AVIFAUNAL IMPACT ASSESSMENT

Electrical Grid Infrastructure (EGI) for the proposed Great Karoo Cluster of Renewable Energy Facilities located near Richmond in the Northern Cape Province

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EXECUTIVE SUMMARY

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a 132kV central collector substation and a 132kV double circuit power line on a site located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province. The collector substation that comprises both the Eskom switching station and the IPP's substation is proposed on Portions 0 and 1 of Farm Rondavel 85. One grid corridor has been considered for assessment and placement of the 132kV double circuit power line.

The entire extent of the site falls within the Central Corridor of the Strategic Transmission Corridors. The grid connection infrastructure is known as the Great Karoo Electrical Grid Infrastructure (EGI).

The development of the 132kV central collector substation and 132kV power line is required to enable the connection for the Great Karoo Cluster of Renewable Energy Facilities, which comprises three (3) 100MW solar photovoltaic (PV) energy facilities, and two (2) 140MW wind farms, to the national grid for the evacuation of the generated electricity. The connection point into the national grid will be the existing Eskom Gamma Substation.

The projects which the proposed grid connection infrastructure will facilitate the grid connection for are known as:

- Angora Wind Farm;
- Merino Wind Farm;
- Nku Solar PV Energy Facility;
- Moriri Solar PV Energy Facility; and
- Kwana Solar PV Energy Facility.

AVIFAUNA

The SABAP2 data indicates that a total of 167 bird species could potentially occur within the study area and immediate surroundings – Appendix 1 provides a comprehensive list of all the species. Of these, 49 species are classified as priority species (see definition of priority species in section 4) and 12 of these are South African Red List species. Of the priority species, 35 are likely to occur regularly at the study area and immediate surrounding area, and another 14 could occur sporadically.

An integrated pre-construction monitoring programme was implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities (i.e. Kwana, Moriri and Nku Solar Energy Facilities (SEF) and Angora and Merino Wind Energy Facilities (WEF)) between October 2020 and November 2021.

The surveys produced a combined list of 113 species covering both the Great Karoo Cluster of Renewable Energy Facilities study area and to a limited extent, the surrounding area. Blue Crane (n=296), Karoo Korhaan *Eupodotis vigorsii* (n=51), Northern Black Korhaan *Afrotis afraoides* (n=49) and Southern Pale-chanting Goshawk *Melierax canorus* (n=24) were recorded in the largest abundances. Other notable observations included, 11 Verreaux's Eagle, four Tawny Eagle and two Martial Eagle nest locations. Relevant to this assessment, the two Martial Eagle and three Tawny Eagle nests present on the existing transmission (TX) infrastructure, that are aligned parallel to the proposed 132kV double circuit power line, are of particular importance. Although part of the southern portion of the 132kV power line corridor has not been surveyed, the identified microhabitats and existing power line infrastructure occur throughout the Great Karoo EGI study area and are likely to support an identical suite of priority species. All other observations were of small passerine, waterbird and wader species.

POTENTIAL IMPACTS

The following impacts have been identified in the Avifauna Specialist Assessment.

Construction Phase

- Displacement due to disturbance associated with the construction of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line; and
- Displacement due to habitat transformation associated with the construction of the 132kV central collector substation, associated infrastructure and to a lesser extent the 132kV double circuit power line.

Operational Phase

- Collisions with the 132kV double circuit power line;
- Electrocutions within the substation yard; and
- Electrocution of vultures on the 132kV power line infrastructure.

Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line.

Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line;
- Displacement due to habitat transformation associated with the 132kV central collector substation, associated infrastructure and 132kV double circuit power line;
- Collisions with the 132kV double circuit power line;
- Electrocutions within the substation yard; and
- Electrocution of vultures on the 132kV power line infrastructure.

ENVIRONMENTAL SENSITIVITIES

At a site-specific level, environmentally sensitive features present within the proposed study area include the existing eagle nests, in addition to permanent and ephemeral waterbodies. These areas are classified as areas of **HIGH** sensitivity. Construction in the areas containing eagle nests will need to be carefully managed to ensure minimal disturbance to the breeding birds and/or their progeny. The construction of the proposed power line across or within close proximity to the waterbodies will necessitate the marking of the power line with bird flight diverters to mitigate the collision impact. Site specific recommendations for the management of the disturbance and collision impacts associated with these HIGH sensitivity areas will be provided following the pre-construction avifaunal walk-through (inspection). The remainder of the study area is considered to be of **MEDIUM** sensitivity, given its propensity to support Ludwig's Bustard.

MANAGEMENT ACTIONS

The following management actions have been proposed in this assessment:

Construction phase

- Conduct a pre-construction inspection (avifaunal walk-through) of the final central collector substation layout and power line alignment to identify priority species that may be breeding within the substation area and to record the status of the eagle nests on the existing transmission power lines. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding pair of eagles during the construction period. This could include measures such as delaying some of the activities until after the breeding season.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Vegetation clearance should be limited to what is absolutely necessary.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.

Operational phase

- The avifaunal specialist must conduct a walk-through prior to implementation to demarcate sections of power line that need to be marked with Eskom approved bird flight diverters. The bird flight diverters should be installed on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.
- Construction of the power line should be undertaken using an approved bird friendly pole/tower design **in** accordance with the Distribution Technical Bulletin relating to bird friendly structures. The final pole design must be signed off by the avifaunal specialist.
- The hardware within the proposed central collector substation is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the central collector substation infrastructure.

De-commissioning phase

- The existing transmission lines must be inspected for active raptor nests prior to the commencement of the decommissioning activities. Should any active nests be present, decommissioning activities during the breeding season should be avoided if possible.
- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.

STATEMENT AND REASONED OPINION

The table below indicates the overall impact significance for each phase before and after mitigation, as well as cumulative impacts.

Environmental Parameter	Nature of the Impact	Rating prior to mitigation	Rating post mitigation
Avifauna	*Displacement of priority species due to **disturbance** associated with construction of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line).*	44 MEDIUM	18 LOW
	*Displacement of priority species due to **habitat transformation** associated with construction of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line).*	33 MEDIUM	18 LOW
	*Mortality of priority species due to **collisions** with the Great Karoo EGI (132kV power line).*	56 MEDIUM	36 MEDIUM
	*Mortality of priority species due to **electrocution** within the Great Karoo EGI (132kV central collector substation).*	42 MEDIUM	20 LOW
	*Mortality of priority species due to **electrocution** on the 132kV power line infrastructure.*	42 MEDIUM	10 LOW
	*Displacement of priority species due to **disturbance** associated with decommissioning of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line).*	44 MEDIUM	18 LOW

CUMULATIVE IMPACTS

The proposed Great Karoo EGI equates to a maximum of 37.5km. An intensive internet search was conducted to source information on the grid connections of the abovementioned projects available within the public domain, but in a few instances no information could be obtained. However, based on the information that could be sourced, it is estimated that the proposed grid connections for the approved renewable energy projects come to at least ~100km of high voltage lines. There are approximately 403km of existing high voltage lines within the 30km radius around the Great Karoo EGI project (counting parallel lines as one). The Great Karoo EGI project will thus increase the total number of existing and planned high voltage lines by ~7 %. The contribution of the proposed Great Karoo EGI 132kV double circuit power line to the cumulative impact of all the high voltage lines is thus low. However, the combined cumulative impact of the existing and proposed power lines on avifauna within a 30km radius is considered to be moderate.

The cumulative impact of displacement due to disturbance and habitat transformation at the 132kV central collector substation associated with the Great Karoo EGI project is considered to be low, due to the small size of the footprint (0.7km^2) and the availability of similar habitat within the 30km radius area. The cumulative impact of potential electrocutions within the central collector substation yard is also likely to be low as it is expected to be a rare event.

NO-GO ALTERNATIVE

The no-go alternative will result in the current status quo being maintained within the proposed study area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would maintain the natural habitat which would be beneficial to the avifauna currently occurring there.

CONCLUDING STATEMENT

The expected impacts of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line) were rated to be of MEDIUM significance and negative status pre-mitigation. However, with appropriate mitigation, the overall post-mitigation significance of the identified impacts should be reduced to LOW negative (see Table above). No fatal flaws were discovered in the course of the investigation. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix 6) are strictly implemented.

CONTENTS

DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT

Chris van Rooyen (Avifaunal Specialist)

Chris has 24 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Avifaunal and GIS Specialist)

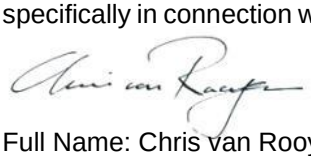
Albert has an M. Sc. in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and he is currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Megan Diamond (Avifaunal Specialist)

Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in the environmental sector for 20 years. She has 16 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 140 projects. Megan currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Powerline Network (2013-2015). She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

SPECIALIST DECLARATION

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



Full Name: Chris van Rooyen
Position: Director

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations 2014 (as amended) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations 2014 (as amended)		Clause	Section in Report
Appendix 6	(1)	A specialist report prepared in terms of these Regulations must contain —	Appendix 6
	(a)	details of –	
		(i) the specialist who prepared the report; and	Pg.8
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Pg.8
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Pg.8
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 2
	(cA)	An indication of the quality and age of base data used for the specialist report;	Section 3
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 7
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Section 3
	(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 6 - 9
	(g)	An indication of any areas to be avoided, including buffers;	Not applicable
	(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Not applicable
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
	(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Sections 9 and 10
	(k)	Any mitigation measures for inclusion in the EMPr;	Section 9
	(l)	Any conditions for inclusion in the environmental authorization;	Section 9 Appendix 3
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Not applicable
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Sections 9 -10

		(iA) regarding the acceptability of the proposed activity or activities; and	Sections 9 -10
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 10
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	No comments received
	(q)	Any other information requested by the authority.	Not applicable
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

1 INTRODUCTION

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a 132kV central collector substation and a 132kV double circuit power line on a site located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province. The collector substation that comprises both the Eskom switching station and the IPP's substation is proposed on Portions 0 and 1 of Farm Rondavel 85. One grid corridor has been considered for assessment and placement of the 132kV double circuit power line.

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The projects which the proposed grid connection infrastructure will facilitate the grid connection for are known as:

- Angora Wind Farm;
- Merino Wind Farm;
- Nku Solar PV Energy Facility;
- Moriri Solar PV Energy Facility; and
- Kwana Solar PV Energy Facility.

Details of the proposed grid connection infrastructure are provided in the table below:

Corridor width	One grid connection corridor has been identified for the assessment and placement of the grid connection infrastructure. The grid connection corridor comprises a 1km wide power line corridor to allow for avoidance of environmental sensitivities, and suitable placement within the identified preferred corridor. Therefore, the entire corridor is being proposed for the development provided the infrastructure remains within the assessed corridor and environmental sensitivities within this corridor are avoided.
Power line capacity	580MVA at 132kV (double-circuit)
Tower height	Up to 32m
Power line servitude width	Up to 40m
Length of power line corridor	Collector Sub – Gamma ~ 37.5km
Development footprint of the Collector Substation (including the Eskom switching station)	1000mx700m
Capacity of the Collector Substation	580MVA at 132kV

Figure 1: Locality map indicating the location of the Great Karoo EGI area near Richmond, Northern Cape Province

2 PROJECT SCOPE

The terms of reference for this assessment report are as follows:

- Conduct a site sensitivity verification (Appendix 5) through the use of a desk top analysis of primary species occurrence data emanating from pre-construction monitoring, conducted at the proposed Great Karoo Cluster of Renewable Energy Facilities) in addition to secondary avifaunal data sets (detailed below);
- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts associated with the proposed 132kV central collector substation and the 132kV power line grid connection;
- Perform an assessment of the potential impacts; and
- Recommend mitigation measures to reduce the significance of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of sixteen pentads some of which intersect and others that are near the study area. The decision to include multiple pentads around the study area was influenced by the fact that the pentads within which the proposed development is located have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The sixteen pentad grid cells are the following: 3125_2325, 3125_2330, 3125_2335, 3125_2340, 3130_2325, 3130_2330, 3130_2335, 3130_2340, 3135_2325, 3135_2330, 3135_2335,

3135_2340, 3140_2325, 3140_2330, 3140_2335 and 3140_2340 (Figure 2). A total of 69 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 155 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the sixteen pentads within which the study area is located. The SABAP2 data is regarded as a reliable reflection of the avifauna which occurs in the area.

- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the study area relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the Northern Cape Province .
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the study area (February, 2022).
- Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
- Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
- Primary avifaunal diversity and abundance data collected as part of an integrated pre-construction monitoring programme, implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities (i.e. Kwana, Moriri and Nku Solar Energy Facilities (SEF) and Angora and Merino Wind Energy Facilities (WEF)) between October 2020 and November 2021 (See Appendix 3 and 4).

