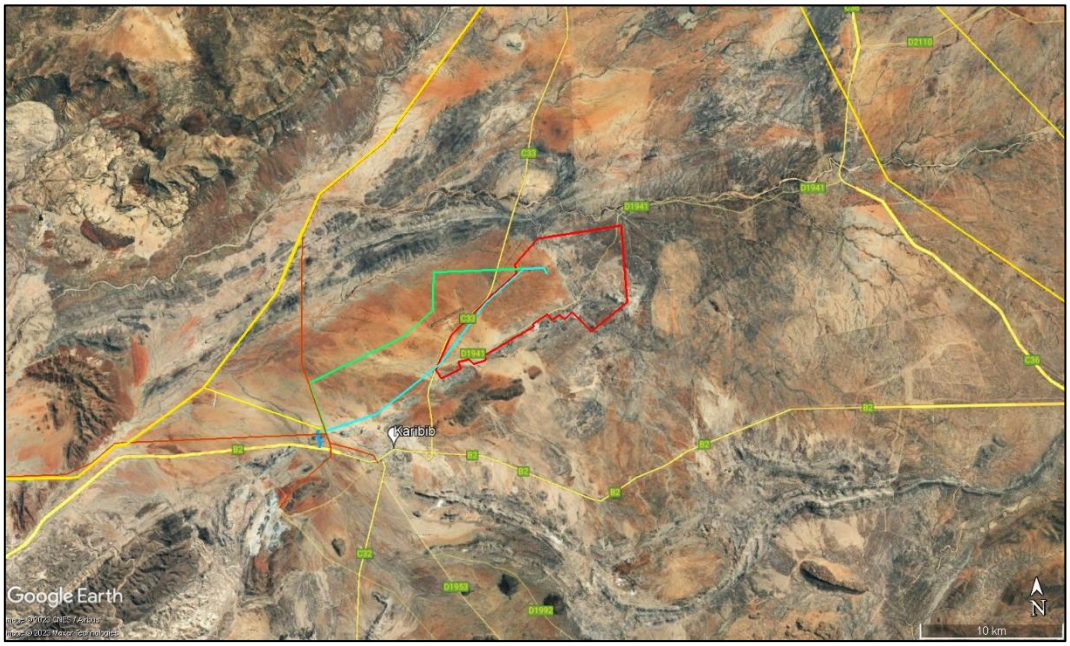
Environmental Impact Assessment for the Osino Twin Hills Gold Project 66 kV power line, Erongo Region, Namibia

Avifauna baseline/scoping and assessment



Prepared by:

African Conservation Services cc

Prepared for:

Environmental Compliance Consultancy

20 June 2023

Name of project	**Environmental Impact Assessment for the Osino Twin Hills Gold Project 66 kV power line, Erongo Region, Namibia** **Avifauna baseline/scoping and assessment** *PROJECT NUMBER: ECC-103-443-BID-03-D*
Principal client	Osino Gold Exploration and Mining (Pty) Ltd P O Box 3489, Windhoek, Namibia
Lead Environmental Assessment Practitioner	Environmental Compliance Consultancy (ECC) PO Box 91193, Klein Windhoek, Namibia Email: stephan@eccenvironmental.com; samuel@eccenvironmental.com Tel. +264 81 476 5261 / +264 81 669 7608 Representatives: Stephan Bezuidenhout; Samuel Shinyemba
Sub-consultant	African Conservation Services cc PO Box 2604, Swakopmund, Namibia Email: ecoserve@iway.na Tel: +264 64 404 866 / +264 81 284 5130 Representatives: Dr Ann Scott and Mike Scott
Report version and date	Draft 1: 3 June 2023 Draft 2: 20 June 2023

Expertise and declaration of independence

We, African Conservation Services cc, as the appointed independent avifauna specialist for the Environmental Impact Assessment for the Osino Twin Hills Gold Project 66 kV power line, Erongo Region, Namibia, hereby declare that we:

- have acted as the independent specialist in this Environmental Clearance Certificate application;
- have expertise and experience in conducting the avifauna specialist report relevant to this application;
- have performed the work relating to the application in an objective manner;
- regard the information contained in this report as it relates to our specialist input/study to be true and correct;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the EIA (amendment);
- declare that there are no circumstances that may compromise our objectivity in performing such work;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- undertake to disclose to the applicant and the competent authority all material information in our possession that reasonably has or may have the potential of influencing the decision of the competent authority; and that
- all the particulars furnished by us in this specialist input/study are true and correct.

Name of specialist: African Conservation Services cc

Representatives:

HA Scott RM Scott

Date: 20 June 2023

Executive summary

Osino Gold Exploration and Mining (Pty) Ltd (Osino), the Proponent, has contracted Environmental Compliance Consultancy (ECC) to conduct an environmental impact assessment (EIA) and develop an environmental management plan (EMP) on behalf of Namibia Power Cooperation (NamPower) (Pty) Ltd, for the proposed construction of a 66 kV overhead transmission power line connecting the planned Erongo Substation with the Twin Hills Gold Project near Karibib, Erongo Region, Namibia. An associated 11 kV onsite distribution power line is being assessed separately. The present avifauna baseline/scoping and assessment for the 66 kV power line forms part of this EIA.

The proposed 66 kV overhead transmission line will be constructed from the Erongo Substation in the west to the Twin Hills Gold Project in the east. The structure comprises a steel monopole with height ~20.6 m and average span lengths 300 m. The structure is self-supporting, with stay wires at strain poles/bend points, and terminal H-poles. The steel pole is permanently earthed. An optical ground wire (OPGW) will be attached near the top of the pole, 2.2 m above the three conductors that are (vertically) in delta formation.

Two proposed route options were assessed. For the Twin Hills Substation and Metering Station within the Mining Licence 238 (ML), a preferred site and an alternative site were also assessed for the metering station. Several existing power lines in area, of various capacities and structures, could contribute to any cumulative impacts of the new power line.

According to the avifauna baseline and scoping of sites and species, the study area is potentially sensitive in terms of birds and their habitats.

The study area lies ~12 km north-east of the town of Karibib, in Central Namibia. The area lies some 110 km from the nearest (large) formally protected area, the Namib-Naukluft Park, with the Dorob National Park to the west. The conservation status of the greater area is regarded as relatively high.

The study area falls within the Tree-and-shrub Savanna biome. The vegetation type is classed as Western Highlands. The habitat is lightly bush-encroached, but only in parts. The main avifauna habitats in the area include plains with grass (after rains), scattered bush and trees: the dominant landscape; aquatic habitats: mainly ephemeral river catchments, including the large Khan River catchment to the north and north-west, and its tributaries; low, rocky hills in the south-eastern parts of the study area; and artificial habitats, including existing power line structures, used by birds as perches and nesting sites.

A relatively moderate-high bird species richness has been recorded in the study area and surrounds, with a total of 180 species, or 27% of the 676 species currently recorded in Namibia; however, the area is not well atlased in parts. The site visits for the present study took place at the end of the rainy season (April-May 2023), and the bird species richness then observed was good. To address any gaps, however, data from several sources were combined for an overall checklist.

The checklist includes 11 species (6% of the total) that are threatened in Namibia (and comprising 16% of the 71 species on the Namibian Red Data List); seven of the 11 species are also Globally Threatened. The checklist also includes a relatively high number of species (at least nine) that are near-endemic to Namibia, with at least 90% of the populations occurring within the country, as well as several migrant species. Breeding in the form of an active Lappet-faced Vulture nest is reported on Farm Karibib.

Risk assessment and mitigation efforts are directed towards priority species, defined as those that have a high biological significance, i.e. primarily Red Data species (including those with migrant status) and/or endemic or near-endemic species.

Twenty-three priority bird species have been short-listed from a total of 42 potential priority species, as a focal group identified as being at higher risk to potential impacts resulting from the proposed

project. Although the focus of the impact assessment is on the above short-listed species, the full priority list also needs to be taken into account due to the high species numbers and the difficulty in predicting those likely to be impacted. The emphasis should be on groups of birds likely to be at risk, rather than on individual species; and the precautionary principle should prevail. Note that (mainly) only Red Data and raptor migrant species are listed; a number of other migrant species (both aquatic and terrestrial) also need to be taken into account.

The details of the 23 short-listed priority species and their sensitivities are mentioned below (asterisk denotes recent [2023] confirmation of occurrence; power line-prone = susceptible to impacts of power line construction; local abundance score on a scale of 3 = likelihood of occurrence in the study area at present).

14 high priority species (11 Namibian Red Data [7 also Globally Endangered] / 9 migrant / 4 near endemic to Namibia), in the groups:

- **2 large terrestrial bird species**
  - ***Ludwig's Bustard** (Endangered, also Globally Endangered; nomadic; power line-prone; local abundance 3/3)
  - ***Kori Bustard** (Near Threatened, also Globally Near Threatened; nomadic; power line-prone; local abundance 3/3)
- **6 raptors**
  - ***White-backed Vulture** (Critically Endangered, also Globally Critically Endangered; resident, with large-scale movements, especially in juveniles; power line-prone; nesting colony on adjacent farms; local abundance 3/3)
  - **Lappet-faced Vulture** (Endangered, also Globally Endangered; resident, with extensive movements in non-breeding birds; power line-prone; nesting reported on Farm Karibib; local abundance 3/3)
  - **Martial Eagle** (Endangered, also Globally Endangered; resident; power line-prone; local abundance 2/3)
  - **Common Buzzard** (Palearctic migrant; power line-prone; local abundance 3/3)
  - **Yellow-billed Kite** (intra-African migrant; power line-prone; local abundance 3/3)
  - ***Lanner Falcon** (resident, migratory; power line-prone; local abundance 3/3)
- **4 Namibian near-endemics**
  - ***Damara Red-billed Hornbill** (near-endemic to Namibia; cavity breeder; power line-prone; local abundance 3/3)
  - ***Monteiro's Hornbill** (near-endemic to Namibia; nomadic; cavity breeder; power line-prone; local abundance 3/3)
  - **Rockrunner** (near-endemic to Namibia; nests mostly in grass tufts; impacted by disturbance/ habitat destruction; local abundance 3/3)
  - **White-tailed Shrike** near-endemic to Namibia; nests in shrubs; impacted by disturbance/ habitat destruction; local abundance 3/3)
- **2 other large terrestrial migrant species**
  - **Abdim's Stork** (intra-African migrant; local abundance 2/3)
  - **Woolly-necked Stork** (resident, migrant; local abundance 2/3)

9 non-Red Data / non-near-endemic priority species, comprising 9 raptors

- Black-chested Snake Eagle (resident, nomadic; power line-prone; local abundance 3/3)

- Brown Snake Eagle (resident, nomadic; power line-prone; local abundance 3/3)
- *Pygmy Falcon (resident; power line-prone; local abundance 3/3)
- Gabar Goshawk (resident; power line-prone; local abundance 3/3)
- *Pale Chanting Goshawk (sedentary, with local movements; electrocution-prone; local abundance (3/3)
- *African Hawk-eagle (resident, sedentary; power line-prone; local abundance 3/3)
- Greater Kestrel (sedentary, local movements; power line-prone; local abundance 3/3)
- *Rock Kestrel (resident; power line-prone; local abundance 3/3)
- Black-winged Kite (nomadic; power line-prone; local abundance 3/3)

All the above 23 priority bird species are potentially at risk to impacts associated with the construction and operation of a power line. Most are potentially at risk to collisions on power line structures. Further potential impacts include physical disturbance and habitat destruction/ modification during the construction of power lines; and electrocution (including by streamers of excrement) during operation.

Other (mostly non-priority) species with the potential to cause impacts on infrastructure

- Sociable Weaver (actives nests; local abundance 3/3)
- Pied Crow (local abundance 2/3)
- Red-billed Buffalo Weaver (old nests observed; likely to be seasonal)

Potential impacts of the development may be summarised as follows:

- Physical/human disturbance of birds (resulting in avoidance/displacement); this could include road mortalities and/or poaching during construction
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Direct and indirect modification/loss/destruction of bird habitat (resulting in avoidance/ displacement)
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Bird collisions with power line infrastructure, including power lines and associated structures (which could lead to injury of mortality of birds)
  - Rated as moderate-major (negative; 6-8), and minor-moderate (4-6) post-mitigation
- Bird electrocutions on power line infrastructure (including by streamers of excrement) (which could lead to injury/ mortality of birds)
  - Rated as moderate (negative; 6), and minor (4) post-mitigation
- Attraction of birds to novel (artificial) habitats and resources created by the development; this impact could lead to negative impacts on infrastructure, caused by bird nesting, perching and other activities
  - Rated as minor (negative; 4), and low (2) post-mitigation. The provison of novel habitats to birds may have some positive impacts.

Overall significance of the impacts

The overall significance is negative, low-minor (total score 24-26, reduced to 14-16 with mitigation). The provison of novel habitats to birds may have some positive impacts.

Of the above, the impacts of bird collisions and of bird electrocutions on power line infrastructure receive the highest rating. Cumulative impacts are an important consideration.

Recommendations are made for the mitigation and monitoring of the above impacts. Route alternative 1 is recommended as the preferred option. It is considered that the effective application

of these recommendations will reduce the impacts associated with the construction of the 66 kV power line.

Table of contents

List of figures

List of tables

Abbreviations, acronyms and glossary of terms

AEWA	African-Eurasian Migratory Waterbird Agreement
BFD	Bird Flight Diverter
CBD	Convention on Biological Diversity
CIA	Cumulative Impact Assessment
CMS	Convention on Migratory Species
DEA	Department of Environment Affairs
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EIS	Environmental Information Service (www.the-eis.com)
EMA	Environmental Management Act
EMP	Environmental Management Plan
Endemic	Occurring within a restricted distribution range
Endemic status categories	
	E = endemic, NE = near-endemic, sA = southern Africa, Nam = Namibia
IBA	Important Bird (and Biodiversity) Area
IUCN	International Union for the Conservation of Nature
IUCN Red List Categories	
	LC Least Concern
	NT Near Threatened
	VU Vulnerable
	EN Endangered
	CE Critically Endangered
	EW Extinct in the Wild
	EX Extinct
	G Global status
kV	kilovolt
MEFT	Ministry of Environment, Forestry and Tourism
NNF	Namibia Nature Foundation
OPGW	Optical ground wire (earth wire): a type of cable used in overhead power lines, combining the functions of communications and grounding/earthing
Pentad	A 5-minute x 5-minute coordinate grid super-imposed over the continent for spatial reference; nine pentads make up one Quarter Degree Square
Power line interaction categories	
	C = collision, D = disturbance, E = electrocution, H = habitat destruction, N = potential to disrupt the power supply through nesting and other activities
QDS	quarter degree square
Residency	R = resident, N = nomadic, M = migrant, V = vagrant; Ra = rare
SABAP	Southern African Bird Atlas Project (SABAP1 & SABAP2)
S/S	Substation

1 Background

Environmental Compliance Consultancy (ECC) has been contracted by Osino Gold Exploration and Mining (Pty) Ltd (Osino), the Proponent, to conduct an environmental impact assessment (EIA) and develop an environmental management plan (EMP) on behalf of Namibia Power Cooperation (NamPower) (Pty) Ltd, for the proposed construction of a 66 kV overhead transmission power line connecting the proposed Erongo Substation with the Twin Hills Gold Project near Karibib, Erongo Region, Namibia (see Figure 1 and 2 for locality). An associated 11 kV onsite distribution power line is being assessed separately. Consistent with the Environmental Management Act, No 7 of 2007 and its associated 2012 regulations, an Environmental Clearance Certificate (ECC) application will be submitted to the competent authority, being the Ministry of Mines and Energy (MME) and Ministry of Environment, Forestry and Tourism (MEFT), to make a Record of Decision (RoD) with regard to the proposed project.

Desktop studies as well as all available field surveys and specialist studies from the Project area are used to help define the baseline for the EIA. These studies also give a further indication of whether any local or regional future developments could impact on the project or *vice versa*.

The potential environmental and social impacts that have been anticipated may include the following:

- Potential avifauna collision risk and electrocutions with the overhead power lines; and
- Potential disturbance or displacement of protected or vulnerable species.

The present avifauna baseline/scoping and assessment for the new 66 kV power line therefore forms part of the above EIA.

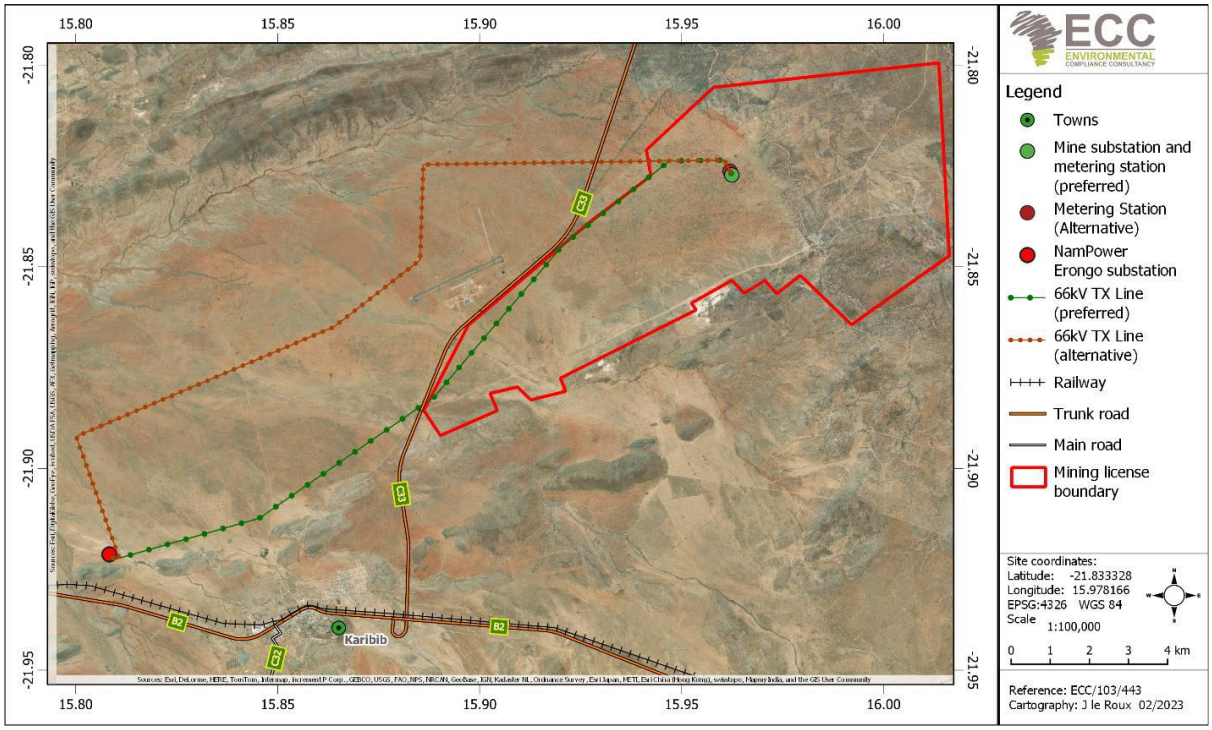


Figure 1. Location for the Osino Twin Hills Gold Mine, Erongo Region, showing the two alternative routes/servitudes for the proposed 66 kV transmission power line for the project.

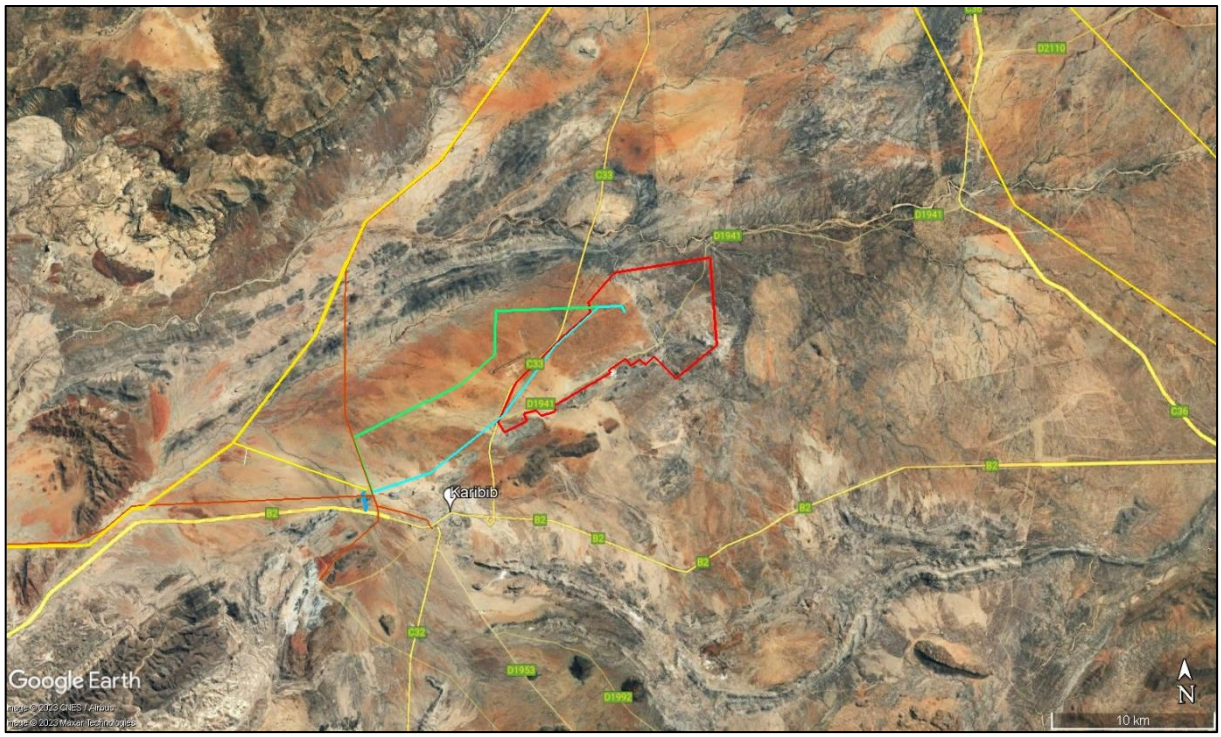


Figure 2. The greater study area for the Osino Twin Hills Gold Mine Project 66 kV power line, showing the Mining Licence area (red); two alternative routes/servitudes for the proposed 66 kV power line (blue and green); roads (pale yellow); and existing transmission power lines (220 kV = dark yellow; 66 kV = brown).

2 Description of the proposed project

2.1 Introduction

The proposed 66 kV overhead transmission power line will be constructed from the Erongo Substation in the west to the Twin Hills Gold Project in the east. Two proposed route options are indicated in Figure 1 (see below).

For the Twin Hills Substation and Metering Station within the Mining Licence 238 (ML) there is also a preferred site, and an alternative site for the metering station (see Section 2.3 below).

The study area is defined as the Osino Mining Licence (ML) area, and the area covered by the two alternative power line routes, including the above substations.

Need for the project

The Twin Hills Gold Project has received an Environmental Clearance Certificate to proceed with the Project on ML 238. As a result, the project will require electricity to operate. The proposed 66 kV overhead power line will form the initial power supply for the project; the Proponent is also looking into the possibility of adding renewable energy to supplement the bulk power supply to the mine during the mine operation.

Constructional and operational phases

The following are envisioned during the proposed Project:

- Development of the 66 kV overhead transmission power line from the proposed NamPower Erongo Substation to the proposed Twin Hills Gold Mine Substation and Metering Station.
- The 66 kV overhead power line will be constructed according to NamPower standards on behalf of NamPower, and will be handed over to them once completed; the ECC will thus be on the name of NamPower.
- The 66/11 kV Twin Hills Substation at Twin Hills Gold Mine will be constructed, owned and operated by the Proponent (Osino).
- A 66 kV metering station is also required and will be constructed adjacent to the above substation. This 66 kV metering station will also be constructed according to NamPower standards and handed over to NamPower once construction is completed.
- NamPower is in the planning phase of developing and constructing the proposed Erongo Substation (Figure 1), and the Proponent will be responsible for linking the overhead power line to this substation.

