Xha! Boom Wind Energy Facility

Loeriesfontein, Northern Cape

Bird Impact Assessment Report for proposed 132kV Grid Connection

July 2017

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Chris van Rooyen
Chris has 20 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 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 (Pr.Sci.Nat)
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). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). 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 they are 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.

DECLARATION OF INDEPENDENCE

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 Aurecon 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 work performed, specifically in connection with the Basic Assessment for the Xha! Boom Wind Energy Facility Grid Connection.

Director: Chris van Rooyen Consulting

EXECUTIVE SUMMARY

The proposed Xha! Boom grid connection and associated substations will have potential impacts on Red Data avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss; and
- Collisions with the earthwire of the 132kV grid connection

Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace Red Data species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in June 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. Options 1 and 3 are approximately 1.2km from the nest at their closest point, while Options 2 and 4 are 2km from the nest at their closest point.

The pre-mitigation risk of displacement due to disturbance during the construction phase is rated as low, but could be further reduced through appropriate mitigation.

Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at the proposed Xha! Boom substation sites is common in the greater study area and the transformation of a few hectare of habitat should not impact any of the Red Data species significantly.

The risk of displacement through habitat destruction during construction is rated as low, which could be reduced through appropriate mitigation.

Collisions of Red Data species with the earthwire of the 132kV grid connection

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as high which can be reduced to medium through appropriate mitigation.

Concluding statement

The proposed Ithemba grid connection will have potential impacts on avifauna, ranging from high to low, prior to the implementation of mitigation. With the implementation of mitigation measures, the high impacts could be reduced to medium, while the low impacts can be further reduced. All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred:

- It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions;
- About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and
- It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be moderate to minor within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

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DEFINITIONS

Greater study area: This refers to the area that are covered by the 16 SABAP2 pentads where the proposed alignments are located.

WEF study area: This refers to the area that comprises the four proposed Leeuwberg WEFs plus a control area and immediate environment.

Powerline study area: This refers to a 2km zone around the proposed alignments.

1. INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, namely the Xha! Boom Substation, a 132kV Linking Substation and an associated 132kV power line near Loeriesfontein in the Northern Cape Province (hereafter referred to as the 'proposed development'). The proposed development is aimed at feeding electricity generated by Mainstream's proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

1.2 Project Description

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely Xha! Boom Substation), as well as a 132kV Linking Substation and a 132kV power line. The aim of this development is to feed electricity generated by the proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the "proposed Xha! Boom Substation")
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV power line from the proposed Xha! Boom Substation, via the proposed Linking Substation to Helios substation, approximately 33km south-east of the proposed Xha! Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A power line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed power line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

It should be noted that two (2) alternative sites for the proposed on-site Xha! Boom Substation and the proposed Linking Substation have been assessed during the Basic Assessment (BA), in conjunction with four (4) power line corridor alternatives.

The proposed power line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures (**Figure 1**) for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the power line.

Figure 1: **Tower Type**

The proposed Xha! Boom Wind Farm (part of a separate on-going EIA process) application site, proposed Xha! Boom Substation site and associated 132kV power line corridor route alternatives are shown in the locality map below (Figure 2).

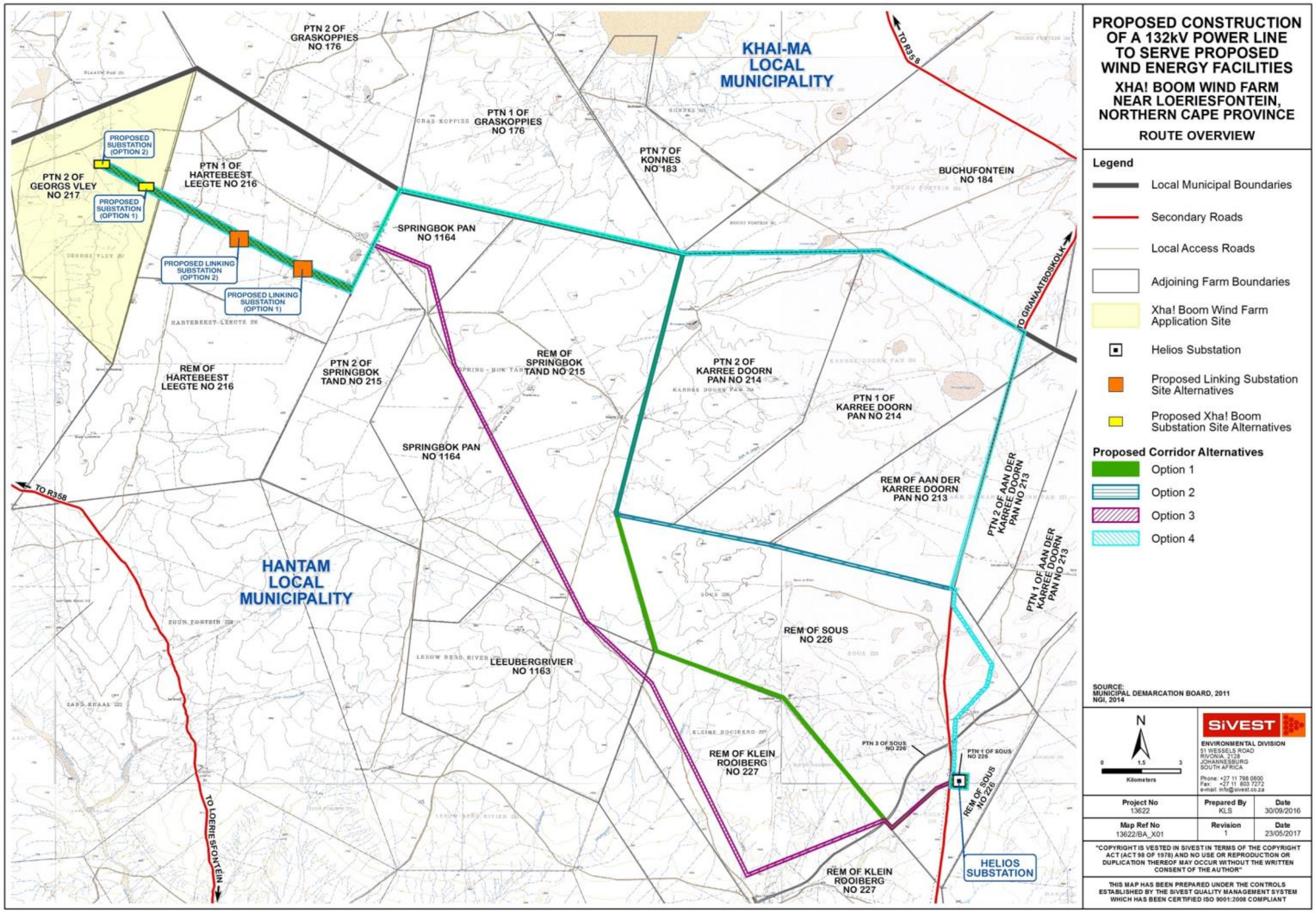

Figure 2: **The proposed layout of the Xha! Boom grid connection, showing the various corridor alternatives**

2. TERMS OF REFERENCE

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts; and
- Recommend mitigation measures to reduce the expected impacts.

3. SOURCES OF INFORMATION

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e. within an area consisting of 16 pentad grid cells within which the proposed alignments are situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between January 2009 and January 2017, a total of 63 full protocol cards (i.e. 63 surveys lasting a minimum of two hours or more each) have been completed for this area (see Table 3 -1 and Figure 3).
- The national threatened status of all Red Data 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 Red Data species was determined by consulting the IUCN Red List of Threatened Species Version 2016.2.[1]
- A classification of vegetation types was obtained from Southern African Bird Atlas 1 (Harrison *et al.* 1997) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird Areas of Southern Africa (Barnes 1998; Marnewick *et al*. 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery obtained from Google Earth (May 2016) was used in order to view the broader powerline study area on a landscape level and to help identify bird habitat on the ground.
- Information on the micro habitat level was obtained through a pre-construction monitoring programme for the proposed WEFs which was conducted in the greater study area over four seasons between November 2015 and September 2016, as well as through a site visit conducted in June 2017.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of the pre-construction monitoring programme in the greaetr study area which was implemented between November 2015 and Sept 2016. The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **APPENDIX A** for a detailed explanation of the monitoring methods).
- Information gained from previous Environmental Impact Assessments at three neighbouring sites in close proximity to the current site, namely Khobab WEF (under construction), Loeriesfontein WEF (under

[1] http://www.iucnredlist.org/

construction), and Dwarsrug WEF (authorised in 2015) assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area (see Figure 1).

