development. However, considering that the proposed power line corridor (Alternative 1) follows an existing 400kV power line to the Aggeneis MTS, the potential impacts are not considered significantly accumulative.
- Initiate increased monitoring along power line corridors in the area 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.

6 CONCLUSION & RECOMMENDATIONS

The proposed Aggeneys 2 grid connection alternatives traverse two vegetation types characterised by open plains and undulating dunes, which are considered to be of Low to Medium and High avifaunal sensitivity respectively. The two substation alternatives are located near to each other within the low sensitivity plains habitat and are considered similar in terms of potential impacts. The study area lies within the Nama-Karoo bioregion and supports the typical avifaunal assemblage expected for the area. The diversity and density of birds is generally low, but may increase dramatically during favourable years when significant numbers of nomadic species occupy the area.

The expected impacts of the proposed grid connection infrastructure will include the following, 1) some habitat loss and fragmentation associated with the Bushmanland Arid Grassland and Bushmanland Sandy Grassland, 2) limited disturbance and displacement caused during the construction and maintenance phases, 3) direct mortality of avifauna colliding with the power line and collector substation, as well as electrocutions with power line infrastructure, and 4) cumulative habitat loss at a broader scale from renewable energy developments and mining in the area. Mostly large non-passerine species, many of which are red-listed, may be impacted by the minor 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.

The dune habitat is the primary habitat for the Vulnerable Red Lark in the area and is therefore considered to be of High sensitivity. Although the preferred corridor (Alternative 1) of the grid connection infrastructure skirts the northern margin of the dune habitat, the potential impact of the development is expected to be low for this species, which is not susceptible to collisions with power lines. The Alternative 2 corridor traverses mainly the plains habitat, which is an extensive vegetation type and supports mainly species with wide distributions. However, species such as the collision-prone Ludwig's Bustard may be more common in the plains habitat, and may therefore be more susceptible to collisions from a power line in the Alternative 2 corridor.

Although eight Threatened and four Near-threatened species have been reported for the area, most of these are not common in the area and probably occur in low numbers. However, species such as Martial Eagle, Verreaux's Eagle and Ludwig's Bustard appear to frequent the study area fairly regularly as suitable habitat exists throughout the area. The project site supports few species or features of concern, such as communal nesting or roosting sites of red-listed species. Impacts on avifauna with the development in this area are likely to be medium and no high post-mitigation impacts are likely.

Cumulative impacts in the area are a concern due to the proliferation of solar energy development in the Aggeneys area. In terms of habitat loss, both of the affected vegetation types are mostly intact. In terms of potential losses to landscape connectivity, the site is not considered to lie within an area that is considered a likely avifaunal movement corridor or along an important avifaunal habitat gradient. However, the presence of an IBA within the western half of the power line corridors, namely the Haramoep and Black Mountain Mine, is a potential concern. Any future solar developments proposed for the broader area should ensure that the associated grid connections do not intercept the corridor between this IBA and two other IBAs in the region, namely the Bitterputs Conservation Area to the south of Aggeneys, and the Mattheus-Gat Conservation Area to the east of Pofadder. Hence it is essential that the cumulative impact of further solar developments and their grid connections are carefully considered. The two grid connection alternatives considered in this study are adjacent to existing power lines where they traverse the IBA and as such the additional extent of habitat loss and likely long-term impact of the power line on avifaunal within the IBA is considered to be low, especially for the target species of the IBA. As such, the impact of the development on the IBA is considered acceptable.

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 power line 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) 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 development can be reduced to an acceptable level and as such there are no fatal flaws associated with the development that should prevent it from proceeding.

The proposed routes are therefore considered favourable, although Alternative 1 is the preferred corridor, and 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.

Avifaunal Impact Statement:

The proposed grid connection infrastructure for the Aggeneys 2 solar PV facility 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 or roosting sites of red-listed priority species within the immediate vicinity, there are no impacts associated with the development of the grid connection infrastructure that are considered to be of high residual significance and which cannot be mitigated to a low level. Consequently, it is the reasoned opinion of the specialist that grid

connection Corridor Alternative 1 can be authorised, subject to the implementation of the recommended mitigation measures. Should this alternative not be feasible due to technical or other reasons, then Alternative 2 is considered to be acceptable but less desirable.