Technical details of the proposed 66 kV distribution line are described below (Section 1.2.2).

Power line alternatives are mentioned in Section 2.3 below. Other existing power lines in the greater area are also mentioned (Section 2.4).

2.2 Technical details of the new 66 kV transmission line

Technical details of the proposed 66 kV distribution line are described below (see Figure 3-6). Technical input was kindly supplied by Francois de Wet.

The 66 kV structure comprises a steel monopole with the following components (Figure 3 & 4):

- The height of the pole structure will be approximately 20.6 m (20,600 mm), with average span lengths of 300 m (spacing between poles).

- On the straight sections of the line, intermediate poles will be used that are self-supporting, with no stay wires. Three conductors are suspended above one another in delta configuration, each resting on an insulator.
- Bend poles (a 20 m pole length planted 2 m into the ground) with seven backstays will be used at points where the line changes direction.
- A terminal H-Pole is normally used at the start and at the end of the line, with the last pole at substations (Figure 5 & 6). The pole length is as above, with six stay wires/backstays.
- The steel pole is permanently earthed. An optical ground wire (OPGW) will be attached near the top of the pole, 2.2 m (2,200 mm) above the conductors, to increase the reliability of the power supply. The cable closest to the top of the pole, namely the OPGW, will also serve as an earth.
- A steel bar is placed at the top of the pole structure, i.e. 2.2 m above the highest conductor, to serve as a perch (as a mitigation for electrocutions) and thereby attract birds to safer areas of the structure.

Typical substation structures are shown in Figure 6.

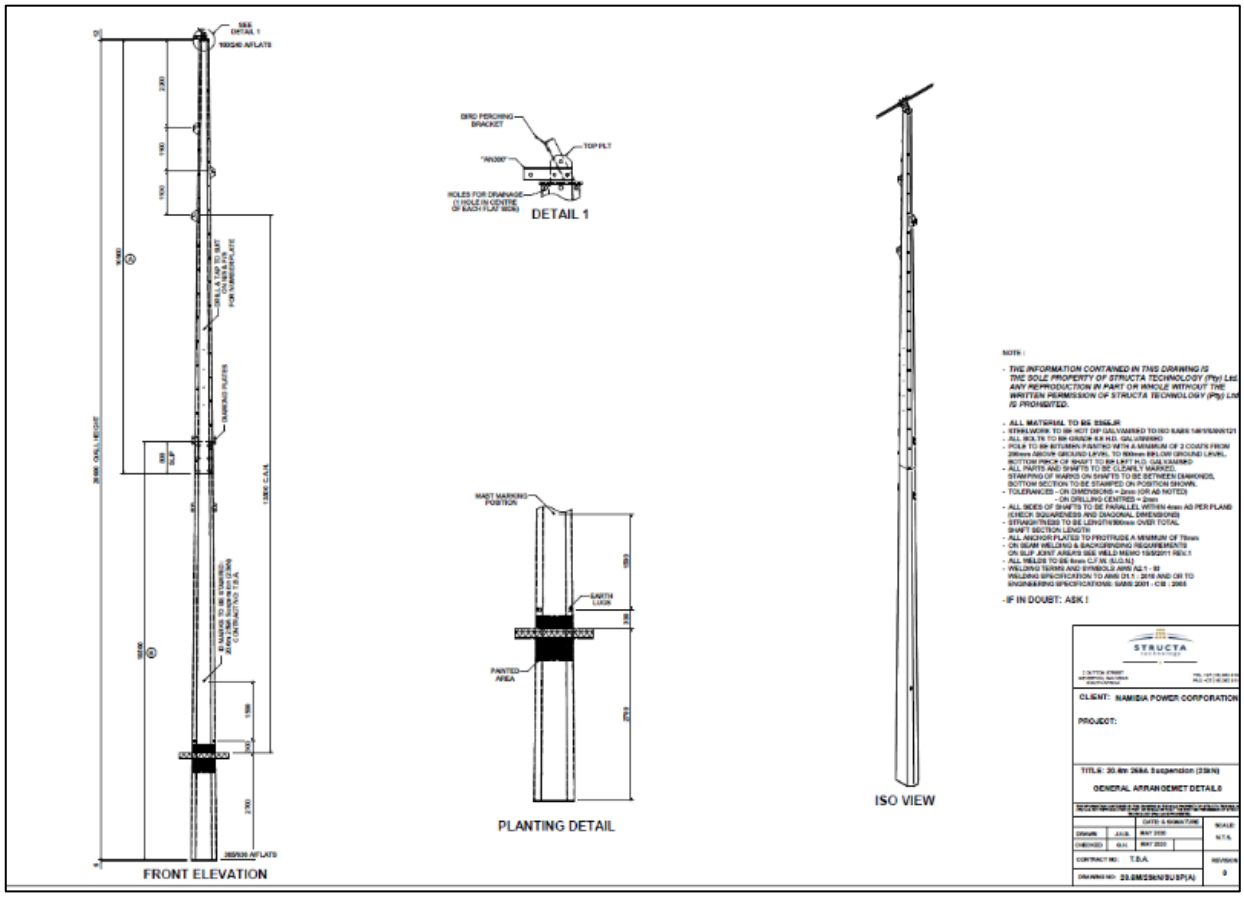


Figure 3. NamPower standard 66 kV steel monopole transmission line pole drawings that will be used on the line.

Figure 4. Examples of the proposed self-supporting steel monopole structure for the 66 kV power line, showing structure at a bend point, with stay wires (top left & right; photos F de Wet); and configuration of conductors with optical ground wire (OPGW) above, topped by steel perching device as a mitigation for electrocutions.

Figure 5. Examples of terminal H-pole structures used at the substation (top left & right); typical construction activities, illustrating the type of disturbance and habitat modification associated with this phase of the project (centre left & right, bottom; photos F de Wet).

Figure 6. Typical substation and metering structures for the power line (photos F de Wet).

2.3 Consideration of alternatives

Best practice environmental assessment methodology calls for consideration and assessment of alternatives to a proposed project. In a project such as this one, it is difficult to identify alternatives to satisfy the need of the proposed project. During the assessment, alternatives will consider optimisation and using eco-friendly solutions to reduce potential impacts.

Alternative power sources

Alternative power sources could include an onsite heavy fuel oil (HFO)/diesel baseload power station/generator. However, a connection to NamPower via an overhead power line will be more cost-effective and environmentally friendly. Renewable energy is also being considered and will be implemented to complement the NamPower grid connection during the operational phase of the mine.

The following alternatives are considered in the present study:

Routes

- Two alternative routes for the 66 kV overhead power line (see above; Figure 1). Option 1 shows the preferred route, which is about 20.3 km in length, whereas Option 2 shows the alternative route, about 24.6 km in length. The alternative power line route is thus approximately 4 km longer. Both options each have five bend points (areas of higher risk, with the added potential for collisions on stay wires). Alternative route (No. 2) would run in parallel, close to the existing 66 kV Omburu-Marble power line, for 3.5 km in the western part of the servitude.

Locality for the metering station

- An alternative location for the metering station, 113 m to the north-west of the preferred site for the metering station within the mining licence (ML) 238 (Figure 1). From an avifauna point of view, there is little difference in potential impacts for the two locations.

2.4 Existing power lines in the area

Existing transmission power lines in the area are shown in Figure 2 above. These include the following:

220 kV:

- Omaruru-New Khan1
- Omaruru-New Khan2

66 kV:

- Khan-Marble
- Marble-Navachab
- Marble-Karibib
- Omaruru-Marble

Numerous distribution lines (including from the Auld Casa Guesthouse to the Karibib Farmhouse).

In addition, a new 11 kV distribution line is being planned on the Osino Mine site (subject of a separate assessment).

The ongoing construction of power lines of varying heights and structures in the area is likely to have a cumulative impact in terms of avifauna, particularly where this infrastructure is concentrated around substations and supply points.

3 Legislation and international conservation agreements

The Avifauna Impact Assessment is conducted in accordance with, and ensuring compliance with, the following legal requirements, agreements, and best practice standards and guidelines (Table 1).

Table 1: Legislation, conservation agreements, best practice standards and guidelines for the avifauna impact assessment.

3.1 Namibian environmental legislation	
Namibian Constitution, 1990	Environmental conservation is entrenched in the Namibian Constitution (1990, Article 95, Promotion of the Welfare of the People), in terms of which the State shall actively promote and maintain the welfare of the people by adopting, *inter alia,* policies aimed at the following: (l) maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future … The above description would include the promotion of sustainable energy developments.
Namibian Environmental Management Act, 2007 (Act no. 7 of 2007)	The Environmental Impact Assessment (EIA) process in Namibia is governed and controlled by the Environmental Management Act (EMA), 2007 and the EIA Regulations 30 of 2012 (Anon. 2012), which are administered by the office of the Environmental Commissioner through the Department of Environment Affairs (DEA) of the Ministry of Environment, Forestry and Tourism (MEFT). The above Act requires the full consideration of biodiversity (including birds), habitat and landscape parameters, values and criteria as part of the environmental assessment processes. The present avifauna scoping and assessment study forms part of the above process. Under this legislation, activities that may not be undertaken without an Environmental Clearance Certificate (ECC) include energy generation, transmission and storage activities.
Namibian Nature Conservation Ordinance of 1975	The study area does not fall within an officially protected area proclaimed under the above Nature Conservation Ordinance of 1975. The nearest large officially protected area proclaimed under the Nature Conservation Ordinance of 1975 is the Namib-Naukluft Park, 110 km away, with the Dorob National Park to the west. The conservation of terrestrial birds in Namibia is governed by the Nature Conservation Ordinance of 1975. It is envisaged that the above Ordinance will eventually be replaced by the (draft) Parks and Wildlife Management Bill (2005). The list of Specially Protected Birds according to this Bill is based on the Namibian Red Data Book (Simmons *et al.* 2015), and the Namibian Red Data categories in the latter document are used in the present report, together with those of a recent update (Brown *et al.* 2017).

3.2 International conservation agreements	
Convention on Biological Diversity (CBD) Post-2020 Biodiversity Framework	Namibia is a signatory to the international Convention on Biological Diversity (CBD). The CBD is the overarching multilateral environmental agreement for biodiversity, with 196 Parties comprising nearly all the world's countries (Bennun *et al.* 2021). The CBD's post-2020 global biodiversity framework will build on the Strategic Plan for Biodiversity 2011–2020 and sets out an ambitious plan to implement broad-based action to bring about a transformation in society's relationship with biodiversity and to ensure that, by 2050, the shared vision of living in harmony with nature is fulfilled.
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	The Convention on the Conservation of Migratory Species of Wild Animals (CMS 2011) is an intergovernmental treaty with global remit (Bennun *et al.* 2021). A number of relevant agreements and memorandums under the CMS umbrella include the Agreement on the Conservation of African-Eurasian Migratory Birds (AEWA) and the Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU). Namibia is classed as a range state for AEWA but, although guided by its principles, is not yet a contracting party to this international agreement.
United Nations Sustainable Development Goals (SDGs)	Seventeen United Nations Sustainable Development Goals (SDGs) were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development, which set out a 15-year plan to achieve the Goals (Bennun *et al.* 2021). Namibia has been a member state of the United Nations since 1990. SDGs relevant to energy and biodiversity include: GOAL 7: Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy GOAL 13: Climate Action - Take urgent action to combat climate change and its impacts GOAL 15: Life on Land - Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss
United Nations Framework Convention on Climate Change (UNFCCC)	Since 1995, Namibia has been a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) as a Non-Annex I party (NAI). As party to the convention, Namibia is obliged to prepare and submit National Communications (NCs) and in addition Biennial Updated Reports (BURs) (http://www.met.gov.na/services/national-communications-and-biennial-update-reports/238/). The adoption of the Paris Climate Change Agreement (2015; under the above convention) has also brought home the need for low-carbon development based on environmentally-friendly technologies.
Important Bird and Biodiversity Areas (IBAs)	The BirdLife International Important Bird and Biodiversity Area (IBA) Programme aims to identify, monitor and protect a global network of IBAs for the conservation of the world's birds and other wildlife (Barnes 1998; Simmons *et al.* 1998b; Simmons *et al.* 2001; Kolberg 2015). These areas were initially known as Important Bird Areas. IBAs are thus sites of international significance for the conservation of birds at the Global, Regional (Continental) or Sub-regional (southern African) level,

	selected according to a set of four criteria based on globally threatened species, restricted-range species, biome-restricted species and congregations (Kolberg 2015). However, not all IBAs receive official protection. Namibia has 21 IBAs. The nearest IBAs to the study site is the Namib-Naukluft Park (see above).
3.3 Best practice standards and guidelines for birds and energy	
World Bank Environmental and Social Framework (World Bank 2016); International Finance Corporation Performance Standards on Environmental and Social Sustainability (IFC 2012)	The World Bank Environmental and Social Framework (ESF) sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards (ESS) that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity. The ESF includes the Environmental and Social Standards, which set out the requirements that apply to Borrowers. These include: *ESS1 Assessment and Management of Environmental and Social Risks and Impacts*: sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing (IPF), in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs). *ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources*: recognises that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development; it recognises the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support. The objectives include: • To protect and conserve biodiversity and habitats; • To apply the mitigation hierarchy and the precautionary approach in the design and implementation projects that could have an impact on biodiversity; and • To promote the sustainable management of living natural resources. The World Bank Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The World Bank Group Environmental, Health and Safety Guidelines are endorsed by the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (https://www.ifc.org; IFC 2012) and by the Equator Principles (July 2020), a global financial industry benchmark for determining, assessing and managing environmental and social risk in projects (www.equator-principles.com).
World Bank Environmental, Health, and Safety Guidelines for Electric Power Transmission and	The World Bank EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission (including environmental issues) between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

Distribution (World Bank 2007)	The above guidelines recommend prevention and control measures to minimise avian collisions and electrocutions, including: • Aligning transmission corridors to avoid Critical Habitats* (IFC 2012; World Bank 2016); • Considering the installation of underground transmission and distribution lines in sensitive areas (e.g. critical* natural habitats); • Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters; • Maintaining 1.5 m spacing between energised components and grounded hardware or, where spacing is not feasible, covering energised parts and hardware; and • Retrofitting existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated "V's"), changing the location of conductors, and / or using raptor hoods. *Critical Habitats: defined as areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes (IFC 2012, p37).
Best practice guide – Environmental Principles for Mining in Namibia (Environmental Compliance Consultancy 2019)	Phase 4: Mining and processing operations Case study by NamPower/Namibia Nature Foundation: Best practice for monitoring of powerlines and energy producing structures on mines (pp 22-25) The above case study aims at showcasing generic procedures and guidelines for the monitoring of electricity generation and supply structures and their interactions with wildlife in Namibia.

4 Terms of reference

4.1 Introduction

The aim of the avifauna study is to establish the extent to which the proposed project, namely the construction of a new 66 kV transmission power line, approximately 20-24 km long, will impact on avifauna in the area, especially threatened, endemic or other biologically significant (priority) species. It will identify potential impacts of the development and recommend mitigation measures and a monitoring programme in order to minimise any negative impacts. Additional, cumulative impacts will also be considered.

4.2 Desk-top assessment

The baseline/scoping study will take the form of a desk-top assessment of the bird habitats and their likely avifauna and their sensitivity in terms of the proposed development. This will be supplemented by a site visit to the area, including to representative sections of the servitude of the new power line. Two proposed alternative routes will be considered and assessed. If possible, representative sections of existing power lines in the area will be checked for any signs of avifauna incidents.

The best available data sources (both published and unpublished literature, including existing pre-feasibility studies for the project and other EIA studies) will be used to establish the baseline conditions, also making use of local knowledge (e.g. bird atlas data, local bird clubs/amateur ornithologists/guides who are familiar with the study area), if available. Gaps in baseline data will be identified if applicable, and an indication of the confidence levels will be provided.

The study site will be characterised in terms of:

- the avifauna habitats present, and their sensitivities
- an inclusive list of bird species likely to occur there
- sensitivities of the bird species and the identification of priority species, based on criteria such as conservation (Red Data) status, endemism, residency/seasonality/movements, recorded breeding, abundance etc.
- known and potential sensitivities of the bird species to identified impacts (see below)
- any obvious, highly sensitive, "no-go" areas or aspects to be avoided by the development from the outset.

4.3 Site visit

A two-day site visit will be conducted to supplement the desk-top assessment. The aims of the site visit will be to:

- define the study area
- characterise the study site (as above)
- provide an initial estimation of likely impacts of the proposed power line
- determine whether or not any further level of baseline data collection is necessary, and detail the nature and scale of such work.

4.4 Impact assessment

The study will determine the impact on the avifauna and its habitats of the various changes that may be caused by the construction, operation and decommissioning of power supply structures, on the ecosystems in question including, but not limited to:

- Human disturbance of birds (resulting in avoidance/displacement)
- Direct and indirect modification/loss/destruction of bird habitat (resulting in avoidance/displacement)
- Bird collisions with power line infrastructure
- Electrocution of birds on power line structures
- Attraction of birds to novel (artificial) habitats and resources

The impacts will be assessed according to standard procedures, as provided by the client.

Possible cumulative impacts associated with existing power line infrastructure in the area will be investigated (including monitoring results to date), as well as any other related activities currently taking place in the environment.

Information gaps will be identified, and an indication of confidence in the prediction will be provided.

4.5 Recommendations

Recommendations will be provided for the mitigation of impacts on avifauna and its habitats, together with a monitoring plan, for inclusion in the Environmental Management Plan (EMP).

5 Approach and methodology

5.1 General approach

Avifaunal input to the EIA was requested in the form of a baseline/scoping and impact assessment study to provide an understanding of the potential risks to birds with the proposed development and to serve as a basis for the recommendations of mitigation for such risks and the monitoring programme for the Environmental Management Plan (EMP).

The study includes a baseline scoping of the project area some 12 km north-east of Karibib, in Central Namibia (Figure 1 and 2). A desk-top study was supported by two field visits, on 12-13 April 2023 and 9 May 2023.

Two sources of bird distribution data were used (Brooks *et al.* 2022). The primary data, for the first Southern African Bird Atlas Project (SABAP1; Harrison *et al.* 1997), were gathered during 1987-1992. This information is available on the Environmental Information Service (EIS; www.the-eis.com; EIS 2023). SABAP1 data are recorded on a quarter degree square (QDS) basis and are extremely comprehensive, although the information dates back to 1992.

A follow-up Southern African Bird Atlas Project (SABAP2) was initiated in South Africa in 2007 and in Namibia in 2012 (http://sabap2.adu.org.za). This information comprises more recent distribution data on a finer scale (in units termed pentads, or 5-minute x 5-minute coordinates; nine pentads make up one quarter degree square [QDS]). Although the distribution data are at a finer scale, the data collected to date for Namibia are still patchy and not yet as extensive as those for SABAP1; in particular, the study area is poorly atlased in parts, and the results should be interpreted with caution. It is therefore advisable to use a combination of SABAP1 and SABAP2 data.

The bird checklist for the present study (Appendix 1) is based on both SABAP1 data for QDS 2115DD (Figure 7), and available SABAP2 data for pentads 2155_1550 and 2150_1555 (Figure 7) which fall within the above QDS. For the above SABAP1 and SABAP2 sources, as well as for observations made in the field (April-May 2023), presence/absence of species is indicated (Appendix 1).

Other sources of information include the Environmental Information Service (see above), and the Atlas of Namibia (Mendelsohn *et al.* 2002; Atlas of Namibia Team 2022; https://atlasofnamibia.online); the Red Data Book for Birds in Namibia (Simmons *et al.* 2015), other published sources (e.g. Hockey *et al.* 2005), the global International Union for the Conservation of Nature (IUCN) Red Data list for birds (www.iucnredlist.org; IUCN 2023); discussions with Osino Gold Mine staff, farmers and other local birders; and both the authors' 35+ years of experience of working together on and observing birds in southern Africa, including in Namibia. The above sources were used to compile one combined checklist for the study area.

Potential sensitivities of the avifaunal environment were assessed according to standard criteria, i.e. in the context of protected area status; major topographical features and vegetation habitats; and wetland habitats including ephemeral rivers and associated wetlands (EIS 2023). Avifaunal habitats that are limited in the present context were identified, in particular aquatic habitats.

Potential sensitivities of the bird species were assessed in terms of criteria identified for "priority species" that include bird species diversity (according to recorded distribution data, see above); the most recent Red Data status, both on a national scale (Simmons *et al.* 2015; and an update by Brown *et al.* 2017) and global scale (IUCN 2023; see above); uniqueness or endemism/near-endemism to Namibia (i.e. having ≥90% of their global population in this country; Simmons *et al.* 2015; Brown *et al.* 2017); residency/migrant status (especially for Red Data species); an indication of abundance, based on presence/absence for the above sources; any recorded breeding in the area (focusing on Red Data and endemic species); known sensitivity to collisions with overhead structures; and other

ecological aspects. The NamPower/Namibia Nature Foundation (NNF) Strategic Partnership database (EIS 2023) was also consulted for relevant power line incidents on record in the greater study area.

During the field trips for the present study, the two proposed alternative servitudes for the new 66 kV power line were investigated, and the alternative sites for the substation and metering station.

The results of surveys of sections of other existing 66 kV power lines in the area were also incorporated, to check for signs of recent bird interactions.

The criteria for the assessment of impacts are outlined below.

Gaps in baseline data were identified where applicable, and an indication of the confidence levels is provided. Recommendations were made for future work in terms of the EIA process.

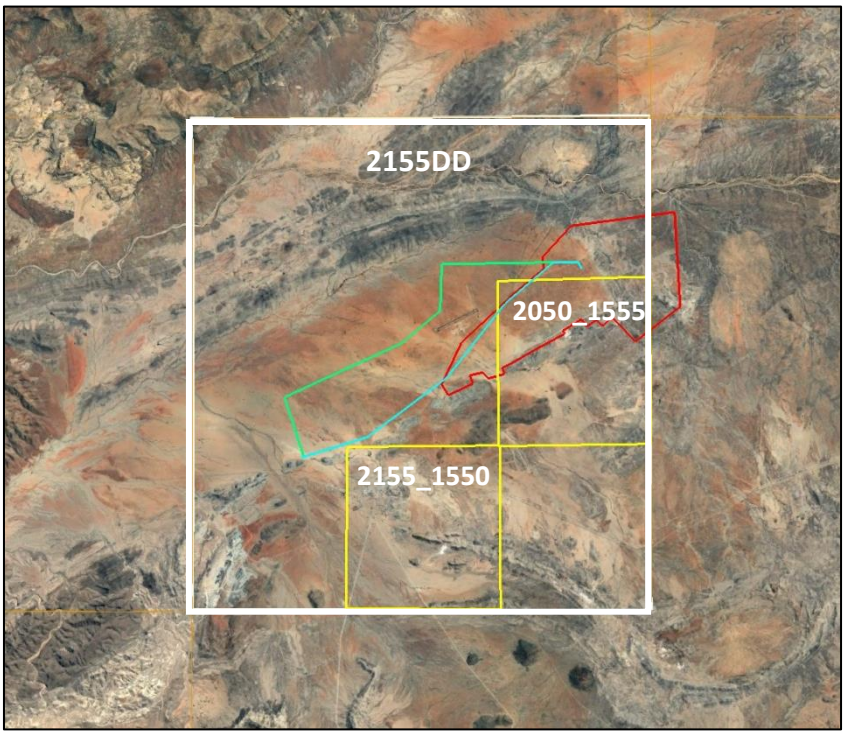


Figure 7. One quarter degree squares (QDS; 2155DD; SABAP1 data; white block) and two pentads (SABAP2 data; yellow blocks) on which available bird atlas data for the checklist for the study area is based.

5.2 Impact assessment methodology

The impact assessment was done according to the methodology of Environmental Compliance Consultancy (ECC).

The detailed methods for the assessment are included in Section 7.1 below.