Table 3-1: The SABAP2 pentads where the study area is located

Pentad	**Number of completed cards**
3015_1915	4
3015_1920	5
3015_1925	0
3015_1930	1
3020_1915	4
3020_1920	4
3020_1925	0
3020_1930	4
3025_1915	1
3025_1920	3
3025_1925	8
3025_1925	11
3030_1915	1
3030_1920	0
3030_1925	4
3030_1930	13
Total	**63**

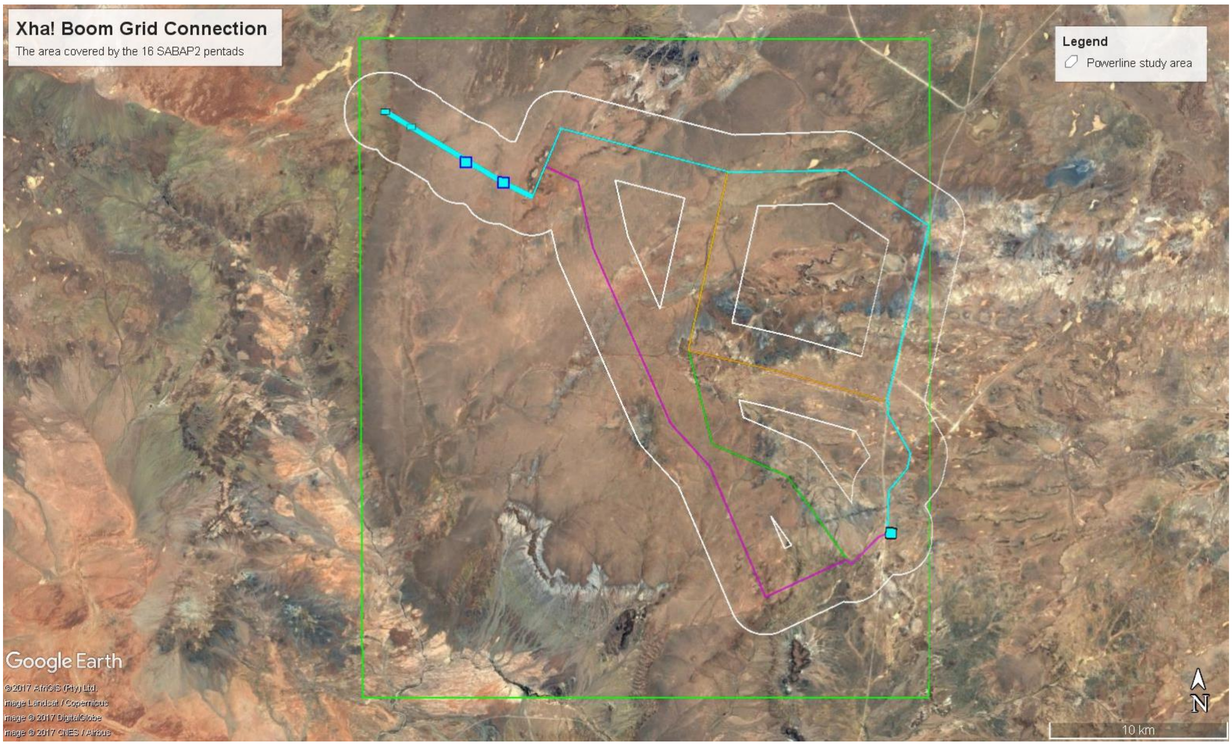

Figure 3: The area covered by the 16 pentads where the proposed alignments are located (green rectangle).

4. ASSUMPTIONS

This study made the basic assumption that the sources of information used are reliable. However, the following must be noted:

- A total of 63 full protocol lists has been completed to date for the 16 pentads where the powerline study area is located (i.e. listing surveys lasting a minimum of two hours each). This is a fairly comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed powerline study area. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, SABAP1 records (Harrison *et al.* 1997), the results of the 12-months pre-construction monitoring and observations during a follow-up site visit.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. However, bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- Specific emphasis was placed on the potential impact on Red Data species.

5. LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 5-1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[2]

Table 5-1: Agreements and conventions which South Africa is party to and which are 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	Global

[2] (BirdLife International (2016) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south africa. Checked: 2016-04-02).

	The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	
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 Best Practice Guidelines

There are currently no best practice guidelines for the assessment of electricity infrastructure impacts on birds.

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 Natural environment

The powerline study area is located on a vast, arid, topographically uniform plain. The habitat is very uniform, and consists primarily of Bushmanland Basin Shrubland. Bushmanland Basin Shrubland consists of dwarf shrubland dominated by a mixture of low, sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also abundant annual flowering plants such as species of *Gazania* and *Leysera* (Mucina & Rutherford 2006). A number of ephemeral drainage lines flow through the powerline study area, but they only hold water for brief periods after exceptional rainfall events, which are rare events. The greater study area is extremely arid with a mean annual rainfall of 170.5mm, with peak rainfall between March and July[3]. The temperatures are highest on average in January, at around 22.8 °C. The lowest average temperatures in the year occur in July, when it is around 9.9 °C.[4] The powerline study area is situated in an ecological transitional zone between the

[3] South African Rain Atlas http://wsopuppenkiste.wiso.uni-goettingen.de/rainfall
[4] http://en.climate-data.org/location/27137/

Nama Karoo and Succulent Karoo biomes (Harrison *et al.* 1997). In comparison with Succulent Karoo, the Nama Karoo has higher proportions of grass and tree cover. The ecotonal nature of the greater study area is apparent from the presence of typical avifauna of both Succulent and Nama Karoo e.g. Karoo Eremomela *Eremomela gregalis* (Succulent Karoo) and Red Lark *Calendulauda burra* (Nama Karoo). The two Karoo vegetation types support a particularly high diversity of bird species endemic to Southern Africa, particularly in the family *Alaudidae* (Larks). Its avifauna typically comprises ground-dwelling species of open habitats (Harrison *et al* 1997). Because rainfall in the Nama Karoo falls mainly in summer, while peak rainfall in the Succulent Karoo occurs mainly in winter, it provides opportunities for birds to migrate between the Succulent and Nama Karoo, to exploit the enhanced conditions associated with rainfall. Many typical karroid species are nomads, able to use resources that are patchy in time and space (Barnes 1998).

A feature of the greater study area where the proposed site is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are typical of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison *et al.* 1997). The proposed powerline study area itself contains a number of small pans (e.g. Kareedoringpan), and there are several larger pans situated north and east of the powerline study area (e.g. Konnes se Pan, Dwaggasoutpan, Boegoefonteinpan and Bitterputspan). The pans are normally dry and covered by a distinctive vegetation type known as Bushmanland Vloere, a form of inland saline scrub vegetation. When these pans hold water (which is only likely after exceptional rainfall events), waterbird movement to and from these pans is possible, including Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoenicopterus minor*. It is possible that nocturnal flamingo movement might take place over the powerline study area between coast and the abovementioned pans, although this should be sporadic rather than regularly.

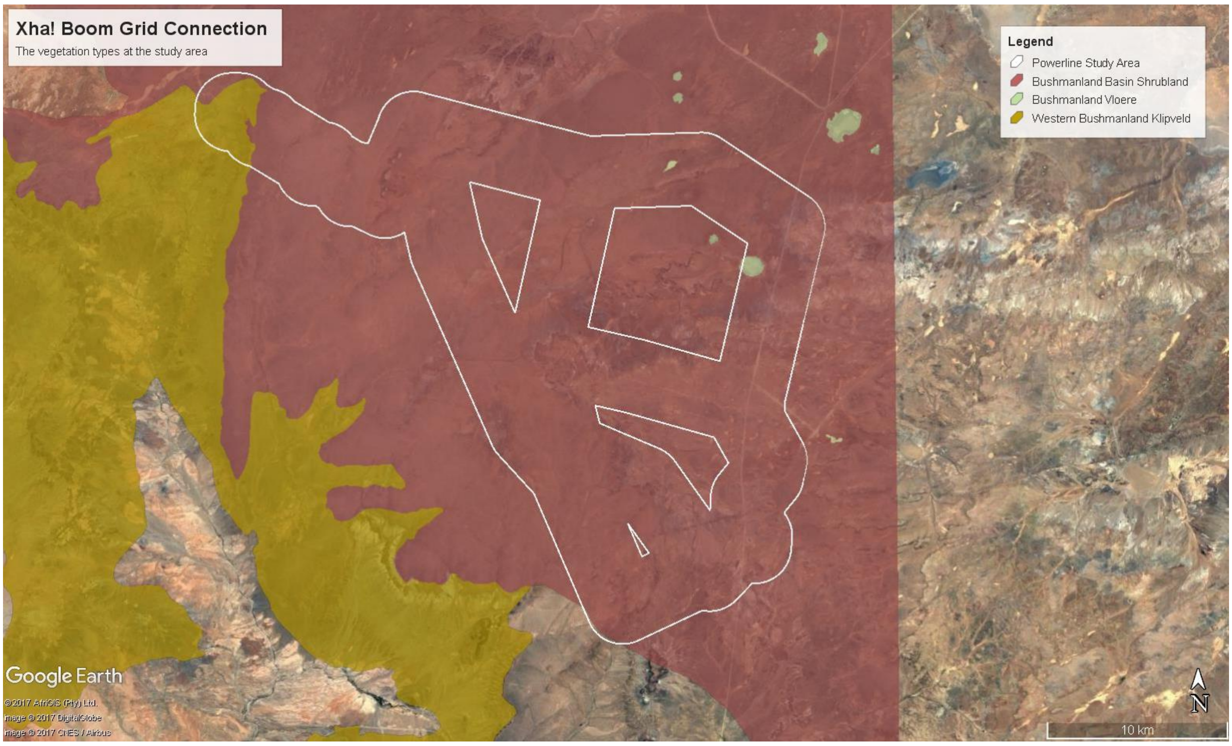

Figure 4: Vegetation types, indicating the homogenous character of the habitat at the powerline study area (Mucina & Rutherford 2006). The powerline study area is indicated by the white polygon.