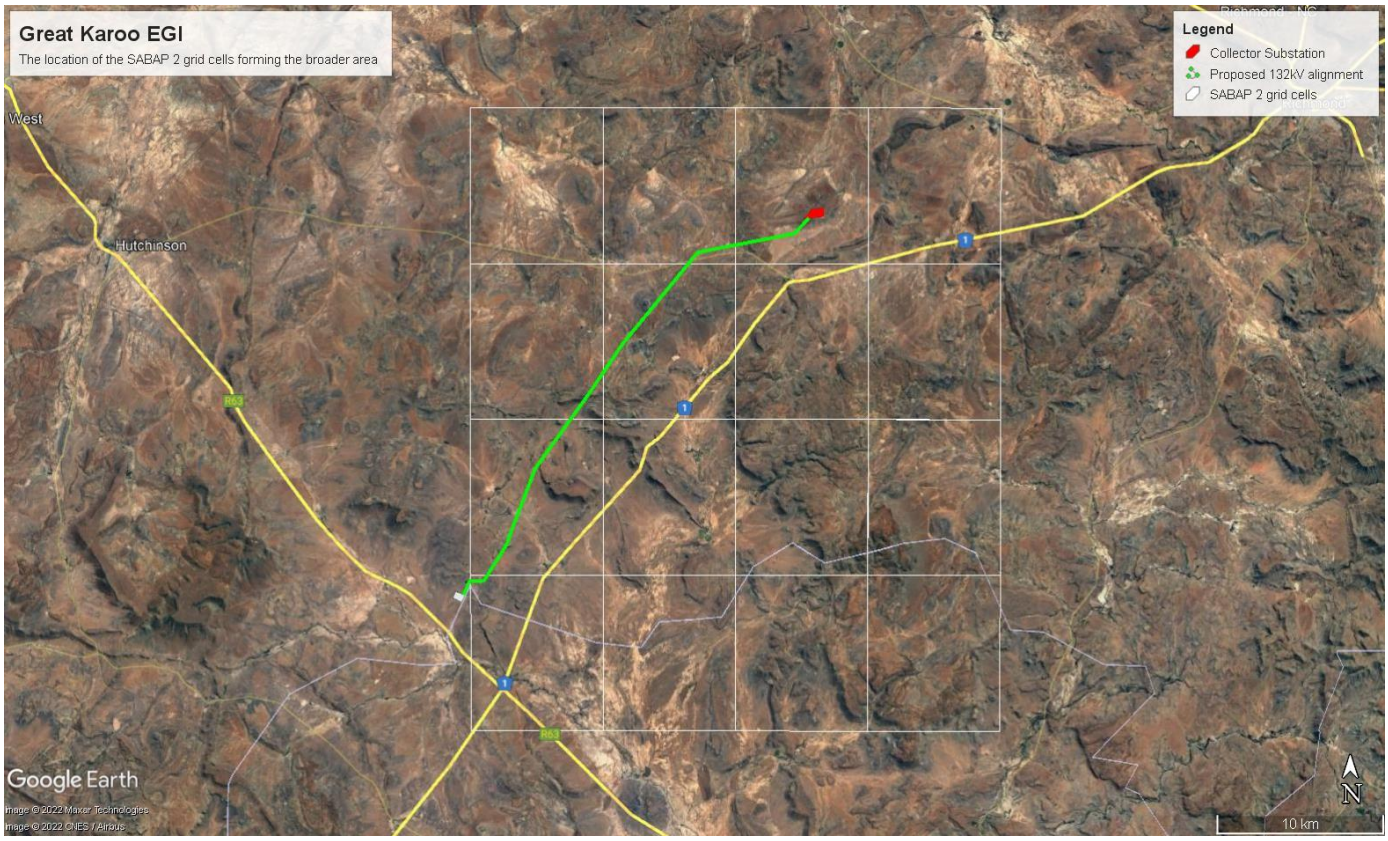


Figure 2: Location of the sixteen South African Bird Atlas Project 2 (SABAP2) pentad grid cells that were considered for the proposed Great Karoo Electrical Grid Infrastructure project.

4 ASSUMPTIONS AND LIMITATIONS

This study assumed that the sources of information used in this report are reliable. In this respect, the following must be noted:

- The focus of this assessment is primarily on the potential impacts of the proposed Great Karoo EGI on priority species. Priority species are defined as species which could potentially be impacted by power line collisions or electrocutions, based on specific morphological and/or behavioural characteristics. Priority species were further subdivided into raptors, waterbirds and terrestrial birds.
- The assessment of impacts is based on the baseline environment as it currently exists in the study area.
- Cumulative impacts include all WEF and SEF (PV) projects with grid connections for which information could be sourced in the public domain, within a 30km radius that currently have open applications or have been approved by the Competent Authority as per the 2021 Q3 database from the Department of Forest Fisheries and Environment (DFFE). An intensive internet search was conducted to source information on the grid connections of the abovementioned projects, but in some instances no information could be obtained.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The study area was defined as a 2km zone around the proposed 132kV central collector substation and 132kV power line grid connection.

5 LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[1].

Table 1: Agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

5.2 National legislation

5.2.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

  (i) prevent pollution and ecological degradation;

  (ii) promote conservation; and

  (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

[1] (BirdLife International (2021) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2021-08-27).

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

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species was published on 30 October 2020. This protocol applies also for the assessment of impacts caused by power lines on avifauna.

5.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act 10 of 2004 read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

5.2.4 The National Environmental Management: Protected Areas Act 57 of 2003

The National Environmental Management: Protected Areas Act (No. 57 of 2003), as amended in 2014, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also provides for the establishment of a national register of all national, provincial and local protected areas that are managed in accordance with national norms and standards; and to endure intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are declared in order to regulate the area as a buffer zone for protection of a special nature reserve, world heritage site or nature reserve; to enable owners of land to take collective action to conserve biodiversity on their land and to seek legal recognition therefor; to protect the area if the area is sensitive to development due to its- (i) biological diversity; (ii) natural characteristics; (iii) scientific, cultural, historical, archaeological or geological value; (iv) scenic and landscape value; or (v) provision of environmental goods and services; to protect a specific ecosystem outside of a special nature reserve, world heritage site or nature reserve; to ensure that the use of natural resources in the area is sustainable. This Act explicitly states that no development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority.

5.2.5 The National Environmental Management Act 107 of 1998 (NEMA) Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and Avifaunal Species

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on terrestrial animal and/or avifaunal species for activities requiring environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for terrestrial animal species. The relevant terrestrial animal species data in the screening tool has been provided by the South African National Biodiversity Institute (SANBI).

5.3 Provincial Legislation

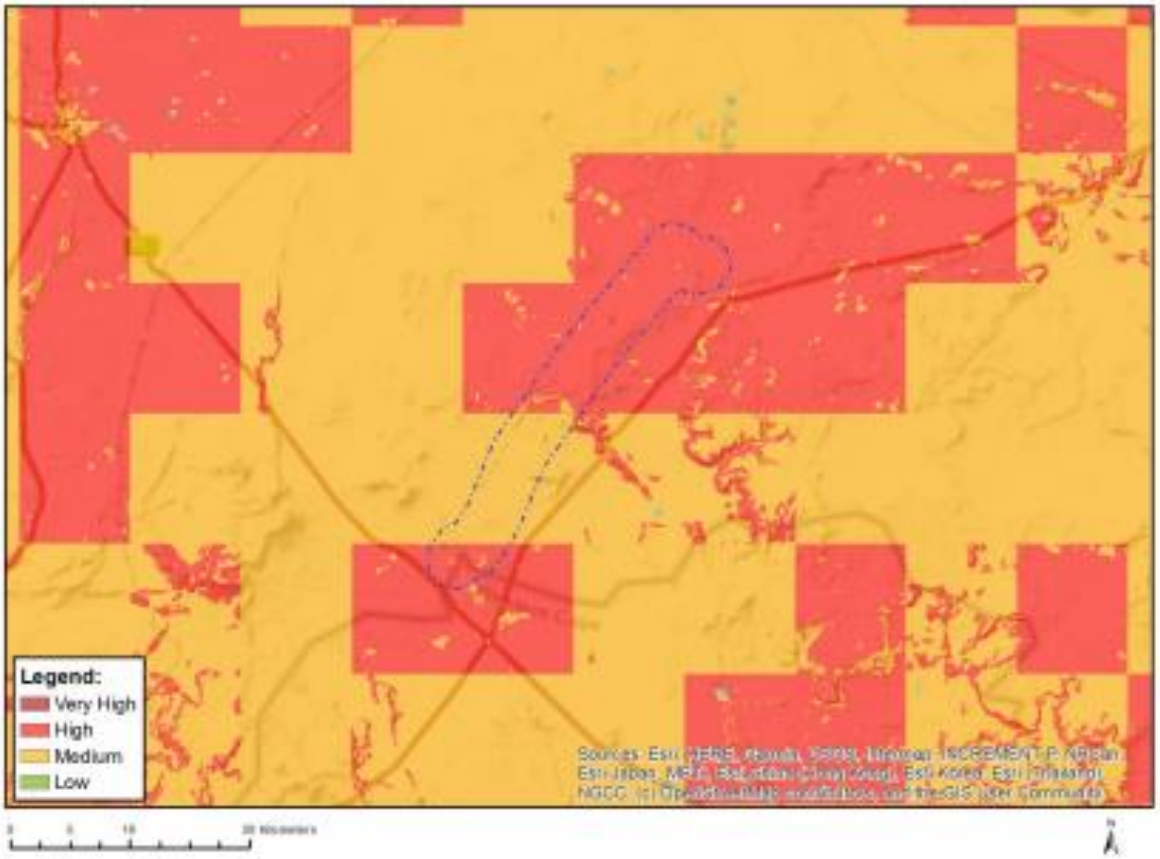
The current legislation applicable to the conservation of fauna and flora in the Northern Cape is the Northern Cape Nature Conservation Act No 9 of 2009. It provides for the sustainable utilisation of wild animals, aquatic biota and plants; the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; describes offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; provides for the issuing of permits and other authorisations; and provides for matters connected therewith.

6 BASELINE ASSESSMENT

6.1 DFFE National Screening Tool

The study area and immediate environment is classified as **MEDIUM and HIGH** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. These classifications are linked to the potential occurrence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable). The study area contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable. The occurrence of SCC was confirmed during the integrated pre-construction monitoring programme, implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities with observations of Ludwig's Bustard, Verreaux's Eagle, Martial Eagle *Polemaetus bellicosus* and Tawny Eagle *Aquila rapax* were recorded within the study area and its immediate surrounds. Based on the field surveys to date, the classification of **HIGH** sensitivity for avifauna in the screening tool is therefore confirmed (Figure 3).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Mammalia-Felis nigripes
High	Aves-Neotis ludwigii
High	Aves-Aquila verreauxii
Low	Low sensitivity
Medium	Aves-Neotis ludwigii
Medium	Aves-Aquila verreauxii
Medium	Mammalia-Bunolagus monticularis

Figure 3: The National Web-Based Environmental Screening Tool map of the three PV project sites, indicating sensitivities for the Terrestrial Animal Species theme. The High sensitivity classification is linked to Ludwig's Bustard *Neotis ludwigii* and Verreaux's Eagle *Aquila verreauxii*.

6.2 Protected Areas

The project site does not fall within a formally protected area.

6.3 Important Bird Areas

There are no Important Bird Areas (IBA) within a 50km radius around the proposed Great Karoo EGI. The closest IBA to the project site is the Platberg-Karoo Conservancy IBA SA037, located approximately 65km north-east of the 132kV central collector substation (Figure 4). It is therefore highly unlikely that the proposed Great Karoo EGI development will have a negative impact on any IBA due to the distance from the project site.

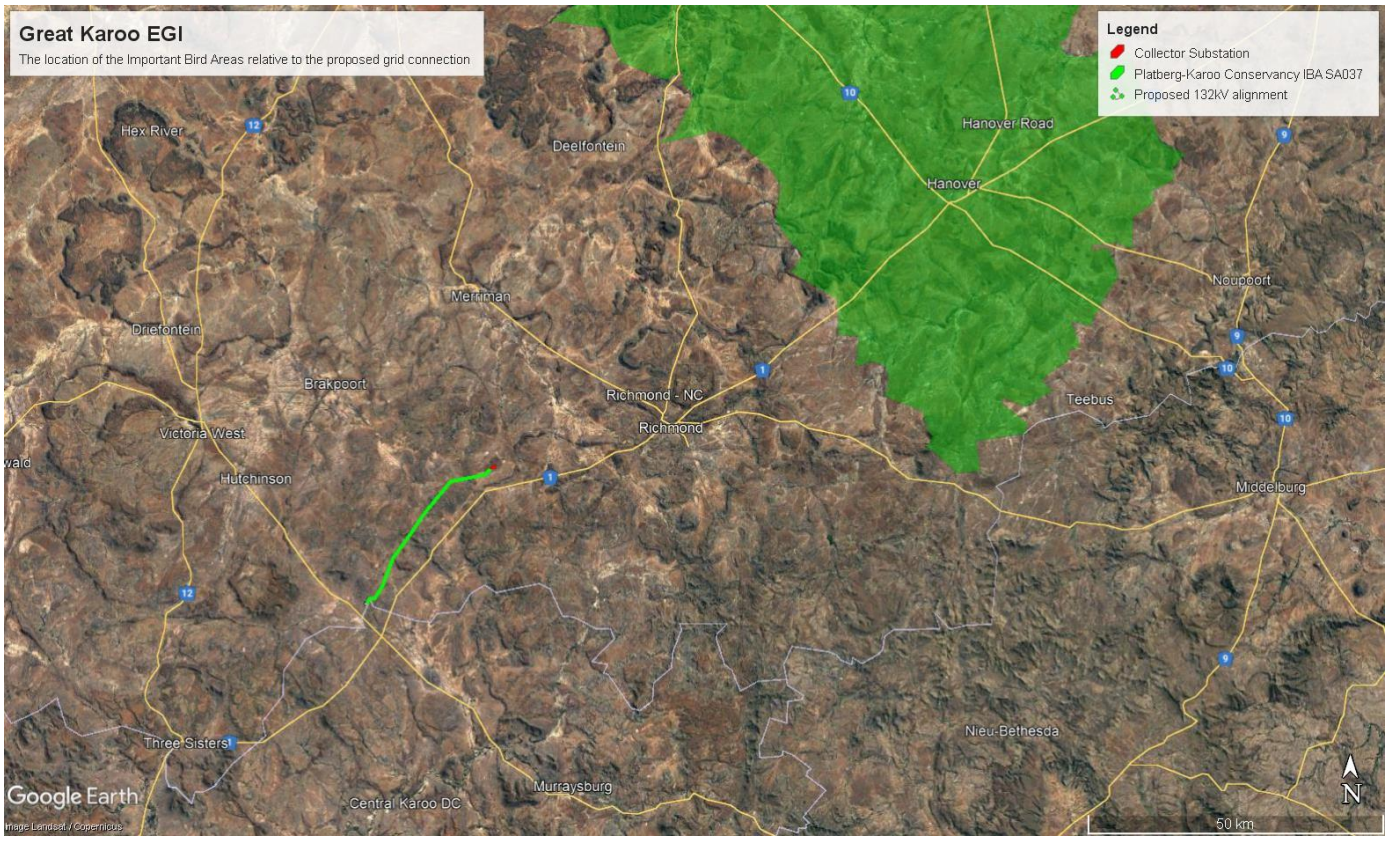


Figure 4: Regional map detailing the location of the proposed Great Karoo EGI in relation to Important Bird Areas (IBAs).