5.3 Limitations and assumptions

Limitations

- The present investigation was limited to some extent by the absence of a survey during the rainy season, although the site visits in April-May covered the latter end of this period, when grass was still present. The avifaunal diversity in general is likely to increase under wetter conditions. These limitations were addressed, in part, by incorporating long term bird atlas data in the assessment; however, further investigations of this aspect would be useful.
- A major limitation to the assessment and mitigation of potential impacts from power line structures is the difficulty in obtaining confirmed records of bird flight paths. To assist with this gap, the flight paths of Lappet-faced Vultures tracked by satellite tagging were incorporated. No similar data exist for either Ludwig's Bustard or Kori Bustard, however, whose local distribution and flight paths are difficult to predict; it is therefore difficult to propose specific sections of power line for the fitting of mitigation devices.
- A further limitation is the lack of representative long-term data on power line incidents in Namibia. Available data from the NamPower/NNF Strategic Partnership (EIS 2023) were consulted in this respect; however, dedicated surveys on power lines in the central parts of the country are limited, due to the difficulty of access on bush-encroached servitudes.

Assumptions

- Combined SABAP1 and SABAP2 and other data used in this report provide a representative indication of the bird species likely to occur in the study area throughout the seasonal and inter-annual cycles.

In all the above respects, the precautionary principle should therefore apply.

6 Potential sensitivities

6.1 Avifaunal environment

The study area lies ~12 km north-east of the town of Karibib, in Central Namibia (Figure 1 & 2). The study area is defined as the Osino Mining Licence (ML) area, and the area covered by the two alternative power line routes.

6.1.1 Protected area status

The area lies some 110 km from the nearest (large) formally protected area, the Namib-Naukluft Park, with the Dorob National Park to the west (Figure 8). The greater area includes many freehold/ commercial conservancies, with communal conservancies to the west, and the conservation status is regarded as relatively high.

Both the above parks have a high bird species richness. The Namib-Naukluft Park is also classed as an Important Bird and Biodiversity Area (IBAs; N011) (Figure 8). With its variety of habitats, this IBA is characterised by high bird species richness, including raptor species and Namibian near-endemics (Simmons *et al.* 1998). The Important Bird and Biodiversity Area (IBA; initially known as Important Bird Area) Programme has been established by BirdLife International, through which it aims to identify, monitor and protect a global network of IBAs for the conservation of the world's birds and other wildlife (Barnes 1998; Simmons *et al.* 1998; Simmons *et al.* 2001; Kolberg 2015; www.birdlife.org.za/conservation/ important-bird-areas). IBAs are thus sites of international significance for the conservation of birds at the Global, Regional (Continental) or Sub-regional (southern African) level, selected according to a set of four criteria based on globally threatened species, restricted-range species, biome-restricted species and congregations (Kolberg 2015); however, not all IBAs receive official protection. IBAs are home to a large number of bird species and individuals, with regular movements among such habitats.

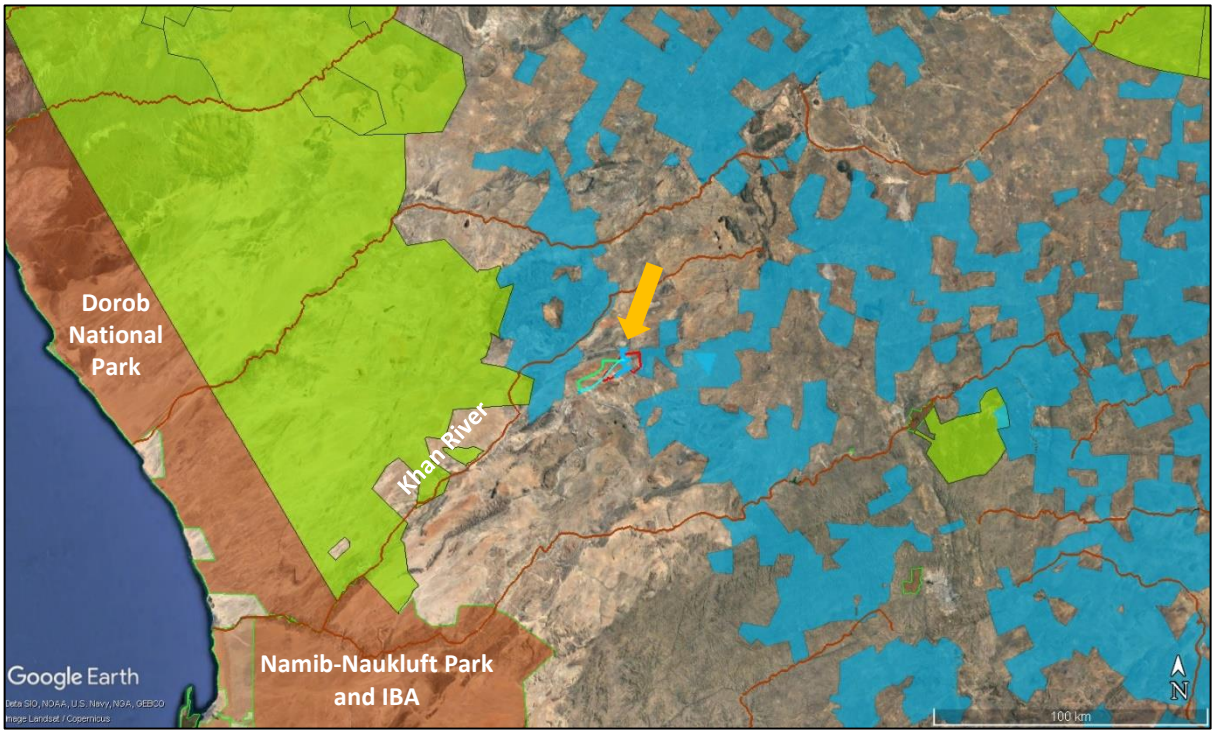


Figure 8. Conservation areas and Important Bird Areas (IBAs) in relation to the study area, also showing ephemeral rivers in the greater area (brown = formally protected areas; green = communal conservancies; blue = freehold/commercial conservancies; based on a Google Earth map, EIS 2023).

6.1.2 Climate

The average annual rainfall for the greater study area is relatively moderate, namely 200-300 mm, falling mainly during January-March (Mendelsohn *et al.* 2002; Atlas of Namibia Team 2022).

Average annual temperatures are 20-22°C. The dominant wind direction is from the east, with average wind speeds of around 15 km per hour.

6.1.3 Major topographical features and vegetation habitats

The study area lies within the Central-western Plains Landscape (Atlas of Namibia Team 2022) and is generally flat. The Erongo Mountains are a prominent inselberg to the north-west, rising to 2,300 m in height (Figure 8). The large Khan River catchment runs from the north-east to the south-west in the larger area.

The study area falls within the Tree-and-shrub Savanna biome (Atlas of Namibia Team 2022). The vegetation type is classed as Western Highlands, dominated by *Acacia reficiens, Commifora spp., Euphorbia guerichiana, Maerua schinzii* and *Adenolobus garipensis.* Tree cover is 2-10% (2-5 m high); shrub cover is 11-25% (0.5-2 m high); dwarf shrub cover is 2-10 m (<0.5 m high); and grass cover is 2-2-10% (<0.5 m high). The habitat is lightly bush-encroached, but only in parts.

6.1.4 Habitats in the study area and surrounds, in relation to birds

The predominant land uses in the greater study area are agriculture, conservation and nature-based tourism, and mining.

Avifauna habitats in the general area comprise:

- Grassy plains with scattered bush and trees: the dominant landscape.
- Aquatic habitats: mainly ephemeral river catchments, including the large Khan River catchment to the north and north-west, and its tributaries.
- Low, rocky hills in the south-eastern parts of the study area.
- Artificial habitats, namely existing power lines, used as perches and nesting sites by birds.

The above habitats are described in more detail below (also see Figure 9-13).

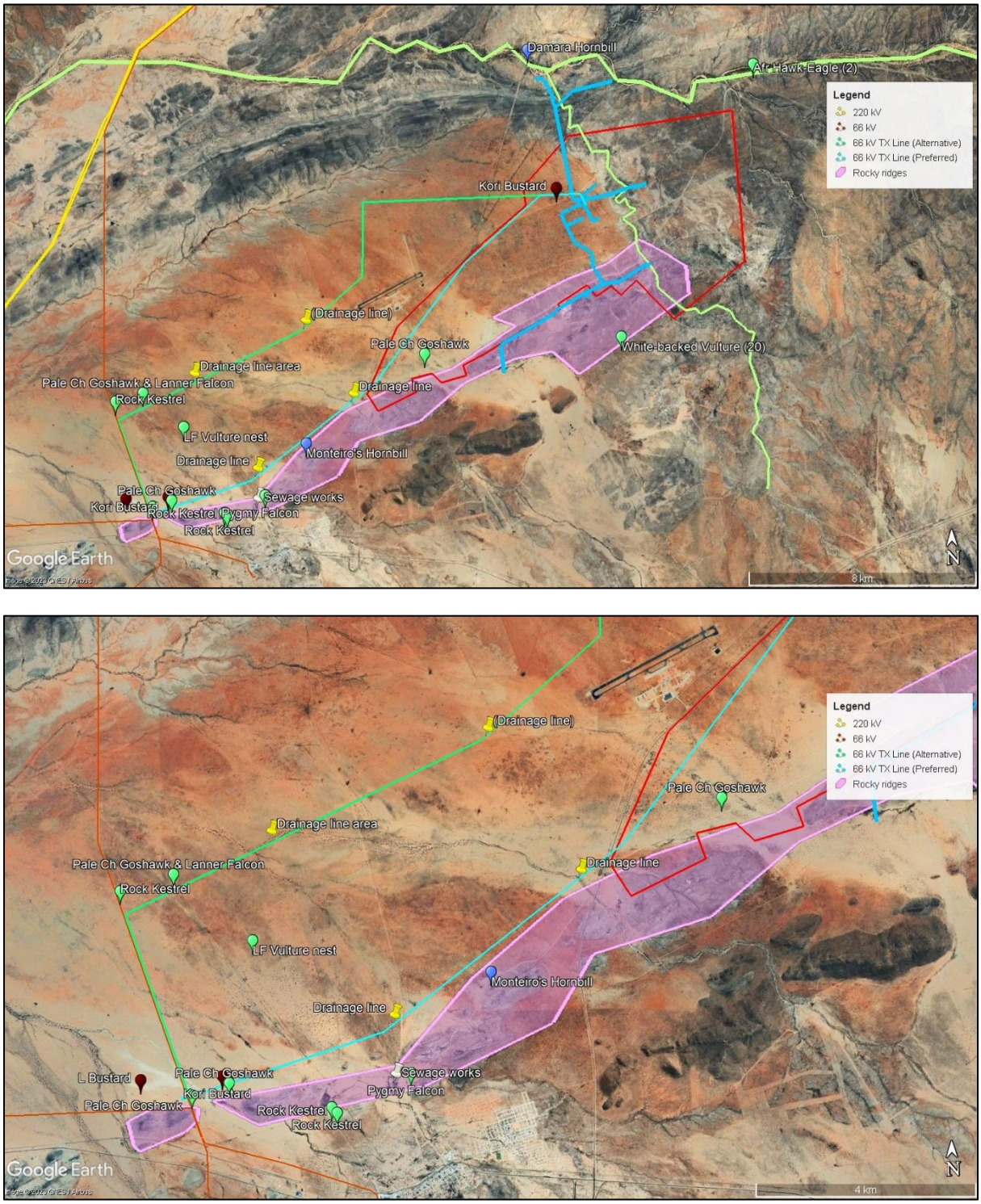


Figure 9 (above & below). Habitats that are potentially sensitive in terms of avifauna in the greater study area, including (major) ephemeral water courses/drainage lines (pale green), low, rocky hills (pink), and grassy plains (remainder; based on a Google Earth map, EIS 2023).

Grassy plains with scattered bush and trees: the dominant landscape

The dominant landscape for the study area is open plains – that were grassy in April and May 2023 – with scattered bush and trees. The bush cover is denser in places, with taller trees.

A few shallow drainage lines intersect the above habitats, with more dense vegetation and taller trees (see below).

Farm fences are a feature of these areas.

Bird species observed in these habitats during the site visits include:

Kori Bustard (2 localities), Ludwig's Bustard (1 locality), a report of an active Lappet-faced Vulture nest on Farm Karibib (J Uys pers. comm. 2023), Pale Chanting Goshawk, Lanner Falcon, Rock Kestrel, Northern Black Korhaan (numerous), Namaqua Sandgrouse, active Sociable Weaver nests.

Figure 10. Typical open plains habitats are dominant in the study area (top left), including on the servitudes of both the preferred (top right, bottom left) and the alternative power line routes (bottom right); used by species such as bustards, korhaans and raptors.

Aquatic habitats: mainly ephemeral river catchments, including the large Khan River catchment to the north and north-west, and its tributaries

The large ephemeral Khan River catchment runs to the north and northwest of the study area, joining the Swakop River before reaching the Atlantic Ocean in the west. The river is meandering, and thickly vegetated with taller trees, which provide shade and shelter.

A large tributary runs to the south, through the eastern part of the study area.

Ephemeral drainage lines are often associated with the movements of birds, including bustards.

Bird species observed in the above habitats during the site visits included the near-endemic Damara Hornbill; African Hawk-Eagle (a pair displaying); Red-crested Korhaan, Yellow-billed Hornbill.

Other aquatic habitats are limited in the area. However, a sewage treatment plant is situated to the north of Karibib. Bird species seen in this habitat include Three-banded Plover, Blacksmith Lapwing. Great White Pelican was recorded in the quarter degree square for the study area (SABAP1 data); as open aquatic habitats are limited in the area, it is speculated that it is possible that the species was recorded at this site.

Figure 11. Typical ephemeral aquatic habitats in the study area include the large Khan River catchment (top left); smaller, dry watercourses (top right); and a more deeply incised watercourse in the eastern part of the study area (bottom left and right); bird species observed in these habitats include the near-endemic Damara Hornbill; African Hawk-Eagle (pair displaying); Red-crested Korhaan, Yellow-billed Hornbill.

Low, rocky hills in the south-eastern parts of the study area.

A chain of low, rocky ridges runs along the southern borders of the study area. Some of these rocky habitats are being mined.

Bird species observed in these habitats during the site visits include the Namibian near-endemic Monteiro's Hornbill. Such restricted species have specific habitat requirements, and others could also occur (see Section 4.2.3 below).

Other species observed included a group of ~20 White-backed Vultures, circling over the hills; Pale Chanting Goshawk; Rock Kestrel; Pygmy Falcon; Rock Kestrel; Yellow-billed Hornbill.

Figure 12. Low, rocky hills in the south-eastern parts of the study area; these habitats are favoured by raptors, and Namibian near-endemic species.

Artificial habitats, namely existing power lines, used as perches and nesting sites.

Power line poles provide attractive perching sites for birds in open areas, where trees are not always plentiful. The attraction to these artificial perching sites is compounded by the presence of newly cleared servitudes beneath the power lines, which facilitate the movements of prey.

Bird species observed in these habitats during the site visits included Rock Kestrel (including a juvenile); Pale Chanting Goshawk; Lanner Falcon.

Also see breeding birds (including observed nesting on power lines; Section 6.2.5 below).

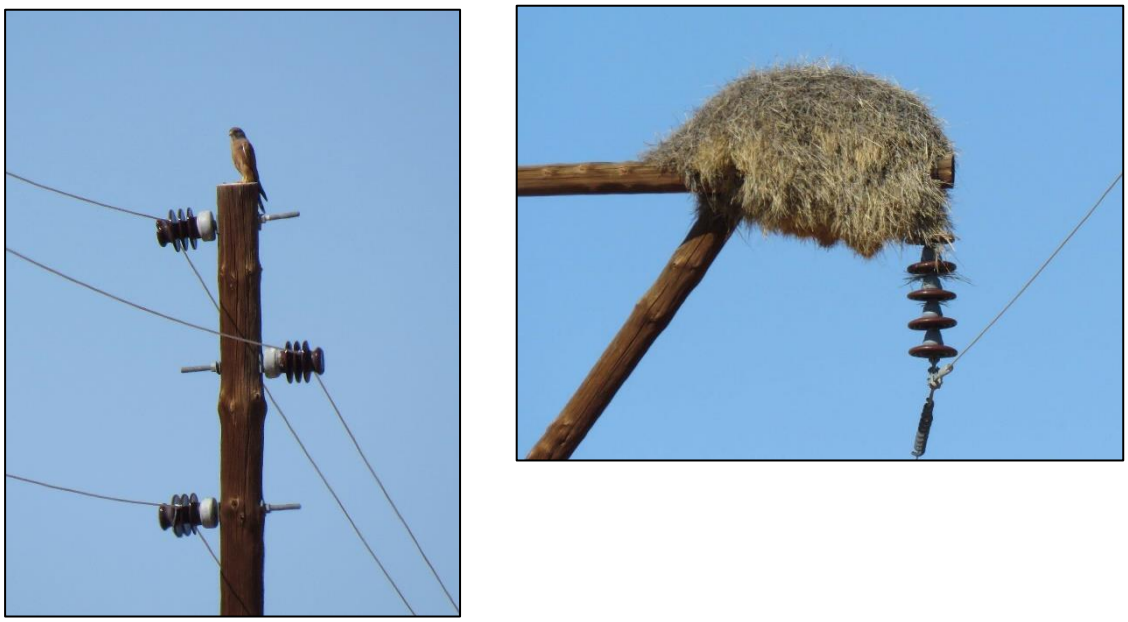


Figure 13. Rock Kestrel making use of a perch on a low voltage distribution line in the study area (left); nest of a Sociable Weaver on a wooden 66 kV power line pole (right).

6.2 Sensitivities in terms of bird species

Sensitivities of the bird species in the area are discussed below, according to relevant criteria.

Note that risk assessment and mitigation efforts are directed towards priority species, namely those species that have a high biological significance, i.e. primarily Red Data species (including those with migrant status) and/or endemic or near-endemic species.

6.2.1 Bird species richness

A total of 180 bird species has been recorded for the study area (SABAP1 and SABAP2 data for QDS 2115DD and pentads 2155_1550, 2150_1555, and other sources: see above; Appendix 1). However, the area is under-atlased (i.e. not well documented) in parts, and the results should be interpreted accordingly, taking all the above data sets into account.

The above total represents 27% of the 676 species currently recorded in Namibia (Brown *et al.* 2017), a richness that is classed as relatively moderate-high (6 on a scale of 8: Figure 14; Atlas of Namibia Team 2022; EIS 2023).

The site visits for the present study took place at the end of the rainy season (April-May 2023), and the bird species richness then observed was good. The combined data in Appendix 1 are, however, considered the best reflection of bird species richness over the longer term.

Typical species observed during the site visits are shown in Figure 15 below.

Figure 14. Bird species richness in the study area is regarded as relatively moderate-high (6 on a scale of 8) (Atlas of Namibia Team 2022; based on a Google Earth map, EIS 2023).

Figure 15. Some of the typical bird species observed in the study area in April-May 2023: Kori Bustard (top left); Ludwig's Bustard (top right); African Hawk-eagle (2nd row left); Rock Kestrel juvenile (2nd row right); Pale Chanting Goshawk (3rd row left); Monteiro's Hornbill (3rd row right); Fork-tailed Drongo [left] and Damara Red-billed Hornbill (4th row left); Namaqua Sandgrouse (4th row right).

6.2.2 Red Data status

The overall checklist for the study area (Appendix 1) includes 11 species (6%) that are threatened in Namibia (Brown *et al.* 2017). This represents 16% of the 71 species that are on the Namibian Red Data List. Seven of these species are also Globally Threatened (IUCN 2023).

For the study area, these 11 Red-listed species include one that is Critically Endangered, five that are Endangered, two that are Vulnerable and three that are Near Threatened; and comprise seven raptors, three other terrestrial species and one wetland-associated species.

The 11 Red-listed species are as follows:

- White-backed Vulture (Critically Endangered, also Globally Critically Endangered)

- Ludwig's Bustard (Endangered, also Globally Endangered)
- Lappet-faced Vulture (Endangered, also Globally Endangered)
- Martial Eagle (Endangered, also Globally Endangered)
- Steppe Eagle (Endangered, also Globally Endangered)
- Tawny Eagle (Endangered, also Globally Vulnerable)

- Secretarybird (Vulnerable, also Globally Endangered)
- Great White Pelican (Vulnerable)

- Kori Bustard (Near Threatened, also Globally Near Threatened)
- Verreauxs' Eagle (Near Threatened)
- Rüppell's Parrot (Near Threatened)

Six of the above species are raptors. It should be noted that large birds that collide with power lines, such as vultures and other raptors, bustards and flamingos, have been identified as one of four major groups of birds classed as threatened in Namibia (Simmons *et al.* 2015).

6.2.3 Endemism

The checklist for the study area includes at least nine species that are near-endemic to Namibia (Appendix 1), with at least 90% of the populations occurring within the country. The above checklist also includes a number of species that are endemic or near-endemic to southern Africa; however, the focus in this study is on those species that are near-endemic to Namibia, which the country has a special responsibility to conserve.

Endemism or having a limited distribution renders populations more vulnerable to threats. The recorded level of endemism in the study area is considered relatively high (5 on a scale of 5; Figure 16).

The nine recorded Namibian near-endemic species are as follows:

- Carp's Tit
- Damara (Red-billed) Hornbill
- Hartlaub's Spurfowl
- Herero Chat
- Monteiro's Hornbill
- Rockrunner
- Rüppell's Korhaan
- Rüppell's Parrot
- White-tailed Shrike

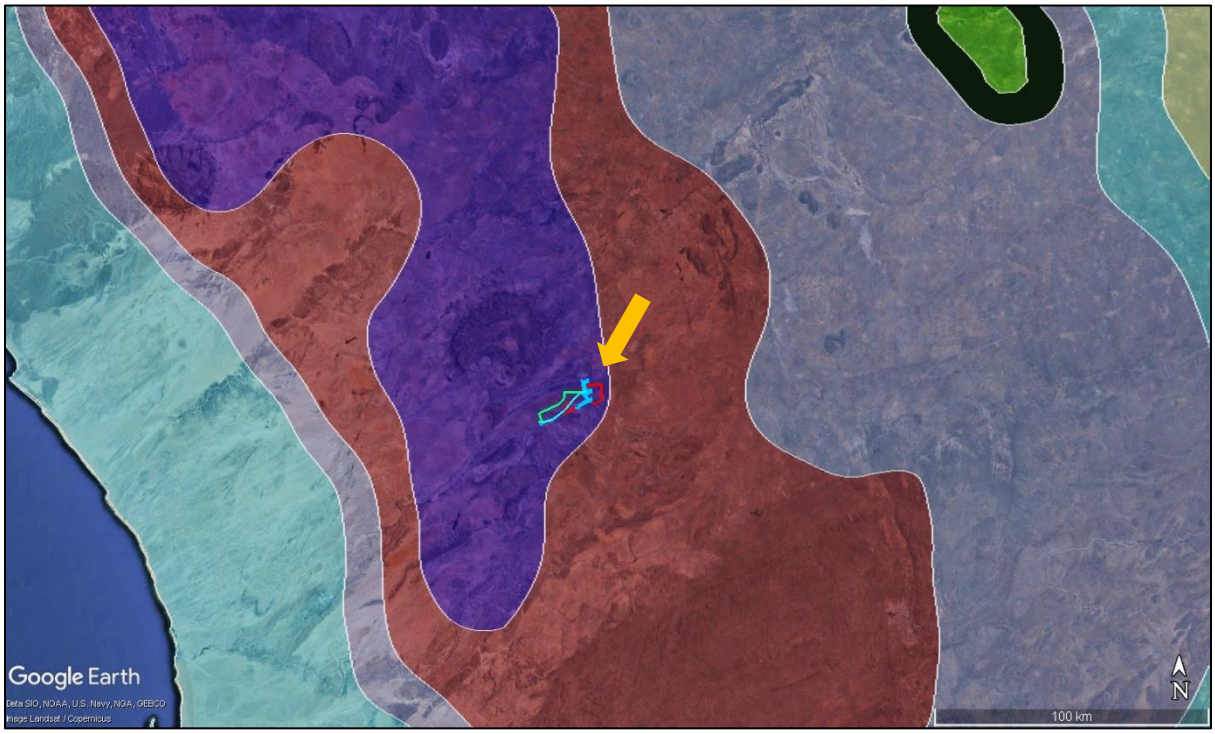


Figure 16. Bird endemism in the study area is regarded as relatively high (rated 5 on a scale of 5) (Atlas of Namibia Team 2022; based on a Google Earth map, EIS 2023).