6.2 Modified environment

Whilst the distribution and abundance of the bird species in the greater study area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine the few external modifications to the environment that may influence the distribution and abundance of avifauna in the powerline study area.

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the powerline study area:

- **Water points:** The land use in the powerline study area is mostly small stock farming. The entire powerline study area is divided into grazing camps, with several boreholes with associated water reservoirs and drinking troughs. In this arid environment, open water is a big draw card for several bird species, including Red Data species such as Martial Eagle and Sclater's Lark that use the open water troughs to bath and drink.
- **Transmission lines:** The Aries - Helios 400kV transmission line runs to the east of the powerline study area, with only small section falling within it. The transmission towers are used by raptors for perching and roosting, and also for breeding. Three Martial Eagle nests were recorded on the Aries - Helios 400kV transmission line, one of which falls within the powerline study area (see Figure 5).

APPENDIX B provides a photographic record of the habitat at the powerline study area and the greater study area. A map of the powerline study area, indicating the location of water points and the Martial Eagle nests is shown in Figure 5.

Figure 5: Location of water points and Martial Eagle nests in the powerline study area.

7. AVIFAUNA

Table 7-1 lists Red Data species that could potentially occur in the proposed powerline study area. The list is based on a combination of the pre-construction monitoring that was conducted in the WEF study area, supplemented with other data sources e.g. SABAP1, SABAP2, environmental impact assessments conducted for other wind farms in the same habitat, and a site visit in June 2017. **It is important to note that while some of the monitoring was not conducted strictly within the powerline study area, or across the whole of the powerline study area, the uniformity of the habitat makes the data gathered during surveys in the greater study area equally relevant for the powerline study area.**

Table 7-2 lists all species that were recorded through pre-construction monitoring in the WEF study area. Data was collected by means of drive transect counts, walk transect counts, vantage point (VP) watches and incidental sightings.

APPENDIX C lists all the species that were recorded by SABAP2 surveys in the period between January 2009 and January 2017.

Table 7-1: Red Data species potentially occurring in the powerline study area. Species recorded during pre-construction monitoring in the WEF study area are shaded.

The following abbreviations and acronyms are used:

VU	Vulnerable
NT	Near threatened
EN	Endangered
SAE	Southern African endemic or near endemic
Dd	Displacement through disturbance
Dh	Displacement through habitat transformation
C	Collisions with grid connection

Name	Scientific name	SABAP2 reporting rate % (63 cards)	Regional threatened status (Taylor et al. 2015)	Global threatened status (IUCN 2016)	Likelihood of occurrence	Potential impact
Martial Eagle	*Polemaetus bellicosus*	18.75	EN	NT	**Confirmed**. One incidental sighting of a flying bird in the broader area, and recorded briefly flying high over the greater study area. Could sporadically be attracted to water troughs. The nest near Helios MTS which falls within the powerline study area was active in June 2017.	Dd
Ludwig's Bustard	*Neotis ludwigii*	31.25	SAE, EN	EN	**Confirmed**. Occurrence likely to be linked to habitat conditions. The species is nomadic and a partial migrant and may occur sporadically.	C, Dd,
Secretarybird	*Sagittarius serpentarius*	0	VU	VU	**Low**. May occur sporadically	C, Dd,
Kori Bustard	*Ardeotis kori*	1.25	NT	Least concern	**Low**. May occur sporadically. Lack of dry watercourses with trees may be an inhibiting factor.	C, Dd,
Lanner Falcon	*Falco biarmicus*	10%	VU	Least concern	**Confirmed**. Breeding resident. Most likely to perch on fence lines and powerlines running through the powerline study area, but may also be attracted to the water points where it hunts small birds.	-

Name	Scientific name	SABAP2 reporting rate % (63 cards)	Regional threatened status (Taylor et al. 2015)	Global threatened status (IUCN 2016)	Likelihood of occurrence	Potential impact
Sclater's Lark	*Spizocorys sclateri*	11.25	SAE, NT	NT	**Confirmed**. The species is nomadic and may occur sporadically.	Dd
Red Lark	*Calendulauda burra*	57.7	SAE, VU	NT	**Confirmed.** The species were recorded regularly all over the site but in relatively low densities.	Dd
Verreaux's Eagle	*Aquila verreauxi*	1.25	VU	Least concern	**Confirmed**. Solitary single birds were recorded sporadically. Could sporadically be attracted to water troughs, one individual was recorded drinking at a water trough.	-
Karoo Korhaan	*Eupodotis vigorsii*	70%	SAE, NT	Least concern	**Confirmed**. One of the most commonly recorded terrestrial species. Occurs all over the greater study area.	Dd, C
Burchell's Courser	*Cursorius rufus*	5%	SAE, VU	Least concern	**Confirmed**. Mostly recorded in the west of the greater study area.	C
Greater Flamingo	*Phoenicopterus roseus*	0	NT	LC	**Low**. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, perhaps once a decade during which the pans will contain standing water for a short period.	C
Lesser Flamingo	*Phoeniconaias minor*	0	NT	NT	**Low**. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, perhaps once a decade during which the pans will contain standing water for a short period.	C

Table 7-2: List of all species recorded during pre-construction surveys and incidental counts in the WEF study area.

Common name	Taxonomic Name
Black-Chested Snake-Eagle	*Circaetus pectoralis*
Booted Eagle	*Aquila pennatus*
Burchell's Courser	*Cursorius rufus*
Double-banded Courser	*Rhinoptilus africanus*
Greater Kestrel	*Falco rupicoloides*
Jackal Buzzard	*Buteo rufofuscus*
Karoo Korhaan	*Eupodotis vigorsii*
Lanner Falcon	*Falco biarmicus*
Ludwig's Bustard	*Neotis ludwigii*
Martial Eagle	*Polemaetus bellicosus*
Northern Black Korhaan	*Afrotis afraoides*
Red Lark	*Calendulauda burra*
Sclater's Lark	*Spizocorys sclateri*
Southern Pale Chanting Goshawk	*Melierax canorus*
Verreaux's Eagle	*Aquila verreauxii*
Yellow-Billed Kite	*Milvus aegyptius*
Acacia Pied Barbet	*Tricholaema leucomelas*
African Pipit	*Anthus cinnamomeus*
Anteating Chat	*Myrmecocichla formicivora*
Barn Swallow	*Hirundo rustica*
Black-Eared Sparrowlark	*Eremopterix australis*
Bokmakierie	*Telophorus zeylonus*
Cape Bunting	*Emberiza capensis*
Cape Crow	*Corvus capensis*
Cape Penduline-Tit	*Anthoscopus minutus*
Cape Sparrow	*Passer melanurus*
Cape Turtle-dove	*Streptopelia capicola*
Capped Wheatear	*Oenanthe pileata*
Chat Flycatcher	*Bradornis infuscatus*
Common Fiscal	*Lanius collaris*
Common Quail	*Coturnix coturnix*
Eastern Clapper Lark	*Mirafra [apiata] fasciolata*
Egyptian Goose	*Alopochen aegyptiaca*
European Bee-eater	*Merops apiaster*
Familiar Chat	*Cercomela familiaris*
Greater Striped Swallow	*Hirundo cucullata*
Grey Tit	*Parus afer*

Grey-backed Cisticola	*Cisticola subruficapilla*
Grey-backed Sparrowlark	*Eremopterix verticalis*
Karoo Chat	*Cercomela schlegelii*
Karoo Eremomela	*Eremomela gregalis*
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	*Streptopelia senegalensis*
Little Swift	*Apus affinis*
Long-billed Crombec	*Sylvietta rufescens*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Pied Crow	*Corvus albus*
Red-Billed Teal	*Anas erythrorhyncha*
Red-Capped Lark	*Calandrella cinerea*
Red-Headed Finch	*Amadina erythrocephala*
Rock Kestrel	*Falco rupicolus*
Rock Martin	*Hirundo fuligula*
Rufous-Eared Warbler	*Malcorus pectoralis*
Sabota Lark	*Calendulauda sabota*
South African Shelduck	*Tadorna cana*
Southern Masked-weaver	*Ploceus velatus*
Southern Pale Chanting Goshawk	*Melierax canorus*
Speckled Pigeon	*Columba guinea*
Spike-Heeled Lark	*Chersomanes albofasciata*
Spotted Thick-Knee	*Burhinus capensis*
Spur-Winged Goose	*Plectropterus gambensis*
Stark's Lark	*Spizocorys starki*
Tractrac Chat	*Cercomela tractrac*
White-rumped Swift	*Apus caffer*
White-throated Canary	*Crithagra albogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-bellied Eremomela	*Eremomela icteropygialis*

8. POTENTIAL IMPACTS ON AVIFAUNA

Because of their size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines. (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013). Other problems include electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen *et al.* 2002), and displacement through disturbance and habitat destruction during construction and maintenance activities.