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 BA and the implementation and operational activities of a project. As the construction and operation of the grid connection infrastructure for the Aggeneys 2 solar PV facility may impact the environment, activities that 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 BA 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 BA. As such the purpose of the EMPr can be outlined as follows:

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

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

CONSTRUCTION PHASE ACTIVITIES

Objective: Limit disturbance and loss of avifaunal microhabitats during construction			
Project component/s	All infrastructure and activities that result in disturbance and loss of intact vegetation: » Vegetation clearing. » 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 grid connection corridor 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 especially 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 construction activity should occur near 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 and nestlings). » Any avifauna threatened or injured by the		ECO	Construction

construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. » If active nests are discovered 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. » All sources of night-lighting should use low-UV type lights (such as most LEDs), which do not attract insects. The lights should also be directed downwards and not result in large amounts of light pollution.		

Performance Indicator	» Avifaunal microhabitat loss restricted to corridor footprint. » 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 and nestlings) by construction personnel. » Removal to safety of entrapped/injured avifauna encountered during construction.
Monitoring	ECO to monitor for compliance during the construction phase. All incidents to be noted.

OPERATION PHASE ACTIVITIES

OBJECTIVE: Limit direct and indirect impacts and disturbances of avifauna during operation	
Project component/s	All activities that result in disturbance of avifauna, including: » Avifaunal collisions and electrocutions involving power lines. » Human presence. » Vehicle traffic.
Potential Impact	» Mortality of avifauna within 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: Target/Objective	Low disturbance and impact of avifauna and low collision and electrocution rates of avifauna with power line infrastructure during operational phase.

Mitigation: Action/control	Responsibility	Timeframe
» All incidents of collisions with and electrocution due to power lines should be recorded as meticulously as possible, including data related to the species involved, the exact date and location of collisions within the corridor, and suspected cause of death (collision or electrocution).	ECO	Operation
» Any movements by vehicle and personnel should be limited to within the corridor of the grid connection 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 mortalities of avifauna due to collisions with power lines and electrocutions. » No disturbance of breeding raptors, if present (i.e. no nest abandonment due to disturbance). » No disturbance of red-listed avifaunal species perched or foraging in the vicinity of the grid corridor. » No poaching or collecting of avifauna or their products (e.g. eggs and nestlings) by maintenance personnel. » Removal to safety of entrapped/injured avifauna encountered during routine maintenance. » Low impact on nocturnal and crepuscular species along roads.	
Monitoring	Annual monitoring for compliance during the operational phase. All incidents to be noted.	

DECOMMISSIONING PHASE ACTIVITIES

Objective: Limit disturbance and loss of avifaunal microhabitats during decommissioning.	
Project component/s	All infrastructure and activities that result in transformation and loss of intact or rehabilitated avifauna microhabitats:

	» Removal and clearing of grid connection and related infrastructure. » Removal and clearing of camps & other temporary infrastructure. » Removal of access roads, where required.
Potential Impact	Disturbance and loss of avifaunal microhabitats, leading to displacement and loss of resident avifaunal species.
Activity/risk source	» Clearing and removal of grid connection and related 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 infrastructure should be done in such a manner that does not cause destruction and pollution of rehabilitated habitats on site or adjoining natural areas. » All vehicles should adhere to clearly defined and demarcated roads. » All vehicles on site should adhere to a low speed limit (40km/h) to avoid collisions with susceptible species such as 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.	Contractor	Decommissioning
» Environmental induction for all personnel regarding basic environmental principles.	ECO	Decommissioning

» 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.		
Performance Indicator	» Avifaunal microhabitat loss restricted to minimum in the footprint of the power line corridor. » Low disturbance of avifauna within corridor and adjacent areas.	
Monitoring	ECO to monitor construction to ensure that: » Vegetation clearing is limited as far as possible within power line corridor and adjoining areas during decommissioning. » No birds, eggs or nestlings 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 Aggeneys grid connection study area, including records from SABAP1, SABAP2 and two site visits (winter and summer), and includes red-list status (Taylor *et al.*, 2015), regional endemism (Taylor *et al.*, 2015), and SABAP2 reporting rates. Species with a zero reporting rate were only recorded during SABAP1 and not SABAP2. Species highlighted in bold text were recorded during the site visits.