6.2.4 Migrant status (Red Data species) and nomadism

The checklist includes one Red-listed species with migrant status (Appendix 1), namely:

- Ludwig's Bustard (partial migrant)

Other migrant species include:

- Booted Eagle (Palearctic migrant)
- Common (Steppe) Buzzard (Palearctic migrant)
- Abdim's Stork (intra-African migrant)
- Woolly-necked Stork (migrant)
- White Stork (Palearctic migrant)

Several other (Red Data) species are nomadic or make extensive movements, including the vulture species and pelicans. Other (non-Red data) migrant species also occur.

Nomadic/migrant habits result in high mobility and consequently increase the risk of impacts such as collisions on overhead structures. It should be emphasised that both short-distance and longer bird movements are possible. This is particularly true under the changing conditions associated with ephemeral wetland habitats, which are prevalent in Namibia. The largest numbers of birds are potentially found in the area between October and April, when summer migrant species may be present, and especially after good rains.

For much of the time, and even for years on end, there are very few birds in ephemeral river systems and associated pans, and their importance as a bird habitat could then easily be under-estimated. During and after times of good rains and occasional flooding, the habitats are transformed. Extensive nomadic movements take place and birdlife increases accordingly, and this is reflected in the SABAP data over the longer term.

6.2.5 Breeding birds

Breeding activity was observed in the following species during the site visits, all on Karibib Farm:

- Active nest of Lappet-faced Vulture (reported by farm manager J Uys, 2023; 21.899087S 15.822490E)
- Several active Sociable Weaver nests
- (Inactive) nests of White-browed Sparrow-weaver
- Juvenile Rock Kestrel

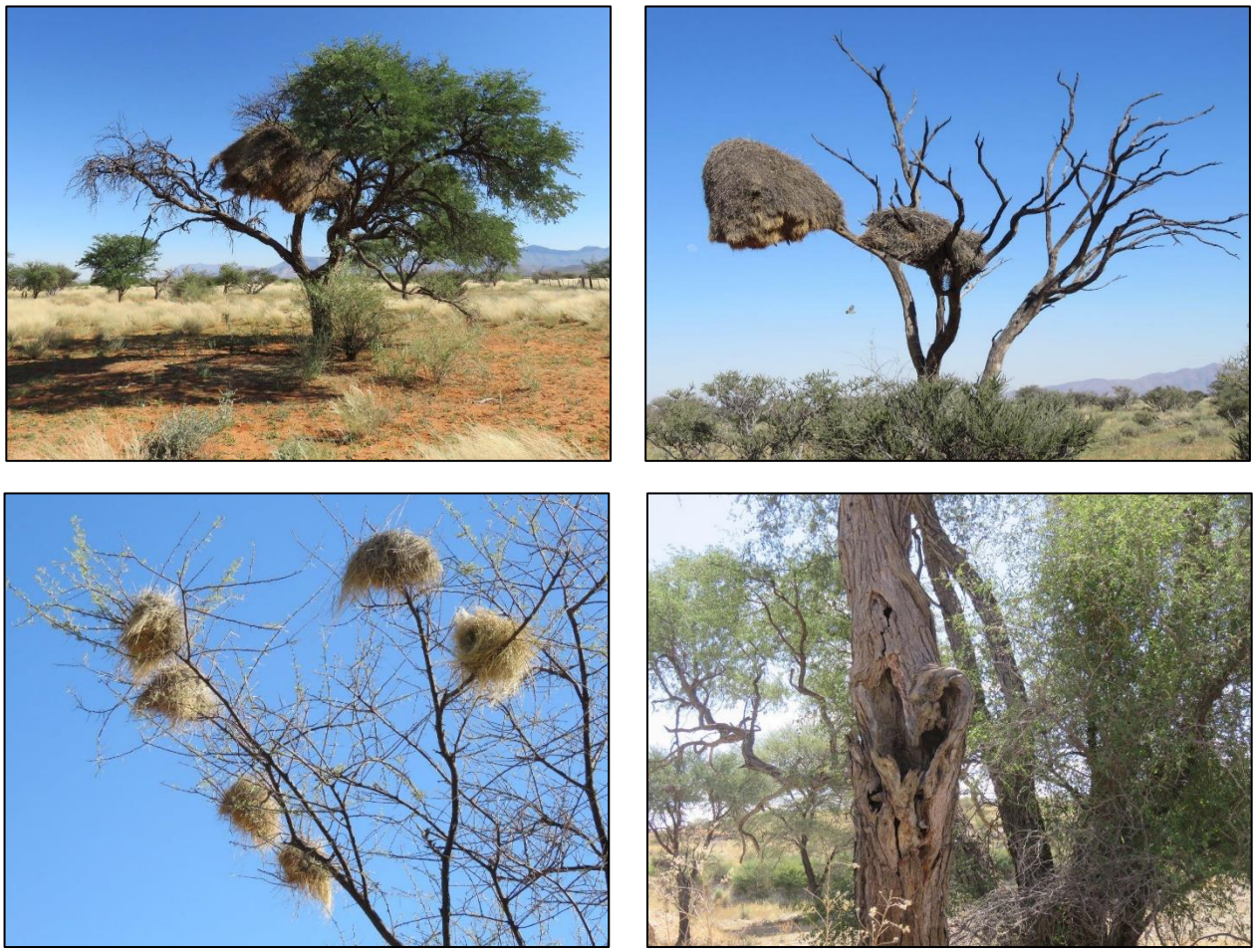


Figure 17. Examples of active Sociable Weaver nests (top left and right); nests of White-browed Sparrow-weaver (bottom left) and typical tree hollow that could be used by cavity-breeders such as hornbills (bottom right).

6.2.6 Sensitivity to power line interactions

Bird species may be sensitive, in varying degrees, to power line impacts such as collision, electrocution and/or disturbance and habitat destruction. The incidence of Red Data power line-sensitive bird species per QDS (based on SABAP1 data) in the greater study area is shown in Figure 18. The sensitivity in the western part of the study area is relatively higher (at least 10 species) in relation to surrounding QDSs (4-7 species).

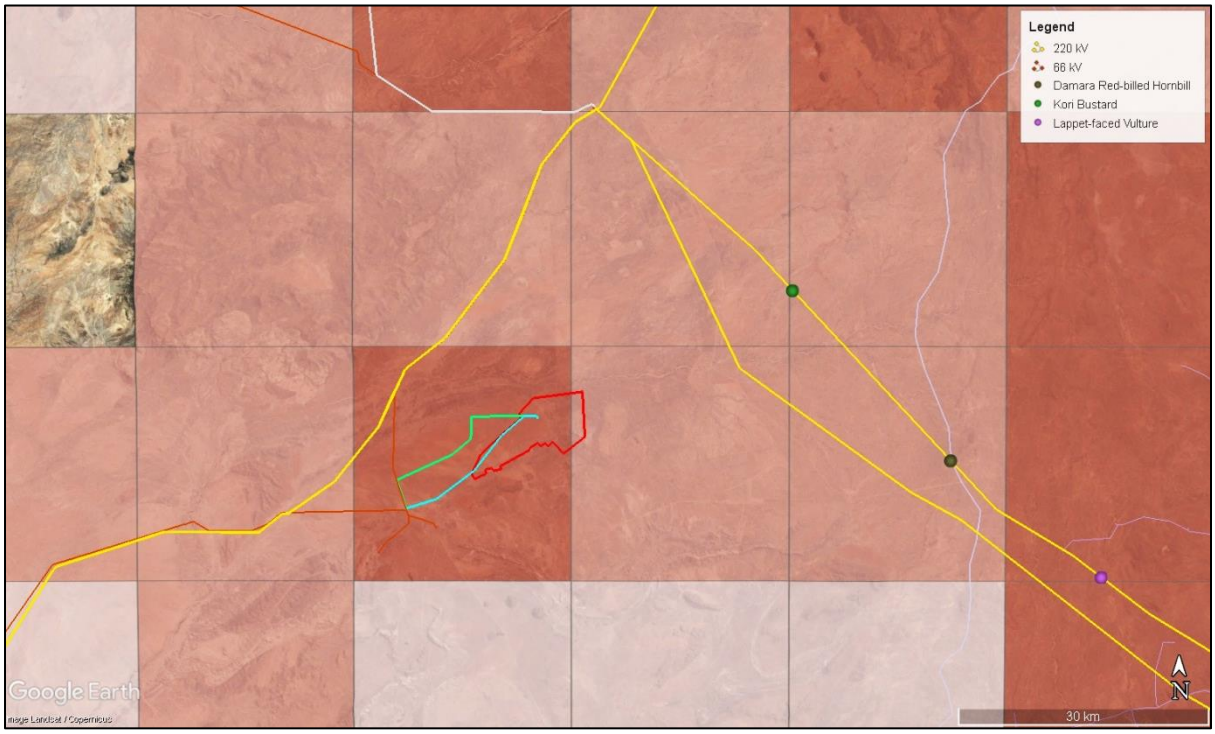


Figure 18. Relative occurrence of power line-sensitive Red Data species in the greater study area 10 spp; based on SABAP1 data; range of sensitivity from low [light] to high [dark]; localities for collision incidents for Damara Red-billed Hornbill, Kori Bustard and Lappet-faced Vulture on an existing 220 kV power line in the greater area are indicated (see legend; EIS 2023).

Examples of power line-sensitive species in the study area

Examples of the distribution of some power line-sensitive species in the greater study area are shown below, namely for Kori Bustard and Ludwig's Bustard (top); and for Lappet-faced Vulture and Martial Eagle (bottom; Figure 19).

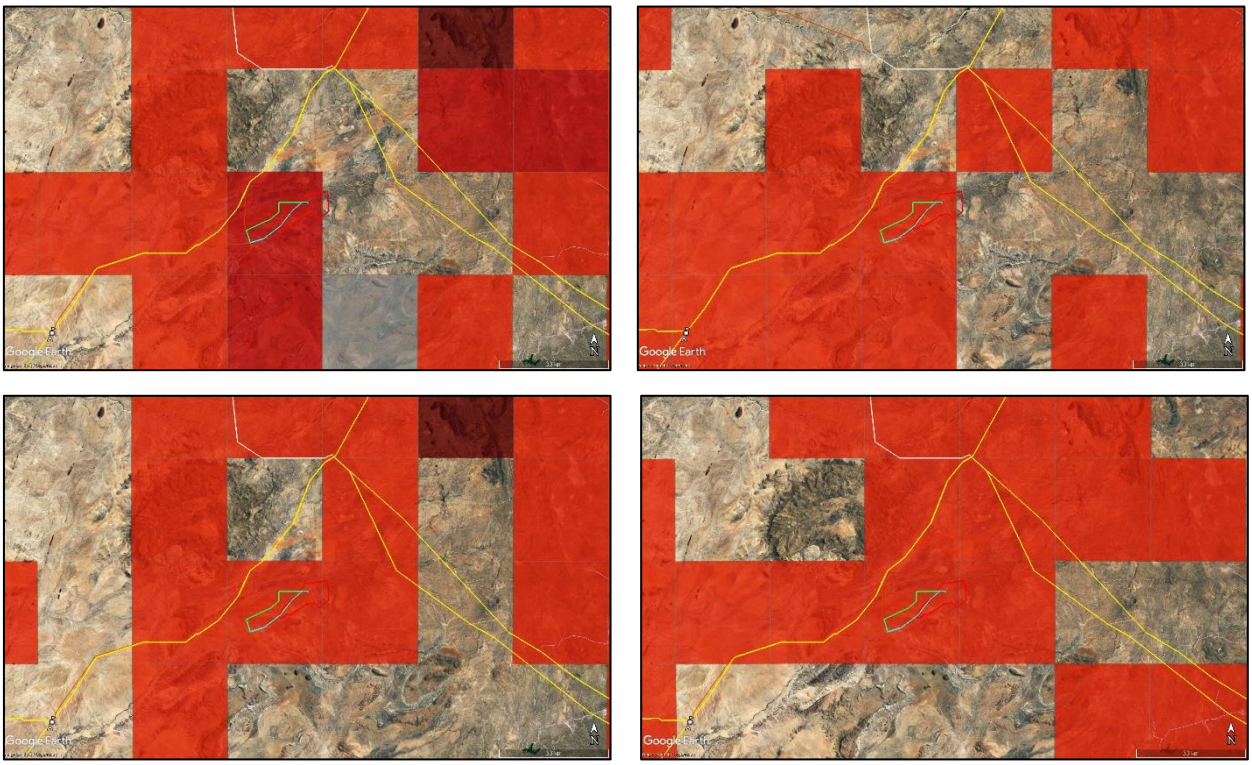


Figure 19. Examples of the distribution of some power line-sensitive species in the greater study area, namely Kori Bustard (top left) and Ludwig's Bustard (top right); and for Lappet-faced Vulture (bottom left) and Martial Eagle (bottom right; (SABAP1 data: EIS 2023).

Power line incidents on record for Namibia

The NamPower/Namibia Nature Foundation Strategic Partnership (http://www.nnf.org.na/project/nampowernnf-partnership/13/5/5.html) has documented wildlife and power line incidents from 2009 to the end of 2020, involving some 847 animals, mostly birds and mostly collisions, but also electrocutions (EIS 2023). Due to the difficulty of obtaining records in bush-encroached areas (especially in the northern and north-eastern parts of the country, including Central Namibia), low reporting rates and the high scavenging rates in general, it is likely that the incidents observed are an under-estimate.

Most of the incidents throughout the country have involved flamingos (39%) and bustards/korhaans (27%; Figure 20). A further 11% have involved raptors, mainly vultures as well as eagles, snake-eagles and owls; and 11% have involved other waterbirds. There are 11 Great White Pelican collisions on record for the country as a whole. Most of the incidents involving White-backed Vulture and Lappet-faced Vulture (33 individuals) have comprised electrocution on low-voltage distribution structures; however, collisions are an ongoing concern.

High mobility of bird species, e.g. among ephemeral resources, may render them prone to power line interactions. Bustards are susceptible to collisions due to their nomadic habits, a large body size

with low manoeuvrability, and a visual "blind spot" when flying forwards (Martin & Shaw 2010). This proneness to collision has also been demonstrated in vultures, storks, snake-eagles and other groups.

Examples of power line incidents recorded in the vicinity of the study area to date are shown in Figure 21 (NamPower/NNF Strategic Partnership database, EIS 2023).

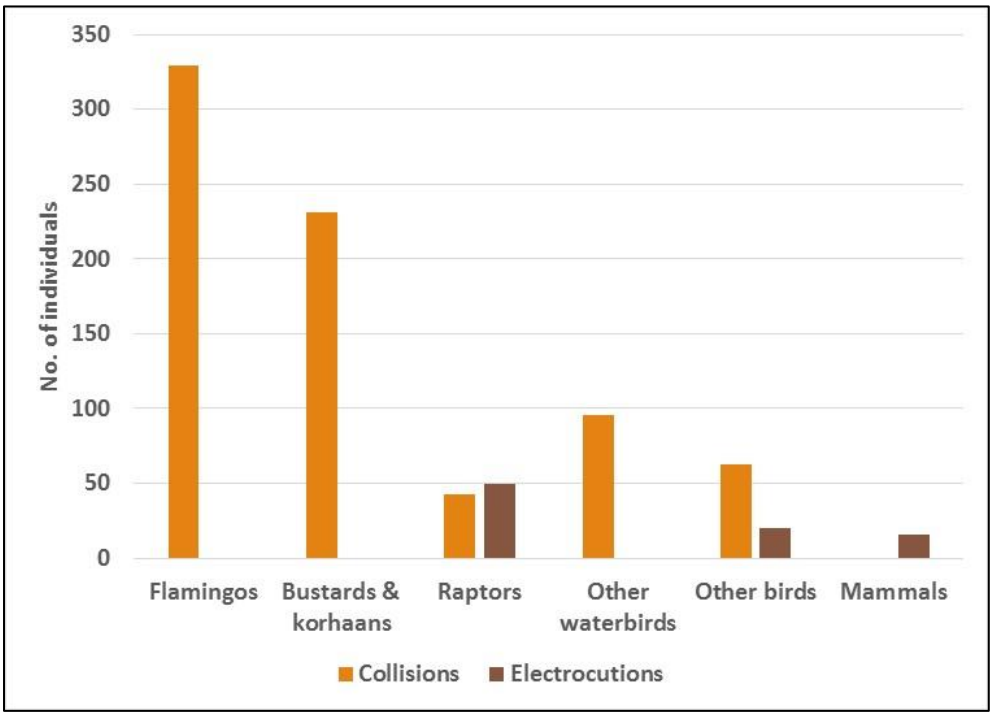


Figure 20. Numbers of birds and other wildlife involved in power line collision/electrocution incidents in Namibia, 2009-2020 (n = 847 individuals; NamPower/NNF Strategic Partnership data; EIS 2022).

Figure 21. Examples of collision incidents of some power line-sensitive bird species in the greater study area, on the 220 kV Omburu-Osona power line (see Figure 18):

Top left: Lappet-faced Vulture
Top right: Kori Bustard
Bottom left & right: Damara Red-billed Hornbill

(NamPower/NNF Strategic Partnership data, EIS 2023; photographs P Cunningham).

6.2.7 Potential flight paths/flyways

Lappet-faced Vultures have been tracked in Namibia by Vultures Namibia and the Ministry of Environment, Forestry and Tourism (MEFT) over the past four years (since 2018; see Kolberg 2022, and preceding issues of *Lanioturdus*).

The results for 33 tracked individuals indicate some movement over the study area, although limited as it does not fall within the core (breeding) area of the Namib-Naukluft Park to the south (Figure 22; www.movebank.org). However, it is likely that the nesting pair of vultures on the farm would make regular flights around the area, with varying flight paths dependent on changing environmental conditions and food supply.

Bustards generally fly low, with varying flight paths that are not possible to predict.

Aquatic habitats are limited in the greater area, and it is not possible to predict flight paths of waterbirds, although they may be associated with the Khan River and tributaries during good rainfall.

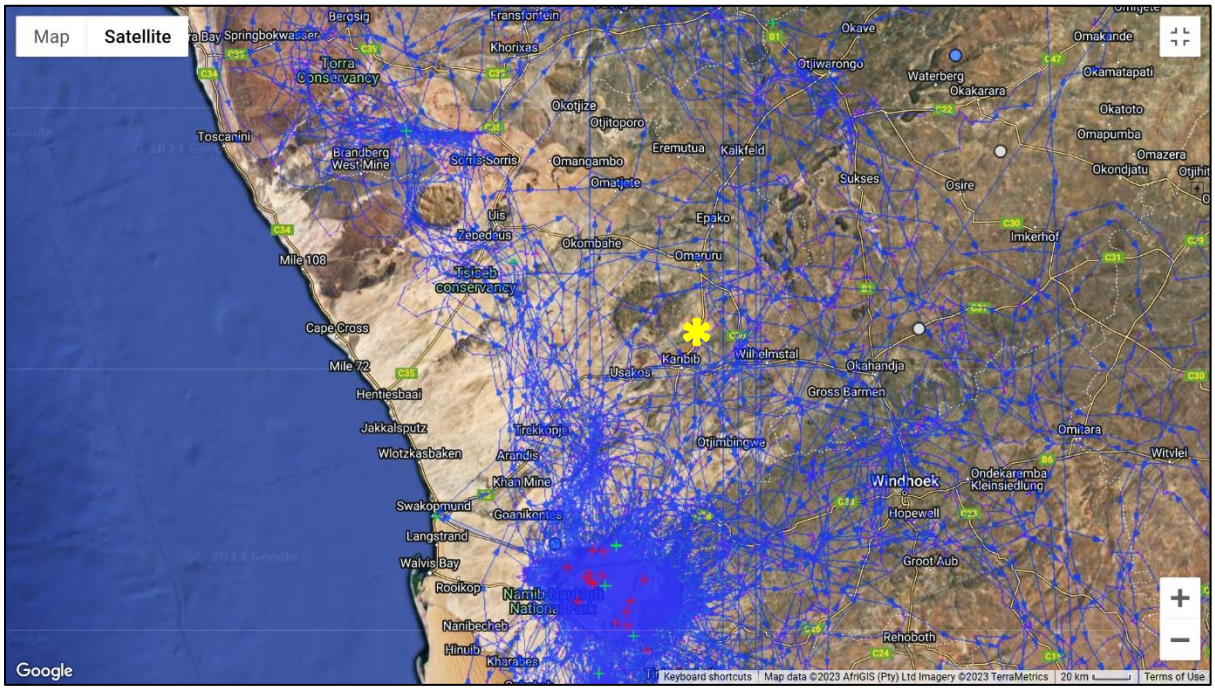


Figure 22. Results of satellite tracking of 33 Lappet-faced Vultures show some movement over the study area*; however, this movement is limited and not over the core (breeding) area within the Namib-Naukluft Park (data: Vultures Namibia and the Ministry of Environment, Forestry and Tourism; www.movebank.org; Kolberg 2022; 21 May 2023).

6.3 Species at risk

6.3.1 Introduction

As mentioned above, risk assessment and mitigation efforts are directed towards priority species, namely those that have a high biological significance, i.e. primarily Red Data species (including any with migrant status) and/or endemic or near-endemic species.

Forty-two priority species were initially identified as being potentially at higher risk in terms of the proposed project (see Appendix 2 for this full list). Taking into account local abundance, where relevant, this list was short-listed to 23 species. The species are listed in Table 2 and described in further detail in Section 6.3.2 below.

Species groups at risk

Raptors (including eagles and vultures) play a key ecological role in ecosystems, being predators at the top of food webs. As a group they are prone to power line interactions, including collision, electrocution and disturbance/habitat modification. They are long-lived and relatively slow to reproduce and to replace themselves, and are already impacted by poisoning, habitat loss and energy supply interactions. At least 27 raptor species have been recorded in the greater study area, including seven Red Data species and three migrants.

Other terrestrial bird species, including larger (cursorial/striding) species such as bustards and korhaans, hornbills, sandgrouse and spurfowl/francolins are also collision-prone. Two large terrestrial Red Data species, namely Kori Bustard and Ludwig's Bustard, occur in the study area. Smaller terrestrial **near-endemic species**, with specific habitat requirements and therefore a restricted distribution, are also subject to habitat destruction and disturbance impacts; these include cavity-, ground- and tree/shrub-nesters.

Waterbirds are particularly susceptible to collisions due to their habit of flying at night or under conditions of poor light, often in groups and at speed. The nomadic habits of species such as Great White Pelican render them prone to collisions on power line infrastructure.

Migrant species (both terrestrial and aquatic) are at higher risk to impacts, due to their mobility.

A final group of bird species has the potential to **impact on infrastructure**, by their perching, nesting and/or other activities, e.g. Sociable Weaver, Red-billed Buffalo-weaver.

Table 2. Preliminary list of potential priority bird species recorded in the Osino Twin Hills Gold Project 66 kV power line, Erongo Region, Namibia (April-May 2023)
*Scientific and common names according to Roberts Bird Guide 2016 (Chittenden *et al.* 2016)

Preliminary list 42 species, short-listed to 23 species

KEY:

RDB = Red Data/conservation status (Brown *et al.* 2017) CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern; G = global status; rare = now rare in Namibia

END = Endemism (Brown *et al.* 2017): NE = near-endemic; Nam = Namibia (≥90% of population in Namibia)

RES = Residency (for Red Data species): Res = resident, Nom = nomadic, Mig = (Red data) species that have migrant status, Pal = Palearctic (breeding), intra-Afr mig = intra-African migrant, mov = local/seasonal movements

SABAP1: Southern African Bird Atlas Project 1 data that was published as Harrison *et al.* (1997), available on EIS 2023

SABAP2: Southern African Bird Atlas Project 2 data, available on http://sabap2.adu.org.za;

Greater area 2023: personal observations April-May 2023

Local abundance: based on SABAP1 & SABAP2 data and personal observations (scale 1-3)

Potential impact: D = disturbance; H = habitat modification/destruction; C = collisions on power line infrastructure; E = electrocutions on power line infrastructure; N = impacts caused by attraction of birds to novel habitats (for perching, nesting etc.)