8.1 Electrocution of Red Data species on the HV powerlines and in the substations

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 pole/tower design largely determines the electrocution risk. The tower design that has been proposed for this project is the steel monopole (see Figure 1).

Clearance between phases on the same side of the 132kV steel monopole structure is approximately 2.2m, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of birds on the towers to negligible. The length of the stand-off insulators is approximately 1.6m. If a very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole, which is an unlikely occurrence, except occasionally with vultures. Vultures are unlikely to occur within the study area; therefore, it can be concluded that the risk of electrocutions on the proposed 132kV power lines is practically non-existent.

Electrocutions within the proposed Xha! Boom substations are possible, but should not affect the more sensitive Red Data bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting.

Given the low risk of electrocutions for Red Data species, this potential impact need not be further assessed in the report

8.2 Collisions of Red Data species with the earthwire of the 132kV grid connection

Collisions are unquestionably the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. 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 transmission 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)."

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).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions, power line configuration and powerline size. The large transmission lines kill more birds than the smaller distribution lines, especially as far as Ludwig's Bustards are concerned. (Shaw 2013). 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, Blue Cranes *Anthropoides paradiseus* 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 (*Accipitridae*) 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.

A potential impact of the proposed 132kV grid connection power line is collisions with the earth wire. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 10 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

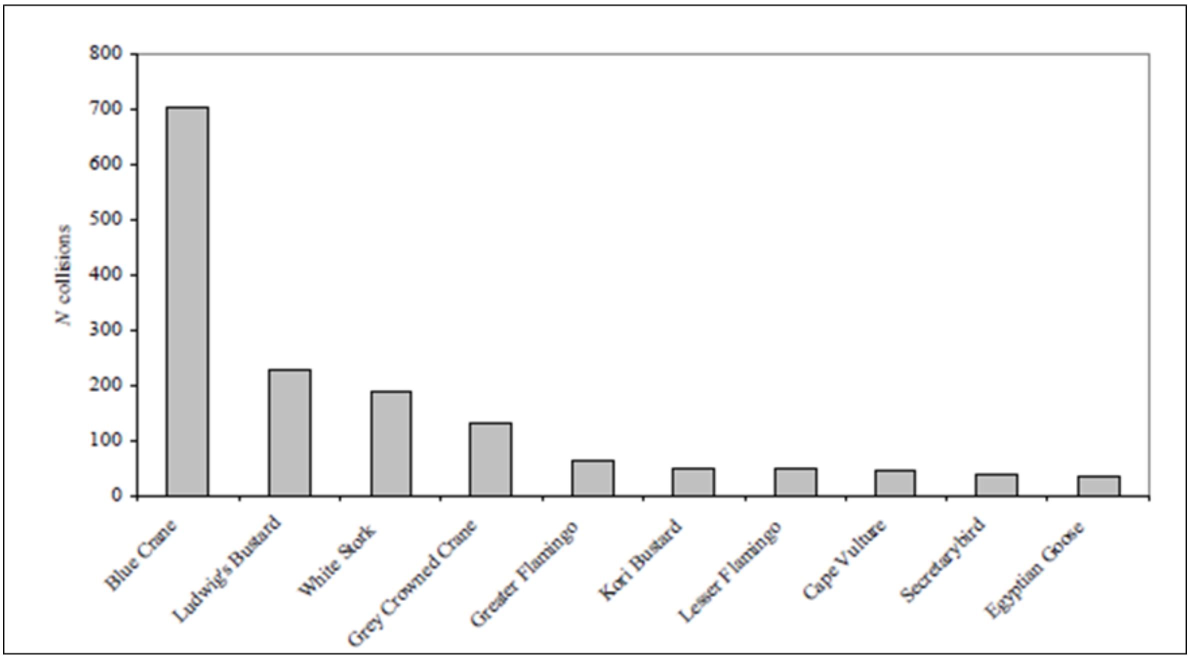

Figure 6:The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom-EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

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. Barrientos *et al.* 2011; Jenkins *et al.* 2010; Alonso & Alonso 1999; Koops & De Jong 1982), although it is less effective 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).

<u>Xha! Boom Grid Connection</u>

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig’s Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

8.3 Displacement due to habitat destruction and disturbance

During the construction phase and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

<u>Xha! Boom Grid Connection</u>

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at both the proposed Xha! Boom and Linking substation sites is common in the greater study area and the transformation of a few hectares of habitat should not impact any of the Red Data species significantly.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities could also potentially displace Red Data species through **disturbance**; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in July 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. The closest potential corridors (Corridor 2 and Corridor 3) are approximately 1.2km from the nest at their closest points, which means that while the potential for disturbance is likely to be low, but cannot be ruled out. This would especially be the case if the construction activities, e.g, the construction of new access roads, is required closer than 1.2km from the nest.

9. ASSESSMENT OF IMPACTS ON AVIFAUNA

9.1 Impact assessment methodology

The Impact Assessment 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.

9.2 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated using the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

9.3 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact is detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 9-1: Description of terms

NATURE		
This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.

3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

Significance

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

9.4 Impact ratings tables

IMPACT TABLE 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance during **construction** phase*
Extent	*The impact will only affect the site.*
Probability	*Impact may occur (between a 25% to 50% chance of occurrence) for some species, particularly the larger ones.*
Reversibility	*Partly reversible. The construction activities will inevitably cause temporary displacement of some Red Data species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, species should re-colonise the areas which have not been transformed by the footprint. However, the indirect effect of habitat fragmentation could result in lower densities of Red Data species.*
Irreplaceable loss of resources	*Marginal loss of resources. The displacement of Red Data species is likely to be partial.*
Duration	*Short term. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, Red Data species should re-colonise the areas which have not been transformed by the footprint, albeit possibly at a lower density.*
Cumulative effect	*Minor cumulative impact. The Red Data species that occur (or are likely to occur) at the proposed site all have large distribution ranges, the cumulative impact of displacement would therefore be at most locally significant in some instances, rather than regionally or nationally significant (see also Section 11 below).*
Intensity/magnitude	*Medium. Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.*
Significance Rating	*Low significance.*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-9 (low negative)

IMPACT TABLE 1	
Mitigation measures	• Restrict the construction activities to the construction footprint area. • Do not allow any access to the remainder of the property during the construction period. • 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. • Ideally, Corridor 1 or 3 should not be used as the two corridors pose a disturbance risk to an active Martial Eagle nest. • A 1.2km exclusion zone should be implemented around the active Martial Eagle nest on the Aries – Helios 400kV line at -30.517644° 19.550840° in the powerline study area where no construction activity or disturbance should take place, in the event of Corridor 1 or 3 being implemented.

IMPACT TABLE 2		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to habitat destruction during* ***construction*** *phase*	
Extent	*The impact will only affect the site.*	
Probability	*Impact may occur (between a 25% to 50% chance of occurrence) for some species, particularly the larger ones.*	
Reversibility	*Partly reversible. The footprint of the powerline is an inevitable result of the development, but it is likely that Red Data species will still utilise the site.*	
Irreplaceable loss of resources	*Marginal loss of resources. It is likely that Red Data species will still utilise the site.*	
Duration	*Long term. The habitat transformation will be permanent in the footprint of the poles.*	
Cumulative effect	*Moderate cumulative impact. There are several renewable energy developments planned around Loeriesfontein which could result in a significant area of transformed habitat, but only at a local scale, for some species (see also Section 11 below).*	
Intensity/magnitude	*Medium. It is likely that Red Data species will still utilise the site.*	
Significance Rating	*Low significance.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-13 (low negative)
Mitigation measures	• The recommendations of the specialist ecological study must be strictly adhered to, especially as far as rehabilitation of vegetation is concerned. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.	