6.4 Biomes and vegetation types

The study area is located within the Nama Karoo biome (Mucina & Rutherford 2006). Two vegetation types are found in the study area, the dominant one being Eastern Upper Karoo, which is found on the plains and Upper Karoo Hardeveld occurring on the ridges (Mucina & Rutherford 2006). Eastern Upper Karoo is dominated by dwarf *mycrophyllus* shrubs, with white grasses of the genera *Aristida* and *Eragrostis*. On the steep slopes, mountain ridges and koppies, Upper Karoo Hardeveld is found which is characterised by dwarf Karoo scrub with drought tolerant grasses of genera such as *Aristida*, *Eragrostis* and *Stipagrostis* (Mucina & Rutherford 2006). The study area contains several large earth dams.

Maximum temperatures in the project site range between 31˚C in January (summer) and 5˚C in July (winter), and rainfall happens mostly between December and March and averages about 384mm per year, which makes for a fairly arid climate (worldweatheronline.com). Winters are very dry. The land is used for sheep and game farming.

Whilst the distribution and abundance of the bird species in the study area are typical of the broad vegetation type, it is also necessary to examine bird habitats in more detail as it may influence the distribution and behaviour of priority species. These are discussed in more detail below. The priority species most likely associated with the various bird habitat features are listed in Table 2.

6.5 Bird habitats

6.5.1 Nama Karoo

The vegetation at the study area consists of Karoo shrub vegetation, punctuated by rugged relief. Although not remarkably rich in species or endemism, the flora and fauna of the region are remarkably adapted to the region's climatic extremes. The major threats to biodiversity are posed by pastoralism, exotic plants, mining and agriculture. Trees and taller woody shrubs are restricted mostly to watercourses and include *Acacia karroo, Diospyros lycioides, Grewia robusta, Rhus lancea,* and *Tamarix usneoides* (Palmer and Hoffman 1997).

6.5.2 Surface water

The study area contains sources of both permanent (i.e. boreholes with water troughs) and ephemeral (i.e. dams) surface waterbodies. When filled with water, the dams typically attract flocks of Blue Crane *Anthropoides paradiseus* and Greater Flamingo *Phoenicopterus roseus* that utilise this habitat type in which to roost, as observed during the seasonal pre-construction monitoring surveys.

6.5.3 Rocky ridges

The study area contains a number of inselbergs with steep, boulder-strewn slopes, exposed rocky ridges and low cliffs. The rocky ridges that occur outside the study area support at least 11 Verreaux's Eagle nests, identified during the pre-construction monitoring programme, implemented at the at the proposed Great Karoo Cluster of Renewable Energy Facilities. Given the availability of similar rocky habitat within the Great Karoo EGI study area, it is possible that additional Verreaux's Eagle nests could occur both within the southern portion of the study area as well as the broader surrounds.

6.5.4 Agricultural lands

Cultivation in the broader area is limited to a few irrigated lands near the N1 national road where lucerne is cultivated. Arable or cultivated land represents a significant feeding area for many bird species in any landscape, but perhaps more so in arid environments. The opening up of the soil surface, and land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the crop or pasture plants cultivated are often eaten by birds, or attract insects which are in turn eaten by birds. Relevant to this development the commercial agricultural lands are located outside of the study area and the subsistence agriculture present at homesteads within the study area are unlikely to significantly increase the collision risk associated with the 132kV power line grid connection.

6.5.5 Alien trees

The study area is largely devoid of trees, except for alien trees which have been planted in homestead areas. Although stands of *Eucalyptus* are strictly speaking invader species, they have become important refuges for certain species of raptors, particularly Amur Falcon *Falco amurensis*, a Palearctic migrant, which will commonly roost in small stands of *Eucalyptus* in suburbs of small towns. Relevant to this project Amur Falcon, Lanner Falcon *Falco biarmicus*, Lesser Kestrel *Falco naumanni*, Greater Kestrel *Falco rupicoloides*, Tawny Eagle and Martial Eagle may utilise this habitat type occasionally.

6.5.6 High voltage lines

Five existing high voltage Transmission (TX) power lines occur within the study area, four of which run parallel to the proposed Great Karoo EGI 132kV power line grid connection, the closest being ~100m from the proposed alignment. Transmission lines are an important breeding substrate for raptors in the Karoo, due to the lack of large trees (Jenkins *et al.* 2013). The pre-construction monitoring programme, implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities revealed two Tawny Eagle nests (31°33'52.23"S 23°29'57.56"E and 31°30'26.86"S 23°33'3.47"E) on the existing Droërivier – Hydra 2 400kV TX power line. In addition, two Martial Eagle nests were also recorded (31°34'33.67"S 23°29'24.05"E and 31°31'28.38"S 23°32'3.41"E) on the Droërivier-Hydra 1 400kV and Droërivier-Hydra 2 400kV transmission lines respectively. There may be additional nests present further south closer to the Gamma substation.

See Appendix 2 for a photographic record of habitat features in the study area, within which the proposed Great Karoo EGI development occurs, and the immediate surroundings.

7 AVIFAUNA IN THE STUDY AREA

7.1 South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 167 bird species could potentially occur within the study area and immediate surroundings – Appendix 1 provides a comprehensive list of all the species. Of these, 49 species are classified as priority species (see definition of priority species in section 4) and 12 of these are South African Red List species. Of the priority species, 35 are likely to occur regularly at the study area and immediate surrounding area, and another 14 could occur sporadically.

Table 2 below lists all the priority species and the possible impact on the respective species by the proposed Great Karoo EGI project. The following abbreviations and acronyms are used:

- EN = Endangered
- VU = Vulnerable
- NT = Near threatened
- H = High
- M = Medium
- L = Low

Table 2: Priority power line species potentially occurring within the study area and immediate surroundings.

Species name	Scientific name	Full Protocol	Adhoc Protocol	Red List Global	Red List Regional	Power line priority	Recorded during surveys	Likelihood of occurrence	Nama Karoo	Surface water	Agriculture	Ridges	Alien trees	HV lines (roosting / breeding)	Substation - Electrocution	Power line - Electrocution	Power line - Collision	Displacement (disturbance)	Displacement (habitat transformation)
African Fish Eagle	*Haliaeetus vocifer*	1,5152	0	-	-	x	x	L		x			x						
African Harrier-Hawk	*Polyboroides typus*	4,5455	1,2903	-	-	x	x	M	x			x	x		x			x	x
African Sacred Ibis	*Threskiornis aethiopicus*	9,0909	5,8065	-	-	x	x	M		x	x				x		x	x	
African Spoonbill	*Platalea alba*	4,5455	3,2258	-	-	x		L		x							x		
Black Harrier	*Circus maurus*	1,5152	0	EN	EN	x		L	x		x				x				x
Black Stork	*Ciconia nigra*	3,0303	0,6452	-	VU	x	x	M		x		x			x		x	x	
Black-headed Heron	*Ardea melanocephala*	9,0909	0,6452	-	-	x		L	x	x					x		x		x
Black-winged Kite	*Elanus caeruleus*	1,5152	0	-	-	x		L	x		x		x	x	x			x	x
Blue Crane	*Grus paradisea*	62,1212	15,4839	VU	NT	x	x	H	x	x	x						x	x	x
Booted Eagle	*Hieraaetus pennatus*	4,5455	0	-	-	x	x	M	x	x		x		x	x				
Cape Crow	*Corvus capensis*	10,6061	5,1613	-	-	x	x	M	x		x		x	x	x			x	x
Cape Shoveler	*Spatula smithii*	1,5152	0,6452	-	-	x		L		x							x		
Cape Teal	*Anas capensis*	3,0303	1,2903	-	-	x		L		x							x		
Cape Vulture	*Gyps coprotheres*	0	0	VU	EN	x	x	L	x			x		x	x	x	x		
Common Buzzard	*Buteo buteo*	1,5152	3,871	-	-	x	x	M	x		x		x	x	x				
Common Moorhen	*Gallinula chloropus*	1,5152	0	-	-	x		L		x									
Egyptian Goose	*Alopochen aegyptiaca*	30,303	5,1613	-	-	x	x	H		x	x				x		x	x	x
Greater Flamingo	*Phoenicopterus roseus*	3,0303	0,6452	-	NT	x	x	M		x							x	x	
Greater Kestrel	*Falco rupicoloides*	27,2727	4,5161	-	-	x	x	H	x				x	x	x			x	x
Grey Heron	*Ardea cinerea*	6,0606	0,6452	-	-	x	x	M		x							x	x	
Hadada Ibis	*Bostrychia hagedash*	27,2727	3,871	-	-	x	x	H	x		x		x	x	x		x	x	x
Hamerkop	*Scopus umbretta*	6,0606	0,6452	-	-	x		L		x							x		
Helmeted Guineafowl	*Numida meleagris*	9,0909	0,6452	-	-	x		M	x		x		x	x	x		x	x	x
Jackal Buzzard	*Buteo rufofuscus*	36,3636	10,3226	-	-	x	x	H	x	x		x		x	x			x	x
Karoo Korhaan	*Eupodotis vigorsii*	51,5152	5,1613	-	NT	x	x	H	x								x	x	x
Lanner Falcon	*Falco biarmicus*	1,5152	1,2903	-	VU	x	x	M	x	x	x	x	x	x	x			x	x

Species name	Scientific name	Full Protocol	Adhoc Protocol	Red List Global	Red List Regional	Power line priority	Recorded during surveys	Likelihood of occurrence	Nama Karoo	Surface water	Agriculture	Ridges	Alien trees	HV lines (roosting / breeding)	Substation - Electrocution	Power line - Electrocution	Power line - Collision	Displacement (disturbance)	Displacement (habitat transformation)
Lesser Kestrel	*Falco naumanni*	3,0303	1,2903	-	-	x	x	M	x		x		x	x	x				
Little Grebe	*Tachybaptus ruficollis*	3,0303	0	-	-	x	x	L		x							x		
Ludwig's Bustard	*Neotis ludwigii*	37,8788	3,871	EN	EN	x	x	H	x		x						x	x	x
Martial Eagle	*Polemaetus bellicosus*	7,5758	1,9355	EN	EN	x	x	H	x	x			x	x	x			x	x
Northern Black Korhaan	*Afrotis afraoides*	68,1818	11,6129	-	-	x	x	H	x		x						x	x	x
Pale Chanting Goshawk	*Melierax canorus*	40,9091	12,9032	-	-	x	x	H	x	x			x	x	x			x	x
Pied Crow	*Corvus albus*	83,3333	38,7097	-	-	x	x	H	x		x	x	x	x	x			x	x
Red-billed Teal	*Anas erythrorhyncha*	10,6061	1,2903	-	-	x	x	M		x							x		
Red-knobbed Coot	*Fulica cristata*	4,5455	0	-	-	x		M		x							x		
Reed Cormorant	*Microcarbo africanus*	3,0303	0	-	-	x		M		x							x		
Rock Kestrel	*Falco rupicolus*	31,8182	1,9355	-	-	x	x	H	x			x	x	x	x			x	x
Secretarybird	*Sagittarius serpentarius*	9,0909	3,2258	EN	VU	x	x	M	x	x			x				x	x	x
South African Shelduck	*Tadorna cana*	39,3939	2,5806	-	-	x	x	M		x							x		
Spotted Eagle-Owl	*Bubo africanus*	6,0606	0	-	-	x		M	x			x	x		x		x	x	x
Spur-winged Goose	*Plectropterus gambensis*	6,0606	3,2258	-	-	x	x	M		x	x						x		
Tawny Eagle	*Aquila rapax*	10,6061	5,8065	VU	EN	x	x	H	x	x			x	x	x			x	x
Verreaux's Eagle	*Aquila verreauxii*	19,697	6,4516	-	VU	x	x	H	x	x		x	x	x	x		x	x	x
Western Barn Owl	*Tyto alba*	1,5152	0	-	-	x		L	x		x		x		x		x		x
Western Cattle Egret	*Bubulcus ibis*	1,5152	0	-	-	x		L	x		x		x		x		x	x	x
White Stork	*Ciconia ciconia*	0	1,2903	-	-	x		L	x	x	x						x		
White-breasted Cormorant	*Phalacrocorax lucidus*	3,0303	0	-	-	x	x	M		x							x		
White-necked Raven	*Corvus albicollis*	34,8485	7,0968	-	-	x	x	H	x			x	x	x	x			x	x
Yellow-billed Duck	*Anas undulata*	15,1515	1,9355	-	-	x	x	M		x							x		

7.4 On-site surveys

An integrated pre-construction monitoring programme was implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities (i.e. Kwana, Moriri and Nku Solar Energy Facilities (SEF) and Angora and Merino Wind Energy Facilities (WEF)) between October 2020 and November 2021. The programme comprised of six seasonal surveys of both the proposed study areas and an identified control site within the broader study area. In order to describe the avifaunal community present, a concerted effort was made to sample the avifauna in all of the primary habitats that were available by applying walked and driven transects, vantage point, focal point and incidental survey techniques (Appendix 3).