Common name	Taxonomic name	Red-list status	Regional endemism	Reporting Rate (%)
Barbet, Acacia Pied	***Tricholaema leucomelas***			**11.5**
Batis, Pririt	*Batis pririt*			3.9
Bee-eater, European	*Merops apiaster*			0
Bokmakierie	***Telophorus zeylonus***			**50.0**
Bulbul, African Red-eyed	*Pycnonotus nigricans*			0
Bunting, Cape	*Emberiza capensis*			38.5
Bunting, Lark-like	***Emberiza impetuani***			**65.4**
Bustard, Kori	*Ardeotis kori*	Near-Threatened		0
Bustard, Ludwig's	***Neotis ludwigii***	**Endangered**		**11.5**
Buzzard, Jackal	***Buteo rufofuscus***		**Near-endemic**	**3.9**
Buzzard, Common	*Buteo vulpinus*			0
Canary, Black-headed	***Serinus alario***		**Near-endemic**	**15.4**
Canary, Black-throated	*Crithagra atrogularis*			0
Canary, White-throated	***Crithagra albogularis***			**69.2**
Canary, Yellow	***Crithagra flaviventris***			**19.2**
Chat, Anteating	***Myrmecocichla formicivora***			**96.2**
Chat, Familiar	***Cercomela familiaris***			**26.9**
Chat, Karoo	***Cercomela schlegelii***			**61.5**
Chat, Sickle-winged	*Cercomela sinuata*		Near-endemic	15.4
Chat, Tractrac	***Cercomela tractrac***			**15.4**
Cisticola, Desert	*Cisticola aridulus*			3.9
Cisticola, Grey-backed	***Cisticola subruficapilla***			**34.6**
Courser, Burchell's	***Cursorius rufus***	**Vulnerable**		**3.9**
Courser, Double-banded	***Rhinoptilus africanus***			**3.9**
Crombec, Long-billed	*Sylvietta rufescens*			7.7
Crow, Cape	*Corvus capensis*			11.5
Crow, Pied	***Corvus albus***			**61.5**
Dove, Laughing	*Streptopelia senegalensis*			15.4
Dove, Namaqua	***Oena capensis***			**38.5**
Eagle, Booted	*Aquila pennatus*			7.7

Eagle, Martial	***Polemaetus bellicosus***	**Endangered**		**3.9**
Eagle, Verreaux's	***Aquila verreauxii***	**Vulnerable**		**3.9**
Eremomela, Karoo	*Eremomela gregalis*		Near-endemic	3.9
Eremomela, Yellow-bellied	***Eremomela icteropygialis***			**23.1**
Falcon, Lanner	*Falco biarmicus*	Vulnerable		3.9
Falcon, Pygmy	***Polihierax semitorquatus***			**19.2**
Finch, Red-headed	***Amadina erythrocephala***			**23.1**
Finch, Scaly-feathered	***Sporopipes squamifrons***			**76.9**
Fiscal, Southern	***Lanius collaris***			**61.5**
Flycatcher, Chat	***Bradornis infuscatus***			**76.9**
Flycatcher, Fairy	*Stenostira scita*		Near-endemic	0
Goshawk, Pale Chanting	***Melierax canorus***			**61.5**
Harrier, Black	*Circus maurus*	Endangered	Near-endemic	0
Kestrel, Greater	***Falco rupicoloides***			**19.2**
Kestrel, Rock	***Falco rupicolus***			**42.3**
Kite, Yellow-billed	*Milvus aegyptius*			0
Korhaan, Karoo	***Eupodotis vigorsii***	**Near-Threatened**		**15.4**
Korhaan, Northern Black	***Afrotis afraoides***			**46.2**
Lapwing, Crowned	*Vanellus coronatus*			3.9
Lark, Cape Clapper	***Mirafra apiata***		**Near-endemic**	**15.4**
Lark, Fawn-coloured	***Calendulauda africanoides***			**38.5**
Lark, Karoo Long-billed	***Certhilauda subcoronata***			**65.4**
Lark, Large-billed	*Galerida magnirostris*		Near-endemic	0
Lark, Pink-billed	*Spizocorys conirostris*			0
Lark, Red	***Calendulauda burra***	**Vulnerable**	**Endemic**	**69.2**
Lark, Red-capped	*Calandrella cinerea*			7.7
Lark, Sabota	*Calendulauda sabota*			26.9
Lark, Sclater's	*Spizocorys sclateri*	Near-Threatened	Near-endemic	0
Lark, Spike-heeled	***Chersomanes albofasciata***			**65.4**
Lark, Stark's	***Spizocorys starki***			**7.7**
Martin, Rock	***Hirundo fuligula***			**80.8**
Masked-weaver, Southern	*Ploceus velatus*			3.9
Mousebird, Red-faced	*Urocolius indicus*			0
Mousebird, White-backed	*Colius colius*			0
Owl, Barn	*Tyto alba*			0
Owl, Cape Eagle-	*Bubo capensis*			0
Owl, Spotted Eagle-	***Bubo africanus***			**3.9**