IMPACT TABLE 5		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Collisions of Red Data species with the powerline in the operational phase*	
Extent	*The impact will affect the local area or district*	
Probability	*Probable. The impact will likely occur (between 50% - 75% chance of occurrence).*	
Reversibility	*Partly reversible. Mitigation measures could reduce the risk of collisions, but not significantly as far as bustards are concerned.*	
Irreplaceable loss of resources	*Significant loss of resources.*	
Duration	*Long term. The risk of collision will be present for the life-time of the development.*	
Cumulative effect	*Moderate cumulative impact. The cumulative impact will depend largely on which species are killed. Depending on the number of Ludwig's Bustards that are killed, the regional impact could be significant (see also Section 11 below).*	
Intensity/magnitude	*Medium. The powerline could cause mortality of some Red Data species.*	
Significance Rating	*High significance.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	-51 (high negative)	-48 (medium negative)
Mitigation measures	• The powerline should be marked with BFDs for its entire length on the earth wire of the line, 5m apart, alternating black and white. See APPENDIX D for the type of BFD which is recommended.	

10. SELECTING A PREFERRED ALIGNMENT

All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred, although it is slightly longer by about 6km (see Table 10 -1 below).

Table 10-1: Comparative assessment of powerline and substation options

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
On-site Substation Option 2	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
Linking Substation Option 1	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
Linking Substation Option 2	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	Not preferred	Ideally this option should not be used due to its proximity to the active Martial Eagle nest on the Aries – Helios 400kV line.
Grid Line Option 2	Favourable	The option is acceptable with the necessary mitigation.
Grid Line Option 3	Not preferred	Ideally this option should not be used due to its proximity to the active Martial Eagle nest on the Aries – Helios 400kV line.

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 4	Preferred	• It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions; • About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and • It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

11. CUMULATIVE IMPACTS

A cumulative impact, in relation to an activity, is the impact of an activity that may not be significant on its own but may become significant when added to the existing and potential impacts arising from similar or other activities in the area.

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors. The Scottish Natural Heritage (2005) recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or 'search area' of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the study area.

11.1 Species to be considered

The potential cumulative impacts on the Red Data species listed in Table 7-1 were considered.

11.2 Area considered in the cumulative assessment

The Helios Main Transmission Substation (MTS) approximately 50km north of the town of Loeriesfontein forms the hub of a proposed renewable energy node which is situated within a 40km radius around the

MTS (See Figure 17 below). Within this 40km radius around the MTS, the habitat and land-use (small-stock farming) is very uniform.

Table 11-1 below lists the renewable energy projects which are currently approved or under construction within a 40km radius around Helios MTS.

Table 11-1: List of other proposed and existing renewable projects within a 40km radius around Helios MTS

Project	Current status of EIA/development	Proponent	Capacity	Farm details	Footprint
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 2 of Farm Sous 226	3 200 ha
Loeriesfontein Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 1 & 2 of Farm Aan de Karree Doorn Pan 213	3 453 ha
Hantam PV Solar Energy Facility	Environmental Authorisation issued / Approved under RE IPPPP	Solar Capital (Pty) Ltd	Up to 525MW	RE of Farm Narosies 228	1 338 ha
Orlight Loeriesfontein PV Solar Power Plant	Environmental Authorisation issued	Orlight SA (Pty) Ltd	70MW	Pt 5 of Farm Kleine Rooiberg 227	334 ha
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan 212 Stinkputs 229	6 800 ha
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Leeuwbergrivier No. 1163 • Remainder of the Farm Kleine Rooiberg No. 227	6 674 ha
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Springbok Pan No. 1164 • Remainder of the Farm Springbok Tand No. 215	6 500 ha
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	• Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm	2468 ha

				Hartebeest Leegte No 216	
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	• Remainder of Hartebeest Leegte No 216	3083 ha
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	• Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216	3008
				Total	**36 858h**

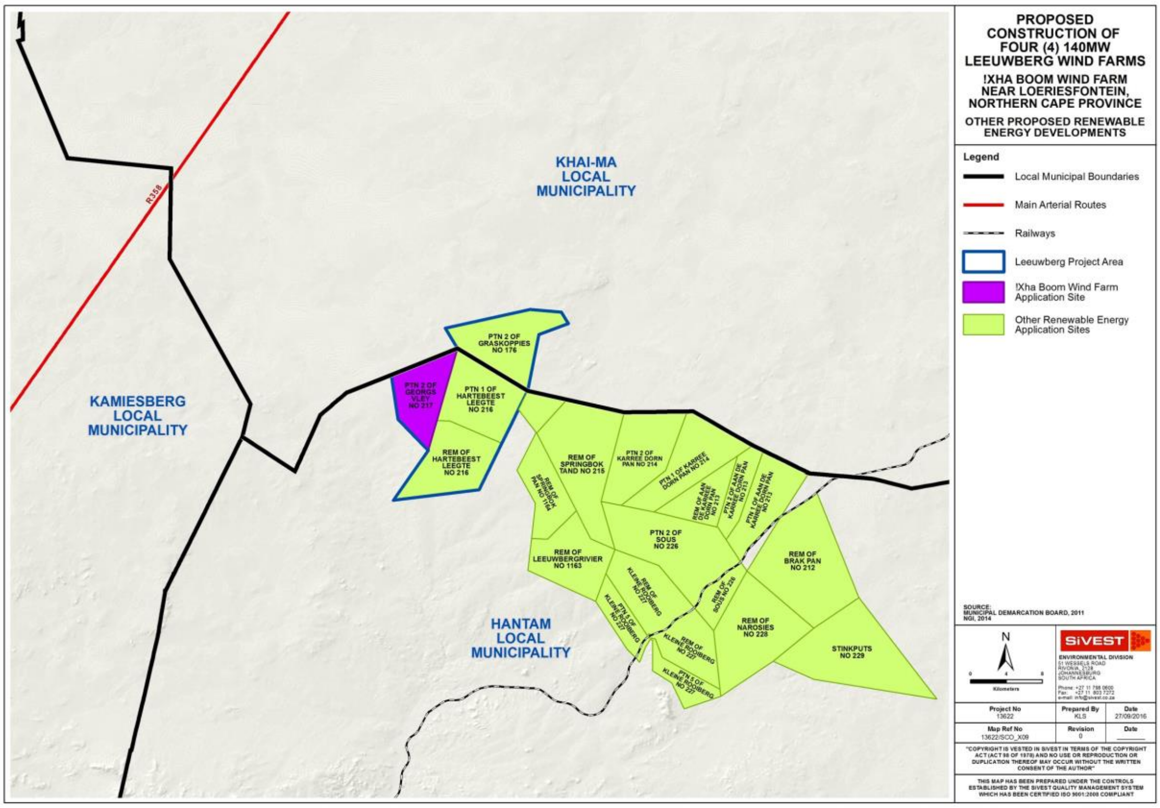

Figure 7: Existing renewable energy applications within a 40km radius around Helios MTS

11.3 Current impacts

Below is a summary of the typical threats currently facing avifauna in the Karoo environment (Marnewick *et al*. 2015):

11.3.1 Overgrazing

This results in a depletion of palatable plant species, erosion, and encroachment by Karoo shrubs. The result is loss of suitable habitat and a decrease in the availability of food for large terrestrial birds, including Red Data species such as Kori Bustard, Karoo Korhaan and Ludwig's Bustard.

11.3.2 Poisoning

Strychnine poison was used extensively in the past to control damage-causing predators, such as Black-backed Jackal *Canis mesomelas* and Caracal *Caracal caracal*, and reduced scavenging raptor populations. The use of poison may be continuing, and the potential impacts on Red Data raptor species such as Martial Eagle has not been confirmed or quantified.

11.3.3 Road-kills

Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl.

11.3.4 Renewable energy developments

Several wind and solar developments have been approved for development within a 40km radius around Helios MTS (see Table 11.1). The combined footprint of these proposed developments is approximately 36 282 hectares[5]. This has implications for several Red Data species, both in terms of collision mortality for some species, especially raptors, and displacement due to permanent habitat transformation, which affects most of the Red Data species to some degree.

11.3.5 Powerlines

Numerous existing and new power lines are significant threats to large terrestrial Red Data species in the Karoo. Power lines kill substantial numbers of all large terrestrial bird species in the Karoo, including threatened species such as Karoo Korhaan, Kori Bustard and Ludwig's Bustard (Jenkins *et al*. 2010; Shaw, J. 2013) There is currently no completely effective mitigation method to prevent collisions. There are currently approximately 130km of Eskom HV lines within a 40km radius around Helios MTS. This figure will increase by at least 100km if all proposed renewable energy developments get to be developed, including the Xha! Boom WEF.

11.3.6 Climate change

Climate change scenarios for the region predict slightly higher summer rainfall by 2050, and increased rainfall variability. Droughts are expected to become more severe. The climate change is predicted to have both positive and negative consequences for Red Data species. Increased summer rainfall could improve survival, and conversely drought years can lower long-term average survival. Large, mainly resident species dependent on rainfall are also more vulnerable to climate change. This would include the slow-breeding Martial Eagle, which also exhibit extended parental care. Severe hailstorms kill many Red Data species and could become more frequent.