Probability (also taking into account local abundance, based on SABAP1 & SABAP2 data and personal observations [scale 1-3]): D = definite, H = high; M = moderate; L = low; I = improbable

Priority species potentially at higher risk from the project are highlighted (see also Appendix 1)

Common group	Common species	Priority status / sensitivity	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob	Impact
				FP (RR%)	Latest record				
1. Priority (Red Data / near-endemic / migrant) species with a higher potential to be impacted by the proposed development (26)									
1.1 Large terrestrial bird species (2)									
Bustard	**Ludwig's**	EN, G EN, nom, partial mig	√	25.0	2014		A (1)	3	
Bustard	**Kori**	NT, G NT, nom	√	25.0	2015		A (2)	3	
1.2 Raptors (11)									
Vulture	**White-backed**	CR, G CR, raptor		0.0	2022		A (20)	3	

Common group	Common species	Priority status / sensitivity	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob	Impact
				FP (RR%)	Latest record				
Vulture	**Lappet-faced**	EN, G EN; res, movements, raptor	√	25.0	2015		M (= active nest J Uys)	3	
Eagle	**Martial**	EN, G EN; res, raptor	√	25.0	2015			2	
Buzzard	**Common (Steppe)**	Pal mig, raptor	√	25.0	2023			3	
Kite	**Yellow-billed**	Raptor		25.0	2023			3	
Falcon	**Lanner**	Raptor, res / mig	√	25.0	2014		M	3	
Eagle	Steppe	EN, G EN, Pal mig	√					1	
Eagle	Tawny	EN, raptor	√					1	
Secretarybird		VU, G EN; res, nom, raptor	√					1	
Eagle	Verreauxs'	NT; res, raptor	√					1	
Eagle	Booted	Pal mig, raptor	√					1	
1.3 Aquatic species (1)									
Pelican	Great White	VU; sed, nom	√					1	
1.4 Namibian near-endemic species (9)									
Hornbill	**Damara Red-billed**	NamNE		25.0	2018		A (1)	3	
Hornbill	**Monteiro's**	NamNE	√	50.0	2022	√	M (3)	3	
Rockrunner	**Rockrunner**	NamNE	√	50.0	2022			3	
Shrike	**White-tailed**	NamNE	√	50.0	2022	√		3	
Parrot	Rüppell's	NT, NamNE (nom)	√					1	
Korhaan	Rüppell's	NamNE	√					1	
Tit	Carp's	NamNE	√					1	
Chat	Herero	NamNE	EIS 2023	50.0	2019			1	

Common group	Common species	Priority status / sensitivity	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob	Impact
				FP (RR%)	Latest record				
Spurfowl	Hartlaub's	NamNE	EIS 2023					1	
1.5 Other large terrestrial migrant species (3)									
Stork	**Abdim's**	Intra-Afr mig	√	0.0	2020			2	
Stork	**Woolly-necked**	Res, mig		0.0	2021			2	
Stork	White	Pal mig	√					1	
2. Non-Red Data / non-near-endemic (Namibia) priority species with the potential to be impacted by the proposed development (16 - raptors)									
Eagle	**Black-chested Snake**	Res, nom, raptor	√	25.0	2015	√		3	
Eagle	**Brown Snake**	Res, nom, raptor	√	0.0	2020			3	
Falcon	**Pygmy**	Raptor	√	25.0	2015	√	M	3	
Goshawk	**Gabar**	Res, raptor	√	25.0	2018			3	
Goshawk	**Pale Chanting**	Sed, movements, raptor	√	25.0	2023	√	A M	3	
Hawk-eagle	**African**	Res, sed, raptor	√	25.0	2014		A (2)	3	
Kestrel	**Greater**	Sed, movements, raptor	√	0.0	2019			3	
Kestrel	**Rock**	Res, raptor	√	25.0	2022		A M (+ juv)		
Kite	**Black-winged**	Nom, raptor	√	0.0	2022			3	
Buzzard	Augur	Res, nom, raptor	√					3	
Eagle-Owl	Spotted	Res, raptor	√					1	
Eagle-Owl	Verreaux's (Giant)	Res, raptor	√					1	
Owl	African Scops	Res, raptor	√					1	
Owl	Western Barn	Res, raptor	√					1	
Owlet	Pearl-spotted	Res, raptor	√					1	

Common group	Common species	Priority status / sensitivity	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob	Impact
				FP (RR%)	Latest record				
Shikra		Raptor	√					1	
3. Species with the potential to impact on power lines through their perching, nesting or other activities on novel habitats (3)									
Weaver	**Sociable**		√	100.0	2022		A M (birds & active nests)	3	
Crow	**Pied**			25.0	2018			2	
Weaver (Buffalo-Weaver)	Red-billed Buffalo		√				A (old nests - only)	2	

6.3.2 Details of priority bird species

Due to the high species richness of the study area, 23 priority bird species have been short-listed from a total of 42 potential priority species (Table 2 above), as a focal group identified as being at higher risk to potential impacts resulting from the proposed project. This short-listing takes into account the probability of the species occurring in the study area and surrounds (using an index of local abundance, on a scale of 1-3).

Although the focus of the impact assessment is on the short-listed species, the full priority list still needs to be taken into account due to the relatively high species numbers and the difficulty in predicting those likely to be impacted. The emphasis for assessment should be on groups of birds likely to be at risk, rather than on individual species; and the precautionary principle should prevail. Note that only selected (e.g. Red Data and raptor) migrant species are listed; a number of other migrant species also occur in the area.

Summary of priority groups

As mentioned above, the 23 short-listed priority bird species may be summarised in the following groups:

- 14 higher priority species (11 Red Data [7 also Globally Endangered] / 9 migrant / 4 near-endemic to Namibia), in the groups:
  - 2 large terrestrial species (2 Red Data / 1 partial migrant)
  - 6 raptors (4 Red Data / 3 migrant)
  - 4 Namibian near-endemics
  - 2 other large terrestrial migrants
- 9 non-Red Data / non-near-endemic priority raptor species

A further group of birds comprises species with the potential to impact on infrastructure (3 examples).

Details of priority species

The details of the potential priority species and their sensitivities are mentioned below (* = pers. obs. 2023; "power line-prone" indicates a susceptibility to collisions, electrocutions and/or other impacts associated with power line structures, including disturbance/habitat destruction during construction; local abundance on a scale of 1-3).

14 high priority species (11 Red Data [7 also Globally Endangered] / 9 migrant / 4 near-endemic to Namibia **), in the groups:**

- **2 large terrestrial bird species**
  - **Ludwig's Bustard** (Endangered, also Globally Endangered; nomadic; power line-prone; local abundance 3/3)
  - **Kori Bustard** (Near Threatened, also Globally Near Threatened; nomadic; power line-prone; local abundance 3/3)
- **6 raptors**
  - **White-backed Vulture** (Critically Endangered, also Globally Critically Endangered; resident, with large-scale movements, especially in juveniles; power line-prone; nesting colony on adjacent farms; local abundance 3/3)

- **Lappet-faced Vulture** (Endangered, also Globally Endangered; resident, with extensive movements in non-breeding birds; power line-prone; nesting on farm Karibib reported; local abundance 3/3)
- **Martial Eagle** (Endangered, also Globally Endangered; resident; power line-prone; local abundance 2/3)
- **Common Buzzard** (Palearctic migrant; power line-prone; local abundance 3/3)
- **Yellow-billed Kite** (intra-African migrant; power line-prone; local abundance 3/3)
- ***Lanner Falcon** (resident, migratory; power line-prone; local abundance 3/3)

- **4 Namibian near-endemics**
  - **Damara Red-billed Hornbill** (near-endemic to Namibia; cavity breeder; power line-prone; local abundance 3/3)
  - **Monteiro's Hornbill** (near-endemic to Namibia; nomadic; cavity breeder; power line-prone; local abundance 3/3)
  - **Rockrunner** (near-endemic to Namibia; nests mostly in grass tufts; impacted by disturbance/ habitat destruction; local abundance 3/3)
  - **White-tailed Shrike** near-endemic to Namibia; nests in shrubs; impacted by disturbance/ habitat destruction; local abundance 3/3)
- **2 other large terrestrial migrant species**
  - **Abdim's Stork** (intra-African migrant; local abundance 2/3)
  - **Woolly-necked Stork** (resident, migrant; local abundance 2/3)

9 non-Red Data / non-near-endemic priority species, comprising 9 raptors

- Black-chested Snake Eagle (resident, nomadic; power line-prone; local abundance 3/3)
- Brown Snake Eagle (resident, nomadic; power line-prone; local abundance 3/3)
- *Pygmy Falcon (resident; power line-prone; local abundance 3/3)
- Gabar Goshawk (resident; power line-prone; local abundance 3/3)
- *Pale Chanting Goshawk (sedentary, with local movements; electrocution-prone; local abundance (3/3)
- *African Hawk-eagle (resident, sedentary; power line-prone; local abundance 3/3)
- Greater Kestrel (sedentary, local movements; power line-prone; local abundance 3/3)
- *Rock Kestrel (resident; power line-prone; local abundance 3/3)
- Black-winged Kite (nomadic; power line-prone; local abundance 3/3)

All the above 23 priority bird species are potentially at risk to collisions on power line structures. Further potential impacts include physical disturbance and habitat destruction/modification during the construction of power lines; and electrocution (including by streamers of excrement).

Other (mostly non-priority) species with the potential to cause impacts on infrastructure

Several other (mostly non-priority) bird species have the potential to impact power line structures, through their perching, nesting and other activities. Examples include:

- Sociable Weaver (actives nests; local abundance 3/3)
- Pied Crow (local abundance 2/3)
- Red-billed Buffalo Weaver (old nests observed; likely to be seasonal)

Sociable Weaver and Red-billed Buffalo-Weaver have a low potential to impact on the power supply through their nesting activities on 66 kV steel monopole power line structures. Transformer and

associated structures may, however, prove to be attractive to Sociable Weaver. Pied Crow may move into the area during construction, attracted to novel food sources, and the species' activities including nesting will need to be monitored.

7 Impact description, assessment and mitigation recommendations

7.1 Impact identification and evaluation methodology

7.1.1 Introduction

This chapter outlines the methods followed to identify and evaluate the impacts arising from the proposed project. The findings of the assessment are presented in this chapter.

This chapter provides the following:

- Details on the assessment guidance used to assess impacts
- Lists the limitations, uncertainties and assumptions with regards to the assessment methodology
- Details how impacts were identified and evaluated, and how the level of significance was derived
- Details how mitigation was applied in the assessment and how additional mitigation was identified, and
- Details the Cumulative Impact Assessment (CIA) method.

7.1.2 Assessment guidance

The principal documents used to inform the assessment method are:

- International Finance Corporation standards and models, in particular Performance Standard 1, "Assessment and management of environmental and social risks and impacts" (International Finance Corporation, 2017) (International Finance Corporation, 2012);
- International Finance Corporation Cumulative Impact Assessment (CIA) and Management Good Practice Handbook (International Finance Corporation, 2013) and
- Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008);

7.1.3 Limitations, uncertainties and assumptions

The following limitations and uncertainties associated with the assessment methodology were observed:

- Topic specific assessment guidance has not been developed in Namibia. A generic assessment methodology was applied to all topics using IFC guidance and professional judgement;
- Guidance for CIA has not been developed in Namibia, and a single accepted state of global practice has been established. The IFC's guidance document (International Finance Corporation 2013) has been used for the CIA.

7.1.4 Determination of significance

The evaluation and identification of the environmental and social impacts require the assessment of the project characteristics against the baseline characteristics, ensuring all potentially significant impacts are identified and assessed. The significance of an impact is determined by taking into consideration the combination of the sensitivity and importance/ value of environmental and social receptors that may be affected by the proposed project,

the nature and characteristics of the impact, and the magnitude of potential change. The magnitude of change (the impact) is the identifiable changes to the existing environment which may be negligible, low, minor, moderate, high, or very high; temporary/short term, long-term or permanent; and either beneficial or adverse.

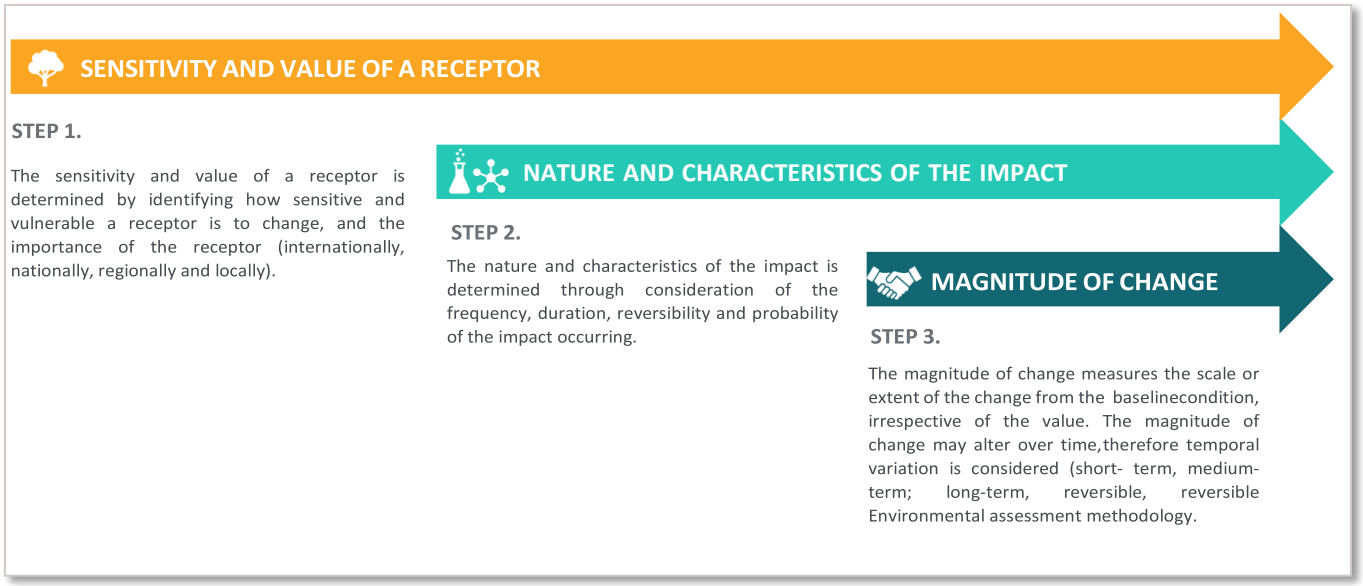


Figure 23. Determination of significance (ECC 2023).

The tables provided below (Table 3-12) set the description and thresholds used in determining impact significance.

Table 3. Nature of impact

NATURE	
Term	**Description**
Beneficial (Positive)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse (Negative)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.

Table 4. Type of impact

TYPE	
Term	**Description**
Direct	Impacts causing an impact through direct interaction between a planned project activity and the receiving environment/receptors.
Indirect	Impacts that result from other activities that are encouraged to happen as a result / consequence of the Project. Associated with the project and may occur at a later time or wider area
Cumulative	Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect

Table 5. Reversibility of impact

REVERSIBILITY	
Term	**Description**
Reversible	Impacts are reversible and recoverable in the future
Partly Reversible	Some parts of the impact can be reversed while others remain
Irreversible	Impacts which are not reversible and are permanent

Table 6. Magnitude of change

MAGNITUDE OF CHANGE	
Term	**Description**
None / negligible	Very minor loss or detrimental alteration to one (or maybe more) characteristic, feature or element; or Very minor benefit to, or positive addition of, one (or maybe more) characteristic, feature or element.
Low / Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (or maybe more) key characteristic, feature or element; or Minor benefit to, or addition of, one (or maybe more) key characteristic, feature or element; some beneficial effect on attribute quality or a reduced risk of a negative effect occurring.
Moderate	Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, features or elements; or Benefit to, or addition of, key characteristics, features or elements; improvements of attribute quality.
High / Major	Loss of resource, and quality and integrity of resource; severe damage to key characteristics, features or elements; or Large scale or major improvement of resources quality; extensive restoration or enhancement; major improvement of attribute quality.
Very high / unknown	Loss of resource, significantly affecting the long term quality and integrity of a resource; irreparable damage or loss of key characteristics, features or elements; or the magnitude is too great to quantify as it is unknown.

Table 7. Duration of impact

DURATION	
Term	**Description**
Temporary	Transient; a period of less than 1 year
Short term	Impacts that are likely to last for the duration of the activity causing the impact and are recoverable (1-5 years)
Medium term	Impacts that are likely to continue after the activity causing the impact and are recoverable (5-15 years)
Long term	Impacts that are likely to last far beyond the end of the activity causing the damage (greater than 15 years with impact ceasing after decommissioning of the project)
Permanent	Permanent

Table 8. Scale of change

SCALE OF CHANGE - EXTENT / GEOGRAPHIC SCALE	
Term	**Description**
On-site	Impacts that are limited to the boundaries of the proposed project site
Local	Impacts that occur in the local area of influence, including around the proposed site and within the wider community
Regional	Impacts that affect a receptor that is regionally important by virtue of scale, designation, qualityor rarity.

National	Impacts that affect a receptor that is nationally important by virtue of scale, designation, qualityor rarity.
International	Impacts that affect a receptor that is internationally important by virtue of scale, designation, quality or rarity.

Table 9. Probability of change

PROBABILITY	
Term	**Description**
Improbably (Rare)	The event may occur in exceptional circumstances yet rarely occurs in the industry. The event could occur once every 100 years
Low probability (Unlikely)	The event has happened elsewhere yet, is unlikely to occur. The event could occur once every 10 years
Medium Probability (Possible)	The event could occur under some circumstances. The event could occur once every 5 years.
High probability (Likely)	The event is expected to occur. The event could occur twice per year
Definite (Almost certain)	The event will occur. The event could occur once per month

Table 10. Significance description

SIGNIFICANCE OF IMPACT	**DESCRIPTION**
Low – Major (Beneficial) All scores	Impacts are considered to be beneficial to the environment and society:
Low (negative) 0 - 25	Impacts are considered to be local factors that are unlikely to be critical to decision-making.
Minor (negative) 25 - 50	Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent.
Moderate (negative) 50 - 75	Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated.
Major (negative) 75 - 100	Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non- reversible on a national scale and/or have international significance or result in a legislative non- compliance.

Table 11. Sensitivity and value of receptor

SENSITIVITY AND VALUE	DESCRIPTION
Low	Of value, importance or rarity on a local scale; and/or not particularly sensitive to change or has considerable capacity to accommodate a change.
Medium	Of value, importance or rarity on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change, or moderate capacity to accommodate a change.
High	Of value, importance or rarity on an international and national scale, and with very limited potential for substitution; and/or very sensitive to change or has little capacity to accommodate a change.

Table 12. Significance of impact.

				Significance of Impact			
			Significance of Impact	Impacts are considered to be local factors that are unlikely to be critical to decision-making.	Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent.	Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated.	Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non- reversible on a national scale and/or have international significance or result in a legislative non- compliance.
	Biophysical	Social		Low	Minor (2)	Moderate (3)	Major (4)
Sensitivity	A biophysical receptor that is protected under legislation or international conventions (CITES) listedas rare, threatened or endangered IUCN species. Highly valued/sensitive resource/receptors	Those affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.	High (3)	Minor (3)	Moderate (6)	Major (9)	Major (12)
	Of value, importance or rarity on a regional scale, and with limited potential for substitution; and/or Not protected or listed (globally) but may be a rare or threatened species in country; with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Able to adapt with some difficulty and maintain preimpact status but only with a degree of support	Medium (2)	Low (2)	Minor (4)	Moderate (6)	Major (8)
	Not protected or listed as common / abundant; or not critical to other ecosystems functions	Those affected are able to adapt with relative ease and maintain pre-impact status. There is no perceptible change to people's livelihood.	Low (1)	Low (1)	Low (2)	Minor (3)	Moderate (4)

To ensure the beneficial impacts are brought out in the assessment, green has been applied to ensure the different type of impact is clear. The description for each level of significance presented in Table 10 was also followed when determining the level of significance of a beneficial impact.

The significance of impacts has been derived by applying the identified thresholds for receptor sensitivity and magnitude of change, as well as the definition of significance. Moderate and major adverse impacts are considered as significant. The following thresholds were therefore used to double check the assessment of significance had been applied appropriately; a significant impact would meet at least one of the following criteria:

- It exceeds widely recognized levels of acceptable change;
- It threatens or enhances the viability or integrity of a receptor or receptor group of concern; and

- It is likely to be material to the ultimate decision about whether or not the environmental clearance certificate is granted.

7.1.5 Mitigation

Mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement. The mitigation hierarchy is avoidance; reductionat source; reduction at receptor level; repairing and correcting; compensation; remediation; and enhancement.

Mitigation measures can be split into three distinct categories, broadly defined as:

1. Actions undertaken by the EIA process that influence the design process, through implementing design measures that would entirely avoid or eliminate an impact or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered as embedded mitigation.
2. Standard practices and other best practice measures for avoiding and minimizing environmental impacts. These are considered as good practice measures.
3. Specified additional measures or follow-up action to be implemented to further reduce adverse impacts that remain after the incorporation of embedded mitigation. These are considered as additional mitigation.

The EIA is an iterative process whereby the outcomes of the environmental assessments inform the project. Considerable mitigation has been built into the proposed project as potentially significant adverse environmental impacts have been identified and design changes have been identified to overcome or reduce them. The EMP provides the good practice measures and specified additional measures or follow-up action.

Embedded mitigation and good practice mitigation have been taken into account in the assessment. Additional mitigation measures have been identified when the significance of impact requires it and causes the impact to be further reduced. Where additional mitigation has been identified, a final assessment of the significance of impacts (residual impacts) was carried out taking into consideration the additional mitigation.

7.1.6 Cumulative impacts

Cumulative impacts may arise as a result of other project activities or the combination of two or more projects in the project area.

In terms of the present study, cumulative impacts are defined as those impacts that result from the successive, incremental and/or combined effects of existing, planned and/or reasonably anticipated future human activities in combination with project development impacts (Bennun *et al.* 2021). They may arise from multiple projects in one sector (including renewable energy projects) and/or due through pressures from many sectors and sources (sometimes referred to as "aggregated" or "in-combination" impacts). Cumulative impacts can be highly significant for sensitive species and ecosystem services, but are often overlooked (Bennun *et al.* 2021). Although recorded mortalities may be in low numbers, the cumulative impacts of such negative interactions over the entire lifespan of the development are an important consideration. Sensitive species that are already under threat, including Red Data and endemic species, raptors, waterbirds and other migrants/nomadic species, are at particular risk to such cumulative effects.

According to Environmental Compliance Consultancy (ECC), the Cumulative Impact Assessment (CIA) has been undertaken by applying the IFC CIA Good Practice Handbook (International Finance Corporation 2013), which recommended that a rapid CIA is

undertaken. A rapid CIA takes into consideration the challenges associated with a good CIA process, which includes lack of basic baseline data, uncertainty associated with anticipated development, limited government capacity, and absence of strategic regional, sectoral or integrated resource planning schemes.