The surveys produced a combined list of 113 species (Appendix 3) covering both the Great Karoo Cluster of Renewable Energy Facilities study area and to a limited extent, the surrounding area. Blue Crane (n=296), Karoo Korhaan *Eupodotis vigorsii* (n=51), Northern Black Korhaan *Afrotis afraoides* (n=49) and Southern Pale-chanting Goshawk *Melierax canorus* (n=24) were recorded in the largest abundances. Other notable observations included, Eleven (11) Verreaux's Eagle, four (4)Tawny Eagle and two (2) Martial Eagle nest locations. Relevant to this assessment, the two (2) Martial Eagle and two (2) Tawny Eagle nests present on the existing TX infrastructure (Figure 5), that are aligned parallel to the proposed 132kV double circuit power line, are of particular importance (Appendix 4). Although part of the southern portion of the 132kV power line corridor could not be surveyed due to time constraints, the identified microhabitats and existing power line infrastructure occur throughout the Great Karoo EGI study area and are likely to support an identical suite of priority species. All other observations were of small passerine, waterbird and wader species.

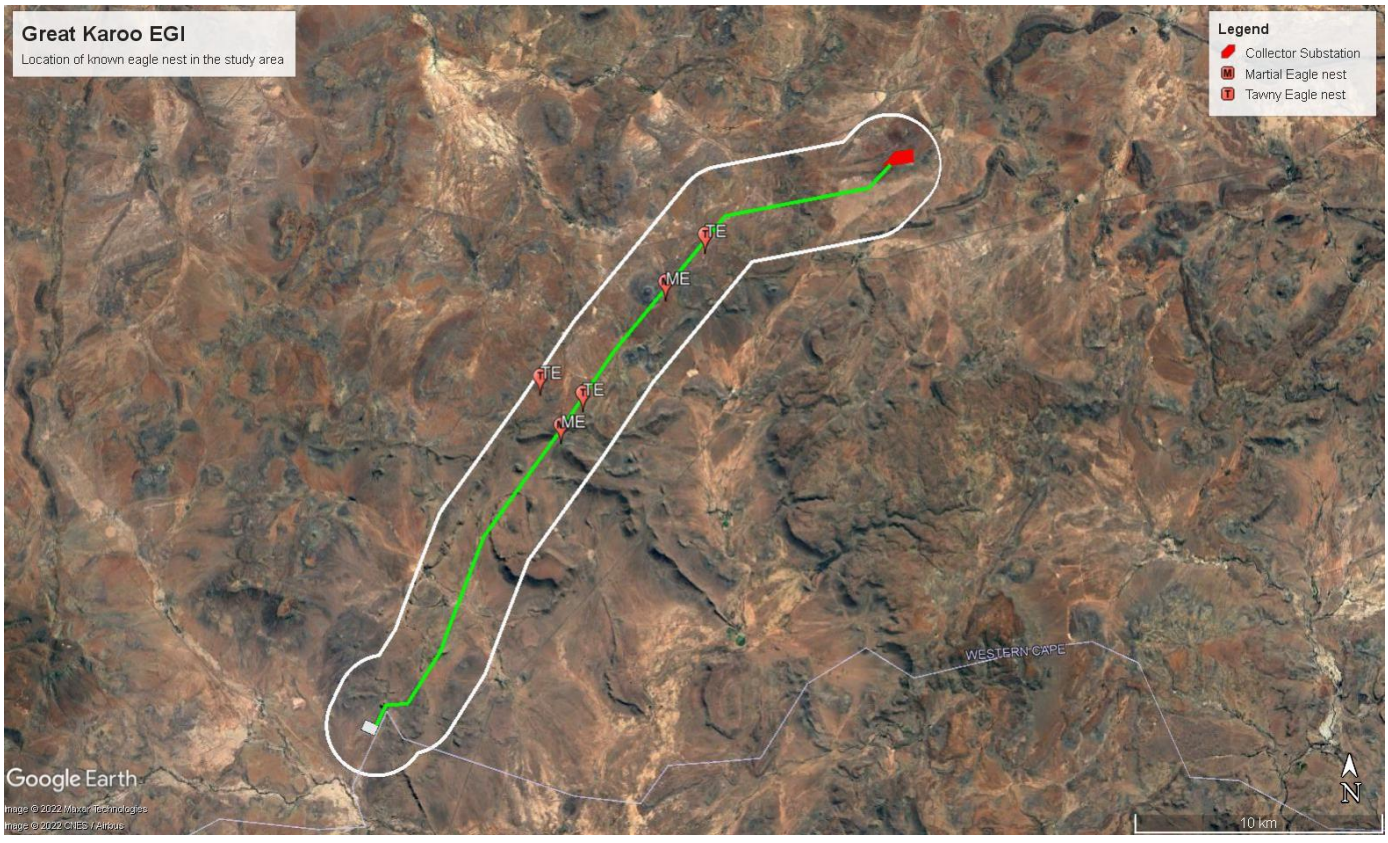


Figure 5: Known priority species nest locations within the study area.

8 IMPACT ASSESSMENT

8.1 General

Negative impacts on avifauna by electricity infrastructure generally take two (2) main forms, namely electrocution and collisions (Ledger & Annegarn, 1981; Ledger 1983; Ledger, 1984; Hobbs and Ledger, 1986a; Hobbs & Ledger, 1986b;

Ledger, Hobbs & Smith, 1992; Verdoorn, 1996; Kruger & Van Rooyen, 1998; Van Rooyen, 1998; Kruger, 1999; Van Rooyen, 1999; Van Rooyen, 2000; Van Rooyen, 2004; Jenkins *et al*., 2010). Displacement due to habitat destruction and disturbance associated with the construction of the electricity infrastructure and other associated infrastructure is another impact that could potentially impact on avifauna.

The following potential impacts have been identified:

8.1.1 Construction Phase

- Displacement due to disturbance associated with the construction of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line; and
- Displacement due to habitat transformation associated with the construction of the 132kV central collector substation, associated infrastructure and to a lesser extent the 132kV double circuit power line.

8.1.2 Operational Phase

- Collisions with the 132kV double circuit power line;
- Electrocutions within the substation yard; and
- Electrocution of vultures on the 132kV power line infrastructure.

8.1.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line.

8.1.4 Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the 132kV central collector substation, associated infrastructure and 132kV double circuit power line;
- Displacement due to habitat transformation associated with the 132kV central collector substation, associated infrastructure and 132kV double circuit power line;
- Collisions with the 132kV double circuit power line;
- Electrocutions within the substation yard; and
- Electrocution of vultures on the 132kV power line infrastructure.

8.2 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. Relevant to the proposed 132kV Great Karoo EGI overhead power line, the significance of the electrocution impact on the majority of priority species will be low. The only priority species capable of bridging the clearance distances of the proposed power line infrastructure is the Cape Vulture recorded in the study area, due to their size and gregarious nature. SABAP 2 data suggests that the species is unlikely to occur regularly in the study area, a premise that is supported by the observation of an individual bird during the six seasonal visits to the broader study area. However, pastoral activities feature prevalently, so their sporadic occurrence cannot be ruled out. The only envisaged high risk scenario would be when a carcass becomes available within a few hundred metres of the proposed power line, attracting vultures which may cluster on a few towers. The best possible mitigation is the construction of the power line using an approved bird friendly pole/tower design in accordance with the Eskom Distribution Technical Bulletin relating to bird friendly structures.

Electrocutions within the proposed central collector substation yard are possible; however, the likelihood of this impact on the more sensitive Red List priority species is remote, as these species are unlikely to regularly utilise the infrastructure within the substation yard for perching or roosting. Species that are more vulnerable to this impact are

medium-sized raptors, corvids, owls and certain species of waterbirds. The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

132kV double circuit power line:

- Cape Vulture

132kV central collector substation:

- African Harrier-Hawk
- African Sacred Ibis
- Black Harrier
- Black Stork
- Black-headed Heron
- Black-winged Kite
- Booted Eagle
- Cape Crow
- Cape Vulture
- Common Buzzard
- Egyptian Goose
- Greater Kestrel
- Hadada Ibis
- Helmeted Guineafowl
- Jackal Buzzard
- Lanner Falcon
- Lesser Kestrel
- Martial Eagle
- Pale Chanting Goshawk
- Pied Crow
- Rock Kestrel
- Spotted Eagle-Owl
- Tawny Eagle
- Verreaux's Eagle
- Western Barn Owl
- Western Cattle Egret
- White-necked Raven

8.3 Collisions

Collisions are the biggest threat posed by high voltage power lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with high voltage power lines (Van Rooyen 2004, Anderson 2001). In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

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

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings

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

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

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

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (Figure 6).

Power line collisions are generally accepted as a key threat to bustards (Raab *et al*. 2009; Raab *et al*. 2010; Jenkins & Smallie 2009; Barrientos *et al*. 2012, Shaw 2013). In a recent study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

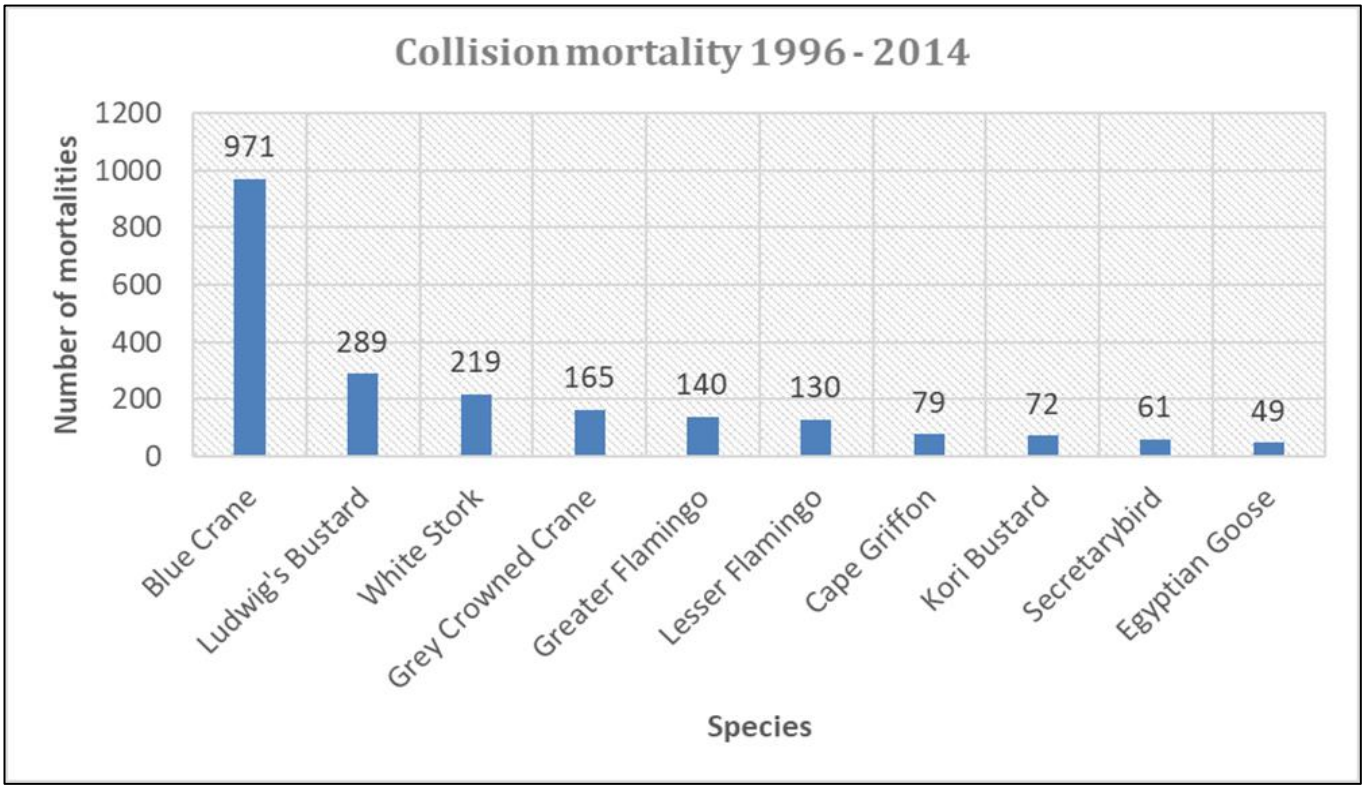


Figure 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

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

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al*. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Bernardino *et al.* 2018; Sporer *et al.* 2013, Barrientos *et al*. 2011; Jenkins *et al*. 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al*. 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of

flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al*. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al*. 2010).

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

The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

- African Sacred Ibis
- African Spoonbill
- Black Stork
- Black-headed Heron
- Blue Crane
- Cape Shoveler
- Cape Teal
- Cape Vulture
- Egyptian Goose
- Greater Flamingo
- Grey Heron
- Hadeda Ibis
- Hamerkop
- Helmeted Guineafowl
- Karoo Korhaan
- Little Grebe
- Ludwig's Bustard
- Northern Black Korhaan
- Red-billed Teal
- Red-knobbed Coot
- Reed Cormorant
- Secretarybird
- South African Shelduck
- Spotted Eagle-Owl
- Spur-winged Goose
- Verreaux's Eagle
- Western Barn Owl
- Western Cattle Egret
- White-breasted Cormorant
- Yellow-billed Duck

8.4 Displacement due to habitat destruction and disturbance

During the construction of power lines, service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. The construction activities will constitute the following:

- Site clearance and preparation;
- Excavations for infrastructure;
- Construction of the infrastructure (i.e. the 132kV central collector substation and 132kV double circuit power line); and
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site.