11.3.7 Shale gas fracking

[5] This figure refers to the actual infrastructure footprint and not the land parcels, which are naturally much bigger than the area that will be actually developed. This information was obtained through internet searches.

There is a potential threat of shale gas fracking throughout the Karoo. Populations of bird species may be locally reduced through disturbance caused by lights, vibration, vehicles and dust, and may be affected by pollutants in ponds containing contaminated water produced by returned fracking fluids.

11.3.8 Persecution

Although it is difficult to prove, the direct persecution of raptors such as Verreaux's Eagle and Martial Eagle for stock predation is still taking place (R. Visagie pers. comm).

11.4 Methods

The cumulative impact of the proposed grid connection was assessed individually for each Red Data species (see Table 11-2 below).

Table 11-2: Framework for assessing significance of cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account because the receptor/resource is irretrievably compromised, resulting in a fatal flaw.
Major	Effects that may become a key decision-making issue, potential fatal-flaw.
Moderate	Effects that are unlikely to affect the viability of the project, but mitigation might be required.
Minor	Effects which might be locally/site significant, but probably insignificant for the greater study area.
Not Significant	Effects that are within the ability of the resource to absorb such change both at local/site level and within the greater study area.

11.5 Assumptions and limitations: cumulative impacts

The information on proposed WEFs and grid connections in the study area was received from Sivest and from various websites. The assessment was made on this basis, but it cannot be guaranteed that these are the only proposed developments.

11.6 Assessment

See Table 11-3 below for a systematic exposition of the expected cumulative impacts of the proposed Xha! Boom grid connection on Red Data species.

Table 11-3: The expected cumulative impact of the Xha! Boom Grid Connection on Red Data species within the 40km development node.

Priority species	Taxonomic name	Level of current and future impacts on species	Susceptibility to powerline impacts	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Pre-mitigation	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Post-mitigation
Karoo Korhaan	*Eupodotis vigorsii*	Low: Powerlines, solar, overgrazing, climate change	Medium	Moderate	Minor
Kori Bustard	*Ardeatis kori*	High: Powerlines,solar, overgrazing, climate change	High	High	Moderate
Lanner Falcon	*Falco biarmicus*	Low: Powerlines, poisoning, road kills, solar, WEF	Low	Low	Not significant
Ludwig's Bustard	*Neotis ludwigii*	High: Powerlines, solar, overgrazing, climate change	High	High	Moderate
Martial Eagle	*Polemaetus bellicosus*	High: Powerlines, persecution, solar, overgrazing, WEFs, climate change	High	Moderate	Minor
Secretarybird	*Sagittarius serpentarius*	High: Powerlines, solar , overgrazing, WEFs, climate change	High	High	Moderate
Sclater's Lark	*Spizocorys sclateri*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Red Lark	*Calendulauda burra*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Burchell's Courser	*Cursorius rufus*	Medium: Solar, overgrazing, WEFs, climate change	Low	Not significant	Not significant
Verreaux's Eagle	*Aquila verreauxii*	High: Powerlines, persecution, solar, overgrazing, WEFs, climate change	High	Moderate	Minor

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be minor to moderate within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

11.7 No-Go Alternative

The no-go alternative will result in the current status quo being maintained as far as the avifauna is concerned. Overall, the very low human population in the study area is definitely advantageous to avifauna in general. The no-go option would be advantageous for the ecological integrity of the study area as far as avifauna is concerned.

12. SUMMARY OF FINDINGS AND CONCLUDING STATEMENT

The proposed Xha! Boom grid connection and associated substations will have potential impacts on Red Data avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss; and
- Collisions with the earthwire of the 132kV grid connection

12.1 Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace Red Data species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in June 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. Options 2 and 3 are approximately 1.2km from the nest at their closest point, while Options 1 and 4 are 2km from the nest at their closest point.

The pre-mitigation risk of displacement due to disturbance during the construction phase is rated as low, but could be further reduced through appropriate mitigation.

12.2 Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at the proposed Xha! Boom substation sites is common in the greater study area and the transformation of a few hectare of habitat should not impact any of the Red Data species significantly.

The risk of displacement through habitat destruction during construction is rated as low, which could be reduced through appropriate mitigation.

12.3 Collisions of Red Data species with the earthwire of the 132kV grid connection

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as high which can be reduced to medium through appropriate mitigation.

12.4 Concluding statement

The proposed Ithemba grid connection will have potential impacts on avifauna, ranging from high to low, prior to the implementation of mitigation. With the implementation of mitigation measures, the high impacts could be reduced to medium, while the low impacts can be further reduced. All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred:

- It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions;
- About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and
- It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be moderate to minor within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

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APPENDIX A

Avifaunal pre-construction monitoring at the proposed Leeuwberg Wind Energy Facilities:

Overview of methodology

Objectives

The objective of the pre-construction monitoring at the proposed wind projects was to gather baseline data over a period of 12-months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the broader study area and a suitable control area to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the broader study area to measure the potential collision risk with the turbines.

Methods

The monitoring protocol for the sites is designed according to the latest version (2015) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

Monitoring surveys were conducted at the WEF study areas and a control area by four field monitors during the following periods:

- 10 – 23 November 2015
- 23 February – 03 March 2016
- 18 May - 30 May 2016
- 22 August – 1 September 2016

Monitoring was conducted in the following manner:

- Four drive transects were identified on the study area totalling 52.1km and one drive transect in the control site with a total length of 13.7km.
- Two observers travelling slowly (± 10km/h) in a vehicle records all species on both sides of the drive transect. The observers stop at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects are counted three times per sampling session.
- In addition, eleven walk transects of 1km each were identified at the study area, and four at the control site, and counted 8 times per sampling season. All birds are recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1 - 7);
    - 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).

- Eleven vantage points (VPs) were identified to record the flight altitude and patterns of priority species at the development areas. Two VPs were also identified on the control area. 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. >220m; medium i.e. 30m – 220m; low i.e. <30m);
    - Flight mode (soar; flap; glide; kite; hover); and
    - Flight time (in 15 second-intervals).

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 development areas by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the November 2014 BLSA list of priority species for wind farms.

Four potential focal points of bird activity, two boreholes and two salt pans, one known as Die Soutkomme and the other as Konnes se Pan, were identified in the greater study area and monitored.

Figure 1 below indicates the area where monitoring was performed.