The five-step rapid CIA process has been followed:

- Step 1: Scoping - Determine spatial and temporal boundaries
- Step 2: Scoping - Identify valued environmental and social receptors and identify reasonably foreseeabledevelopments
- Step 3: Determine present condition of valued environmental and social receptors (the baseline)
- Step 4: Evaluation of the significance of the cumulative impacts
- Step 5: Identification of mitigation measures to avoid or reduce cumulative impacts

The following information has been applied to the final EIA assessment in line with the above steps and IFC Guidance:

- The spatial and temporal boundaries of the CIA are the extent of the ML boundaries and the duration of the decline development and operation phases of the proposed project (up to 7 years from the date of commencement);
- Valued environmental and social receptors that may be affected are those presented in Chapter 5. No additional ones have been identified through this CIA;
- A review of existing and reasonable anticipated and/or planned developments has been undertaken which is based on the information presented in chapter 4.
- The predicted future conditions of sensitive and common environmental and social receptors have been takeninto consideration in the assessment;
- The assessment findings presented in Chapter 7 have been applied to the CIA in combination with professionaljudgment and published environmental assessment reports; and
- A review of mitigation and monitoring measures have been undertaken, with any additional ones identified.

7.2 Impact description, assessment and management/mitigation recommendations

7.2.1 Introduction

Electricity transmission and distribution grids are expanding rapidly worldwide, with significant recorded negative impacts on biodiversity and, in particular, on birds; however, some information gaps on impacts still need to be addressed (Bernardino *et al.* 2018).

The impacts of power line structures on avifauna, and recommended mitigation measures, are well documented, both globally and for the southern African subregion (e.g. Bevanger 1994, 1998; Lehman *et al.* 2007; Jenkins *et al.* 2010; Prinsen *et al.* 2011; Scottish Natural Heritage 2016; Simmons *et al.* 2015; Bernardino *et al.* 2018; Shaw *et al.* 2018; Bernardino *et al.* 2019; D'Amico *et al.* 2019; Gális, Ševčík 2019; Anon. 2021; Shaw *et al.* 2021.). Impacts include disturbance of birds, habitat modification/destruction, collisions and electrocutions on infrastructure. Of these, bird collisions on power line infrastructure are one of the major concerns.

Five potential impacts have been identified for the project, namely:

- Physical/human disturbance of birds (resulting in avoidance/displacement of birds); this could include road mortalities and/or poaching during construction
- Direct and indirect modification/loss/destruction of bird habitat (resulting in avoidance/ displacement of birds)
- Bird collisions with power line infrastructure including power lines and associated power supply structures (resulting in injury/death of birds)
- Bird electrocutions on power line infrastructure (resulting in injury/death of birds)
- Attraction of birds to novel (artificial) habitats and resources created by the development; although potentially positive for birds, this impact could also lead to negative impacts on infrastructure, caused by bird nesting, perching and other activities, and to electrocutions of birds

The above impacts are described and assessed below. Note that, due to certain uncertainties regarding the recorded specifics of impacts of solar developments on birds, especially in the Region, the precautionary principle should apply.

Details of the priority species that could become affected by the above impacts are included in Table 2 (and Section 6.3.2) above.

7.2.2 Impact description, assessment and management/mitigation recommendations

The potential impacts of the proposed 66 kV transmission line are described below, together with recommended mitigation and management measures. Note that the impacts during the decommissioning phase are likely to be similar to those during construction, and are therefore not discussed separately. Recommendations for monitoring are provided in Section 8 below. An adaptive management approach should be used, based on ongoing evaluation and interpretation of monitoring results.

7.2.2.1 Physical/human disturbance of birds

Physical/human disturbance, i.e. human noise and activity (including of machinery) during construction (and operational) activities can potentially impact on birds during both the construction (and operational) phases, thereby affecting the presence or foraging and/or breeding success of key species (see references in Section 7.2.1, including Bevanger 1998; Bernardino *et al*. 2018).

During the construction phase, vehicle and human activity on the site is at a peak, with high levels of disturbance. Once operational, the amount of disturbance should decrease.

Further forms of disturbance include road mortality and poaching of birds (and of eggs). Once operational, these sources of mortality should decrease.

Statement of impact:

Birds are displaced temporarily or permanently from the site by human noise and activity during construction (and operational activities); this could place unnatural stress on territorial species, due to competition for alternative territories, and ultimately result in a reduction of breeding success; poaching/ road kills may result in loss of chicks/ injury/ mortality of birds.

The above impact could affect **large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard); **raptors** (e.g. Lappet-faced Vulture [recorded breeding in the study area], White-backed Vulture, Martial Eagle); other terrestrial birds, including smaller **Namibian near-endemics** (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill, Rockrunner, White-tailed Shrike); in particular, any birds that are **breeding**/ rearing young; and migrant bird species, although to a lesser extent as they are not present throughout the year.
The nature of the impact is adverse; direct; cumulative (interacting with impacts from other activities in the area); partly reversible.
The magnitude of change is considered low, with minor loss of, or alteration to bird habitats.
The duration is short-term, but may be long term/permanent; the scale of change is mainly on-site.
Human noise and activity during construction will definitely occur.
The **value/sensitivity of (biophysical) receptors**, i.e. birds, is rated as medium, i.e. important or rare on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change.

The **significance of the impact** is assessed as **minor** (4 on a scale of 12): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impact is considered to be short-term (but may be long term/permanent), partly reversible and localised in extent.

The residual impact after mitigation is assessed as **low** (2): impacts are local factors that are unlikely to be critical to decision-making.

Table 13. Summary of the impact assessment: Physical/ human disturbance of birds.

Description of activity	Receptors	Description of impact	Effect of impact/ description of magnitude	Value/ sensitivity	Significance	Residual impact after mitigation
Human noise and activity during construction and operational activities; including poaching/ road kills	**Large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard) **Raptors** (e.g. Lappet-faced Vulture, White-backed Vulture, Martial Eagle) Other terrestrial birds, including **Namibian near-endemics** (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill, Rockrunner, White-tailed Shrike) *In particular, any birds that are **breeding**/ rearing young Migrant bird species, to a lesser extent	Disturbance may cause barrier effects to normal bird movements. Birds may avoid/leave the study site and surrounding areas (dis-placement), either temporarily or permanently. Disturbance to breeding birds can be severe and may result in a reduction of breeding success. Poaching/ road kills may result in injury/ mortality of birds / loss of chicks Individuals affected but not populations	Nature of impact: adverse Type of impact: direct; cumulative Reversibility of impact: partly reversible Magnitude of change: low Duration: short term, but may be long term/ permanent Scale of change: on-site/local Probability: definite	Medium	Minor (4)	Low (2)

Mitigation recommendations

Construction phase

Avoidance:

- Disturbance of nesting/chick-rearing birds should be avoided. Before construction starts, the proposed power line route should be inspected for any signs of bird breeding activity. In particular, the more sensitive breeding season for Lappet-faced Vultures is winter (May-October). The varying timing

of the breeding seasons for the other bird groups makes it impractical to avoid all such times with further scheduling of construction activities (January-March for near-endemic species; August-February for bustards), and monitoring is thus important.

Minimisation:

- Abatement controls to reduce noise disturbance created during construction.
- Operational controls to manage and regulate contractor activity, such as:
  - A speed limit should be strictly enforced.
  - Exclusion fencing should be erected around identified sensitive areas, if required (e.g. pre-identified active nesting sites).
  - Anti-poaching measures should be strictly enforced, with zero tolerance, and this should be emphasised during induction to contractors; offenders should be prosecuted.
- Ongoing awareness should be promoted about the value of biodiversity and the negative impacts of disturbance, especially to breeding birds, and of poaching and road mortality.

7.2.2.2 Direct and indirect modification/loss/destruction of bird habitat

The construction of a power line can potentially affect birds by destroying or degrading areas of habitat in the power line servitudes and access routes, as well as on the substation sites; these modifications in habitat may result in avoidance/displacement of sensitive bird species, particularly those with narrow habitat requirements; and ultimately result in a reduction of breeding success.

Any removal or disturbance of natural vegetation will result in a change to the habitat available to the birds in the area, potentially impacting on their ability to breed, forage and roost safely in the vicinity. Larger trees are particularly vulnerable to habitat destruction. Drainage lines/water courses are important habitats for birds, and susceptible to habitat destruction. The use of machinery (e.g. bulldozers, front-end loaders, and large trucks) and uncontrolled off-road driving could heighten the risk.

Further negative potential impacts on habitat include emissions and pollutants (erosion, dust, waste) created during construction; and mismanagement of wastewater.

Statement of impact:

The construction of a power line can potentially affect birds by destroying or degrading areas of habitat in the power line servitudes and access routes, as well as on the substation sites; birds could avoid the site or be displaced either temporarily or permanently; this could place unnatural stress on territorial species, and ultimately result in a reduction of breeding success. Large trees are particularly vulnerable to damage/destruction, as are drainage lines/ water courses; other negative impacts could result from emissions and pollutants (it is assumed that the latter impact will be addressed in more detail in the overall EIA report).

The above impact could affect **large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard); **raptors** (e.g. Lappet-faced Vulture, White-backed Vulture, Martial Eagle); other terrestrial birds, in particular **Namibian near-endemics** which have specific, restricted habitat requirements (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill, Rockrunner, White-tailed Shrike); any birds that are **breeding**/ rearing young, and therefore bound to a site (including cavity-breeders); and migrant bird species, although to a lesser extent.
The nature of the impact is adverse; direct; cumulative (interacting with impacts from other activities in the area); partly reversible.
The magnitude of change is considered low, with minor loss of, or alteration to bird habitats.
The duration is medium-permanent; the scale of change is mainly on-site.
Some form of habitat modification/loss/destruction will definitely occur.
The **value/sensitivity of (biophysical) receptors**, i.e. birds, is rated as medium, i.e. important or rare on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change.

The **significance of the impact** is assessed as **minor** (4 on a scale of 12): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impacts is short-term, partly reversible and localised in extent.

The residual impact after mitigation is assessed as **low** (2): impacts are local factors that are unlikely to be critical to decision-making.

Table 14. Summary of the impact assessment: Direct and indirect modification/loss/destruction of bird habitat.

Description of activity	Receptors	Description of impact	Effect of impact/ description of magnitude	Value/ sensitivity	Significance	Residual impact after mitigation
Destruction or degradation of areas of bird habitat during construction, including larger trees; emissions and pollutants (erosion, dust, waste) created during construction; mismanagement of wastewater	**Large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard) **Raptors** (e.g. Lappet-faced Vulture, White-backed Vulture, Martial Eagle) Other terrestrial birds, including **Namibian near-endemics** (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill,	Permanent modification/ destruction of sensitive habitats during construction may cause avoidance/ barrier effects to bird movements and activities, resulting in displacement, either temporarily or permanently.	Nature of impact: adverse Type of impact: direct; cumulative Reversibility of impact: partly reversible Magnitude of change: low Duration: medium-permanent Scale of change: on-site/ local Probability: definite	Medium	Minor (4)	Low (2)

	Rockrunner, White-tailed Shrike) In particular, any birds that are **breeding**/ rearing young Migrant bird species, to a lesser extent	The loss of habitat may result in unnatural stress on territorial species, due to competition for alternative territories, ultimately leading to a reduction of breeding success. Individuals affected but not populations				

Mitigation recommendations

Avoidance and minimisation:

- Micro-siting: where possible, the unnecessary destruction of habitat or degradation of the environment, including sensitive habitats (such as nesting sites identified pre-construction; cavity-nesting locations [in larger trees and/or dead trees]) should not be destroyed or removed.
- In particular, the destruction of larger trees and drainage lines/water courses should be avoided.

Construction phase

Restoration and rehabilitation:

- Repair of degradation or damage to biodiversity features and ecosystem services from project-related impacts that cannot be completely avoided and/or minimised, e.g. by restoration of temporary-use and lay down areas as soon as reasonably practicable after construction activities are complete.

Operational phase

Minimisation:

- Abatement controls to reduce emissions and pollutants (erosion, dust, waste) created during construction; wastewater management and water conservation measures.
- Operational controls to manage and regulate contractor activity, such as exclusion fencing around sensitive areas (e.g. pre-identified active nest sites), designated machinery and lay-down areas, minimisation of vegetation loss and disturbance to soil; managing the timing of vegetation control activities at suitable intervals.
- Ongoing awareness should be promoted about the value of biodiversity and the negative impacts of habitat destruction.

7.2.2.3 Bird collisions on power line infrastructure

Bird collisions are possible on power lines and associated infrastructure.

A collision occurs when a bird in mid-flight does not see the overhead cables or structures (including conductors and/or earth/optical ground wires [OPGWs]) until it is too late to take evasive action. These impacts could take place on any parts of the power line, but are more likely in sections where the line crosses flight paths/corridors or flyways, such as water courses/drainage lines or ridges. Both the above habitats occur in the proposed power line servitude(s).

Collisions may also take place on stay wires (which are usually included on strain poles/bend points), for instance when a bird is flushed from its position on the ground, and on other associated structures. Collisions may take place even during the construction phase, once the conductors have been strung although not yet energised, but occur mainly during the operational phase. Environmental conditions, including topography, vegetation and climatic factors (e.g. strong winds, dust, rain, fog), may strongly affect both exposure to collision risk, and susceptibility to collision (Jenkins *et al.* 2010).

Recent research has highlighted the fact that the most susceptible groups to collision mortality on power lines are large, long-lived and slow-reproducing birds, often habitat specialists with hazardous behavioural traits (especially flight height and flocking flight), with high spatial exposure to collision risk with power lines, and with unfavourable conservation status (Jenkins *et al.* 2010; Bernardino *et al.* 2018 and authors cited therein; D'Amico *et al.* 2019).

The collision risk for birds is believed to be increased by factors that include a large wingspan and low manoeuvrability, nomadic/migrant habits, flying in groups, flying in low light (e.g. flamingos and other waterbirds), territorial or courtship behaviour, juvenile inexperience and predation. Predominantly, the above collision-prone group comprises large terrestrial or wetland species (Jenkins *et al.* 2010). The concern about bustard collisions is particularly high, both regionally and globally (e.g. Shaw 2013; Shaw *et al*. 2018; Silva *et al.* 2022). Gregarious species (such as vultures) are generally thought to be more vulnerable than species with solitary habits (Bernardino *et al.* 2018).

A further contributory factor to bird collisions is the occurrence of a visual "blind spot" when flying forwards, which has been demonstrated in some groups of birds, including bustards (and korhaans), vultures, snake-eagles and storks (Martin & Shaw 2010; Martin 2011); while searching for food on the ground, or observing conspecifics, these birds thus fail to see overhead structures such as power lines in their path, especially cables.

Collisions may occur when birds cross power lines in their local, daily movements between breeding/nesting or roosting sites, and foraging areas (or between foraging areas); often such regular flights may take place at dawn and/or dusk (Bernardino *et al.* 2018). High mobility and nomadism, especially in habitats with ephemeral resources, may render bird species prone to power line interactions. In the present study, groups such as bustards are particularly susceptible to collisions due to their nomadic habits. Juvenile birds are also usually nomadic and at higher risk, due to inexperience.

Artificial lighting may impact on night-flying and/or migrant birds, especially in terms of causing disorientation and/or collisions on structures. Aquatic bird species (e.g. flamingos, grebes, ducks) usually fly at night, and fall into this group. New forms of lighting in areas that were previously unlit may exacerbate the problem of collisions, and also affect movement patterns and corridors. It has been found that nocturnally migrating birds (small passerines, in this case) may become attracted to an isolated pool of diffused light (G Martin pers. comm.). When there is no moon, plus low fog, the birds could also become

disorientated because they are used to following visual clues such as the moon. Research indicates that lights can attract and confuse migrating birds (Gehring *et al.* 2009; Manville 2005, 2009, 2013). Some insectivorous birds may also be attracted to lights.

An additional collision risk that would apply to the present study is the configuration and close proximity of adjacent power lines (of different structures and heights) in the same area, e.g. where the proposed 66 kV line (alternative 2) would run in parallel, close to the existing 66 kV Omburu-Marble power line, for 3.5 km in the western part of the servitude. The lines are of different heights thus, although this increases the visual barrier, the physical barrier to a bird in flight (and thereby, the cumulative impact) is also increased. The risk is greater when an earth and/or OPGW run above the conductors (as in the case of the proposed 66 kV steel monopole structure), as these cables are usually thinner and less visible.

The marking of wires is currently regarded as the most widespread and recommended measure for reducing bird collisions on power line infrastructure (Barrientos 2011, 2012; Bernardino *et al.* 2019; Martin 2022; Silva *et al*. 2022), although not always as effective in the case of bustards (Shaw et al. 2021). Zones with a collision risk and/or likely regular flight paths have been identified on the servitude of the proposed 66 kV power line (both alternatives), with recommendations for mitigation marking, e.g. RAPTOR-CLAMP Diverter (also known as Viper Live Bird Flapper ["Viper"] and/or SWAN-FLIGHT Diverter; both manufactured by PLP; see below).

Ongoing monitoring, and evaluation of monitoring results, is critically important. Should monitoring results indicate a further need, the relevant sections can be retro-fitted with a suitable device (as above).

Statement of impact:

A collision occurs when a bird in mid-flight does not see the overhead cables or structures that obstruct its passage until it is too late to take evasive action. A collision usually results in injury or mortality, ultimately resulting in reduced breeding success. Should a breeding adult be involved, the loss of eggs or death of a chick (chicks) could be a further indirect effect.
The above impact could affect **large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard, both species observed in the study area in 2023); **raptors** (e.g. Lappet-faced Vulture [active nest reported in the study area, 2023], White-backed Vulture, Martial Eagle); other terrestrial birds, including **Namibian near-endemics** (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill) and other, non-priority species; and migrant bird species, that are less familiar with the area. Juvenile birds are at higher risk, due to inexperience.
The nature of the impact is adverse; direct; cumulative (interacting with impacts from other activities in the area); partly reversible.
The magnitude of change is considered moderate, with loss of resource, but may not adversely affect its integrity.
The duration is long term (and may be permanent, in the case of mortality); the scale of change is mainly on-site.
Bird collisions are likely to occur.
The **value/sensitivity of (biophysical) receptors**, i.e. birds, is rated as medium, i.e. important or rare on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change.

The **significance of the impact** is assessed as **moderate-major** (6-8 on a scale of 12): impacts are considered to be key factors, but still within acceptable limits and standards. Impacts are long-term and may have regional significance, but partly reversible (provided that mitigation is effectively applied; however, ongoing monitoring is critically important).

The residual impact after mitigation is assessed as **minor-moderate** (4-6): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impacts is considered to be short-term, partly reversible and localised in extent.

Table 15. Summary of impact assessment: Bird collisions with power line infrastructure.

Description of activity	Receptors	Description of impact	Effect of impact/ description of magnitude	Value/ sensitivity	Significance	Residual impact after mitigation
Overhead cables or structures (including conductors and/ or earth/ optical ground wires [OPGWs]) obstruct the passage of a bird in mid-flight until it is too late to take evasive action, resulting in a bird collision	The majority of the (larger) priority species (Table 2) are prone to power line collisions. These include the following groups: **Large terrestrial bird species** (in particular Kori Bustard, Ludwig's Bustard) **Raptors** (including Lappet-faced Vulture, White-backed Vulture, Martial Eagle) Other terrestrial birds, including **Namibian near-endemics** (e.g. Damara Red-billed Hornbill, Monteiro's Hornbill) and other, non-priority species In particular, any birds that are **breeding**/ rearing young Migrant bird species	A collision occurs when a bird in mid-flight does not see the overhead cables or structures until it is too late to take evasive action. A collision usually results in injury or mortality.	Nature of impact: adverse Type of impact: direct; cumulative Reversibility of impact: partly reversible Magnitude of change: moderate Duration: long term (permanent) Scale of change: on-site/ local Probability: likely	Medium	Moderate-major (6-8)	Minor-moderate (4-6)

Mitigation recommendations

Project design phase

Avoidance & minimisation:

- Route alternative 1 (the southernmost servitude) is recommended as it is relatively shorter than Alternative 2, and does not run in parallel to an existing power line (with potential cumulative impacts).
- As far as possible, the use of outdoor lighting at substations should be minimised. Security lighting should be kept to a minimum, and directed downward.

Construction phase

Avoidance & minimisation:

- To address the collision risk on the proposed 66 kV transmission line, the marking of the more sensitive sections of the line to increase visibility is recommended, with the minimum for each option as follows (Table 16 below, also see Figure 24 below):

Table 16. Recommended (minimum) sections of power line to be marked, for route alternatives 1 and 2 (also see Figure 24 for map).

Marking section for each route option (see Figure 24 below)	Distance (km)	Start	End
Route alternative 1			
A	2.8	21.823360 15.960715	21.831887 15.936683
B	0.7	21.886465 15.882608	21.889987 15.877487
C	4.9	21.907199 15.852673	21.922611 15.809391
Total km	*8.4*		
Route alternative 2			
A	3.3	21.823360 15.960715	21.823889 15.928973
D	0.4	21.863478 15.865709	21.865332 15.862954
E	2.6	21.874953 15.839624	21.884616 15.817577
F	1.2	21.912377 15.807287	21.922206 15.810763
Total km	*7.5*		

- The top horizontal cable (OPGW/earth) should be marked, for the full length of each span.
  - Examples of recommended marking devices (Figure 25) include the following, both made in South Africa:

  - BIRD-FLIGHT Diverter (BFD); the RAPTOR-CLAMP Diverter (or Viper Live Bird Flapper ["Viper]) could also be considered, possibly on an experimental basis on some sections, alternating with the BFDs
- The marking distance between devices on each line should be 10 m; the colours should be offset where possible (e.g. black and white/yellow).
- At this stage, no nocturnally visible marking is recommended, but it should become mandatory should monitoring results indicate the necessity (e.g. repeat collisions of any nocturnal fliers such as flamingos or owls on power lines).
- The need for fitting any mitigation for collisions on stay wires (e.g. marking with vibration dampers) should also be based on monitoring results, using an adaptive management approach.
- Aircraft warning spheres will be installed at all tar road crossings and possibly on sections near the Karibib Air Force Base (F de Wet pers. comm.). This will increase visibility of the lines.

Operational phase

Minimisation:

- The need for reporting power line incidents should be stressed, and reporting procedures clarified (see Section 8 below). Should monitoring indicate that collisions are still taking place despite the above marking, further mitigation would need to be investigated.

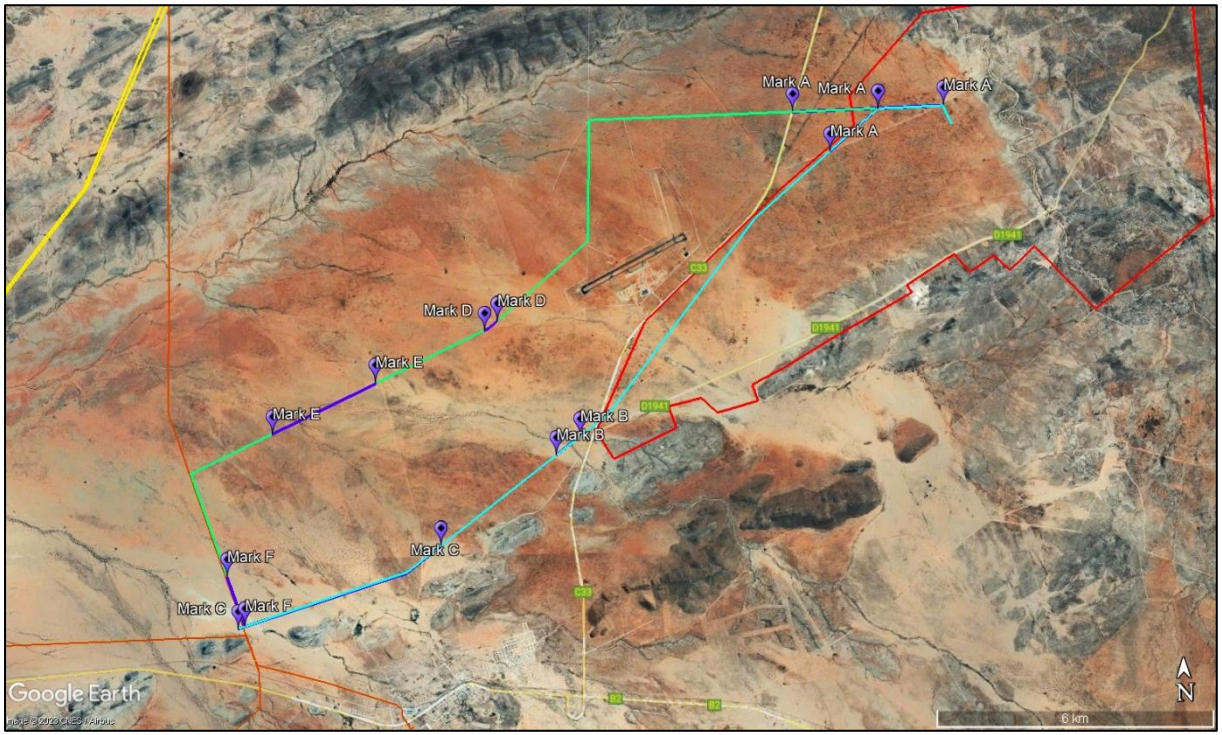


Figure 24. Recommended (minimum) sections of power line to be marked for the proposed 66 kV power line, for route alternatives 1 and 2.