These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed 132kV central collector substation and 132kV double circuit power line through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the central collector substation is unavoidable. In the case of the 132kV overhead power line, the direct habitat transformation is limited to the pole footprints and the narrow access road/track under the power line. The habitat in the study area is highly uniform from a bird impact perspective. The loss of habitat a relatively small quantity of the habitat for priority species due to direct habitat transformation associated with the construction of the proposed Great Karoo EGI is likely to be fairly minimal.

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle. Terrestrial species and the raptors breeding on the existing TX power line infrastructure are most likely to be affected by displacement due to disturbance.

The priority species which are potentially vulnerable to this impact are listed in Table 2, and below:

- African Harrier-Hawk
- African Sacred Ibis
- Black Harrier
- Black Stork
- Black-headed Heron
- Black-winged Kite
- Blue Crane
- Cape Crow
- Egyptian Goose
- Greater Flamingo
- Greater Kestrel
- Grey Heron
- Hadeda Ibis
- Helmeted Guineafowl
- Jackal Buzzard
- Karoo Korhaan
- Lanner Falcon
- Ludwig’s Bustard
- Martial Eagle
- Northern Black Korhaan

- Pale Chanting Goshawk
- Pied Crow
- Rock Kestrel
- Secretarybird
- Spotted Eagle-Owl
- Tawny Eagle
- Verreaux's Eagle
- Western Barn Owl
- Western Cattle Egret
- White-necked Raven

9 IMPACT RATING

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

9.1 Determination of Significance of Impacts

Direct, indirect and cumulative impacts of the issues identified through the EIA process were assessed in terms of the following criteria:

- The nature, which includes a description of what causes the effect, what will be affected and how it will be affected.

- The extent, wherein it is indicated whether the impact will be
    - 1 = site only
    - 2 = local
    - 3 = regional
    - 4 = national
    - 5 = international

- The duration, wherein is indicated whether:
    - 1 = the lifetime of the impact will be of a very short duration (0–1 years)
    - 2 = the lifetime of the impact will be of a short duration (2-5 years)
    - 3 = medium-term (5–15 years)
    - 4 = long term (> 15 years)
    - 5 = permanent

- The consequences (magnitude), quantified on a scale from 0-10, where:
    - 0 = small and will have no effect on the environment
    - 2 = minor and will not result in an impact on processes
    - 4 = low and will cause a slight impact on processes
    - 6 = moderate and will result in processes continuing but in a modified way
    - 8 = high (processes are altered to the extent that they temporarily cease)
    - 10 = very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale of 1–5, where:

- 1 = very improbable (probably will not happen)
- 2 = improbable (some possibility, but low likelihood)
- 3 = probable (distinct possibility)
- 4 = highly probable (most likely)
- 5 is definite (impact will occur regardless of any prevention measures)

- The significance, which is determined through a synthesis of the characteristics described above and is assessed as low, medium or high

- The status, which is 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.

The significance is calculated by combining the criteria in the following formula:
S = (E+D+M)P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

9.2 Impact Assessment

The impact assessments are summarised in the tables below.

9.2.1 Construction Phase

Nature: *Displacement of priority species due to* ***disturbance*** *associated with construction of the Great Karoo EGI 132kV central collector substation and 132kV overhead power line.*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	1 very short	1 very short
Magnitude	8 high	6 moderate
Probability	4 highly probable	2 improbable
Significance	**44 MEDIUM**	**18 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High

Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Conduct a pre-construction inspection (avifaunal walk-through) of the final central collector substation layout and power line alignment to identify priority species that may be breeding within the substation area and to record the status of the eagle nests on the existing transmission power lines. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding pair of eagles during the construction period. This could include measures such as delaying some of the activities until after the breeding season.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.

Residual Risks:

The residual risk of displacement will be reduced to a low level after mitigation, if the proposed mitigation measures are implemented.

Nature: *Displacement of priority species due to* ***habitat transformation*** *associated with construction of the Great Karoo EGI 132kV central collector substation and 132kV overhead power line.*

	Without mitigation	**With mitigation**
Extent	1 site only	1 site only
Duration	4 long term	4 long term
Magnitude	6 moderate	4 low
Probability	3 probable	2 improbable
Significance	**33 MEDIUM**	**18 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To a limited extent	

Mitigation:

- Vegetation clearance should be limited to what is absolutely necessary.
- The mitigation measures proposed by the biodiversity specialist must be strictly enforced.

Residual Risks:

The residual risk of displacement will be further reduced after mitigation.

9.2.2 Operational Phase

Nature: *Mortality of priority species due to* ***collisions*** *with the Great Karoo EGI 132kV power line*

	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	4 long term	4 long term

Magnitude	8 high	6 moderate
Probability	4 highly probable	3 improbable
Significance	**56 MEDIUM**	**36 MEDIUM**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- The avifaunal specialist must conduct a walk-through prior to implementation to demarcate sections of power line that need to be marked with Eskom approved bird flight diverters. The bird flight diverters should be installed on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

Residual Risks:

There will be an ongoing residual risk of collisions with the grid connection power line, but mitigation should make a marked difference.

Nature: *Mortality of priority species due to* ***electrocution*** *within the Great Karoo EGI central collector substation*

	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	4 long term	4 long term
Magnitude	8 high	4 low
Probability	3 possible	2 improbable
Significance	**42 MEDIUM**	**20 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- The hardware within the proposed central collector substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the switching station and substation and be electrocuted.

Residual Risks:

The residual risk of electrocution will be low once mitigation is implemented.

Nature: *Mortality of priority species due to* ***electrocution*** *on the 132kV power line infrastructure*

	Without mitigation	**With mitigation**
Extent	2 local	2 local

Duration	4 long term	4 long term
Magnitude	8 high	4 low
Probability	3 possible	1 very improbable
Significance	**42 MEDIUM**	**10 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Construction of the power line must be undertaken using an approved bird friendly pole/tower design in accordance with the Distribution Technical Bulletin relating to bird friendly structures. The avifaunal specialist must sign off on the final design.

Residual Risks:

The residual risk of electrocution will be low once mitigation is implemented.

9.2.3 Decommissioning Phase

Nature: *Displacement of priority species due to* ***disturbance*** *associated with decommissioning of the Great Karoo EGI 132kV central collector substation and 132kV overhead power line.*

	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	1 very short	1 very short
Magnitude	8 high	6 moderate
Probability	4 highly probable	2 improbable
Significance	**44 MEDIUM**	**18 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- The existing transmission lines must be inspected for active raptor nests prior to the commencement of the decommissioning activities. Should any active nests be present, decommissioning activities during the breeding season should be avoided, if possible.
- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

Residual Risks:

The residual risk of displacement will be reduced to a low level after mitigation, if the proposed mitigation is implemented.

The impacts are summarized, and a comparison made between pre-and post-mitigation phases as shown in Table 3 below. The rating of environmental issues associated with different parameters prior to, and post mitigation of a proposed activity was averaged.

Table 3: Comparison of summarised impacts on environmental parameters

Environmental Parameter	Nature of the Impact	Rating prior to mitigation	Rating post mitigation
Avifauna	*Displacement of priority species due to **disturbance** associated with construction of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line).*	44 MEDIUM	18 LOW
	*Displacement of priority species due to **habitat transformation** associated with construction of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line).*	33 MEDIUM	18 LOW
	*Mortality of priority species due to **collisions** with the Great Karoo EGI (132kV power line).*	56 MEDIUM	36 MEDIUM
	*Mortality of priority species due to **electrocution** within the Great Karoo EGI central collector substation.*	42 MEDIUM	20 LOW
	*Mortality of priority species due to **electrocution** on the 132kV power line infrastructure.*	42 MEDIUM	10 LOW
	*Displacement of priority species due to **disturbance** associated with decommissioning of the Great Karoo EGI (132kV central collector substation and 132kV overhead power line.*	44 MEDIUM	18 LOW
	AVERAGE SIGNIFICANCE RATING	**50 MEDIUM**	**20 LOW**

9.3 Cumulative impacts

“Cumulative Impact”, in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section addresses whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment
- Unacceptable increase in impact

According to the official database of DFFE, there were at least nine approved renewable energy projects, within a 30km radius around the proposed development as at the third quarter (Q3) of 2021 (Figure 7)

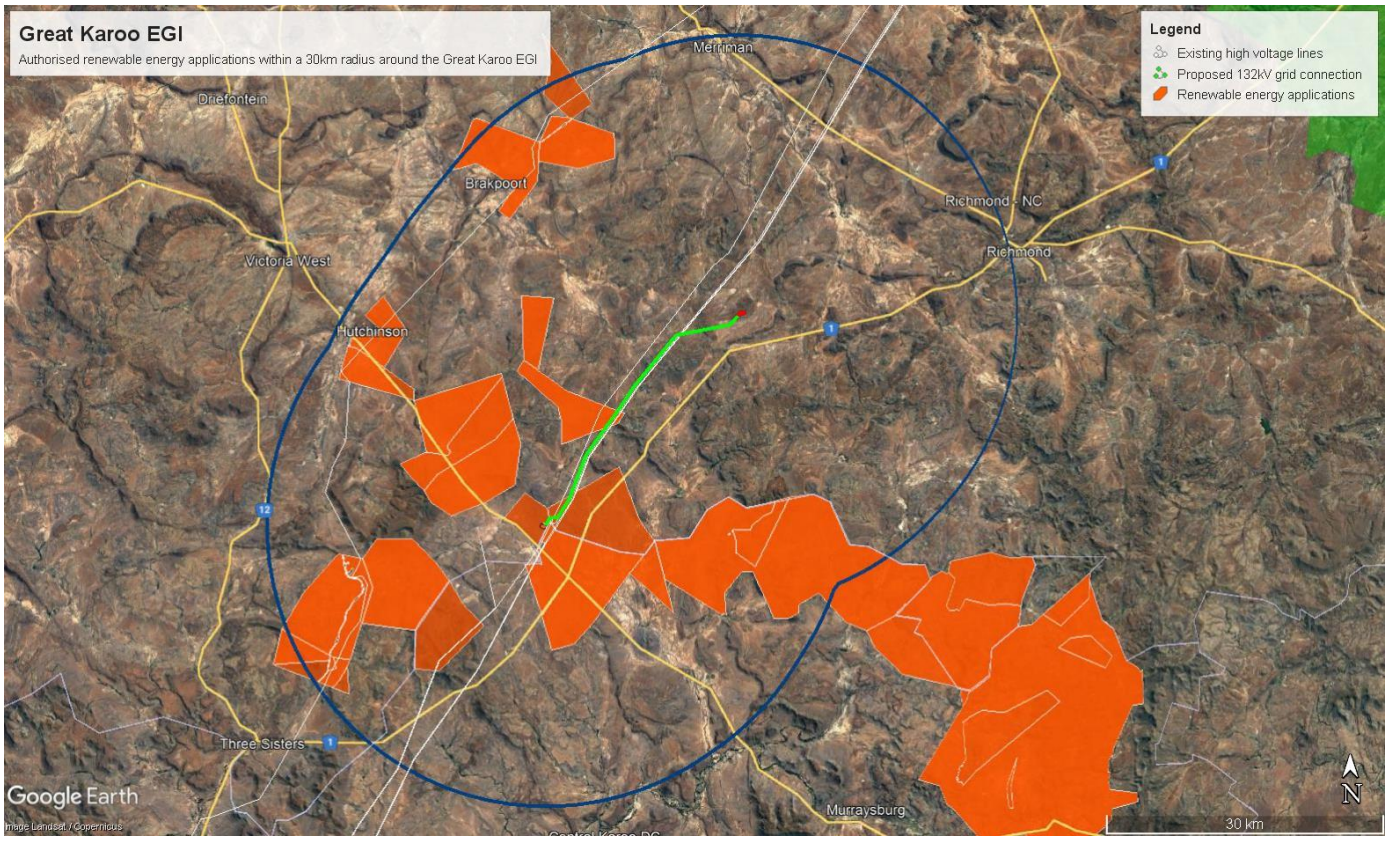


Figure 7: Approved renewable energy applications and existing high voltage power lines within 30km of the proposed Great Karoo EGI

The proposed Great Karoo EGI equates to a maximum of 37.5km. An intensive internet search was conducted to source information on the grid connections of the abovementioned projects available within the public domain, but in a few instances no information could be obtained. However, based on the information that could be sourced, it is estimated that the proposed grid connections for the approved renewable energy projects come to at least ~100km of high voltage lines. There are approximately 403kms of existing high voltage lines within the 30km radius around the Great Karoo EGI project (counting parallel lines as one). The Great Karoo EGI project will thus increase the total number of existing and planned high voltage lines by ~7 %. The contribution of the proposed Great Karoo EGI 132kV double circuit power line to the cumulative impact of all the high voltage lines is thus low. However, the combined cumulative impact of the existing and proposed power lines on avifauna within a 30km radius is considered to be moderate.

The cumulative impact of displacement due to disturbance and habitat transformation at the 132kV central collector substation associated with the Great Karoo EGI project is considered to be low, due to the small size of the footprint (0.7km^2) and the availability of similar habitat within the 30km radius area. The cumulative impact of potential electrocutions within the central collector substation yard is also likely to be low as it is expected to be a rare event.