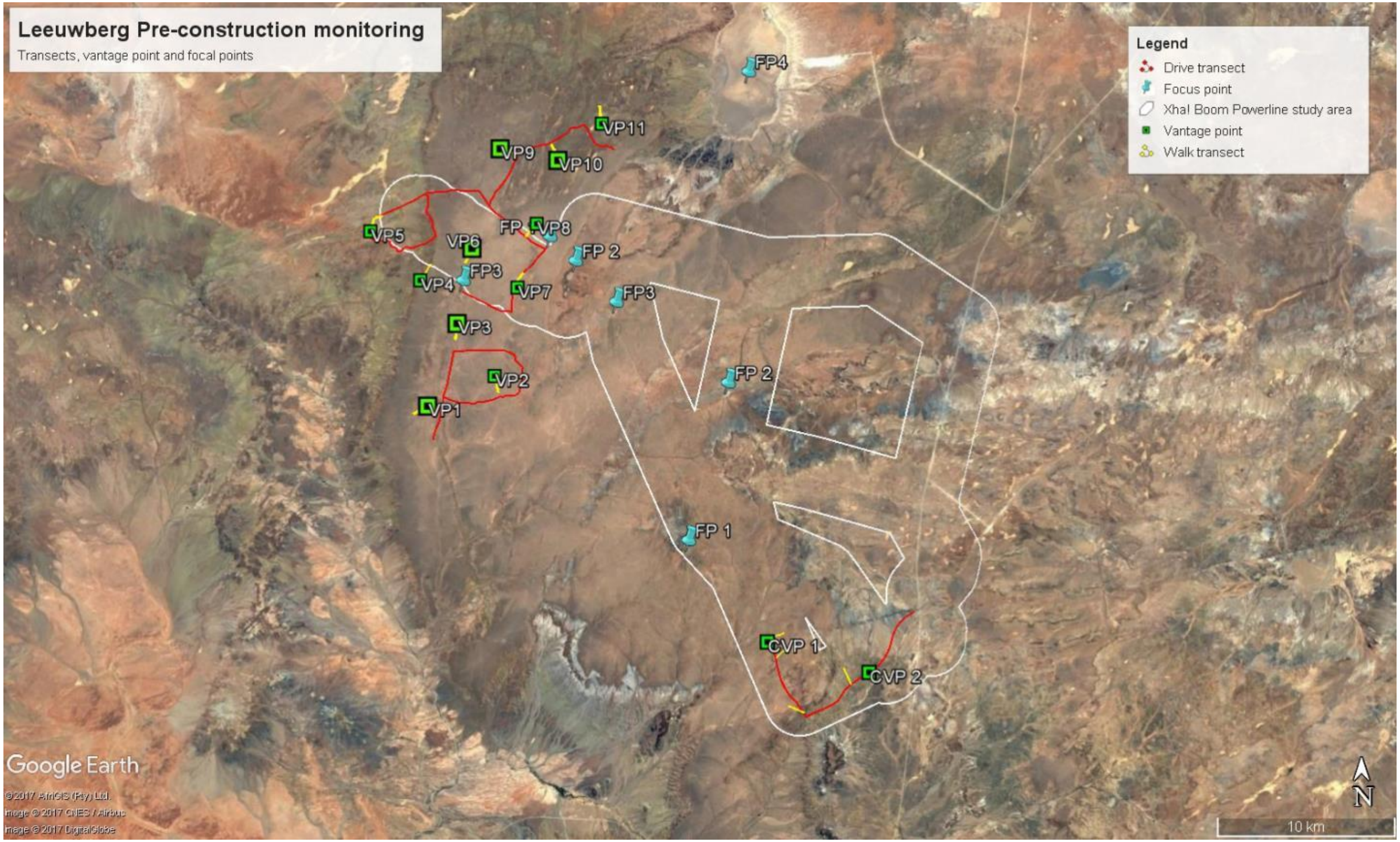

Figure 1: The WEF study area where the pre-construction monitoring was conducted for the proposed Leeuwberg WEFs. The white polygon indicates the boundaries of the powerline study area.

APPENDIX B: BIRD HABITAT

Figure 1: An example of Bushmanland Basin Shrubland at the powerline study area. This is also the dominant habitat in the greater study area.

Figure 2: A typical water point in the powerline study area.

Figure 3: The habitat at the control area, indicating the homogenous nature of the habitat in the greater study area.

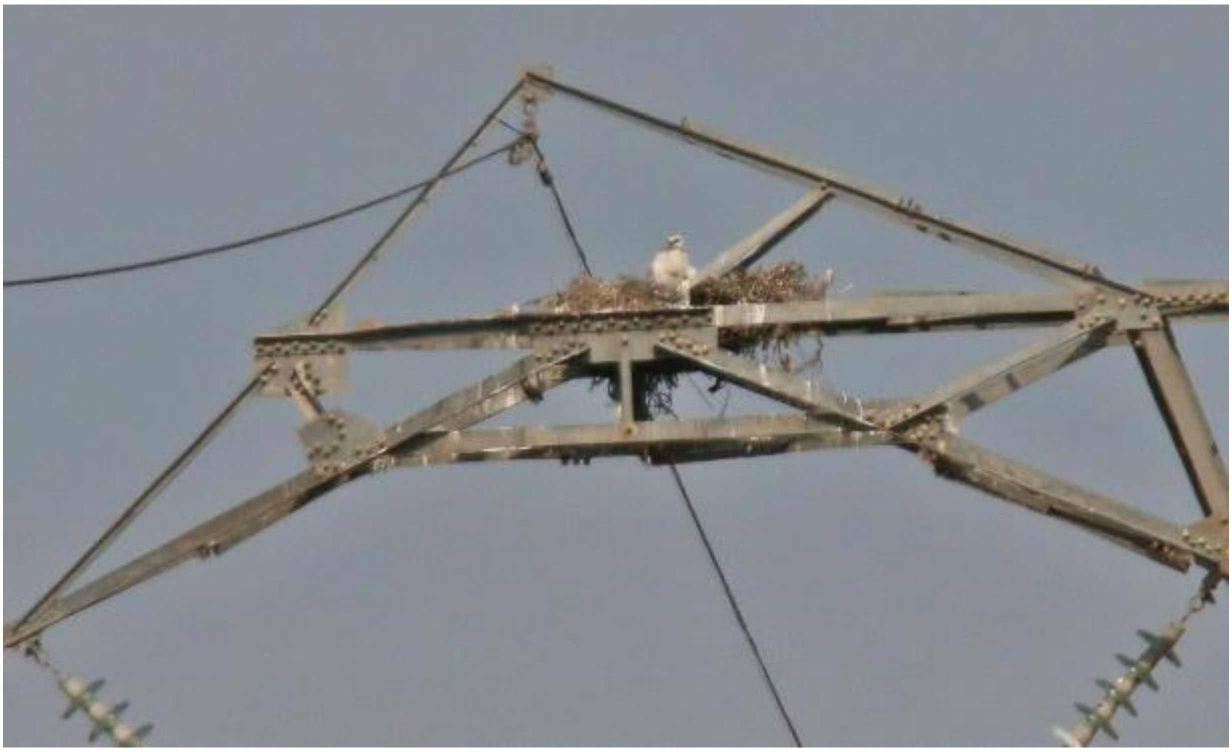

Figure 4: An active Martial Eagle nest on the Aries – Helios 400kV transmission line.

APPENDIX C: SABAP2 SPECIES LIST

Species	**Taxonomic name**
Acacia Pied Barbet	*Tricholaema leucomelas*
African Hoopoe	*Upupa africana*
African Pipit	*Anthus cinnamomeus*
African Red-eyed Bulbul	*Pycnonotus nigricans*
Ant-eating Chat	*Myrmecocichla formicivora*
Barn Swallow	*Hirundo rustica*
Black-chested Snake Eagle	*Circaetus pectoralis*
Black-eared Sparrow-lark	*Eremopterix australis*
Black-headed Canary	*Serinus alario*
Blacksmith Lapwing	*Vanellus armatus*
Black-winged Stilt	*Himantopus himantopus*
Bokmakierie	*Telophorus zeylonus*
Booted Eagle	*Aquila pennatus*
Burchell's Courser	*Cursorius rufus*
Cape Bunting	*Emberiza capensis*
Cape Crow	*Corvus capensis*
Cape Sparrow	*Passer melanurus*
Cape Turtle Dove	*Streptopelia capicola*
Cape Wagtail	*Motacilla capensis*
Cape Weaver	*Ploceus capensis*
Capped Wheatear	*Oenanthe pileata*
Caspian Plover	*Charadrius asiaticus*
Chat Flycatcher	*Bradornis infuscatus*
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*
Common (Steppe) Buzzard	*Buteo vulpinus*
Common Fiscal	*Lanius collaris*
Common Quail	*Coturnix coturnix*
Common Swift	*Apus apus*
Crowned Lapwing	*Vanellus coronatus*
Double-banded Courser	*Rhinoptilus africanus*
Dusky Sunbird	*Cinnyris fuscus*
Eastern clapper Lark	*Mirafra fasciolata*
Egyptian Goose	*Alopochen aegyptiacus*
European Bee-eater	*Merops apiaster*
Fairy Flycatcher	*Stenostira scita*
Familiar Chat	*Cercomela familiaris*
Greater Kestrel	*Falco rupicoloides*

Greater Striped Swallow	*Hirundo cucullata*
Grey Penduline-Tit	*Anthoscopus minutus*
Grey Tit	*Parus afer*
Grey-backed Cisticola	*Cisticola subruficapilla*
Grey-backed Sparrow-lark	*Eremopterix verticalis*
House Sparrow	*Passer domesticus*
Jackal Buzzard	*Buteo rufofuscus*
Karoo Chat	*Cercomela schlegelii*
Karoo Eremomela	*Eremomela gregalis*
Karoo Korhaan	*Eupodotis vigorsii*
Karoo Long-billed Lark	*Certhilauda subcoronata*
Karoo Prinia	*Prinia maculosa*
Karoo Scrub Robin	*Cercotrichas coryphoeus*
Kori Bustard	*Ardeotis kori*
Lanner Falcon	*Falco biarmicus*
Large-billed Lark	*Galerida magnirostris*
Lark-like Bunting	*Emberiza impetuani*
Laughing Dove	*Streptopelia senegalensis*
Layard’s Tit-Babbler	*Parisoma layardi*
Little Swift	*Apus affinis*
Long-billed crombec	*Sylvietta rufescens*
Long-billed Pipit	*Anthus similis*
Ludwig’s Bustard	*Neotis ludwigii*
Malachite Sunbird	*Nectarinia famosa*
Martial Eagle	*Polemaetus bellicosus*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Northern Black Korhaan	*Afrotis afraoides*
Pale Chanting Goshawk	*Melierax canorus*
Pale-winged Starling	*Onychognathus nabouroup*
Pied Crow	*Corvus albus*
Pied Starling	*Spreo bicolor*
Pririt Batis	*Batis pririt*
Red Lark	*Calendulauda burra*
Red-billed Teal	*Anas erythrorhyncha*
Red-capped Lark	*Calandrella cinerea*
Red-faced Mousebird	*Urocolius indicus*
Red-headed Finch	*Amadina erythrocephala*
Rock Kestrel	*Falco rupicolus*