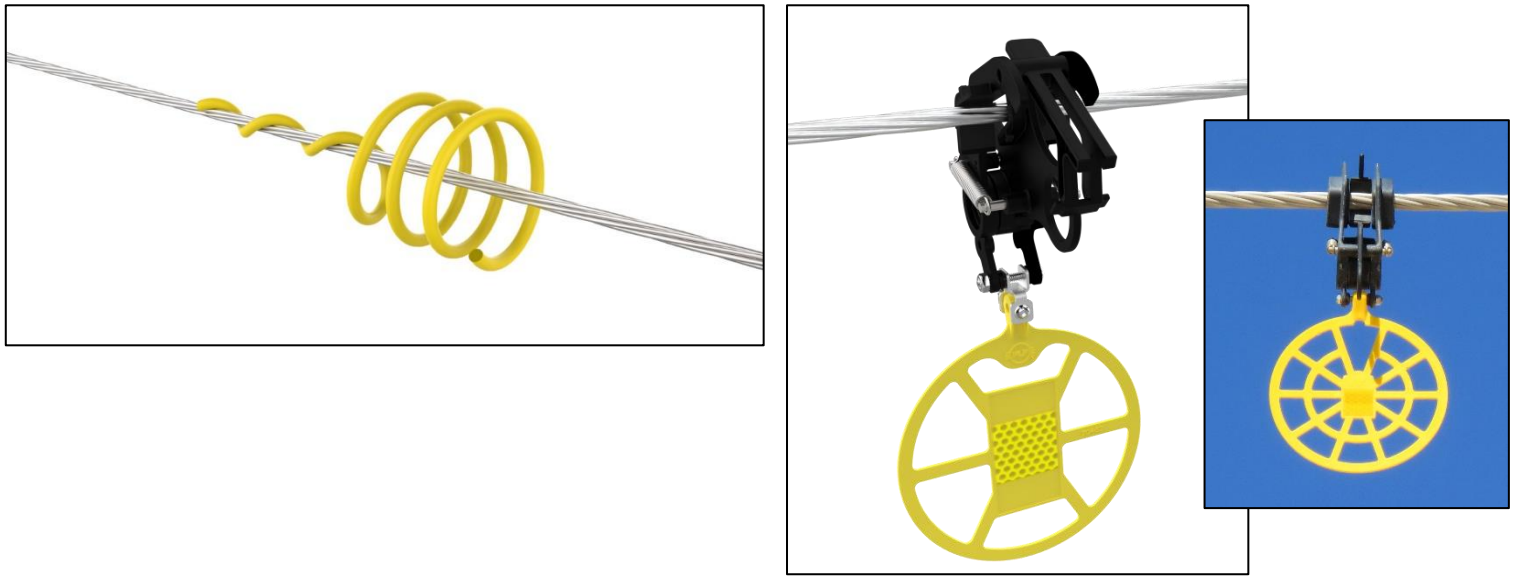


Figure 25. Examples of power line marking devices, used as a mitigation for bird collisions: a. BIRD-FLIGHT Diverter (BFD; left)l and RAPTOR-CLAMP Diverter (or Viper Live Bird Flapper ["Viper"]; centre and right).

7.2.2.4 Bird electrocutions on power line infrastructure

An electrocution occurs when a large bird is perched or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components.

For the proposed 66 kV steel monopole structure the optical ground wire (OPGW) is 2.2 m above the nearest conductor; the conductors are 1.1 m apart, but in "delta" formation, so the highest conductor is in effect 2.2 m above the lowest one (see Section 2 above).

The electrocution risk is increased if the bird is large (e.g. vultures and raptors, pelicans), in view of the relative size of the wingspan (for instance 2.8 m in the case of a Lappet-faced Vulture). The risk is also greater if the structure or bird is wet or damp (e.g. from fog or rain).

An electrocution could also be caused should a large bird perch on top of a tower and send down a "streamer" of excrement that could hit a conductor, thereby bridging the gap between an earthed and a live component. This type of electrocution is possible on the present structure.

On the associated transformer structures (e.g. at substations), the risk of electrocution is also possible, should a bird to touch live and earthed components simultaneously. This would also apply to the H-pole strain structures.

Artificial perches have been fitted above the poles of the 66 kV steel monopole structure as a mitigation for electrocutions, by increasing the clearance between the potentially risky components (e.g. on the new 66 kV Eldorado-B2Gold transmission line near Otjiwarongo). These perches are being presently being used by several raptor species, including Black-chested Snake Eagle, Brown Snake Eagle and Southern Pale Chanting Goshawk. The attraction to these artificial perching sites is compounded by the presence of newly cleared servitudes beneath the power lines, which facilitate the movements of prey.

Statement of impact:

An electrocution occurs when a large bird is perched or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components.

Electrocution usually results in injury or mortality of birds, and ultimately in a reduction of breeding success.

The above impact could affect **raptors** (e.g. Lappet-faced Vulture [recorded breeding in study area], White-backed Vulture, Martial Eagle); other terrestrial birds that may perch on transformer structures (e.g. **near-endemic** Rüppell's Parrot, Damara Red-billed Hornbill, Monteiro's Hornbill); in particular, any birds that are **breeding/** rearing young; and **migrant** bird species.
The nature of the impact is adverse; direct; cumulative (interacting with impacts from other activities in the area); partly reversible.
The magnitude of change is considered low, involving mainly individuals (although in some cases, groups of vultures may be involved), with minor loss to populations.
The duration is long-term (life of the project), although permanent in the case of mortality; the scale of change is mainly on-site.
Electrocutions are possible/likely (without mitigation).
The **value/sensitivity of (biophysical) receptors**, i.e. birds, is rated as medium, i.e. important or rare on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change.

The **significance of the impact** is assessed as **moderate** (6 on a scale of 12): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impact is considered to be long-term, partly reversible and localised in extent.

The residual impact after mitigation is assessed as **minor** (4): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impacts is considered to be short-term, partly reversible and localised in extent.

Table 17. Summary of impact assessment: Bird electrocutions on power line infrastructure.

Description of activity	Receptor	Description of impact	Effect of impact/ description of magnitude	Value/ sensitivity	Magnitude of change	Significance	Residual impact after mitigation
An electrical short circuit, caused when a large bird is perched or attempts to perch on an electrical structure (e.g. power line pole, transformer/ step-down structure) and physically bridges the air gap between live components and/or live and earthed components (including by means of "streamers" of excrement)	Raptors (including Lappet-faced Vulture, White-backed Vulture, Martial Eagle) Perching, larger aquatic species (e.g. Great White Pelican) Other terrestrial birds that may perch on transformer structures (e.g. near-endemic Damara Red-billed Hornbill, Monteiro's Hornbill, Rüppell's Parrot) In particular, any birds that are breeding/ rearing young Migrant bird species	Electrocution of birds is caused by bird nesting, perching and other activities on an electrical structure, which creates a novel structure and attracts birds to high-risk areas; the impact usually results in mortality of individual birds.	Nature of impact: adverse Type of impact: direct, cumulative Reversibility: irreversible Duration: permanent Scale/extent: on-site/ local Probability: possible	Medium	Minor	Moderate (6)	Minor (4)

Mitigation recommendations

Construction phase

Minimisation:

- A perching structure should be fitted above each pole, to increase the clearance between the potentially risky components (Figure 26); this is becoming a standard mitigation measure (see NamPower standard 66kV transmission line pole drawings that will be used on the line, Figure 3).
- Jumpers should be offset where possible, and not placed above one another.

- Any stay wires should be "gapped" by the use of an insulator.

Operational phase

Minimisation:

- The need for reporting power line incidents should be stressed, and reporting procedures clarified (see Section 8, Monitoring below).

Figure 26. Example of use of a perching structure fitted as a mitigation for electrocutions to the 66 kV Eldorado-B2Gold steel monopole structure by a Brown Snake-eagle.

7.2.2.5 Attraction of birds to novel (artificial) habitats and resources created by the development

A potential impact of power line construction is the attraction of birds to novel habitats in an area by the artificial provision of otherwise scarce resources – for example perches and nest sites on poles and transformer structures. The attraction is compounded by the creation of a newly cleared servitude beneath the power line, which facilitates the movement of prey. Raptors in particular may use the nearby power line poles as convenient perches.

The provision of artificial habitats/resources such as power line poles and other structures could also result in negative impacts on the power supply (i.e. flash-overs) caused by bird nesting, perching and other activities (including "streamers" of excrement of raptors).

Scavengers such as crows may be attracted to the area by new food sources, e.g. food waste associated with construction workers.

Should crows nest on power line structures, this activity could result in outages as the nests may contain pieces of wire.

Statement of impact:

Birds may be attracted to novel habitats in an area by the artificial provision of otherwise scarce resources – for example perches and nest sites and, indirectly, newly cleared habitats that favour bird prey. This impact is potentially positive for birds, but may also increase the risk of collisions and/or electrocutions. The above attraction may further result in negative impacts on the power supply (i.e. flash-overs) caused by bird nesting, perching and other activities (including "streamers" of excrement of raptors).

The impact could affect **large terrestrial birds** (e.g. Kori Bustard, Ludwig's Bustard which, although they do not perch on poles, could be favoured by the newly cleared, open servitudes but attracted to areas at higher risk to collisions); **raptors** (e.g. White-backed Vulture, Lappet-faced Vulture, Martial Eagle, with increased opportunities for predation); other terrestrial birds that may perch on transformer structures (e.g. near-endemic Rüppell's Parrot, Damara Red-billed Hornbill, Monteiro's Hornbill; owls); in particular, any birds that are **breeding**/ rearing young; and **migrant** bird species, including raptors.

Electrocution impacts are discussed in Section 7.2.2.4 above.
The nature of the present impact is potentially positive for birds, but could also be adverse (increasing the risk for collisions or electrocutions); the impact could be adverse for the power supply; partly reversible (see recommended mitigations in Sections 7.2.2.3 and 7.2.2.4 above).
The magnitude of change is considered low, involving mainly individuals, with minor impacts to populations. Impacts to the power supply in the case of the present structure are also low. Monitoring is essential.
The duration is long-term (life of the project), although permanent in the case of mortality; the scale of change is mainly on-site.
The impact is likely.
The **value/sensitivity of (biophysical) receptors**, i.e. birds, is rated as medium, i.e. important or rare on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change.

The **significance of the impact** is assessed as **minor** (4 on a scale of 12): the impact is considered to be important, but unlikely to be a key decision-making factor. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and within accepted standards. The impact is considered to be long-term, partly reversible and localised in extent.

The residual impact after mitigation is assessed as **low** (2): impacts are local factors that are unlikely to be critical to decision-making.

Table 18. Summary of the impact assessment: Attraction of birds to novel (artificial) habitats and resources created by the development.

Description of activity	Receptor	Description of impact	Effect of impact/ description of magnitude	Value/ sensitivity	Magnitude of change	Significance	Residual impact after mitigation
Creation of novel (artificial) habitats and resources that could attract birds; although this impact is potentially positive for birds, it may result in negative impacts on the power supply (i.e. flash-overs) caused by bird nesting, perching and other activities (including "streamers" of excrement of larger birds).	Large terrestrial birds (e.g. Kori Bustard, Ludwig's Bustard, which could be favoured by the newly cleared, open servitudes but attracted to areas at higher risk to collisions); Raptors (e.g. White-backed Vulture, Lappet-faced Vulture, Martial Eagle, with increased opportunities for predation) Other terrestrial birds that may perch on transformer structures (e.g. near-endemic Rüppell's Parrot, Damara Red-billed Hornbill, Monteiro's Hornbill; owls) In particular, any birds that are breeding/ rearing young Migrant bird species, including raptors	Birds are attracted to and may occupy new habitats, temporarily or permanently, including perches and nest sites and, indirectly newly cleared habitats that favour bird prey This impact could also lead to negative impacts on infrastructure, caused by bird nesting, perching and other activities	Nature of impact: both beneficial and adverse for birds; but adverse for the power supply Type of impact: direct; cumulative Reversibility of impact: partly reversible Magnitude of change: e.g. low / moderate Duration: long-term (permanent in the case of mortality) Scale of change: on-site/local Probability: likely	Medium	Minor	Minor (4)	Low (2)

Mitigation recommendations

Construction phase

Avoidance:

- Ensure strict and effective waste management (including of food) during construction activities, to discourage an unnatural increase in scavenging species such as Pied Crow.

Operational phase

Minimisation:

- An adaptive management approach is recommended. Monitoring is essential to identify (potential) problem areas (see Section 8 below); any movement of hitherto unrecorded species into the power line servitude should be monitored; and any resulting negative impacts (e.g. increased collisions of bustards; electrocutions; perching or nesting activity; movements and numbers of crows), should be addressed accordingly.
- Should any nesting or other activity by crows (or other species) on power supply structures cause disruptions of the power supply, consult with the Ministry of Environment, Forestry and Tourism (MEFT) for appropriate measures to discourage and manage such activities, e.g. by removing nests at a stage when this is acceptable.
- *Also see mitigation measures recommended in Section 7.2.2.3 (power line collisions) and 7.2.2.4 (electrocutions) above.

7.3 Summary of impact assessment

Potential impacts of the development may be summarised as follows:

- Physical/human disturbance of birds (resulting in avoidance/displacement); this could include road mortalities and/or poaching during construction
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Direct and indirect modification/loss/destruction of bird habitat (resulting in avoidance/ displacement)
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Bird collisions with power line infrastructure, including power lines and associated structures (which could lead to injury of mortality of birds)
  - Rated as moderate-major (negative; 6-8), and minor-moderate (4-6) post-mitigation
- Bird electrocutions on power line infrastructure (including by streamers of excrement) (which could lead to injury/mortality of birds)
  - Rated as moderate (negative; 6), and minor (4) post-mitigation
- Attraction of birds to novel (artificial) habitats and resources created by the development; this impact could lead to negative impacts on infrastructure, caused by bird nesting, perching and other activities
  - Rated as minor (negative; 4), and low (2) post-mitigation. The provison of novel habitats to birds may have some positive impacts.

Overall significance of the impacts

The overall significance is negative, low-minor (total score 24-26, reduced to 14-16 with mitigation). The provison of novel habitats to birds may have some positive impacts.

Of the above, the impacts of bird collisions and of bird electrocutions on power line infrastructure receive the highest rating. Cumulative impacts are an important consideration.

7.4 Assessment of power line alternatives

The primary mitigation at the design stage is the choice of route options and alternatives for a power line; if possible, areas where impacts on birds are likely to take place (sensitive habitats/sites) should be avoided as far as possible.

Routes

Route 1: the preferred option

The route is 20.3 km long and has five bend points (structures with a higher risk, including stay wires).

One (live) Kori Bustard was observed on this route, in the mine area; and one more, and a Ludwig's Bustard, in the eastern part of the route.

Drainage lines occur on this route; bird activity and movements may be concentrated in such areas at times.

The route passes closer to the rocky hills habitats in the south-east, favoured by some Namibian near-endemic bird species.

Recommended areas requiring mitigation comprise a total of 8.4 km.

Route 2: the alternative option

The route is slightly longer: 24.6 km long and also has five bend points.

Habitat for both the above bustard species is available.

The route is further from the rocky hills habitats, but runs in parallel with the existing 66 kV power line (presenting a higher cumulative risk).

As above, drainage lines occur on this route.

Recommended areas requiring mitigation are relatively shorter, comprising a total of 7.5 km.

Assessment

From an avifauna point of view, both routes present risks to birds. Overall, the shorter route (No. 1, the preferred option) would comprise a relatively shorter area of risk, provided that recommended mitigation measures are applied.

Metering station sites

There is no difference from an avifaunal point of view in the two proposed alternative sites for the metering station.

8 Monitoring recommendations

The following monitoring initiatives should be conducted by the Proponent, in collaboration with and with the support of any other partners. Note that, should Ludwig's Bustards and/or Kori Bustards, or any other sensitive species start to visit the area regularly, the need for monitoring for power line incidents would increase proportionately.

If possible, the above monitoring activities should be aligned with any such activities for the proposed new 11 kV distribution line in the study area (subject of a separate report).

- Ensure that the entire power line is monitored in an acceptable way for any signs of bird mortalities resulting from the construction and operation of the line; ideally, regular dedicated monitoring patrols should be carried out once a month for at least the first year after construction, and thereafter at least once per quarter.
- Pay particular attention to sensitive areas such as those closest to drainage line systems, and rocky hills habitats.
- Also inspect other existing power lines in the area from time to time, to check for cumulative impacts.
- Monitor bird nesting and perching activities on power line structures and follow up if any electrocution incidents occur. Monitoring active vulture nests (from a distance, to avoid disturbance).
- Monitor numbers and nesting activity by species such as Cape Crow and Pied Crow; also monitor the management of food/vegetable wastes on construction sites strictly to avoid an increase in crow numbers.
- Set up a reporting channel, and clarify monitoring and reporting procedures and their importance to all partners. Record all bird mortalities on a standardised form, with the GPS locality, relevant power line structure and other details, and photographs of the bird carcass (including head and beak), structure and general habitat.
- Monitor the effectiveness of mitigation measures; should repeated incidents involving any priority species, or any other group of birds, occur, consider the retro-fitting of further mitigation; replace mitigation devices as and when necessary.

9 Conclusion

According to the avifauna baseline and scoping of sites and species, the study area is potentially sensitive in terms of birds and their habitats.

The study area lies ~12 km north-east of the town of Karibib, in Central Namibia (Figure 1 and 2). The area lies some 110 km from the nearest (large) formally protected area, the Namib-Naukluft Park, with the Dorob National Park to the west. The conservation status of the greater area is regarded as relatively high.

A relatively moderate-high bird species richness has been recorded in the study area and surrounds, with a total of 180 species, or 27% of the 676 species currently recorded in Namibia; however, the area is not well atlased in parts. To address any gaps, data from several sources were combined for an overall checklist.

Risk assessment and mitigation efforts are directed towards priority species, namely those that have a high biological significance, i.e. primarily Red Data species (including those with migrant status) and/or endemic or near-endemic species.

Twenty-three priority bird species have been short-listed from a total of 42 potential priority species, as a focal group identified as being at higher risk to potential impacts resulting from the proposed project. Although the focus of the impact assessment is on the short-listed species, the full priority list also needs to be taken into account due to the high species numbers and the difficulty in predicting those likely to be impacted. The emphasis should be on groups of birds likely to be at risk, rather than on individual species; and the precautionary principle should prevail.

The 23 short-listed priority bird species may be summarised in the following groups:

- 14 higher priority species (11 Red Data [7 also Globally Endangered] / 9 migrant / 4 near-endemic to Namibia), in the groups:
  - 2 large terrestrial species (2 Red Data / 1 partial migrant)
  - 6 raptors (4 Red Data / 3 migrant)
  - 4 Namibian near-endemics
  - 2 other large terrestrial migrants
- 9 non-Red Data / non-near-endemic priority raptor species

A further group of birds comprises species with the potential to impact on infrastructure.

Five potential impacts for the proposed 66 kV transmission power line have been identified and assessed (on a scale of 12), summarised as follows:

Potential impacts of the development may be summarised as follows:

- Physical/human disturbance of birds (resulting in avoidance/displacement); this could include road mortalities and/or poaching during construction
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Direct and indirect modification/loss/destruction of bird habitat (resulting in avoidance/ displacement)
  - Rated as minor (negative; 4), and low (2) post-mitigation
- Bird collisions with power line infrastructure, including power lines and associated structures (which could lead to injury of mortality of birds)
  - Rated as moderate-major (negative; 6-8), and minor-moderate (4-6) post-mitigation
- Bird electrocutions on power line infrastructure (including by streamers of excrement) (which could lead to injury/mortality of birds)
  - Rated as moderate (negative; 6), and minor (4) post-mitigation

- Attraction of birds to novel (artificial) habitats and resources created by the development; this impact could lead to negative impacts on infrastructure, caused by bird nesting, perching and other activities

    - Rated as minor (negative; 4), and low (2) post-mitigation. The provison of novel habitats to birds may have some positive impacts.

Overall significance of the impacts

The overall significance is negative, low-minor (total score 24-26, reduced to 14-16 with mitigation). The provison of novel habitats to birds may have some positive impacts.

Of the above, the impacts of bird collisions and of bird electrocutions on power line infrastructure receive the highest rating. Cumulative impacts are an important consideration.

Recommendations are made for the mitigation and management, and for the monitoring of the above impacts. Route alternative 1 is recommended as the preferred option. It is considered that the application of these recommendations will reduce the impacts associated with the construction of the 66 kV power line.

Acknowledgements

We would like to thank the following persons for their invaluable assistance with this report and the site visits:

Environmental Compliance Consultancy: Samuel Shinyemba

GSFA Consulting Engineers: Francois de Wet (technical information)

Osino Gold Exploration and Mining (Pty) Ltd: Sem Nakale, Johannes Salies

Farm Karibib: Wilson Lungu (owner); Jaco & Lisma Uys (manager); Blasius (foreman)

References

Anon. 2012. Government Gazette of the Republic of Namibia No. 4878, Windhoek, 6 February 2012.

Anon. 2020. Environmental Impact Assessment for the B2Gold transmission power line, Otjiwarongo. Avifauna baseline/scoping and assessment. African Conservation Services cc, for Environmental Compliance Consultancy, Windhoek.

Anon. 2021. Electrocutions & Collisions of Birds in EU Countries: The Negative Impact & Best Practice for Mitigation. Raptor Protection of Slovakia.

Atlas of Namibia Team. 2022. Atlas of Namibia: its land, water and life. Namibia Nature Foundation, Windhoek.

Barrientos R, Alonso JC, Ponce C, Palacín C 2011. Meta-analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893–903. DOI: 10.1111/j.15231739.2011.01699. x.

Barrientos R, Ponce C, Palacín C, Martín CA, Martín B, Alonso JC 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI designed study. PLoS ONE, 7(3): 1–10. DOI:10.1371/journal.pone.0032569.

Barnes KN (ed.) 1998. The Important Bird Areas of southern Africa, BirdLife South Africa, Johannesburg.

Bennun L, Van Bochove J, Ng C, Fletcher C, Wilson D, Phair N, Carbone G. 2021. Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy. 229pp.

Bernardino J, Bevanger K, Barrientos R, Dwyer JF, Marques AT, Martins RC, Shaw JM, Silva JP, Moreira F 2018. Bird collisions with power lines: State of the art and priority areas for Research. Biological Conservation 222 (2018) pp1-13.

Bernardino J, Martins RC, Bispo R, Moreira F 2019. Re-assessing the effectiveness of wire-marking to mitigate bird collisions with power lines: A meta-analysis and guidelines for field studies. Journal of Environmental Management 252 (2019) 109651 1-10.

Bevanger K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412-425.

Bevanger K. 1998. Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biological Conservation 86: 67-76.

Brooks M, Rose S, Altwegg R, Lee ATK, Nel H, Ottosson U, Retief E, Reynolds C, Ryan PG, Shema S, Tende T, Underhill LG, Thomson RL. 2022. The African Bird Atlas Project: a description of the project and BirdMap data-collection protocol, Ostrich, DOI: 10.2989/00306525.2022.2125097. To link to this article: https://doi.org/10.2989/00306525.2022.2125097.