The tables below summarise the post-mitigation cumulative impacts associated with the proposed development.

Nature: *Displacement of priority avifauna due to disturbance due to the construction of the 132kV double circuit power line and central collector substation*		
	Cumulative impact of the proposed Great Karoo EGI 132kV power line and central collector substation within a 30km radius (post mitigation).	**Cumulative impact of the proposed Great Karoo EGI 132kV power line and central collector substation and other planned and existing power lines and substations within a 30km radius (post mitigation)**
Extent	2 local	3 regional
Duration	1 very short	2 short term

Magnitude	4 low	6 moderate
Probability	2 improbable	4 highly probable
Significance	**14 LOW**	**44 MEDIUM**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Confidence in findings: Medium.

Mitigation:

- Conduct a pre-construction inspection (avifaunal walk-through) of the final central collector substation layout and power line alignment to identify priority species that may be breeding within the substation and to record the status of the eagle nests on the existing transmission power lines. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding pair of eagles during the construction period. This could include measures such as delaying some of the activities until after the breeding season.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.

Nature: *Displacement of priority avifauna due to habitat transformation due to the construction of the 132kV double circuit power line and central collector substation*

	Overall impact of the proposed Great Karoo EGI 132kV power line and central collector substation (post mitigation) within a 30km radius (post mitigation).	**Cumulative impact of the proposed Great Karoo EGI 132kV power line and central collector substation and other planned and existing substations within a 30km radius (post mitigation)**
Extent	1 site only	3 regional
Duration	4 long term	4 long term
Magnitude	2 minor	4 low
Probability	2 improbable	3 probable
Significance	**14 LOW**	**33 MEDIUM**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, but only to some extent	

Confidence in findings: Medium.

Mitigation:

- Vegetation clearance should be limited to what is absolutely necessary.
- The mitigation measures proposed by the biodiversity specialist must be strictly enforced.

Nature: *Collision mortality of priority avifauna due to the construction of the 132kV double circuit power line.*

	Cumulative impact of the proposed grid connection (post mitigation) within a 30km radius (post mitigation).	The combined cumulative impact of the proposed grid connection and all the other high voltage lines within a 30km radius (post mitigation)
Extent	2 local	3 regional
Duration	4 long term	4 long term
Magnitude	4 low	6 moderate
Probability	2 improbable	3 probable
Significance	**20 LOW**	**39 MEDIUM**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings: Medium.		
Mitigation: • The avifaunal specialist must conduct a walk-through prior to implementation to demarcate sections of power line that need to be marked with Eskom approved bird flight diverters. The bird flight diverters should be installed on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.		

Nature: *Electrocution of priority avifauna due to the construction of the central collector substation*		
	Overall impact of the proposed Great Karoo EGI central collector substation (post mitigation) within a 30km radius (post mitigation).	**Cumulative impact of the proposed Great Karoo EGI central collector substation and other planned and existing substations within a 30km radius (post mitigation)**
Extent	2 local	3 regional
Duration	4 long term	4 long term
Magnitude	2 minor	4 low
Probability	2 improbable	2 improbable
Significance	**16 LOW**	**22 LOW**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings: Medium.		
Mitigation: • The hardware within the proposed central collector substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the switching station and substation and be electrocuted		

Nature: *Electrocution of priority avifauna due to the construction of the 132kV double circuit power line*		
	Overall impact of the proposed Great Karoo EGI 132kV double circuit power line (post mitigation) within a 30km radius (post mitigation).	**Cumulative impact of the proposed Great Karoo EGI 32kV double circuit power line and other planned and power lines within a 30km radius (post mitigation)**
Extent	2 local	3 regional
Duration	4 long term	4 long term
Magnitude	4 low	6 moderate
Probability	2 improbable	2 improbable
Significance	**20 LOW**	**26 LOW**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings: Medium.		
Mitigation: • Construction of the power line using an approved bird friendly pole/tower design accordance with the Distribution Technical Bulletin relating to bird friendly structures. The final powerline design must be signed off by the avifaunal specialist.		

9.4 No-Go Alternative

The no-go alternative will result in the current status quo being maintained within the proposed study area as far as the avifauna is concerned. The study area itself consists mostly of natural Karoo shrub and surface waterbodies. The no-go option would result in no additional impacts on priority avifauna which would be beneficial to the avifauna currently occurring there.

9.5 Environmental sensitivities

At a site-specific level, environmentally sensitive features present within the proposed study area include the existing eagle nests, in addition to permanent and ephemeral waterbodies. These areas are classified as areas of **HIGH** sensitivity. Construction in the areas containing eagle nests will need to be carefully managed to ensure minimal disturbance to the breeding birds and/or their progeny. The construction of the proposed power line across or within close proximity to the waterbodies will necessitate the marking of the power line with bird flight diverters to mitigate the collision impact. Site specific recommendations for the management of the disturbance and collision impacts associated with these **HIGH** sensitivity areas will be provided following the pre-construction avifaunal walk-through (inspection). The remainder of the study area is considered to be of **MEDIUM** sensitivity, given its propensity to support Ludwig's Bustard.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

Refer to Appendix 6 for a description of the key mitigation and monitoring recommendations for each applicable mitigation measure identified for all phases of the project.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

11.1 Statement and Reasoned Opinion

The expected impacts of the Great Karoo EGI 132kV central collector substation and 132kV overhead power line were rated to be of MEDIUM significance and negative status pre-mitigation. However, with appropriate mitigation, the overall post-mitigation significance of the identified impacts should be reduced to LOW negative (see Table 3 above). No fatal flaws were discovered in the course of the investigation. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures, as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix 6), are strictly implemented.

11.2 EA Condition Recommendations

The proposed mitigation measures are detailed in the EMPr (Appendix 6).

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE STUDY AREA AND SURROUNDINGS

Species name	Scientific name	Full Protocol Report Rate	Adhoc Protocol Report Rate	Red List Global	Red List Regional
Bokmakierie	Telophorus zeylonus	48,5	9,0	-	-
Hamerkop	Scopus umbretta	6,1	0,6	-	-
Neddicky	Cisticola fulvicapilla	0,0	0,6	-	-
Secretarybird	Sagittarius serpentarius	9,1	3,2	EN	VU
Pied Avocet	Recurvirostra avosetta	12,1	2,6	-	-
Acacia Pied Barbet	Tricholaema leucomelas	47,0	5,2	-	-
Pririt Batis	Batis pririt	7,6	1,9	-	-
European Bee-eater	Merops apiaster	15,2	0,0	-	-
Southern Red Bishop	Euplectes orix	27,3	4,5	-	-
Little Bittern	Ixobrychus minutus	1,5	0,0	-	-
African Red-eyed Bulbul	Pycnonotus nigricans	56,1	9,0	-	-
Cape Bunting	Emberiza capensis	39,4	6,5	-	-
Lark-like Bunting	Emberiza impetuani	68,2	12,3	-	-
Ludwig's Bustard	Neotis ludwigii	37,9	3,9	EN	EN
Common Buzzard	Buteo buteo	1,5	3,9	-	-
Jackal Buzzard	Buteo rufofuscus	36,4	10,3	-	-
Black-headed Canary	Serinus alario	19,7	1,3	-	-
Black-throated Canary	Crithagra atrogularis	19,7	2,6	-	-
Cape Canary	Serinus canicollis	9,1	1,3	-	-
White-throated Canary	Crithagra albogularis	62,1	9,0	-	-
Yellow Canary	Crithagra flaviventris	12,1	1,9	-	-
Ant-eating Chat	Myrmecocichla formicivora	60,6	15,5	-	-
Familiar Chat	Oenanthe familiaris	30,3	5,2	-	-
Karoo Chat	Emarginata schlegelii	27,3	3,9	-	-
Sickle-winged Chat	Emarginata sinuata	47,0	5,2	-	-
Tractrac Chat	Emarginata tractrac	3,0	2,6	-	-
Desert Cisticola	Cisticola aridulus	19,7	1,9	-	-
Grey-backed Cisticola	Cisticola subruficapilla	24,2	3,9	-	-
Levaillant's Cisticola	Cisticola tinniens	4,5	0,0	-	-
Red-knobbed Coot	Fulica cristata	4,5	0,0	-	-
Reed Cormorant	Microcarbo africanus	3,0	0,0	-	-
White-breasted Cormorant	Phalacrocorax lucidus	3,0	0,0	-	-
Double-banded Courser	Rhinoptilus africanus	4,5	0,0	-	-
Blue Crane	Grus paradisea	62,1	15,5	VU	NT
Long-billed Crombec	Sylvietta rufescens	15,2	0,6	-	-
Cape Crow	Corvus capensis	10,6	5,2	-	-
Pied Crow	Corvus albus	83,3	38,7	-	-
Diederik Cuckoo	Chrysococcyx caprius	7,6	0,6	-	-
Cape Turtle Dove	Streptopelia capicola	59,1	4,5	-	-
Laughing Dove	Spilopelia senegalensis	34,8	5,2	-	-
Namaqua Dove	Oena capensis	16,7	5,8	-	-
Red-eyed Dove	Streptopelia semitorquata	33,3	1,9	-	-
Fork-tailed Drongo	Dicrurus adsimilis	4,5	0,6	-	-
Yellow-billed Duck	Anas undulata	15,2	1,9	-	-
African Fish Eagle	Haliaeetus vocifer	1,5	0,0	-	-
Booted Eagle	Hieraaetus pennatus	4,5	0,0	-	-
Martial Eagle	Polemaetus bellicosus	7,6	1,9	EN	EN

Species name	Scientific name	Full Protocol Report Rate	Adhoc Protocol Report Rate	Red List Global	Red List Regional
Tawny Eagle	Aquila rapax	10,6	5,8	VU	EN
Verreaux's Eagle	Aquila verreauxii	19,7	6,5	-	VU
Spotted Eagle-Owl	Bubo africanus	6,1	0,0	-	-
Western Cattle Egret	Bubulcus ibis	1,5	0,0	-	-
Karoo Eremomela	Eremomela gregalis	1,5	2,6	-	-
Yellow-bellied Eremomela	Eremomela icteropygialis	40,9	3,9	-	-
Lanner Falcon	Falco biarmicus	1,5	1,3	-	VU
Red-headed Finch	Amadina erythrocephala	4,5	4,5	-	-
Southern Fiscal	Lanius collaris	53,0	5,2	-	-
Greater Flamingo	Phoenicopterus roseus	3,0	0,6	-	NT
Chat Flycatcher	Melaenornis infuscatus	50,0	7,7	-	-
Fairy Flycatcher	Stenostira scita	12,1	1,3	-	-
Fiscal Flycatcher	Melaenornis silens	28,8	1,3	-	-
Grey-winged Francolin	Scleroptila afra	9,1	2,6	-	-
Egyptian Goose	Alopochen aegyptiaca	30,3	5,2	-	-
Spur-winged Goose	Plectropterus gambensis	6,1	3,2	-	-
Pale Chanting Goshawk	Melierax canorus	40,9	12,9	-	-
Little Grebe	Tachybaptus ruficollis	3,0	0,0	-	-
Common Greenshank	Tringa nebularia	7,6	0,6	-	-
Helmeted Guineafowl	Numida meleagris	9,1	0,6	-	-
Black Harrier	Circus maurus	1,5	0,0	EN	EN
African Harrier-Hawk	Polyboroides typus	4,5	1,3	-	-
Black-headed Heron	Ardea melanocephala	9,1	0,6	-	-
Grey Heron	Ardea cinerea	6,1	0,6	-	-
African Hoopoe	Upupa africana	16,7	2,6	-	-
African Sacred Ibis	Threskiornis aethiopicus	9,1	5,8	-	-
Hadada Ibis	Bostrychia hagedash	27,3	3,9	-	-
Greater Kestrel	Falco rupicoloides	27,3	4,5	-	-
Lesser Kestrel	Falco naumanni	3,0	1,3	-	-
Rock Kestrel	Falco rupicolus	31,8	1,9	-	-
Brown-hooded Kingfisher	Halcyon albiventris	3,0	0,0	-	-
Black-winged Kite	Elanus caeruleus	1,5	0,0	-	-
Karoo Korhaan	Eupodotis vigorsii	51,5	5,2	-	NT
Northern Black Korhaan	Afrotis afraoides	68,2	11,6	-	-
Blacksmith Lapwing	Vanellus armatus	31,8	1,9	-	-
Eastern Clapper Lark	Mirafra fasciolata	57,6	11,6	-	-
Karoo Lark	Calendulauda albescens	1,5	0,0	-	-
Karoo Long-billed Lark	Certhilauda subcoronata	54,5	7,1	-	-
Large-billed Lark	Galerida magnirostris	45,5	7,7	-	-
Pink-billed Lark	Spizocorys conirostris	1,5	0,0	-	-
Red-capped Lark	Calandrella cinerea	15,2	0,0	-	-
Sabota Lark	Calendulauda sabota	51,5	7,7	-	-
Spike-heeled Lark	Chersomanes albofasciata	71,2	13,5	-	-
Brown-throated Martin	Riparia paludicola	13,6	0,0	-	-
Rock Martin	Ptyonoprogne fuligula	59,1	5,2	-	-
Common Moorhen	Gallinula chloropus	1,5	0,0	-	-
Red-faced Mousebird	Urocolius indicus	12,1	1,3	-	-
White-backed Mousebird	Colius colius	42,4	3,9	-	-