Penduline-tit, Cape	*Anthoscopus minutus*			0
Pigeon, Speckled	***Columba guinea***			**50.0**
Pipit, African	*Anthus cinnamomeus*			0
Pipit, African Rock	*Anthus crenatus*	Near-Threatened		0
Pipit, Long-billed	*Anthus similis*			0
Plover, Three-banded	*Charadrius tricollaris*			0
Prinia, Black-chested	*Prinia flavicans*			19.2
Prinia, Karoo	*Prinia maculosa*		Near-endemic	0
Quail, Common	***Coturnix coturnix***			0
Sandgrouse, Namaqua	***Pterocles namaqua***			**88.5**
Scrub-robin, Karoo	***Cercotrichas coryphoeus***			**46.2**
Secretarybird	*Sagittarius serpentarius*	Vulnerable		0
Shelduck, South African	*Tadorna cana*			3.9
Shrike, Lesser Grey	*Lanius minor*			0
Snake-eagle, Black-chested	***Circaetus pectoralis***			**11.5**
Sparrow, Cape	***Passer melanurus***			**76.9**
Sparrow, House	*Passer domesticus*			0
Sparrow-weaver, White-browed	*Plocepasser mahali*			11.5
Sparrowlark, Black-eared	***Eremopterix australis***		**Near-endemic**	**19.2**
Sparrowlark, Grey-backed	***Eremopterix verticalis***			**76.9**
Starling, Pale-winged	***Onychognathus nabouroup***			**80.8**
Starling, Wattled	*Creatophora cinerea*			0
Sunbird, Dusky	***Cinnyris fuscus***			**23.1**
Sunbird, Southern Double-collared	*Cinnyris chalybeus*		Near-endemic	3.9
Swallow, Barn	***Hirundo rustica***			**26.9**
Swift, Alpine	*Tachymarptis melba*			7.7
Swift, Bradfield's	*Apus bradfieldi*			0
Swift, Common	*Apus apus*			0
Swift, Little	*Apus affinis*			3.9
Thick-knee, Spotted	*Burhinus capensis*			0
Turtle-dove, Cape	***Streptopelia capicola***			**15.4**
Wagtail, Cape	*Motacilla capensis*			0
Warbler, Cinnamon-breasted	*Euryptila subcinnamomea*		Near-endemic	0
Warbler, Rufous-eared	***Malcorus pectoralis***			**73.1**
Warbler, Layard's	*Sylvia layardi*		Near-endemic	0
Weaver, Sociable	***Philetairus socius***			**80.8**
Wheatear, Capped	***Oenanthe pileata***			**11.5**
Wheatear, Mountain	***Myrmecocichla monticola***			**73.1**