Rock Martin	*Hirundo fuligula*
Rufous-cheeked Nightjar	*Caprimulgus rufigena*
Rufous-eared Warbler	*Malcorus pectoralis*
Sclater's Lark	*Spizocorys sclateri*
Sickle-winged Chat	*Cercomela sinuata*
South African Shelduck	*Tadorna cana*
Southern Masked Weaver	*Ploceus velatus*
Speckled Pigeon	*Columba guinea*
Spike-heeled Lark	*Chersomanes albofasciata*
Spotted Eagle-Owl	*Bubo africanus*
Spotted Thick-knee	*Burhinus capensis*
Stark's Lark	*Spizocorys starki*
Three-banded Plover	*Charadrius tricollaris*
Tractrac Chat	*Cercomela tractrac*
Verreauxs' Eagle	*Aquila verreauxii*
Western Barn Owl	*Tyto alba*
White-backed Mousebird	*Colius colius*
White-rumped Swift	*Apus caffer*
White-throated Canary	*Crithagra albogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-bellied Eremomela	*Eremomela icteropygialis*

APPENDIX D: BIRD FLIGHT DIVERTERS[6]

DISTRIBUTION
TECHNICAL BULLETIN

3 April 2009

Enquiries: B P Hill
Tel: (011) 871 2397

TECHNICAL BULLETIN: 09 TB – 01
PART: 4 - MV

APPROVED BIRD FLIGHT DIVERTERS TO BE USED ON ESKOMS LINES (MITIGATING DEVICES)

This Technical Bulletin replaces all other Technical Bulletins that were published previously.

The following two flight diverters (mitigating devices) have been successfully installed and successfully tested on an active line in the Colesberg area.

1) EBM Flapper

Buyers guide number DDT 3053

The EBM bird flapper tested for the following:

- Pull down test (spirally moving along the conductor) for squirrel and hare conductor
- Testing for radio interference at 27kv on fox conductor
- Testing for corona at 27kv on fox conductor
- Salt fog test for 1000 hours.

The flapper was installed live line on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device.

From field experience and the testing of the flapper it was decided at the Envirotech work group meeting that this EBM flapper can be used on conductors ranging from 6mm to 24mm on ACSR, AAAC conductors and shield wires.

The EBM Flapper can be attached with a link stick and a standard attachment or by hand from a bucket live line or under dead conditions.

Contact Roger Martin: EBM Tel 011 288 0000

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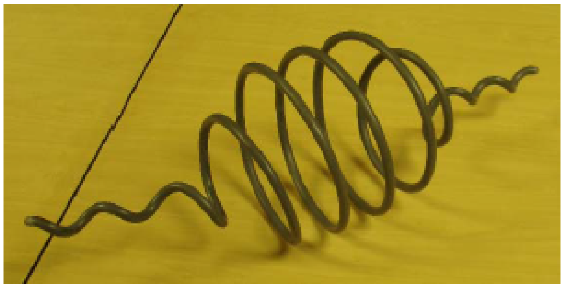
[6] The devices in this appendix are the current (February 2017) recommended devices, but that at the time of construction the most current, Eskom approved devices should be used.

2) Tyco Flight Diverter.



Buyers guide number DDT 3107

The TYCo flight diverter has been used successfully in many places around the world and has been installed on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device. The device is supplied in colours white and grey.

Contact person: Mr Silas Moloko: TIS Tel 011 635 8000

3) Installing Flight Diverters

- Spacing of the bird diverters are to be 5m apart alternating on each phase, for single phase lines the colours would alternate 5m apart on the two lines.
- The flight diverters are to be installed with alternating colours,

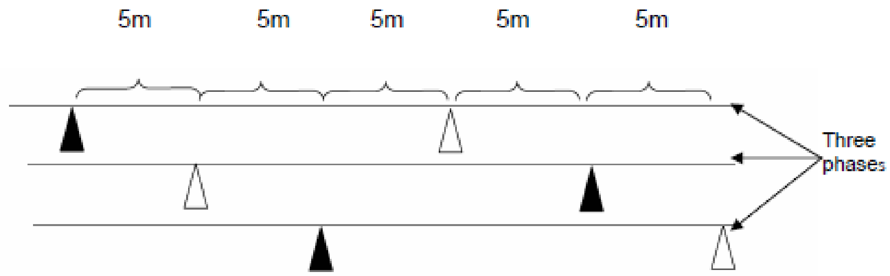


Figure 1

Signed

COMPILED BY:

DATE: **April 2009**
B P Hill
Chief Engineer
IARC

Signed

APPROVED BY:

DATE: **April 2009**
Vinod Singh
Power Plant Technologies Manager
IARC

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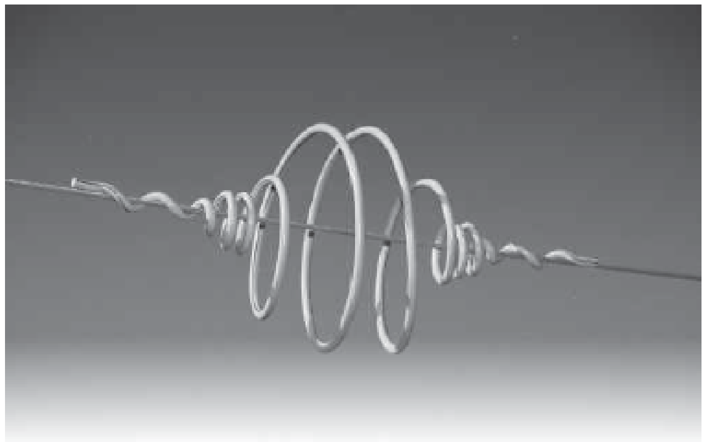
Double Loop Bird Flight Diverter



General Recommendation

The Bird Flight Diverter is designed to make overhead lines visible to birds and provides and economic means of reducing the hazard to both lines and birds. For low and medium voltage construction (up to 40kV) it is applied to the phase conductors (bare or jacketed). For high voltage it is used on the earth wire.

The fitting is light in weight, offers little wind resistance and is easily and quickly applied. The positive grip of the fitting on the conductor ensures that it remains in the applied position and cannot move along the span under vibration.

Visibility: The diverter section increases the visibility profile of the cable or conductor to a degree necessary to ensure safety, but avoids undesirably bulky outline.

Spacing: Spacing distances are not critical and will depend upon local conditions. Since wind resistance is very limited, sufficient fittings can be used to ensure adequate visibility without creating stresses on the line. When marking adjacent spans, overall visibility is improved by staggering the application.

We recommend generally a spacing of 10 or 15 metres.

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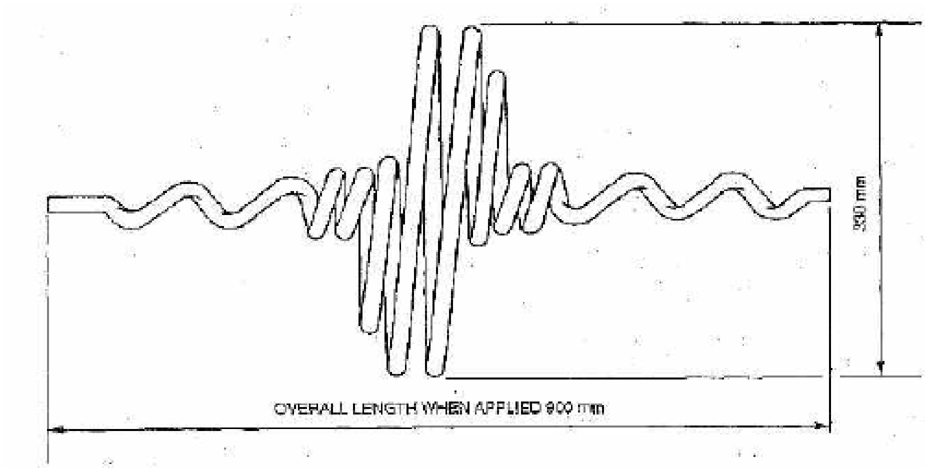
Double Loop Bird Flight Diverter



Material Used: Manufactured from rigid solid high impact polyvinyl chloride, possessing excellent chemical and strength properties and which will retain good physical characteristics within the range of extreme temperatures. Outdoor aging tests indicate that the material does not deteriorate in function or appearance from the effects of severe weather conditions. Industrial fumes and salt water cannot seriously degrade the properties of rigid PVC.

Colour: White or Black

Lay Direction: Bird Flight Diverters are supplied right hand lay for both right hand and left hand lay bare conductors and insulated cables.

CATALOGUE NO.	CONDUCTOR/ E/WIRE DIA. RANGE
BFD 0914/LD2*	9 mm – 14 mm

*Add B or W to denote colour

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