Species name	Scientific name	Full Protocol Report Rate	Adhoc Protocol Report Rate	Red List Global	Red List Regional
Rufous-cheeked Nightjar	Caprimulgus rufigena	3,0	0,0	-	-
Western Barn Owl	Tyto alba	1,5	0,0	-	-
Speckled Pigeon	Columba guinea	45,5	7,1	-	-
African Pipit	Anthus cinnamomeus	16,7	1,3	-	-
African Rock Pipit	Anthus crenatus	7,6	0,6	NT	NT
Buffy Pipit	Anthus vaalensis	4,5	0,0	-	-
Long-billed Pipit	Anthus similis	4,5	0,6	-	-
Nicholson's Pipit	Anthus nicholsoni	12,1	0,6	-	-
Plain-backed Pipit	Anthus leucophrys	15,2	0,6	-	-
Kittlitz's Plover	Charadrius pecuarius	4,5	0,6	-	-
Three-banded Plover	Charadrius tricollaris	25,8	0,0	-	-
Karoo Prinia	Prinia maculosa	39,4	3,2	-	-
Red-billed Quelea	Quelea quelea	31,8	2,6	-	-
White-necked Raven	Corvus albicollis	34,8	7,1	-	-
Cape Robin-Chat	Cossypha caffra	30,3	1,3	-	-
Namaqua Sandgrouse	Pterocles namaqua	27,3	1,3	-	-
Common Sandpiper	Actitis hypoleucos	1,5	0,0	-	-
Marsh Sandpiper	Tringa stagnatilis	1,5	0,0	-	-
Karoo Scrub Robin	Cercotrichas coryphoeus	78,8	13,5	-	-
South African Shelduck	Tadorna cana	39,4	2,6	-	-
Cape Shoveler	Spatula smithii	1,5	0,6	-	-
Cape Sparrow	Passer melanurus	84,8	12,9	-	-
House Sparrow	Passer domesticus	25,8	1,9	-	-
Southern Grey-headed Sparrow	Passer diffusus	33,3	2,6	-	-
Black-eared Sparrow-Lark	Eremopterix australis	15,2	1,3	-	-
Grey-backed Sparrow-Lark	Eremopterix verticalis	34,8	7,7	-	-
African Spoonbill	Platalea alba	4,5	3,2	-	-
Pale-winged Starling	Onychognathus nabouroup	53,0	2,6	-	-
Pied Starling	Lamprotornis bicolor	33,3	6,5	-	-
Red-winged Starling	Onychognathus morio	19,7	1,9	-	-
Wattled Starling	Creatophora cinerea	10,6	0,6	-	-
Black-winged Stilt	Himantopus himantopus	9,1	1,9	-	-
Little Stint	Calidris minuta	3,0	0,0	-	-
African Stonechat	Saxicola torquatus	3,0	1,3	-	-
Black Stork	Ciconia nigra	3,0	0,6	-	VU
White Stork	Ciconia ciconia	0,0	1,3	-	-
Dusky Sunbird	Cinnyris fuscus	24,2	1,9	-	-
Malachite Sunbird	Nectarinia famosa	10,6	1,3	-	-
Southern Double-collared Sunbird	Cinnyris chalybeus	3,0	0,0	-	-
Barn Swallow	Hirundo rustica	22,7	7,1	-	-
Greater Striped Swallow	Cecropis cucullata	34,8	7,1	-	-
Pearl-breasted Swallow	Hirundo dimidiata	3,0	0,0	-	-
South African Cliff Swallow	Petrochelidon spilodera	9,1	4,5	-	-
White-throated Swallow	Hirundo albigularis	15,2	1,3	-	-
African Palm Swift	Cypsiurus parvus	6,1	1,3	-	-
Alpine Swift	Tachymarptis melba	3,0	0,0	-	-
Common Swift	Apus apus	1,5	0,6	-	-

Species name	Scientific name	Full Protocol Report Rate	Adhoc Protocol Report Rate	Red List Global	Red List Regional
Little Swift	Apus affinis	24,2	3,2	-	-
White-rumped Swift	Apus caffer	12,1	4,5	-	-
Cape Teal	Anas capensis	3,0	1,3	-	-
Red-billed Teal	Anas erythrorhyncha	10,6	1,3	-	-
Spotted Thick-knee	Burhinus capensis	4,5	1,3	-	-
Karoo Thrush	Turdus smithi	37,9	2,6	-	-
Short-toed Rock Thrush	Monticola brevipes	1,5	0,6	-	-
Cape Penduline Tit	Anthoscopus minutus	25,8	1,9	-	-
Grey Tit	Melaniparus afer	21,2	2,6	-	-
Cape Wagtail	Motacilla capensis	57,6	3,9	-	-
African Reed Warbler	Acrocephalus baeticatus	7,6	0,6	-	-
Chestnut-vented Warbler	Curruca subcoerulea	18,2	1,3	-	-
Layard's Warbler	Curruca layardi	22,7	1,9	-	-
Lesser Swamp Warbler	Acrocephalus gracilirostris	10,6	0,0	-	-
Namaqua Warbler	Phragmacia substriata	1,5	0,0	-	-
Rufous-eared Warbler	Malcorus pectoralis	65,2	16,8	-	-
Common Waxbill	Estrilda astrild	15,2	0,6	-	-
Cape Weaver	Ploceus capensis	3,0	0,6	-	-
Scaly-feathered Weaver	Sporopipes squamifrons	0,0	1,3	-	-
Southern Masked Weaver	Ploceus velatus	62,1	6,5	-	-
Capped Wheatear	Oenanthe pileata	16,7	1,9	-	-
Mountain Wheatear	Myrmecocichla monticola	40,9	5,2	-	-
Cape White-eye	Zosterops virens	9,1	1,9	-	-
Orange River White-eye	Zosterops pallidus	6,1	0,0	-	-
Pin-tailed Whydah	Vidua macroura	12,1	0,6	-	-

APPENDIX 2: HABITAT WITHIN THE STUDY AREA

Figure 1: Typical Nama Karoo habitat which comprises the vast majority of the study area.

Figure 2: An example of a large dam within the study area

Figure 3: A borehole with a water reservoir in the study area

Figure 4: Rocky ridges and inselbergs in the study area

Figure 5: An example of alien trees observed within the study area

Figure 6: Existing Droërivier Hydra 400kV transmission power line with Tawny Eagle nest in the study area (shown is the red arrow)

APPENDIX 3: PRE-CONSTRUCTION MONITORING AT THE GREAT KAROO CLUSTER OF RENEWABLE ENERGY FACILITIES

Monitoring was conducted in the following manner:

- Two drive transects were identified totalling 14km on the development site and one drive transect in the control site with a total length of 7.59km.
- Two monitors travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the transect. The observers stopped at regular intervals (every 500m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- In addition, 8 walk transects of 1km each were identified at the wind study areas, and 9 transects of 1km each at the solar study area, and two at the control site. The wind transects were counted 4 times per each seasonal sampling season. The PV transects were counted 4 times in spring and then again 4 times in autumn. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species
    - Number of birds
    - Date
    - Start time and end time
    - Estimated distance from transect
    - Wind direction
    - Wind strength (estimated Beaufort scale)
    - Weather (sunny; cloudy; partly cloudy; rain; mist)
    - Temperature (cold; mild; warm; hot)
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground) and
    - Co-ordinates (priority species only)

The aim with drive transects was primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects were primarily aimed at recording small passerines. The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind and solar farm activities.

- Eight vantage points (VPs) were identified from which the majority of the wind buildable area can be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:
    - Species
    - Number of birds
    - Date
    - Start time and end time
    - Wind direction
    - Wind strength (estimated Beaufort scale 1-7)
    - Weather (sunny; cloudy; partly cloudy; rain; mist)
    - Temperature (cold; mild; warm; hot)
    - Flight altitude (high i.e. above rotor height; medium i.e. rotor height; low i.e. below rotor height)
    - Flight mode (soar; flap; glide; kite; hover) and
    - Flight time (in 15 second intervals).

The objective of vantage point counts was to measure the potential collision risk with the turbines.

A total of twelve potential focal points (FPs) of bird activity were identified and were monitored. The focal points were as follows:

- FP ME1: Martial Eagle nest on Droërivier - Hydra 1 400kV
- FPME 2: Martial Eagle nest on Droërivier - Hydra 1 400kV
- FP TE1: Tawny Eagle nest on Droërivier – Hydra 2 400kV
- FP TE2: Tawny Eagle nest on Droërivier – Hydra 1 400kV
- FP TE3: Tawny Eagle nest on Droërivier – Hydra 2 400kV
- FP TE4: Tawny Eagle nest on Droërivier – Hydra 1 400kV
- FP VE1: Verreaux's Eagle nest on cliff
- FP VE2: Verreaux's Eagle nest on cliff
- FP VE3: Verreaux's Eagle nest on cliff
- FP VE4: Verreaux's Eagle nest on cliff
- CFP VE: Verreaux's Eagle nest on cliff at control site
- FP5 – FP9: Earth dams

APPENDIX 4: PRE-CONSTRUCTION MONITORING DIVERSITY & ABUNDANCE DATA

Priority Species		Transects turbine	Transects control	Focal points	VP	VP control	Incidental
African Fish Eagle	*Haliaeetus vocifer*						*
African Harrier-Hawk	*Polyboroides typus*		*		*		
Amur Falcon	*Falco amurensis*						*
Black Stork	*Ciconia nigra*			*			*
Blue Crane	*Grus paradisea*	*	*	*	*	*	*
Booted Eagle	*Hieraaetus pennatus*				*		*
Cape Vulture	*Gyps coprotheres*				*		
Common Buzzard	*Buteo buteo*	*					*
Greater Flamingo	*Phoenicopterus roseus*			*			
Greater Kestrel	*Falco rupicoloides*			*	*		*
Grey-winged Francolin	*Scleroptila afra*						*
Jackal Buzzard	*Buteo rufofuscus*	*		*	*		*
Karoo Korhaan	*Eupodotis vigorsii*	*	*		*	*	*
Lanner Falcon	*Falco biarmicus*	*	*		*		*
Lesser Kestrel	*Falco naumanni*	*			*		*
Ludwig's Bustard	*Neotis ludwigii*	*	*		*	*	*
Martial Eagle	*Polemaetus bellicosus*			*			*
Northern Black Korhaan	*Afrotis afraoides*	*	*		*	*	*
Pale Chanting Goshawk	*Melierax canorus*	*	*		*	*	*
Secretarybird	*Sagittarius serpentarius*	*					
Tawny Eagle	*Aquila rapax*			*	*		*
Verreaux's Eagle	*Aquila verreauxii*		*	*	*	*	*
22		**10**	**8**	**8**	**14**	**6**	**18**

Non-Priority Species		Transects turbine	Transects control	Focal points
Acacia Pied Barbet	*Tricholaema leucomelas*	*	*	
African Pipit	*Anthus cinnamomeus*	*	*	
African Red-eyed Bulbul	*Pycnonotus nigricans*	*		
African Sacred Ibis	*Threskiornis aethiopicus*			*
Ant-Eating Chat	*Myrmecocichla formicivora*	*	*	
Barn Swallow	*Hirundo rustica*	*	*	
Black-eared Sparrow-Lark	*Eremopterix australis*	*		
Black-headed Canary	*Serinus alario*	*	*	
Blacksmith Lapwing	*Vanellus armatus*			*
Black-winged Stilt	*Himantopus himantopus*			*
Bokmakierie	*Telophorus zeylonus*	*	*	
Burchell's Courser	*Cursorius rufus*			
Cape Bunting	*Emberiza capensis*	*	*	
Cape Crow	*Corvus capensis*	*		
Cape Penduline Tit	*Anthoscopus minutus*	*		
Cape Sparrow	*Passer melanurus*	*	*	
Cape Turtle Dove	*Streptopelia capicola*	*	*	
Cape Wagtail	*Motacilla capensis*	*		*
Cape White-eye	*Zosterops virens*	*		
Capped Wheatear	*Oenanthe pileata*	*	*	
Chat Flycatcher	*Melaenornis infuscatus*	*	*	
Chestnut-vented Tit-Babbler	*Sylvia subcoerulea*	*		
Common Greenshank	*Tringa nebularia*			*
Common Quail	*Coturnix coturnix*	*		
Common Swift	*Apus apus*	*	*	
Double-banded Courser	*Rhinoptilus africanus*			
Dusky Sunbird	*Cinnyris fuscus*		*	
Eastern Clapper Lark	*Mirafra fasciolata*	*	*	
Egyptian Goose	*Alopochen aegyptiaca*	*	*	*
European Bee-eater	*Merops apiaster*		*	
Familiar Chat	*Oenanthe familiaris*	*	*	
Fork-tailed Drongo	*Dicrurus adsimilis*	*		

Non-Priority Species		Transects turbine	Transects control	Focal points
Greater Striped Swallow	*Cecropis cucullata*	*	*	
Grey Heron	*Ardea cinerea*			*
Grey Tit	*Melaniparus afer*	*	*	
Grey-Backed Cisticola	*Cisticola subruficapilla*	*		
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	*	*	
Hadeda Ibis	*Bostrychia hagedash*	*		
House Sparrow	*Passer domesticus*	*		
Karoo Chat	*Emarginata schlegelii*	*	*	
Karoo Eremomela	*Eremomela gregalis*	*		
Karoo Lark	*Calendulauda albescens*	*		
Karoo Long-billed Lark	*Certhilauda subcoronata*	*	*	
Karoo Prinia	*Prinia maculosa*	*		
Karoo Scrub Robin	*Cercotrichas coryphoeus*	*	*	
Large-billed Lark	*Galerida magnirostris*	*	*	
Lark-Like Bunting	*Emberiza impetuani*	*	*	
Laughing Dove	*Spilopelia senegalensis*	*		
Layard's Tit-Babbler	*Sylvia layardi*	*		
Little Grebe	*Tachybaptus ruficollis*			*
Little Stint	*Calidris minuta*			*
Little Swift	*Apus affinis*	*	*	
Long-billed Crombec	*Sylvietta rufescens*	*		
Long-billed Pipit	*Anthus similis*	*		
Mountain Wheatear	*Myrmecocichla monticola*	*	*	
Namaqua Dove	*Oena capensis*	*	*	
Namaqua Sandgrouse	*Pterocles namaqua*	*	*	
Pale-winged Starling	*Onychognathus nabouroup*	*		
Pied Avocet	*Recurvirostra avosetta*			*
Pied Crow	*Corvus albus*	*	*	
Pied Starling	*Lamprotornis bicolor*	*	*	
Plain-backed Pipit	*Anthus leucophrys*	*		
Pririt Batis	*Batis pririt*	*		
Red-billed Quelea	*Quelea quelea*	*	*	