Brown CJ, Mendelsohn JM, Thomson N, Boorman M. 2017. Checklist and analysis of the birds of Namibia as at January 2016. Biodiversity Observations 8.20: 1-153 URL: http://bo.adu.org.za/content.php?id=315 (Published online 22 April 2017).

Chittenden H, Davies G, Weiersbye I. 2016. Roberts Bird Guide. Second edition. Trustees of the John Voelcker Bird Book Fund, Cape Town, South Africa.

D'Amico M, Martins RC, Álvarez-Martínez JM, Porto M, Rafael Barrientos R, Moreira F 2019. Bird collisions with power lines: Prioritizing species and areas by estimating potential population-level

impacts. Diversity and Distributions, Vol. 25, No. 6 (June 2019), pp. 975-982. https://www.jstor.org/stable/26635144

EIS 2023. Environmental Information Service, www.the-eis.com.

Environmental Compliance Consultancy 2019. Best practice guide – Environmental Principles for Mining in Namibia. Phase 4: Mining and processing operations. Case study by NamPower/Namibia Nature Foundation: Best practice for monitoring of powerlines and energy producing structures on mines, pp 22-25 (available on https://n-c-e.org/resources/best-practice-guides and https://chamberofmines.org.na/service/sustainable-development/).

Gális M, Ševčík M 2019. Monitoring of effectiveness of bird flight diverters in preventing bird mortality from powerline collisions in Slovakia. Raptor Journal 2019, 13: 45–59. DOI: 10.2478/srj20190005. © Raptor Protection of Slovakia (RPS).

Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V, Brown CJ (eds). 1997. The atlas of southern African birds. Vol 1: Non-Passerines, and Vol 2: Passerines. BirdLife South Africa, Johannesburg.

Hockey PAR, Dean WRJ, Ryan PG (eds). 2005. Roberts Birds of Southern Africa, 7th Edition. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

IFC 2012. Performance Standards on Environmental and Social Sustainability. International Finance Corporation (www.ifc.org).

IFC 2013. Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. International Finance Corporation. IFC_GoodPracticeHandbook_CumulativeImpactAssessment.pdf

IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-1 <http://www.iucnredlist.org>.

Jenkins AR, Smallie JJ, Diamond M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.

Kolberg H. 2015. Namibia's Important Bird and Biodiversity Areas 1: Introduction and Overview. Lanioturdus. 48.

Kolberg H. 2022. Tracked vultures. Lanioturdus 55(4).

Lehman RN, Kennedy PL, Savidge JA. 2007. The state of the art in raptor electrocution research: a global review. Biological Conservation 136: 159-174.

Martin, G, Shaw, J. 2010. Bird collisions with power lines: Failing to see the way ahead? Biological Conservation 143: 2695-2702.

Martin GR. 2011. Understanding bird collisions with man-made objects: a sensory ecology approach. Ibis 153, 239–254. http://dx.doi.org/10.1111/j.1474-919X.2011.01117.x.

Martin GR. 2022. Vision-Based Design and Deployment Criteria for Power Line Bird Diverters. Birds 2022, 3, 410–422. https://doi.org/10.3390/birds3040028.

Mendelsohn J, Jarvis A, Roberts S, Robertson T. 2002. Atlas of Namibia. A Portrait of the Land and its People. David Philip Publishers, Cape Town.

Prinsen HAM, Smallie JJ, Boere GC, Pires N (Eds) 2011. Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region. Bonn: AEWA Conservation Guidelines No. 14, CMS Technical Series No. 29, AEWA Technical Series No. 50, CMS Raptors MOU Technical Series No. 3.

Scottish Natural Heritage 2016. Assessment and mitigation of impacts of power lines and guyed meteorological masts on birds. Guidance. Version 1, July 2016.

Shaw JM. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard (PhD Thesis). University of Cape Town, Cape Town.

Shaw JM, Reid TA, Schutgens M, Jenkins AR, Ryan PG. 2018. High power line collision mortality of threatened bustards at a regional scale in the Karoo, South Africa. Ibis 160, 431–446.

Shaw JM, Reid TA, Gibbons BK, Pretorius M, Jenkins AR, Visagie R, Michael MD, Ryan PG 2021. A large-scale experiment demonstrates that line marking reduces power line collision mortality for large terrestrial birds, but not bustards, in the Karoo, South Africa. *Ornithological Applications*, Volume 123, Issue 1, 1 February 2021, duaa067, https://doi.org/10.1093/ornithapp/duaa067

Silva JP, Marques AT, Bernardino J, Allison T, Andryushchenko Y, Dutta S, Kessler A, Martins RC, Moreira F, Pallett J, Pretorius MD, Scott HA, Shaw JM, Collar NJ. 2022. The effects of powerlines on bustard populations: how best to mitigate, how best to monitor? Biological Conservation International.

Simmons RE, Boix-Hinzen C, Barnes KN, Jarvis AM, Robertson A. 1998. Important Bird Areas of Namibia. in: The Important Bird Areas of southern Africa. Barnes, KN (ed.). pp295-332. BirdLife South Africa, Johannesburg.

Simmons RE, Boix-Hinzen C, Barnes K, Jarvis AM, Robertson A. 2001. Namibia. In: Important Bird Areas of Africa and Associated Islands: Priority Sites for Conservation. Fishpool, L.D.C. and Evans, M.I. (eds) pp 639-660 Pisces Publications/BirdLife International, Newbury/Cambridge, UK.

Simmons RE, Brown CJ, Kemper J. 2015. Birds to watch in Namibia: red, rare and endemic species. Ministry of Environment and Tourism and Namibia Nature Foundation, Windhoek.

World Bank 2007. Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution. April 20, 2007.

World Bank 2016. World Bank Environmental and Social Framework. World Bank, Washington, DC. https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf#page=81&zoom=80

Appendix 1: Checklist of bird species recorded in the Osino Twin Hills Gold Project 66 kV power line, Erongo Region, Namibia (April-May 2023)

*Scientific and common names according to Roberts Bird Guide 2016 (Chittenden *et al.* 2016)

180 species

KEY:

RDB = Red Data/conservation status (Brown *et al.* 2017) CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern; G = global status; rare = now rare in Namibia

END = Endemism: (Brown *et al.* 2017): NE = near-endemic; Nam = Namibia (≥90% of population in Namibia)

RES = Residency (for Red Data species): Res = resident, Nom = nomadic, Mig = Red Data species that have migrant status, Pal = Palearctic-breeding, intra-Afr mig = intra-African migrant, mov = local/seasonal movements

SABAP1 EIS: Southern African Bird Atlas Project 1 data that was published as Harrison *et al.* (1997), available on EIS 2019

SABAP1 NAD: Southern African Bird Atlas Project 1 and other data, available on Namibian Avifaunal Database (NAD; www.biodiversity.org.na)

SABAP2: Southern African Bird Atlas Project 2 data, available on http://sabap2.adu.org.za; 4 pentads; rep = reported

Oct 2019 & Oct 2022: personal observations September/October 2019 and October 2022

Local abundance: based on SABAP1 & SABAP2 data and personal observations (scale 1-3)

Potential impact: D = disturbance; H = habitat modification/destruction; C = collisions on power line infrastructure; E = electrocutions on power line infrastructure; N = impacts caused by creation of novel habitats (for perching, nesting etc.)

Probability (also taking into account local abundance): D = definite, H = high; M = moderate; L = low; I = improbable

Priority species potentially at risk from the project are highlighted

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Babbler	Southern Pied	*Turdoides*	*bicolor*			√					
Barbet	Acacia Pied	*Tricholaema*	*leucomelas*			√	75.0	2022	√	A M	
Batis	Pririt	*Batis*	*pririt*			√	50.0	2019	√	A	
Bee-eater	European	*Merops*	*apiaster*			√					
Bee-eater	Swallow-tailed	*Merops*	*hirundineus*			√	25.0	2017		A	
Brubru	Brubru	*Nilaus*	*afer*			√	25.0	2015			
Bulbul	African Red-eyed	*Pycnonotus*	*nigricans*			√	50.0	2022	√	A M	
Bunting	Cape	*Emberiza*	*capensis*			√					
Bunting	Cinnamon-breasted	*Emberiza*	*tahapisi*			√	0.0	2015			
Bunting	Golden-breasted	*Emberiza*	*flaviventris*			√					
Bunting	Lark-like	*Emberiza*	*impetuani*			√	75.0	2022			
Bustard	**Kori**	*Ardeotis*	*kori*	NT, G NT, nom		√	25.0	2015		A (2)	
Bustard	**Ludwig's**	*Neotis*	*ludwigii*	EN, G EN, nom, partial mig		√	25.0	2014		A (1)	
Buzzard	**Augur**	*Buteo*	*augur*	Res, nom		√					
Buzzard	**Common (Steppe)**	*Buteo*	*buteo*	Pal mig		√	25.0	2023			
Camaroptera	Grey-backed	*Camaroptera*	*brevicaudata*			√				A?	
Canary	Black-throated	*Crithagra*	*atrogularis*			√	25.0	2017			
Canary	White-throated	*Crithagra*	*albogularis*			√	50.0	2018			

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Canary	Yellow	*Crithagra*	*flaviventris*			√	25.0	2018		A?	
Chat	Ant-eating	*Myrmecocichla*	*formicivora*			√	25.0	2015		M	
Chat	Familiar	*Oenanthe*	*familiaris*			√	25.0	2015			
Chat	**Herero**	*Namibornis*	*herero*	NamNE			50.0	2019			
Chat	Karoo	*Emarginata*	*schlegelii*			√	25.0	2016			
Cisticola	Desert	*Cisticola*	*aridulus*			√	25.0	2015	√		
Cisticola	Rattling	*Cisticola*	*chiniana*						√		
Courser	Burchell's	*Cursorius*	*rufus*			√					
Courser	Double-banded	*Rhinoptilus*	*africanus*			√				A	
Courser	Temminck's	*Cursorius*	*temminckii*			√					
Crombec	Long-billed	*Sylvietta*	*rufescens*			√	25.0	2014			
Crow	**Pied**	*Corvus*	*albus*				25.0	2018			
Cuckoo	African	*Cuculus*	*gularis*			√	0.0	2019			
Cuckoo	Black	*Cuculus*	*clamosus*			√					
Cuckoo	Diederik	*Chrysococcyx*	*caprius*			√	25.0	2014			
Cuckoo	Great Spotted	*Clamator*	*glandarius*			√					
Cuckoo	Jacobin	*Clamator*	*jacobinus*			√					
Dove	Cape Turtle (Ring-necked)	*Streptopelia*	*capicola*			√	100.0	2022	√	A M	
Dove	Laughing	*Spilopelia*	*senegalensis*			√	75.0	2022		A	
Dove	Namaqua	*Oena*	*capensis*			√	100.0	2023	√		
Dove (Pigeon)	Rock (Feral)	*Columba*	*livia*	Alien		√	25.0	2019			
Drongo	Fork-tailed	*Dicrurus*	*adsimilis*			√	75.0	2022	√	A M	
Duck	Comb (Knob-billed)	*Sarkidiornis*	*melanotos*			√					

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Eagle	**Black-chested Snake**	*Circaetus*	*pectoralis*	Res, nom		√	25.0	2015	√		
Eagle	**Booted**	*Hieraaetus*	*pennatus*	Pal mig		√					
Eagle	**Brown Snake**	*Circaetus*	*cinereus*	Res, nom		√	0.0	2020			
Eagle	**Martial**	*Polemaetus*	*bellicosus*	EN, G EN; res		√	25.0	2015			
Eagle	**Steppe**	*Aquila*	*nipalensis*	EN, G EN, Pal mig		√					
Eagle	**Tawny**	*Aquila*	*rapax*	EN		√					
Eagle	**Verreauxs'**	*Aquila*	*verreauxii*	NT; res		√					
Eagle-Owl	**Spotted**	*Bubo*	*africanus*	Res		√					
Eagle-Owl	**Verreaux's (Giant)**	*Aquila*	*verreauxii*	Res		√					
Eremomela	Yellow-bellied	*Eremomela*	*icteropygialis*			√	25.0	2015	√		
Falcon	**Lanner**	*Falco*	*biarmicus*			√	25.0	2014		M	
Falcon	**Pygmy**	*Polihierax*	*semitorquatus*			√	25.0	2015	√	M	
Finch	Red-headed	*Amadina*	*erythrocephala*			√	75.0	2018	√	A?	
Fiscal	Southern (Common)	*Lanius*	*collaris*			√	75.0	2022	√	A	
Flycatcher	Chat	*Melaenornis*	*infuscatus*			√	50.0	2019	√	A M	
Flycatcher	Marico	*Melaenornis*	*mariquensis*			√	75.0	2018	√	A	
Flycatcher	Spotted	*Muscicapa*	*striata*			√					
Go-away-bird	Grey	*Crinifer*	*concolor*			√	0.0	2019			
Goose	Egyptian	*Alopochean*	*aegyptiaca*							M	
Goshawk	**Gabar**	*Micronisus*	*gabar*	Res		√	25.0	2018			

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Goshawk	**Pale Chanting**	*Melierax*	*canorus*	Sed, movements		√	25.0	2023	√	A M	
Guineafowl	Helmeted	*Numida*	*meleagris*			√	0.0	2013		A	
Hawk-eagle	**African**	*Aquila*	*spilogaster*	Res, sed		√	25.0	2014		A (2)	
Heron	Grey	*Ardea*	*cinerea*			√					
Honeyguide	Lesser	*Indicator*	*minor*			√					
Hoopoe	African	*Upupa*	*africana*			√	25.0	2019			
Hornbill	African Grey	*Lophoceros*	*nasutus*			√					
Hornbill	**Damara Red-billed**	*Tockus*	*damarensis*	NamNE			25.0	2018		A (1)	
Hornbill	**Monteiro's**	*Tockus*	*monteiri*	NamNE		√	50.0	2022	√	M (3)	
Hornbill	(Southern) Red-billed	*Tockus*	*erythrorhynchus*			√					
Hornbill	Southern Yellow-billed	*Tockus*	*leucomelas*			√	25.0	2016	√	A	
Kestrel	**Greater**	*Falco*	*rupicoloides*	Sed, movements		√	0.0	2019			
Kestrel	**Rock**	*Falco*	*rupicolus*	Res		√	25.0	2022		A M (+ juv)	
Kite	**Black-winged**	*Elanus*	*caeruleus*	Nom		√	0.0	2022			
Kite	**Yellow-billed**	*Milvus*	*aegyptius*				25.0	2023			
Korhaan	Northern Black	*Afrotis*	*afraoides*			√	50.0	2022		A M	
Korhaan	Red-crested	*Lophotis*	*ruficrista*			√	25.0	2014		A	
Korhaan	**Rüppell's**	*Eupodotis*	*rueppellii*	NamNE		√					
Lapwing	Blacksmith	*Vanellus*	*armatus*			√				M	
Lapwing	Crowned	*Vanellus*	*coronatus*			√	25.0	2015	√	A M	
Lark	Dusky	*Pinarocorys*	*nigricans*			√					

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Lark	Fawn-colored	*Calendulauda*	*africanoides*			√	25.0	2015			
Lark	Monotonous	*Mirafra*	*passerina*				25.0	2014			
Lark	Red-capped	*Calandrella*	*cinerea*			√					
Lark	Sabota	*Calendulauda*	*sabota*			√	100.0	2022	√	A? M	
Lark	Spike-heeled	*Chersomanes*	*albofasciata*			√					
Lark	Stark's	*Spizocorys*	*starki*					0.0	2014	A M	
Lovebird	Rosy-faced	*Agapornis*	*roseicollis*			√	25.0	2023		A M	
Martin	Rock	*Ptyonoprogne*	*fuligula*			√	75.0	2023	√		
Mousebird	Red-faced	*Urocolius*	*indicus*			√					
Mousebird	White-backed	*Colius*	*colius*			√	25.0	2015		A	
Nightjar	Rufous-cheeked	*Caprimulgus*	*rufigena*			√					
Owl	**African Scops**	*Otus*	*senegalensis*	Res		√					
Owl	**Western Barn**	*Tyto*	*alba*	Res		√					
Owlet	**Pearl-spotted**	*Glaucidium*	*perlatum*	Res		√					
Parrot	**Rüppell's**	*Poicephalus*	*rueppellii*	NT, NamNE (nom)		√					
Pelican	**Great White**	*Pelecanus*	*onocrotalus*	VU; sed, nom		√					
Pigeon	Speckled (Rock)	*Columba*	*guinea*			√	25.0	2022		A M	
Pipit	African	*Anthus*	*cinnamomeus*			√				A?	
Plover	Three-banded	*Charadrius*	*tricollaris*			√				M	
Prinia	Black-chested	*Prinia*	*flavicans*			√	75.0	2022		A M	
Puffback	Black-backed	*Dryoscopus*	*cubla*			√					
Pytilia	Green-winged	*Pytilia*	*melba*			√			√		
Quail	Common	*Coturnix*	*corturnix*			√					

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Quelea	Red-billed	*Quelea*	*quelea*			√				A?	
Rockrunner	**Rockrunner**	*Aechaetops*	*pycnopygius*	NamNE		√	50.0	2022			
Roller	European	*Coracias*	*garrulus*								
Roller	Lilac-breasted	*Coracias*	*caudatus*			√	0.0	2021			
Roller	Purple	*Coracias*	*naevius*			√	0.0	2017	√		
Sandgrouse	Double-banded	*Pterocles*	*bicinctus*			√					
Sandgrouse	Namaqua	*Pterocles*	*namaqua*	(End s Afr)		√	25.0	2015		A	
Sandpiper	Wood	*Tringa*	*glareola*			√					
Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*			√	25.0	2018			
Scrub Robin	Kalahari	*Cercotrichas*	*paena*			√	50.0	2015	√	A	
Secretarybird		*Sagittarius*	*serpentarius*	VU, G EN; res, nom		√					
Shelduck	South African	*Tadorna*	*cana*			√					
Shikra		*Accipiter*	*badius*			√					
Shrike	Crimson-breasted	*Laniarius*	*atrococcineus*			√	50.0	2019	√	A M	
Shrike	Lesser Grey	*Lanius*	*minor*			√	50.0	2022			
Shrike	Red-backed	*Lanius*	*collurio*			√	25.0	2014			
Shrike	**White-tailed**	*Lanioturdus*	*torquatus*	NamNE		√	50.0	2022	√		
Sparrow	Cape	*Passer*	*melanurus*			√	0.0	2018		M	
Sparrow	Great	*Passer*	*motitensis*			√	100.0	2022	√	M	
Sparrow	House	*Passer*	*domesticus*			√	50.0	2022			
Sparrow	Southern Grey-headed	*Passer*	*diffusus*			√	50.0	2015			
Sparrow-Lark	Grey-backed	*Eremopterix*	*verticalis*			√	100.0	2022			

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Sparrow-Weaver	White-browed	*Plocepasser*	*mahali*			√	100.0	2023	√	A M (active nests)	
Spurfowl	Hartlaub's	*Pternistis*	*hartlaubii*	NamNE		EIS 2023					
Spurfowl	Red-billed	*Pternistis*	*adspersus*			√					
Starling	Burchell's	*Lamprotornis*	*australis*			√					
Starling	Cape (Glossy)	*Lamprotornis*	*nitens*			√	100.0	2022	√	A M	
Starling	Pale-winged	*Onychognathus*	*nabouroup*			√	50.0	2022		A M	
Starling	Violet-backed	*Cinnyricinclus*	*leucogaster*			√	25.0	2014			
Starling	Wattled	*Creatophora*	*cinerea*			√					
Stork	**Abdim's**	*Ciconia*	*abdimii*	Intra-Afr mig		√	0.0	2020			
Stork	Marabou	*Leptoptilos*	*crumenifer*	Res		√					
Stork	**White**	*Ciconia*	*ciconia*	Pal mig		√					
Stork	**Woolly-necked**	*Ciconia*	*episcopus*	Res, mig			0.0	2021			
Sunbird	Amethyst	*Chalcomitra*	*amethystina*				0.0	2015			
Sunbird	Dusky	*Cinnyris*	*fuscus*			√	50.0	2015	√	A?	
Sunbird	Marico	*Cinnyris*	*mariquensis*			√					
Sunbird	Scarlet-chested	*Chalcomitra*	*senegalensis*			√					
Swallow	Barn	*Hirundo*	*rustica*			√	0.0	2019			
Swallow	Greater Striped	*Cecropis*	*cucullata*			√	25.0	2014		A	
Swallow	Pearl-breasted	*Hirundo*	*dimidiata*			√	0.0	2015			
Swift	African Palm	*Cypsiurus*	*parvus*			√	25.0	2019			
Swift	Alpine	*Tachymarptis*	*melba*			√	0.0	2022			
Swift	Bradfield's	*Apus*	*bradfieldi*			√	25.0	2017			
Swift	Common	*Apus*	*apus*			√	0.0	2022			

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Swift	Little	*Apus*	*affinis*			√	50.0	2023	√		
Swift	White-rumped	*Apus*	*caffer*			√	0.0	2015	√	A?	
Tchagra	Brown-crowned	*Tchagra*	*australis*			√	25.0	2015			
Teal	Red-billed	*Anas*	*erythrorhyncha*			√					
Thick-knee	Spotted	*Burhinus*	*capensis*			√					
Thrush	Groundscraper	*Turdus*	*litsitsirupa*			√					
Thrush	Short-toed Rock	*Monticola*	*brevipes*			√	50.0	2015	√		
Tit	Ashy	*Melaniparus*	*cinerascens*			√	25.0	2015			
Tit	Cape Penduline	*Anthoscopus*	*minutus*			√					
Tit	**Carp's**	*Melaniparus*	*carpi*	NamNE		√					
Vulture	**Lappet-faced**	*Torgos*	*tracheliotos*	EN, G EN; res, movements		√	25.0	2015		M (= active nest J Uys)	
Vulture	**White-backed**	*Gyps*	*africanus*	CR, G CR			0.0	2022		A (20)	
Wagtail	Cape	*Motacilla*	*capensis*			√	0.0	2016		M	
Warbler	Chestnut-vented	*Curruca*	*subcoerulea*			√	25.0	2015	√	A	
Warbler	Sedge	*Acrocephalus*	*schoenobaenus*			√				A (old nests)	
Warbler	Willow	*Phylloscopus*	*trochilus*			√					
Waxbill	Black-faced	*Brunhilda*	*erythronotos*			√				A?	
Waxbill	Violet-eared	*Granatina*	*granatina*			√	50.0	2015			
Weaver	Chestnut	*Ploceus*	*rubiginosus*			√	0.0	2022			
Weaver (Buffalo-Weaver)	Red-billed Buffalo	*Bubalornis*	*niger*			√				A (old nests)	
Weaver	Scaly-feathered	*Sporopipes*	*squamifrons*			√	50.0	2017	√	A M	

Common group	Common species	Genus	Species	Priority status	Hab	SABAP1 [1987-1991]	2155_1550		2150_1555	Greater area 2023 (A = April, M = May)	Prob
							FP (RR%)	Latest record	[2022]		
Weaver	Sociable	*Philetairus*	*socius*			√	100.0	2022		A M (active nests)	
Weaver	Southern Masked	*Ploceus*	*velatus*			√	75.0	2022	√	M	
Wheatear	Capped	*Oenanthe*	*pileata*			√	75.0	2022		A M	
Wheatear	Mountain	*Myrmecocichla*	*monticola*			√	25.0	2015		M	
Wood-hoopoe	Green	*Phoeniculus*	*purpureus*			√					
Woodpecker	Bearded	*Dendropicos*	*namaquus*			√					
Woodpecker	Cardinal	*Dendropicos*	*fuscescens*			√					
Woodpecker	Golden-tailed	*Campethera*	*abingoni*			√			√		
Wren-Warbler	Barred	*Calamonastes*	*fasciolatus*			√	25.0	2014			
TOTAL 180 spp						**174**	**109**		**37**		