Non-Priority Species		Transects turbine	Transects control	Focal points
Red-billed Teal	*Anas erythrorhyncha*			*
Red-capped Lark	*Calandrella cinerea*	*		
Red-Headed Finch	*Amadina erythrocephala*	*		
Rock Kestrel	*Falco rupicolus*	*		
Rock Martin	*Ptyonoprogne fuligula*	*		
Rufous-eared Warbler	*Malcorus pectoralis*	*	*	
Sabota Lark	*Calendulauda sabota*	*	*	
Scaly-feathered Finch	*Sporopipes squamifrons*	*		
Sickle-winged Chat	*Emarginata sinuata*	*	*	
South African Cliff Swallow	*Petrochelidon spilodera*	*		
South African Shelduck	*Tadorna cana*		*	*
Southern Fiscal	*Lanius collaris*	*	*	
Southern Grey-headed Sparrow	*Passer diffusus*	*	*	
Southern Masked Weaver	*Ploceus velatus*	*	*	
Southern Red Bishop	*Euplectes orix*	*	*	
Speckled Pigeon	*Columba guinea*	*		
Spike-heeled Lark	*Chersomanes albofasciata*	*	*	
Spur-winged Goose	*Plectropterus gambensis*			*
Tractrac Chat	*Emarginata tractrac*	*	*	
White-backed Mousebird	*Colius colius*	*		
White-breasted Cormorant	*Phalacrocorax lucidus*			*
White-necked Raven	*Corvus albicollis*	*		
White-throated Canary	*Crithagra albogularis*	*	*	
White-throated Swallow	*Hirundo albigularis*	*		
Yellow Canary	*Crithagra flaviventris*	*	*	
Yellow-bellied Eremomela	*Eremomela icteropygialis*	*	*	
Yellow-billed Duck	*Anas undulata*			*
91	Subtotal	74	45	15
	Grand total	**84**	**53**	**22**

APPENDIX 5: SITE SENSITIVITY VERIFICATION

CONTENTS

1. INTRODUCTION

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a 132kV central collector substation and a 132kV double circuit power line on a site located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province. The collector substation that comprises both the Eskom switching station and the IPP's substation is proposed on Portions 0 and 1 of Farm Rondavel 85. One grid corridor has been considered for assessment and placement of the 132kV double circuit power line.

The entire extent of the site falls within the Central Corridor of the Strategic Transmission Corridors. The grid connection infrastructure is known as the Great Karoo Electrical Grid Infrastructure (EGI).

The development of the 132kV central collector substation and 132kV power line is required to enable the connection for the Great Karoo Cluster of Renewable Energy Facilities, which comprises three (3) 100MW solar photovoltaic (PV) energy facilities, and two (2) 140MW wind farms, to the national grid for the evacuation of the generated electricity. The connection point into the national grid will be the existing Eskom Gamma Substation.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations [4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended], various aspects of the proposed developments may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. In accordance with GN 320 and GN 1150 (20 March 2020)[2] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool).

Chris van Rooyen, in association with Albert Froneman, as avifaunal specialists, have been commissioned to verify the sensitivity of the project sites under these specialist protocols (Appendix 5). The scope of this report is for the proposed Great Karoo EGI 132kV central collector substation and 132kV double circuit power line.

[2] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

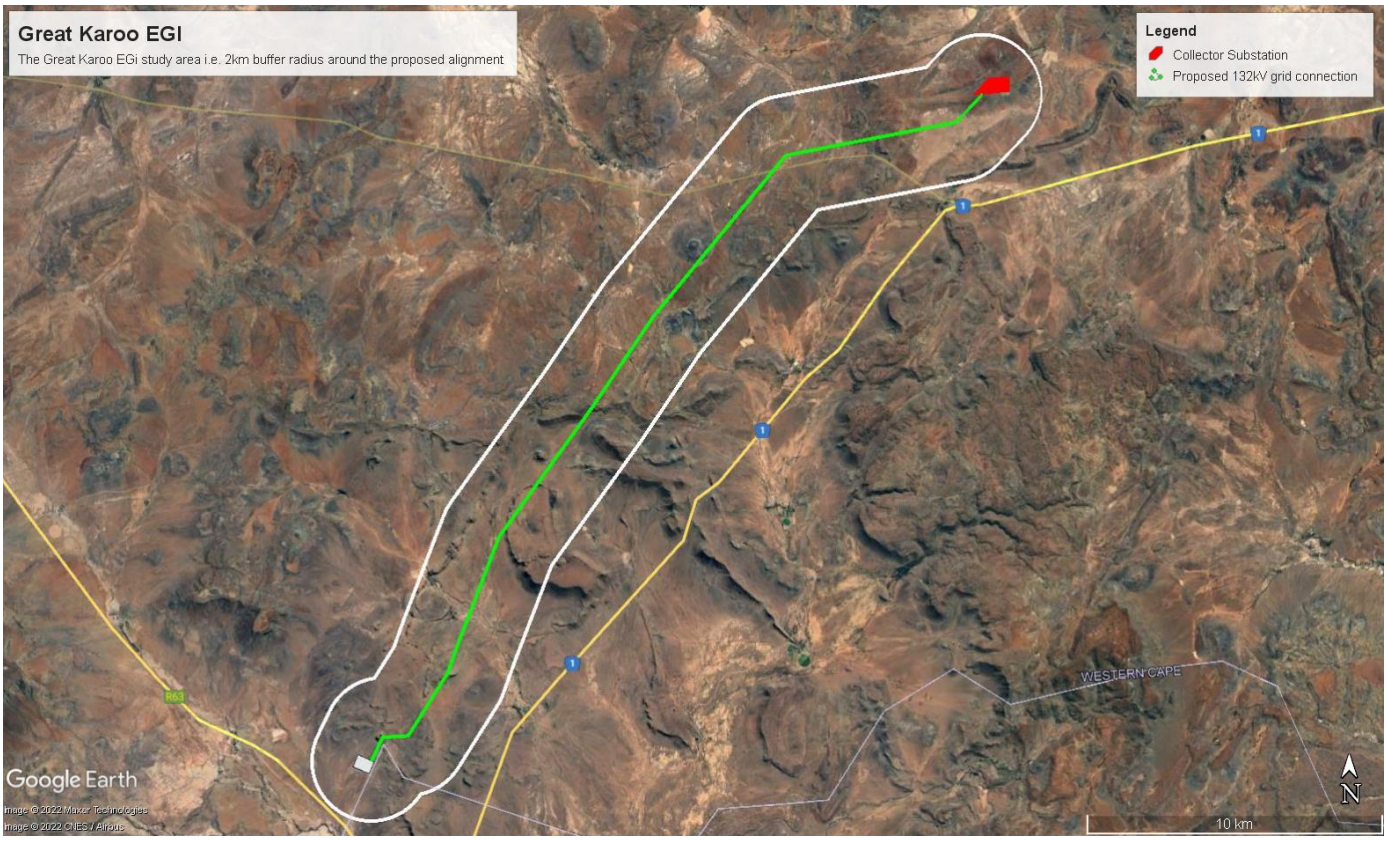

Figure 1: Locality map indicating the location of the Great Karoo EGI and the study area near Richmond, Northern Cape Province

2. SITE SENSITIVITY VERIFICATION METHODOLOGY

The following information sources were consulted to compile this report:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of sixteen pentads some of which intersect and others that are near the study area. The decision to include multiple pentads around the study area was influenced by the fact that the pentads within which the proposed development is located have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The sixteen pentad grid cells are the following: 3125_2325, 3125_2330, 3125_2335, 3125_2340, 3130_2325, 3130_2330, 3130_2335, 3130_2340, 3135_2325, 3135_2330, 3135_2335, 3135_2340, 3140_2325, 3140_2330, 3140_2335 and 3140_2340). A total of 69 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 155 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the sixteen pentads within which the study area is located. The SABAP2 data is regarded as a reliable reflection of the avifauna which occurs in the area.
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).

- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the study area relative to National Protected Areas, National Protected Areas Expansion Strategy (NPEAS) focus areas and Critical Biodiversity Areas in the Northern Cape Province .
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the study area (February, 2022).
- Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
- Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
- Primary avifaunal diversity and abundance data collected as part of an integrated pre-construction monitoring programme, implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities (i.e. Kwana, Moriri and Nku Solar Energy Facilities (SEF) and Angora and Merino Wind Energy Facilities (WEF)) between October 2020 and November 2021.

3. OUTCOME OF SITE SENSITIVITY VERIFICATION

The study area and immediate environment is classified as **MEDIUM and HIGH** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 2). These classifications are linked to the potential occurrence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Verreaux's Eagle *Aquila verreauxii* (Regionally Vulnerable). The study area contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable.

4. CONCLUSION

The occurrence of SCC was confirmed during the integrated pre-construction monitoring programme, implemented at the proposed Great Karoo Cluster of Renewable Energy Facilities with Ludwig's Bustard, Verreaux's Eagle, Martial Eagle *Polemaetus bellicosus* and Tawny Eagle *Aquila rapax* recorded within the study area and its immediate surrounds. Based on the field surveys, the classification of **HIGH** sensitivity for avifauna in the study area by the screening tool is therefore confirmed to be accurate, based on actual conditions recorded on the ground during the 12-months of pre-construction monitoring between October 2020 and November 2021.

Figure 2: The classification of the study area in the DFFE online screening tool.

APPENDIX 6: ENVIRONMENTAL MANAGEMENT PROGRAMME

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Mortality of avifauna, specifically Cape Vulture, due to electrocutions on the overhead power line poles/towers.	Reduction of avian electrocution mortality	The power line must be designed using an approved bird friendly pole/tower design **in** accordance with the Eskom Distribution Technical Bulletin relating to bird friendly structures.	1. Construct the power line using an approved bird friendly pole/tower 2. Avifaunal specialist to sign off on the final design.	Once-off	Developer

Management Plan for the Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	Conduct a pre-construction inspection (avifaunal walk-through) of the final central collector substation layout and power line alignment to identify priority species that may be breeding within the substation and to record the status of the eagle nests on the existing transmission power lines. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding pair of eagles during the construction period. This could include measures such as delaying some of the activities until after the breeding season. A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following:	1. Walk-through by avifaunal specialist to record eagle nests on the existing powerlines. 2. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 3. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 4. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 5. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 6. Ensure that the construction area is demarcated clearly and that construction personnel	1. Once-off 2. On a daily basis 3. Weekly 4. Weekly 5. Weekly 6. Weekly	1. Avifaunal Specialist 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO 6. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		1. No off-road driving; 2. Maximum use of existing roads, where possible; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the biodiversity specialist report pertaining to the limitation of the footprint.	are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
Avifauna: Mortality due to collision with the overhead power line					
Mortality of avifauna due to collisions with the overhead power line.	Reduction of avian collision mortality	Demarcate sections of the overhead power line to be marked with Eskom approved Bird Flight Diverters (BFDs).	1. Walk-through by avifaunal specialist. 2. Fit Eskom approved Bird Flight Diverters on the earthwire at the demarcated sections of the OHL.	1. Once-off 2. Once-off	1. Contractor 2. Contractor and ECO

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to habitat transformation in the substations					
Total or partial displacement of avifauna due to habitat transformation associated with vegetation clearance in the onsite substation area. .	Prevent unnecessary displacement of avifauna by ensuring that rehabilitation of transformed areas is implemented where possible by an appropriately qualified rehabilitation specialist, according to the recommendations of the biodiversity specialist study.	1. Develop a Habitat Restoration Plan (HRP) and ensure that it is approved. 2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.	1. Appointment of rehabilitation specialist to develop HRP. 2. Site inspections to monitor progress of HRP. 3. Adaptive management to ensure HRP goals are met.	1. Once-off 2. Once a year 3. As and when required	1. Facility operator
Avifauna: Mortality of avifauna due to collision with the overhead power line					
Mortality of avifauna due to collisions with the overhead power line.	Reduction of avian collision mortality	1. Monitor the collision mortality on the double circuit power line. 2. Apply additional BFDs if additional collision hotspots are discovered.	1. Avifaunal specialist to conduct quarterly inspections of the double circuit power line for a period of two years. 2. Apply additional BFDs if additional collision hotspots are discovered.	1. Quarterly 2. As and when required	1. Facility operator

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Mortality of avifauna due to electrocution in the central collector substations					
Mortality of avifauna due to electrocutions in the substation.	Reduction of avian electrocution mortality	1. Monitor the electrocution mortality in the substation. 2. Apply mitigation if electrocution happens regularly.	1. Regular inspections of the substation yard	1. Weekly	1. Facility operator

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance					
The noise and movement associated with the decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area.	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Decommissioning EMPr.	A site-specific Decommissioning EMPr (DEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. The DEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the DEMPr. Oversee activities to ensure that the DEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that decommissioning personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO