Environmental Impact Assessment for an 11 kV distribution power line for the proposed Otjikoto agricultural project, Otjiwarongo

Avifauna baseline/scoping and assessment

Prepared by:

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Prepared for:

Environmental Compliance Consultancy

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Name of project	**Environmental Impact Assessment for an 11 kV distribution power line for the proposed B2Gold Otjikoto agricultural project, Otjiwarongo** **Avifauna baseline/scoping and assessment**
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Executive summary

B2Gold Namibia (Pty) Ltd (B2Gold) is conducting an Environmental Impact Assessment (EIA) for a proposed new 11 kV overhead distribution power line from the B2Gold Mine solar farm to a proposed agriculture project for the mine, some 70 km north-east of Otjiwarongo in northern Namibia. The power line will be 8.1 km long and of standard horizontal line post compact delta (HLPCD) overhead distribution structure. No alternative structures were assessed.

Environmental Compliance Consultancy (ECC) has been appointed by B2Gold to undertake the EIA process for the proposed project. The present avifauna baseline/scoping and assessment forms part of this EIA, and is based in part on a previous recent avifauna study in the same area for the B2Gold transmission line (ACS for ECC 2020).

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 55 km north-west of the Waterberg Plateau Park, with the Etosha National Park 135 km further to the north-west. Both national parks are also classed as Important Bird Areas, or places of international significance for the conservation of birds at the Global, Regional or Sub-regional level.

The study area falls within the Tree-and-shrub Savanna biome, with heavily bush-encroached Thornbush Shrubland, dominated by *Acacia* tree and bush species. Three main avifauna habitats in the area include farmland on the plains; (mainly ephemeral) aquatic habitats; and the agricultural irrigated habitats that will be created. On farmland, larger trees (mainly *Acacia luederitzii*) provide nesting habitats for large raptors, including at least eight known active nests for White-backed Vultures; the more open habitats are used by Kori Bustard; and accessible watering points are used by many kinds of birds. The group of aquatic habitats includes a system of shallow ephemeral pans, and earth dams, that are reported to hold water regularly during the rainy season, when many waterbirds may move into the area. On the adjacent B2Gold Mine property, a large ephemeral pan on the nature reserve section is also reported to hold water during the rainy season, while a large (perennial) sewage pond and tailings dam are situated on or near the main entrance road to the mine; these habitats also attract a variety of waterbirds.

A relatively high diversity of bird species has been recorded in the study area and surrounds, with a total of 217 species, or 32% of the 676 species currently recorded in Namibia; however, the birdlife of the area is not well documented in parts. The field trip for the previous study also took place under drought conditions, when the bird diversity observed was fairly low. To address these limitations, data from several sources were combined for an overall checklist.

The checklist includes 18 species (9% of the total) that are threatened in Namibia (and comprising 25% of the 71 species on the Namibian Red Data List); eleven of the 18 species are also Globally Threatened. In particular, the adjacent Waterberg area is well known for its populations of several species of threatened vultures and other raptors. Satellite tracking data indicate that Cape Vultures (now rare) have regularly visited the study area in the past, and perched/roosted on the existing 220 kV Gerus-Otjikoto power line in the past, a behaviour that could increase the risk of collisions on power lines.

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-one species are considered to have the potential to be impacted by power line structures (including 18 Red Data species, four Namibian near-endemic species and four with migrant status), namely:

- *Raptors (8)*
  White-backed Vulture (Critically Endangered, also Globally Critically Endangered)

Cape Vulture (Critically Endangered, also Globally Endangered; now rare in Namibia)
Lappet-faced Vulture (Endangered, also Globally Endangered)
Martial Eagle (Endangered, also Globally Vulnerable)
Bateleur (Endangered, also Globally Near Threatened)
Tawny Eagle (Endangered)
Secretarybird (Vulnerable, also Globally Vulnerable)
Red-footed Falcon (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)

- *Large terrestrial (cursorial) species (2)*
  Blue Crane (Critically Endangered, also Globally Vulnerable; now rare in Namibia)
  Kori Bustard (Near Threatened, also Globally Near Threatened)
- *Aquatic species (7)*
  Saddle-billed Stork (Endangered)
  Lesser Flamingo (Vulnerable, also Globally Near Threatened; intra-African migrant)
  Greater Flamingo (Vulnerable) (intra-African migrant)
  Great White Pelican (Vulnerable)
  Bar-tailed Godwit (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)
  Black-necked Grebe (Near Threatened)
  Marabou Stork (Near Threatened)
- *Other smaller birds/Namibian near-endemic species (4)*
  Rüppell's Parrot (Near Threatened)
  Damara (Red-billed) Hornbill
  Monteiro's Hornbill
  Carp's Tit

The impacts of power line structures on avifauna and recommended mitigation measures are well documented, both globally and for the southern African subregion. Three main potential impacts have been identified for the project.

- *Physical disturbance of birds and habitat destruction/modification during the construction of power lines*

During the construction phase of a project, physical disturbance to birds, as well as habitat destruction and/or modification, will take place. Birds may be disturbed while going about their daily activities such as feeding, roosting and, in particular, breeding.

Groups/habitats at particular risk to these impacts include nesting White-backed Vulture and Lappet-faced Vulture, and other raptors nesting in large trees; the ground-nesting Kori Bustard; and nesting near-endemic species.

This impact is assessed as follows: sensitivity and value high; magnitude of change minor; significance rating moderate, reduced to minor by mitigation.

- *Collision of birds on power line structures*

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 until it is too late to take evasive action.

The species most susceptible 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 unfavourable conservation status. The collision risk is believed to be increased by factors such as a large wingspan and low manoeuvrability, limited frontward vision when flying in some species, nomadic/migrant habits, flying in low light (e.g. flamingos and other waterbirds), courtship behaviour, juvenile

inexperience, and predation; and flying under adverse weather conditions. Collisions may take place on overhead cables as well as on stay wires and other associated structures.

All the above 21 priority bird species are potentially at risk to collisions on power line structures. Areas of particular concern include flight paths around areas with large trees, used for nesting by vultures and other raptors; open areas along fence-lines/roadways/power line servitudes, used by Kori Bustard; and areas around water points accessible to birds, and other (ephemeral) aquatic habitats, when they hold water.

This impact is assessed as follows: sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation.

- *Electrocution of birds on power line structures*

An electrocution occurs when a bird is perched or attempts to perch on an electrical structure (e.g. pole, transformer) and causes an electrical short circuit by physically bridging the air gap between live components and/or between live and earthed components. An electrocution could also be caused should a large bird perch on top of a pole and send down a "streamer" of excrement that could hit a conductor, thereby bridging the gap between an earthed and a live component.

Electrocutions of large raptors, mainly vultures, are possible on the proposed HLPCD structure, should the birds perch or attempt to perch on the insulators and simultaneously touch a conductor and the (earthed) pole. As Lappet-faced Vultures have a wingspan of 2.8 m; Cape Vultures 2.6 m; and White-backed Vultures 2.2 m, there is a considerable risk of electrocution on this structure. The risk is increased by the gregarious nature of the vultures, where one or more birds may attempt to perch on the same spot; or if the bird is wet.

Priority bird species in the study area that may potentially be impacted by electrocution in the above way include at least six large raptors, namely White-backed Vulture, Lappet-faced Vulture, Cape Vulture, Martial Eagle, Tawny Eagle and Bateleur. Tower structures adjacent to areas used regularly by vultures/raptors, including breeding sites on large trees, and water points would be more sensitive to such risks.

Electrocution of birds on power line structures is assessed as follows: sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation.

- *Impacts on the power supply due to bird nesting and other activities*

Bird nesting and other activities on power line structures have the potential to cause flash-overs, with disruptions to the power supply. The risk is higher in wet weather.

The potential for species such as Sociable Weaver (and Red-Billed Buffalo Weaver), and Pied Crow and Cape Crow to impact negatively on the proposed power supply structures is considered relatively low, however.

This impact is assessed as follows: sensitivity and value low (nuisance factor to human activities); magnitude of change negligible; significance rating low, no mitigation recommended.

Although recorded mortalities may be in low numbers, the cumulative impacts of any negative interactions over the entire lifespan of the power line are an important consideration, viewed in association with the increase in power lines and other linear infrastructure in the study area, and the increasing effects of other human activities. Sensitive species that are already under threat, including Red Data and (near-)endemic species, as well as nomads/migrants are at particular risk to such cumulative effects. In particular, the mounting threats to vulture populations throughout the region are well documented; these include poisoning (both indirect and targetted); disturbance and loss of habitat; bush encroachment and its negative effect on the ability of vultures to find food; and trade in vulture parts for traditional medicine.

Mitigation measures are aimed at avoiding, minimising or rehabilitating negative impacts or enhancing potential benefits. The primary mitigation is the choice of route options and alternatives for a power line; if possible, areas where impacts on birds are likely to take place should be avoided.

In view of the cumulative impacts of overhead structures in the area, the relatively short length of the proposed power line, and its proposed routing that includes along sections of already disturbed servitudes/roads, the possibility of burying the power line is strongly recommended, should this be possible within practical and financial constraints. Apart from some initial, short-term disturbance, this would eliminate all of the other impacts.

Recommendations are also made to reduce the impacts of physical disturbance to birds and habitat destruction/modification during the construction of the power line. Should an overhead line be constructed, marking of the entire length of the power line to increase visibility is recommended, according to specified design. Detailed mitigation to reduce the impacts of electrocution is included.

Detailed monitoring initiatives are recommended that should be conducted by B2Gold, with the support of other partners.

Although the proposed power line structure could have potential impacts, it is believed that these risks can be addressed by means of mitigation. If any new power lines are added in the future, the impacts would need to be reassessed.

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Abbreviations, acronyms and glossary of terms

AEWA	African-Eurasian Migratory Waterbird Agreement
BFD	Bird Flight Diverter
CBD	Convention on Biological Diversity
CMS	Convention on Migratory Species
DEA	Department of Environment Affairs
ECC	Environmental Compliance Consultancy
EIA	Environmental Impact Assessment
EIS	Environmental Information Service
EMA	Environmental Management Act
EMP	Environmental Management Plan
Endemic	Occurring within a restricted range
Endemic status categories	E = endemic, NE = near-endemic, sA = southern Africa, Nam = Namibia
HLPCD	Horizontal line post compact delta
IBA	Important Bird Area
IUCN	International Union for 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
MET	Ministry of Environment and Tourism
NAD	Namibian Avifaunal Database
NNF	Namibia Nature Foundation
OPGW	Optical ground wire (earth wire): a type of cable used in overhead power lines, combining the functions of grounding/earthing and communications
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/habitat destruction, E = electrocution, N = potential to disrupt the power supply through nesting activities
QDS	quarter degree square
RED	Regional Electricity Distributor
Residency	R = resident, N = nomadic, M = migrant, V = vagrant, Ra = rare
SABAP	Southern African Bird Atlas Project (SABAP1 & SABAP2)
S/S	Substation

1 Background

1.1 Introduction

B2Gold Namibia (Pty) Ltd (B2Gold) is conducting an Environmental Impact Assessment (EIA) for a proposed new 11 kV overhead distribution power line from the B2Gold Mine solar farm to a proposed agriculture project for the mine, some 70 km north-east of Otjiwarongo in northern Namibia (Figure 1, 2 and 3).

Environmental Compliance Consultancy (ECC) has been appointed by B2Gold to undertake the EIA process for the proposed project.

The present avifauna baseline/scoping and assessment forms part of this EIA.

1.2 Details of the proposed Otjikoto agricultural project and power line

The proposed Otjikoto agricultural project will be sited on Farm Erhardshof (No 575), just north-east of the B2Gold Mine. The project size at the end of the final phase will be 270 hectares. The intention is initially to plant fodder for cattle, such as Rhodes Katambora grass, as well as rotational crops, such as maize and wheat. Should the trial be successful, additional crops could be considered.

The proposed project will be developed in three phases as described below, and will comprise:

- The first phase, year 1: a trial of 60 ha and, if feasible, to expand annually;
- The second phase, year 2: 90ha; and
- The third phase, year 3: 120 ha.

Boreholes on Farm Erhardshof, and the sites of four proposed pivots are indicated in Figure 2.

The intention is to erect an 11Kv overhead power line from the B2Gold Mine solar farm to the agriculture project on Farm Erhardshof (Figure 3). The length of the power line from the solar plant to the farm boundary is 2.7 km and the length on the farm itself is 5.4 km, i.e. a total length of 8.1 km.

Existing (Cenored) distribution lines in the study area in relation to the proposed new line are also shown in Figure 3; however, note that this mapping dates back to 2018, and there may have been changes/additions since.

The proposed power line route is just north of the area for the avifauna study recently completed for the EIA for a proposed B2Gold transmission line (ACS for ECC 2020). As this is a new environmental assessment for a different kind of development, a new, stand-alone report will be required for the avifauna aspects. However, there is some overlap with the above previous study, and reference will be made to relevant aspects, including the field trip.

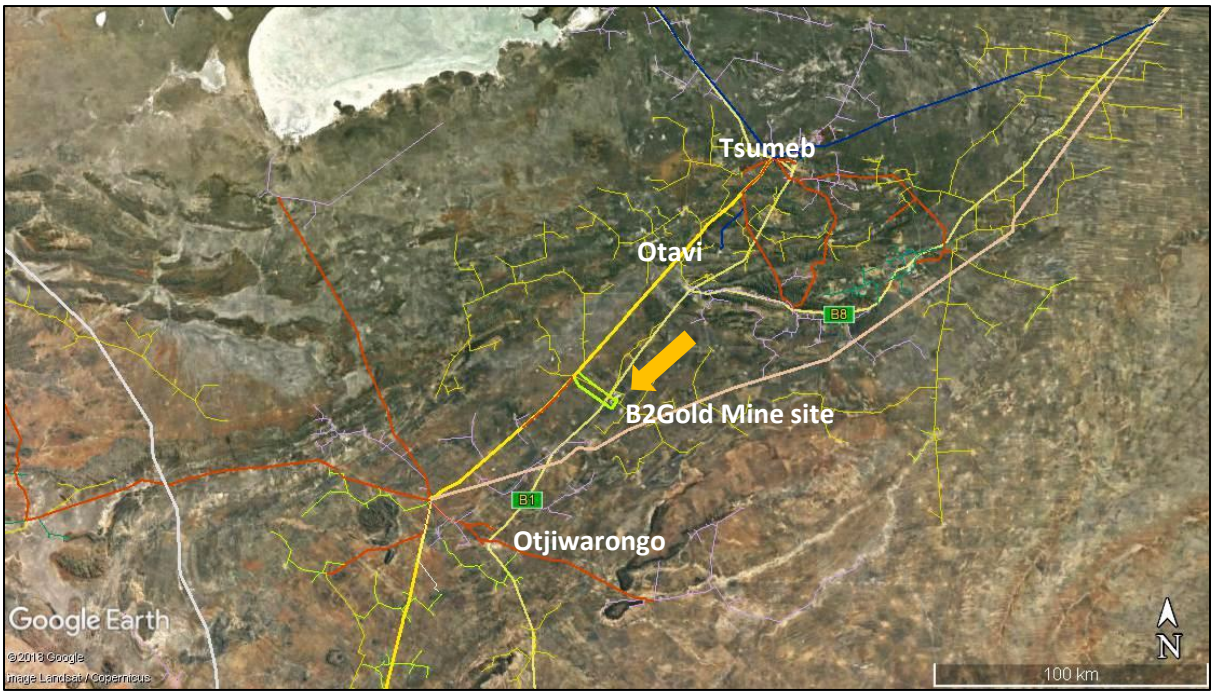
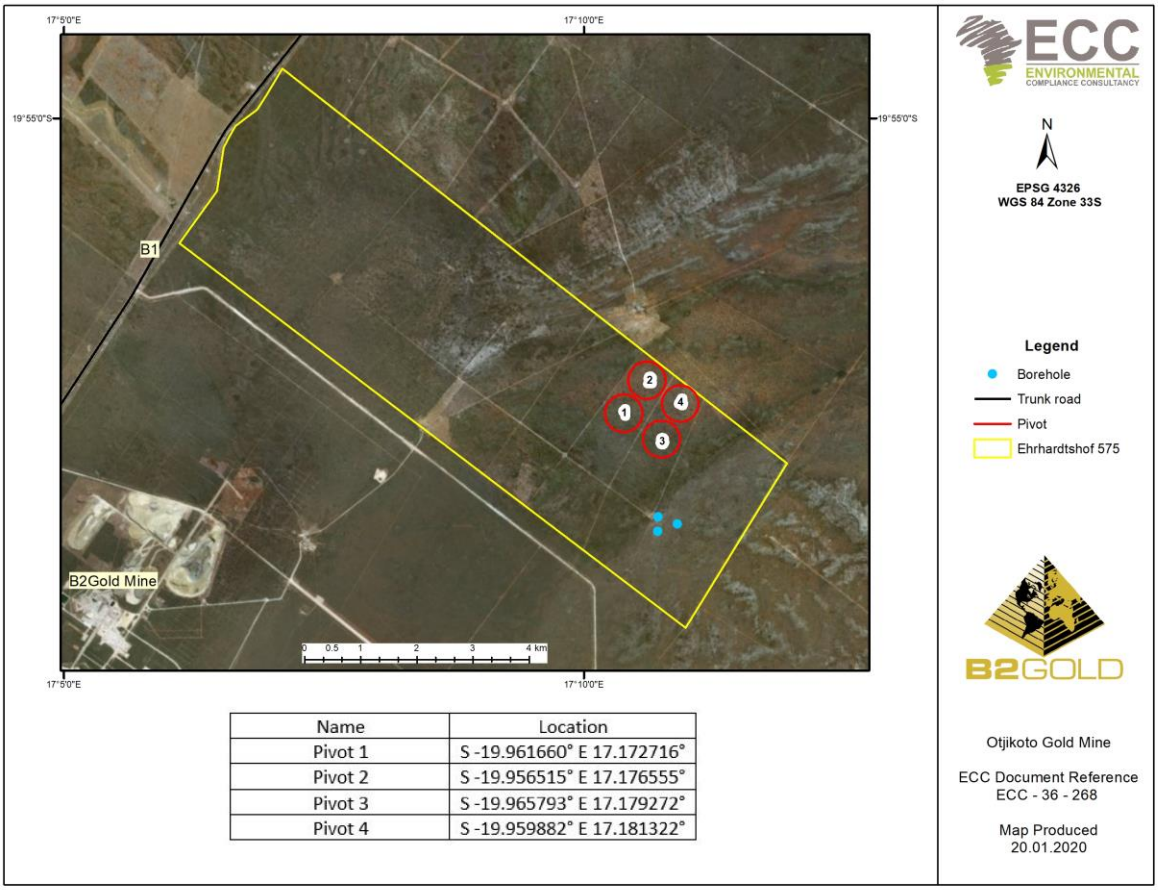


Figure 1. The study area (arrow) north-east of Otjiwarongo in northern Namibia, also indicating the two proposed alternative power line routes (green) that formed the focus of the previous avifauna study (ACS for ECC 2020); closest towns and existing power lines in the greater area (EIS 2019, based on a Google Earth map).



Name	Location
Pivot 1	S -19.961660° E 17.172716°
Pivot 2	S -19.956515° E 17.176555°
Pivot 3	S -19.965793° E 17.179272°
Pivot 4	S -19.959882° E 17.181322°

Figure 2. The study site on Farm Erhardshof (yellow outline), indicating boreholes and four proposed pivot sites (ECC / B2Gold 2020).

Figure 3. The study site to the north-east of the B2Gold Mine site, indicating Farm Erhardshof (yellow outline), proposed 11 kV power line route (red) and existing distribution lines (Cenored, 2018; pale yellow) in the area (EIS 2020, based on a Google Earth map).

1.3 Technical details of the proposed power line

Technical details of the proposed new distribution line are described below.

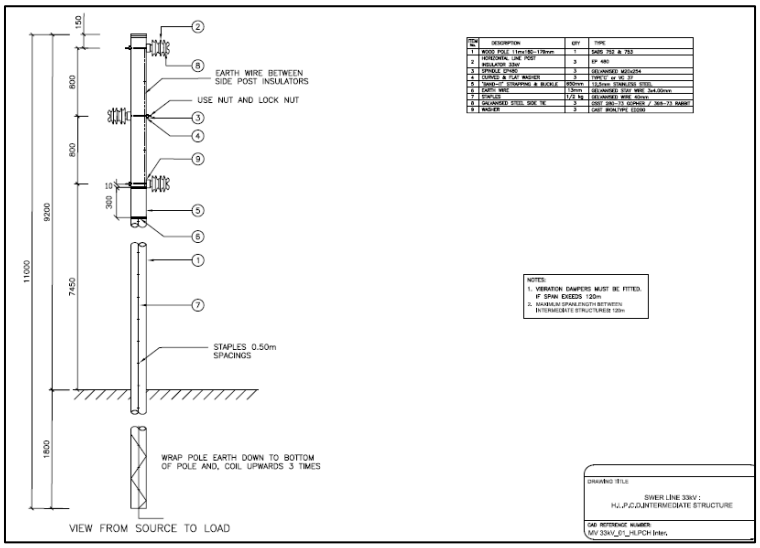
Intermediate poles will be used on the straight sections of the power line. The intermediate power line structure will be a standard horizontal line post compact delta (HLPCD; Figure 4), with single wooden poles around 9.2 m high, span length 120 m and ground clearance at midspan 5.1-5.3 m high. The intermediate poles do not have stay wires. Three conductors are suspended, one above the other, each resting on an insulator. Each pole is earthed by means of a galvanised wire running vertically from the ground to the top of the pole.

The strain pole structures are shown in Figure 5, with two stay wires in-line and three stay wires for angle strains, where the line changes direction. Note the three "jumpers", live wires that enable the continuity of the current between spans.

A typical transformer structure (used at the end of the power line to step down the current) is shown in Figure 6, mounted on a steel A-frame pole. Note the live jumpers (also referred to as "droppers"), conveying the power from the conductors to the transformer. The A-frame pole also has stay wires, and is earthed by means of a vertical cable mounted on the pole.

A servitude will be cleared beneath the power line.

No alternative structure were assessed.



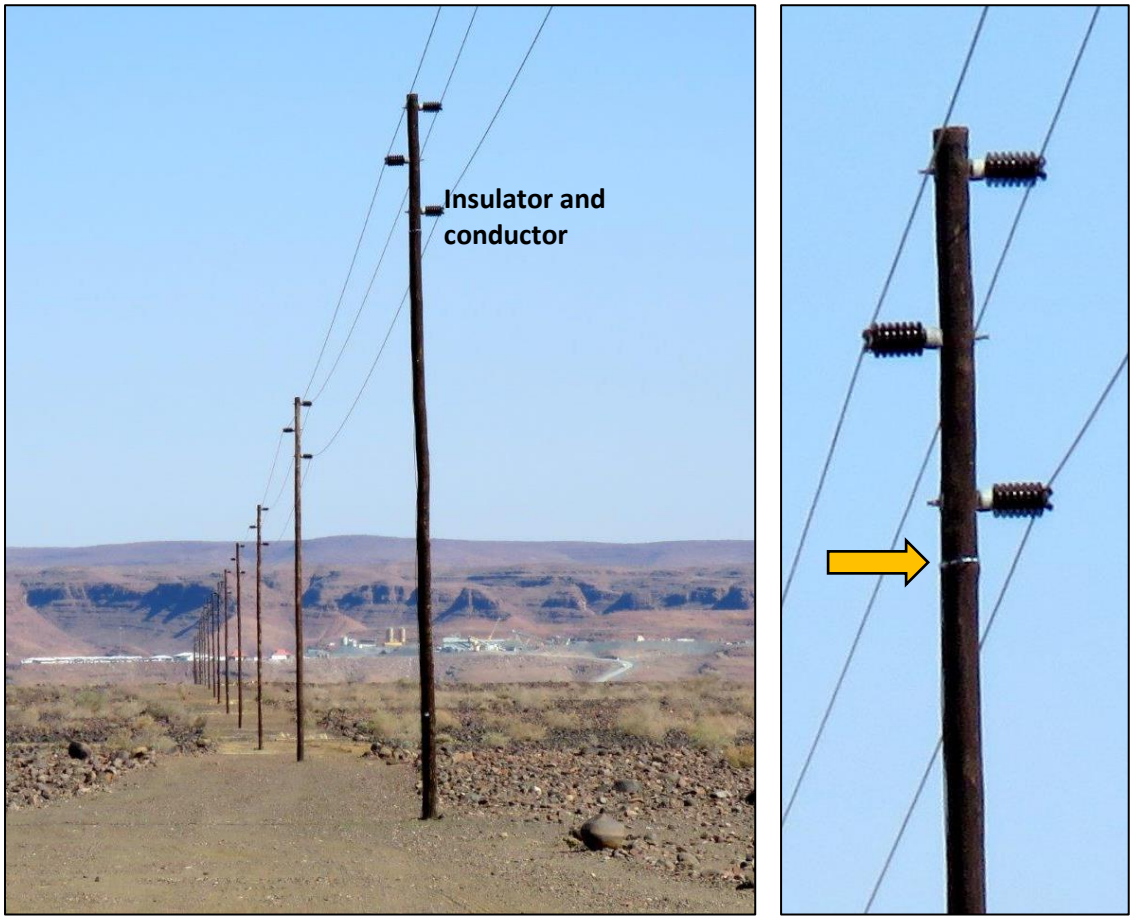
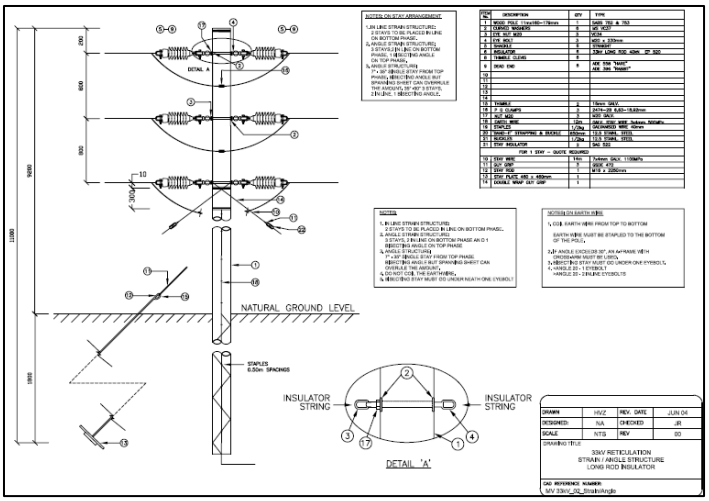


Figure 4 a, b. c. Technical details and photographic example of the proposed HLPCD intermediate structure for the 11 kV power line; note the single wooden poles and three conductors mounted one above the other. The photograph on the right shows the upper limit and fastening of the earth wire (arrow) on the pole.



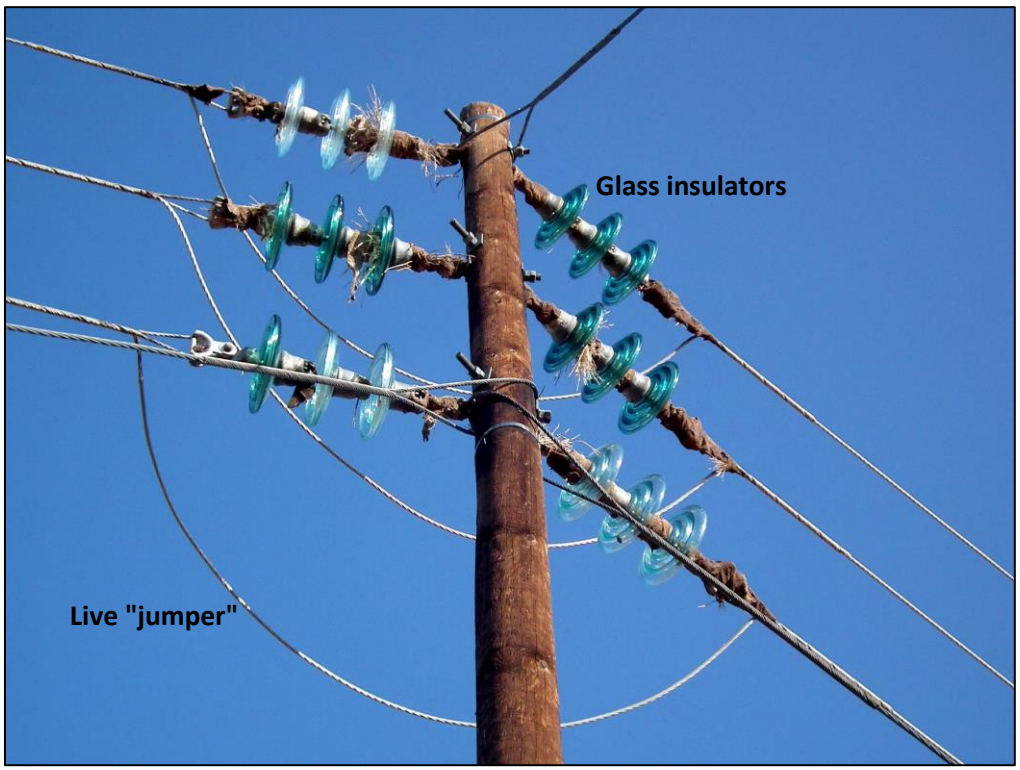
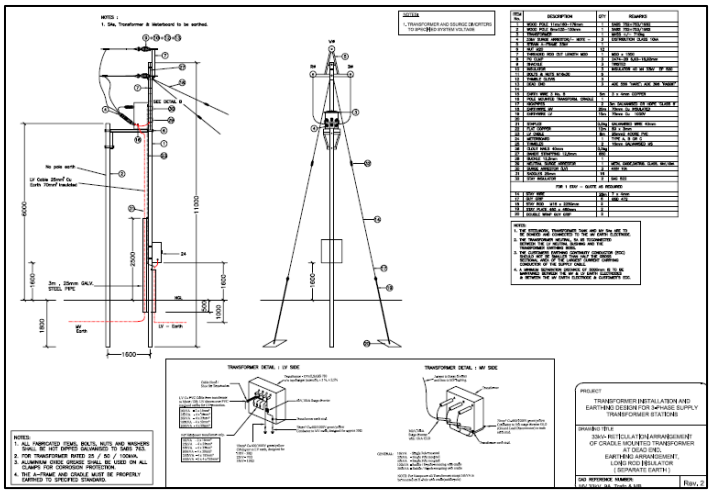


Figure 5 a, b. Technical details and photographic example of the strain pole structures that will be used, with 2-3 stay wires; note the three "jumpers", live wires that enable the continuity of the current between spans. In the photograph, signs of nesting attempts on the insulators by Sociable Weavers are visible.



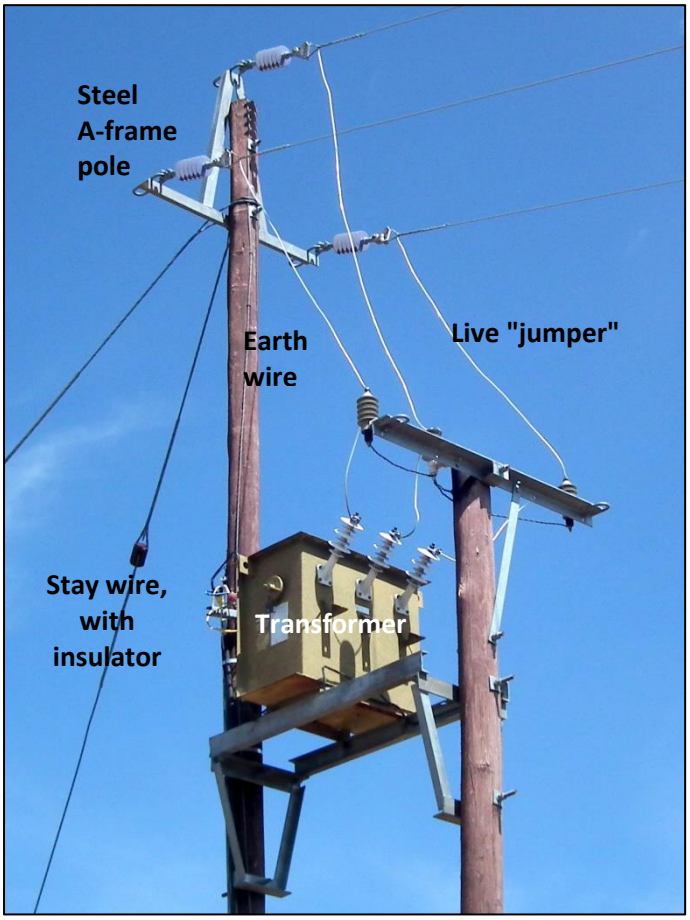


Figure 6 a, b. Technical details and photographic example of the typical transformer structure that will be used at the end of the power line, mounted on a steel A-frame pole. Note the live "jumpers", conveying the power from the conductors to the transformer. The A-frame pole also has stay wires (insulated in this case), and is earthed by means of a vertical cable mounted on the pole.

2 Approach and methodology

2.1 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 70 km north of Otjiwarongo, in the north of Namibia (Figure 1 and 3). As mentioned above, the proposed power line route is just north of the area for the avifauna study recently completed for the EIA for a proposed B2Gold transmission line (ACS for ECC 2020). There is some overlap with the above previous study, and reference will be made to relevant aspects. The present desk-top study was supported by a field visit conducted for the previous study on 30 September – 2 October 2019.

Two sources of bird distribution data were used. The primary data, for the first Southern African Bird Atlas Project (SABAP1; Harrison, Allan, Underhill, Herremans, Tree, Parker, Brown 1997), were gathered during 1987-1992. This information is available on the Environmental Information Service (EIS; www.the-eis.com; EIS 2019) as well as on the comprehensive Namibian Avifaunal Database (NAD; www.biodiversity.org.na; NAD 2019), which includes all available information on birds in Namibia including SABAP1 data, nest record cards, wetland bird counts, Raptor Road Counts for Namibia and museum specimens. 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 atlassed 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 QDSs 1916DD, 1917CC, 2016BB and 2017AA (Figure 7), and available SABAP2 data for pentads 1955_1700, 1955_1705, 2000_1700 and 2000_1705 (Figure 8) which fall within QDS 1917CC and 2017AA. For the above SABAP1 and SABAP2 sources, as well as for observations made in the field (September-October 2019), presence/absence of species is indicated (Appendix 1).

Other sources of information include the Environmental Information Service (see above), the Red Data Book for Birds in Namibia (Simmons, Brown, Kemper 2015), other published sources (e.g. Hockey, Dean, Ryan 2005; Chittenden, Davies, Weiersbye 2016), the global International Union for the Conservation of Nature (IUCN) Red Data list for birds (www.iucnredlist.org; IUCN 2019); discussions with B2Gold environmental 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, including pans and dams (EIS 2020). 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, Mendelsohn, Thomson, Boorman 2017) and global scale (IUCN 2019; 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 (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 2020) was also consulted for relevant power line incidents on record in the vicinity of the study area.

During the field trip for the previous study, the two proposed alternative servitudes for the new transmission power line were surveyed, together with any existing power line servitudes where possible, 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 any future work in terms of the EIA process, if required.

Figure 7. The four quarter degree squares (QDSs; 1916DD, 1917CC, 2016BB and 2017AA; white blocks) and four pentads (red block, see Figure 8) on which available bird atlas data for the checklist for the study area is based (SABAP1 & SABAP2 data, based on a Google Earth map; EIS 2020).

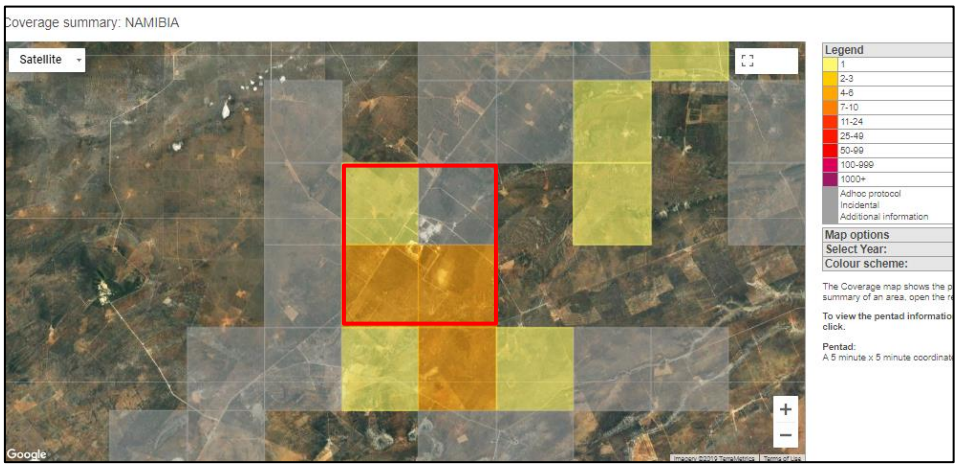


Figure 8. The four representative pentads for the study area (1955_1700, 1955_1705, 2000_1700, 2000_1705; indicated by the red block) for which supplementary bird atlas data from SABAP2 were obtained, which fall within the two QDSs indicated in Figure 7 (SABAP2 data).

2.2 Impact assessment methodology

The EIA methodology applied to this EIA has been developed using the International Finance Cooperation (IFC) 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); Namibian draft procedures and guidance for EIA and EMP (Republic of Namibia, 2008); international and national best practice; and over 25 years of combined EIA experience (Environmental Compliance Consultancy 2019).

EIA determination of significance

The significance of an impact was 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 direct or indirect; temporary/short term, long-term or permanent; and either beneficial or adverse. These are described as follows and thresholds are provided in Table 1, 2 and 3.

- The **sensitivity and value of a receptor** are determined by identifying how sensitive and vulnerable a receptor is to change, and the importance of the receptor (internationally, nationally, regionally and locally).
- The **nature and characteristics of the impact** are determined through consideration of the frequency, duration, reversibility and probability and the impact occurring.
- The **magnitude of change** measures the scale or extent of the change from the baseline condition, irrespective of the value. The magnitude of change may alter over time, therefore temporal variation is considered (short-term, medium-term; long-term, reversible, irreversible or permanent).

TABLE 1 - SENSITIVITY AND VALUE OF RECEPTOR

SENSITIVITY AND VALUE	DESCRIPTION
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.
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.
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.

TABLE 2 - NATURE OF IMPACT

NATURE	DESCRIPTION
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
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
Extent / Geographic Scale	
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, quality or rarity.
National	Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.
International	Impacts that affect a receptor that is internationally important by virtue of scale, designation, quality or rarity.
Duration	
Short-term	Impacts that are likely to last for the duration of the activity causing the impact and are recoverable
Medium-term	Impacts that are likely to continue after the activity causing the impact and are recoverable
Long-term	Impacts that are likely to last far beyond the end of the activity causing the damage but are recoverable over time
Reversibility	
Permanent /Irreversible	Impacts which are not reversible and are permanent
Temporary / Reversible	Impacts are reversible and recoverable in the future
Likelihood	
Certain	The impact is likely to occur
Likely	The impact is likely to occur under most circumstances
Unlikely	The impact is unlikely to occur

TABLE 3- MAGNITUDE OF CHANGE

MAGNITUDE OF CHANGE	DESCRIPTION
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.
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.
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.
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.

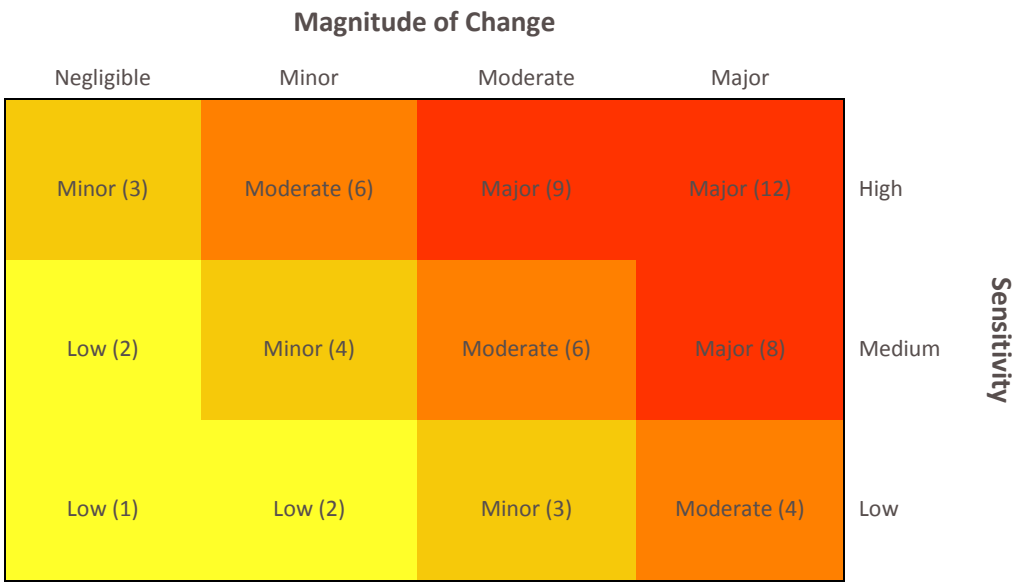
A level of certainty has also been applied to the assessment to demonstrate how certain the assessment to demonstrate how certain the assessment conclusions are and where there is potential for misinterpretation or a requirement to identify further mitigation measures, thereby adopting a precautionary approach. Where there is a low degree of certainty, monitoring and management measures can be implemented to determine if the impacts are worse than predicted and support the identification of additional mitigation measures through the lifetime of the proposed project. Table 4 provides the levels of certainty applied to the assessment, as well as a description.

TABLE 4 – LEVEL OF CERTAINTY

LEVEL OF CERTAINTY	DESCRIPTION
High	– Likely changes are well understood – Design/information/data used to determine impacts is very comprehensive – Interactions are well understood and documented – Predictions are modelled, and maps based on interpretations are supported by a large volume of data, and – Design/information/data has very comprehensive spatial coverage or resolution.
Medium	– Likely changes are understood – Design/information/data used to determine impacts include a moderate level of detail – Interactions are understood with some documented evidence – Predictions are modelled but not yet validated and/or calibrated, and – Mapped outputs are supported by a moderate spatial coverage or resolution.
Low	– Interactions are currently poorly understood and not documented. – Predictions are not modelled, and the assessment is based on expert interpretation using little or no quantitative data. – Design is not fully developed, or information has poor spatial coverage or resolution.

The significance of impacts has been derived using professional judgment and applying the identified thresholds for receptor sensitivity and magnitude of change (as discussed above) and guided by the matrix presented in Table 5. The matrix is applicable for impacts that are either positive or negative. The distinction and description of significance and whether the impact is positive, or negative is provided in Table 6.

TABLE 5 - GUIDE TO SIGNIFICANCE RATINGS



Significance is not defined in the Namibian EIA Regulations, however the Draft Procedure and Guidance for EIA and EMP states that the significance of a predicted impact depends upon its context and intensity. Accordingly, definitions for each level of significance have been provided in Table 6. These definitions were used to check the conclusions of the assessment of receptor sensitivity, nature of impact and magnitude of impact was appropriate.

TABLE 6– SIGNIFICANCE DESCRIPTION

SIGNIFICANCE OF IMPACT	DESCRIPTION
Major (negative)	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.
Moderate (negative)	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.
Minor (negative)	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.

Low (negative)	Impacts are considered to be local factors that are unlikely to be critical to decision-making.
Low – Major (Beneficial)	Impacts are considered to be beneficial to the environment and society:

The colour green has been applied to highlight positive impacts over negative impacts shown in shades of yellow, orange and red. The description for each level of significance presented in Table 6 was also followed when determining the level of significance for a beneficial impact.

The level of significance of impacts has been derived using professional judgment and applying the identified thresholds for receptor sensitivity and magnitude of change, as well as the definition for significance. It most instances, moderate and major adverse impacts are considered as significant, and however, there may be some instances where impacts are lower than this but are still considered to be 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.

2.3 Limitations and assumptions

Limitations

- This report is based on a desk-top study only. In the absence of a supporting field trip, information obtained during a field trip for a similar study in the same overall area in September – October 2019 was used (ACS for ECC, 2020).
- 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. The present investigation was limited in particular by the dry season field visit, under drought conditions, when potential pan habitats did not hold water or associated waterbirds. The avifaunal diversity in general is likely to increase under wetter conditions.
- 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 2020) were consulted in this respect; however, dedicated surveys on power lines in the northern 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.

3 Legislation and international conservation agreements

The Environmental Impact Assessment (EIA) process in Namibia is governed and controlled by the Environmental Management Act (EMA), 2007 (Anon. 2012) and the EIA Regulations 30 of 2012, which are administered by the office of the Environmental Commissioner through the Department of Environment Affairs (DEA) of the Ministry of Environment and Tourism (MET).

The above Environmental Management Act requires the full consideration of biodiversity (including birds), habitat and landscape parameters, values and criteria as part of the environmental assessment processes.

The conservation of terrestrial birds in Namibia is governed by the Nature Conservation Ordinance of 1975. The above Ordinance will eventually be replaced by the (draft) Parks and Wildlife Bill. The list of Specially Protected Birds according to this Bill is based on the Namibian Red Data Book (Simmons, Brown, Kemper 2015), and the Namibian Red Data categories in the latter document are used in the present report, together with a recent update (Brown et al. 2017). The study area does not fall within an officially protected area proclaimed under the above Nature Conservation Ordinance of 1975.

Namibia is a signatory to the international Convention on Biological Diversity (CBD; Rio de Janeiro, 1992), a legally binding instrument for the global conservation and sustainable use of biological diversity.

The Convention on Migratory Species (CMS 2011) has developed an inter-governmental treaty known as the African-Eurasian Migratory Waterbird Agreement (AEWA). Namibia is classed as a range state but, although guided by the principles of AEWA, is not yet a contracting party to this international agreement. The CMS provides guidelines on the management of the conflict between migratory birds and electricity power grids in the African-Eurasian Region.

The study area lies relatively close to an Important Bird Area (IBA; Simmons, Boix-Hinzen, Barnes, Jarvis, Robertson 1998; see below). IBAs are sites of international significance for the conservation of birds at the Global, Regional (Continental) or Sub-regional (southern African) level, selected according to stringent criteria (Barnes 1998). However, not all IBAs have official protection.

The study area does not fall within a proclaimed Ramsar site (Kolberg 2002; see below).

4 Potential sensitivities

4.1 Avifaunal environment

The study area lies between the towns of Otjiwarongo and Otavi in the north of Namibia (Figure 1 and 3).

4.1.1 Protected area status

The area lies some 55 km north-west of the nearest formally protected area and national park, the Waterberg Plateau Park (Figure 9). The Etosha National Park lies about 135 km further to the north-west. The area includes many freehold/commercial conservancies, with communal conservancies to the south-east, and the conservation status is regarded as relatively high.

Both the above national parks are also classed as Important Bird Areas (IBAs), namely Waterberg Plateau Park (N008) and Etosha National Park (N005) (Figure 9). IBAs are places of international significance for the conservation of birds at the Global, Regional (Continental) or Sub-regional (southern African) level, selected according to stringent criteria (Barnes 1998; Simmons et al. 1998).

The Waterberg Plateau Park IBA is characterised by high bird diversity (over 200 species recorded) and provides extensive mountain and cliff breeding habitat for raptors, including the only surviving colony of Cape Vultures in Namibia; and nesting and other habitats for other vulture species and a diversity of other birds. The woodlands and kloofs with perennial springs hold at least 12 near endemic/restricted range species.

The Etosha National Park IBA supports 340 bird species including Greater and Lesser Flamingo (occasional breeding site) and other waterbirds; a rich raptor fauna; and many other species. The Etosha Pan is also a proclaimed Ramsar site, or Wetland of International Importance (Kolberg 2002).

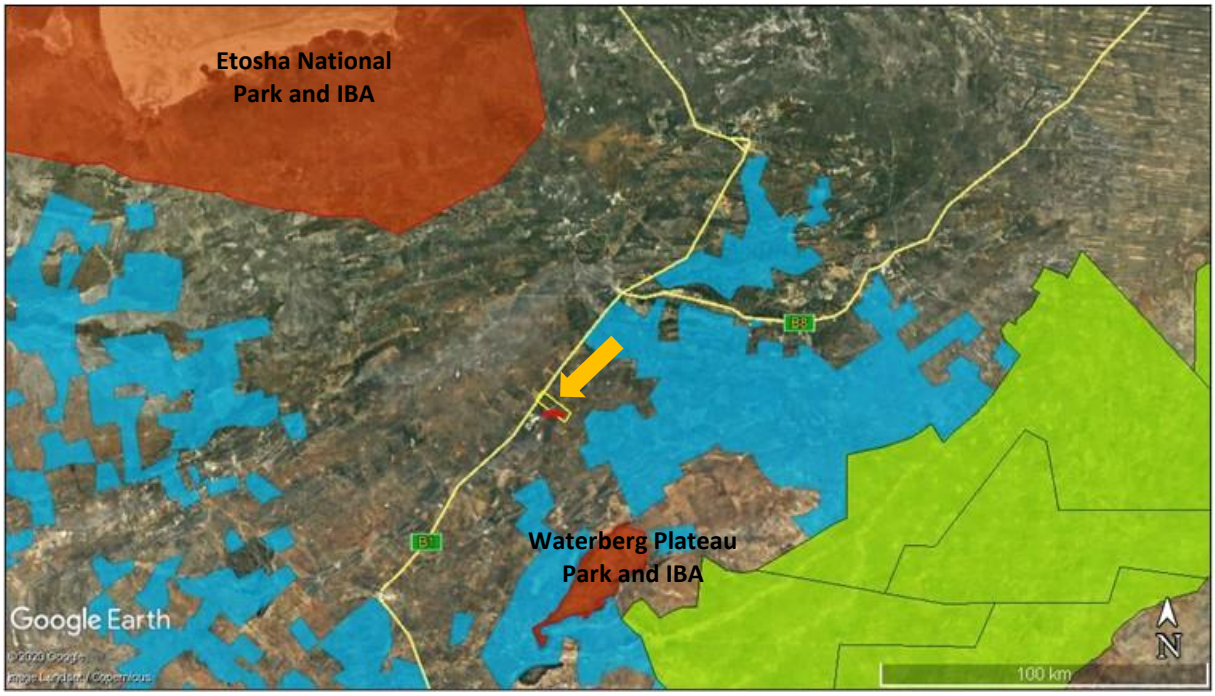


Figure 9. Protected areas and Important Bird Areas (IBAs) in relation to the study area (red = formally protected areas; green = communal conservancies; blue = freehold/commercial conservancies; based on a Google Earth map, EIS 2020).

4.1.2 Climate

The average annual rainfall for the greater study area is relatively high, namely 450-500 mm, falling mainly during December - February (Mendelsohn, Jarvis, Roberts, Robertson 2002).

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

4.1.3 Major topographical features and vegetation habitats

The study area lies within the Central-western Plains Landscape (Mendelsohn et al. 2002) and is generally flat. The Waterberg is a prominent inselberg to the south-east (Figure 1, 10). The Otavi Mountains lie to the north.

The large ephemeral Etosha Pan lies to the north-west. The ephemeral Ugab River system rises just west of the study area, with smaller pan habitats occurring in the upper reaches of its catchment and running south-westwards.

Farm dams and other irrigation facilities are relatively scarce in the area.

The study area falls within the Tree-and-shrub Savanna biome (Mendelsohn et al. 2002). The vegetation type is classed as Thornbush Shrubland, dominated by *Acacia* tree and bush species. The habitat is heavily bush-encroached, and this state is being addressed to varying degrees, and by varying methods, by the landowners.

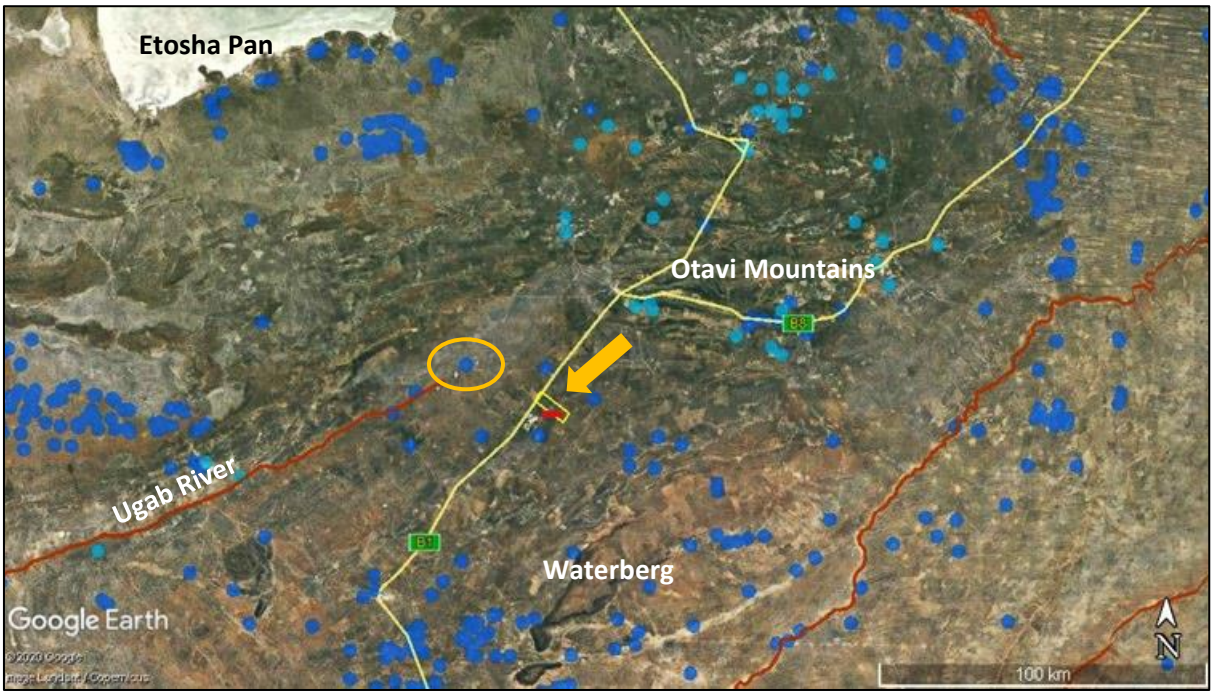


Figure 10. Ephemeral rivers (brown), irrigation facilities and other water bodies (blue) in relation to the study area; the ephemeral pans in the upper Ugab catchment are circled (based on a Google Earth map, EIS 2020).

4.1.4 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. As mentioned above, the Thornbush Shrubland habitats are heavily bush-encroached, and this has an effect on bird distribution and activities.

Three main habitats in the study area and surrounds that are important to birds include farmland on the plains; (mainly ephemeral) aquatic habitats; and the agricultural habitats that will be created by the proposed agricultural irrigation development. Specific localities of some of the vulture nesting sites, shallow pans/farm dams and a drainage line situated in the vicinity of the proposed power line route are mapped below (Figure 11).

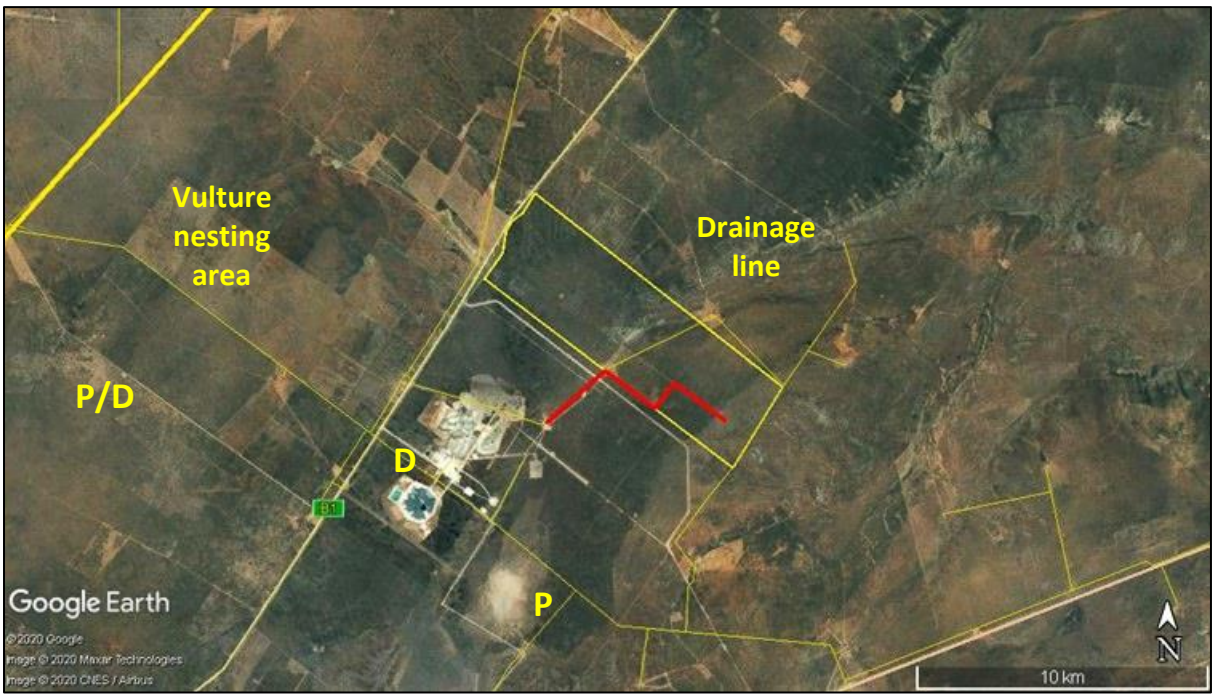


Figure 11. Specific localities of identified vulture nesting area and ephemeral pans/dams (P/D) situated in the vicinity of the proposed power line route (based on a Google Earth map, EIS 2020).

4.1.4.1 Farmland on the plains

Examples of habitats on farmlands in the study area that are potentially sensitive in terms of avifauna are illustrated below (Figure 12 to 14).

The main habitats available to birds in these areas include dense shrubland (bush-encroached to varying degrees), with larger trees (mainly *Acacia luederitzii* Kalahari acacia, Lüderitz acacia) providing nesting habitats for large raptors, including vultures; more open habitats (dry pans and areas that have been cleared, including along roads and fence lines), used by Kori Bustard; and watering points used by many kinds of birds, with easily accessible drinking sites favoured by vultures for drinking and bathing.

Although bush encroachment has been shown to impact negatively on the foraging success of the Cape Vulture (Schultz 2009; Simmons et al. 2015) and by implication of other vulture species, making it difficult for the birds to take off again, the taller trees in this habitat are able to support nesting.

At least six or seven pairs of White-backed Vulture nest regularly in large trees on Farm Hester, to the west of the study site (Figure 11, 14). One more nest was indicated on Farm Maxwell, where the vultures use a nearby 33 kV power line pole for perching (Figure 14b). An additional vulture nest was reported on Farm Lardner, with signs of frequent perching on a 33 kV power line pole. (Note that there is little electrocution risk from "streamers" [excrement] on these structures - which are the

same design as for the proposed new power line - as the wooden pole is earthed, but the earth wire running upwards from the ground stops below the conductors, so it would be difficult for the bird to make contact with the earthed component while sitting on the pole [see Section 5.1.4 below]).


Figure 12 a & b. Examples of bushy habitats and open areas on the farms in the study area.


Figure 13 a & b. Examples of watering points on the farms.


Figure 14 a, b. Examples of White-backed Vulture nests in *Acacia* trees, and 33 kV distribution power line pole used for perching by vultures (right).

4.1.4.2 Ephemeral pans, earth dams and other aquatic habitats

Aquatic habitats form a second main group. These include shallow ephemeral pan systems that are mostly dry, but reported to hold water regularly during the rainy season (Figure 11). At such times these habitats are transformed, and cause many waterbirds to move into the area, by way of varying flight paths.

A drainage line, with indications of some ephemeral aquatic habitats, runs through the centre of Farm Erhardshof (Figure 2, 11). Other similar pan habitats are indicated to the east of the mine property (Figure 15).

On the adjacent B2Gold Mine property, to the south-west, a large ephemeral pan on the nature reserve section (Figure 11, 16a) is also reported to hold water during the rainy season, with many waterbirds, including up to 60 Great White Pelican observed at one time (D Rudman pers. comm.). Several pairs of Lappet-faced Vulture also breed in large trees near this pan area (Figure 16b).

A system of shallow ephemeral pans is found to the west of the study site that are also mostly dry, but reported to hold water regularly during the rainy season. Several of these pans (and earth dams) are indicated on Farm Fisher, and some similar habitats are also apparent on Farm Lardner and Farm Luckenwalde (Figure 16c, d). Other similar habitats in the greater study area include the ephemeral pan system in the upper catchment of the Ugab River (see 4.1.3 above).

On the B2Gold Mine a sewage pond of about 140 m^2, lying on the main entrance road to the mine, provides an attractive habitat to a variety of waterbirds, including Greater Flamingo and Lesser Flamingo (Figure 17). Other species recorded regularly at this site (2016-2019) include Black-winged Stilt, Cape Shoveler, Red-billed Teal, Cape Teal, Blacksmith Lapwing, Little Stint, Little Egret, Egyptian Goose, Kittlitz's Plover, Grey Heron and Pied Avocet, as well as Marabou Stork elsewhere in the mine area (A Kanandjembo pers. comm.). A large tailings dam is situated nearby.

The agricultural irrigated site itself will have an overnight storage dam for water supply to the pivots (size 50 m x 50 m x 2 m), which would be an added attractant to birds.

Figure 15. An ephemeral pan some 15 km to the east of the B2Gold Mine, holding water during the rainy season in March 2012 and attracting a flock of Marabou Stork (photograph posted on Google Earth by Aleksei N.iRudoy).

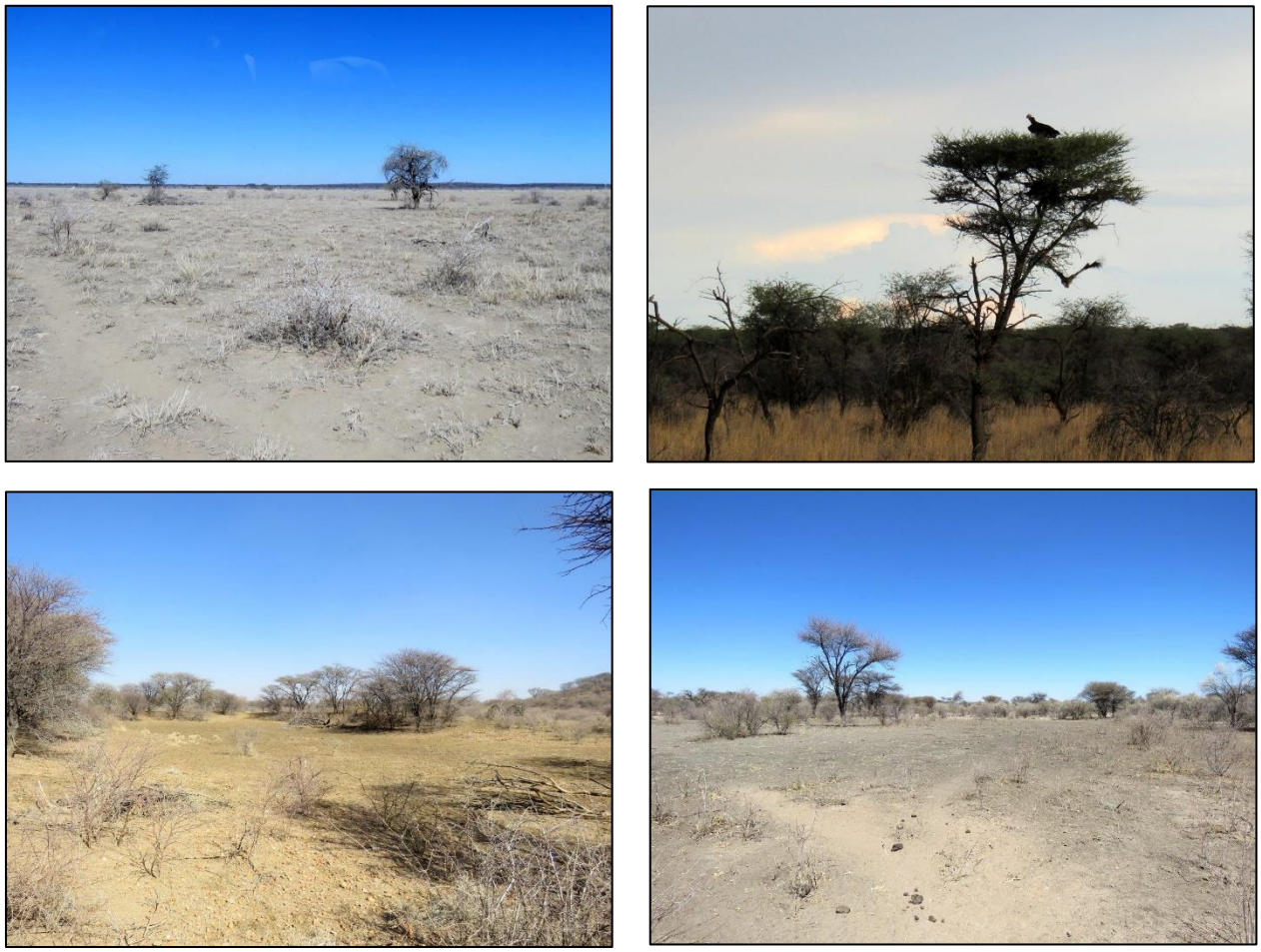


Figure 16 a-d. Examples of (dry) ephemeral pan on B2Gold property (above left) with Lappet-faced Vulture nesting area (above right); and dry earth dams/pans on Farm Fisher (below left) and Farm Maxwell (below right).

Figure 17 a, b. A large sewage pond on the main entrance road to the B2Gold Mine provides an attractive habitat to a variety of waterbirds, including a juvenile Greater Flamingo (right; photographed in October 2019).

4.1.4.3 Agricultural irrigated areas that will be created

The habitat on the proposed agricultural irrigated development is described as dense, Thornbush shrubland, similar to the farmland described above (see 4.1.4.1). No bush clearing has taken place. The bird assemblage is likely to be similar to that described above for the greater study area, including likely occurrences of Kori Bustards, and vultures.

Any agricultural development will attract birds (and other wildlife), particularly if it is associated with an artificial irrigation system, and a storage dam (see above). Such habitats are characterised by changes/increase in food types and availability, i.e. different crops at various stages of the crop growing/harvesting; insects and other predators etc. that may be attracted to the crops; water availability and cover in the area; and especially during dry spells.

Crops that have been proposed (initially) include fodder for cattle, such as Rhodes katambora grass (*Chloris gayana*; Figure 18a), as well as rotational crops, such as maize and wheat. Should the trial be successful, additional crops could be considered.

The above crops are likely to be attractive to a variety of birds, e.g. three Kori Bustards have been observed on lucerne crops and a (migrant) White Stork on maize crops in agricultural irrigated habitats near Mariental, as well as other species including Sacred Ibis (pers. obs.; Figure 18 b-d).

The flight paths of such birds visiting the area would place them at risk to collisions on associated any power lines; power line pole structures are also used as perches by some birds, including predators, thereby placing them at risk to electrocutions.

The attraction of novel bird species into the development area therefore needs to be taken into account with the assessment of power line impacts.

Figure 18 a-d. Examples of agricultural irrigated habitats: Rhodes katambora grass being harvested (top left); three Kori Bustards on lucerne near Mariental (top right); (migrant) White Stork on maize near Mariental (bottom left); and Sacred Ibis on irrigated habitats near Mariental (bottom right).

4.2 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.

4.2.1 Bird species diversity

A total of 217 bird species has been recorded for the study area (SABAP1 and SABAP2 data for QDSs 1916DD, 1917CC, 2016BB and 2017AA and pentads 1955_1700, 1955_1705, 2000_1700 and 2000_1705, and other sources: see above; Appendix 1). However, the area is under-atlassed (i.e. not well documented) in parts, and the results should be interpreted accordingly.

The above total represents 32% of the 676 species currently recorded in Namibia (Brown et al. 2017), a diversity that is classed as relatively high (Figure 19; Mendelsohn et al. 2002; EIS 2020).

The field trip for the previous study (ACS for ECC 2020) took place during the dry season (September-October 2019), and under drought conditions, and the bird diversity then observed was fairly low. The combined data in Appendix 1 are thus considered the best reflection of bird diversity over the longer term.

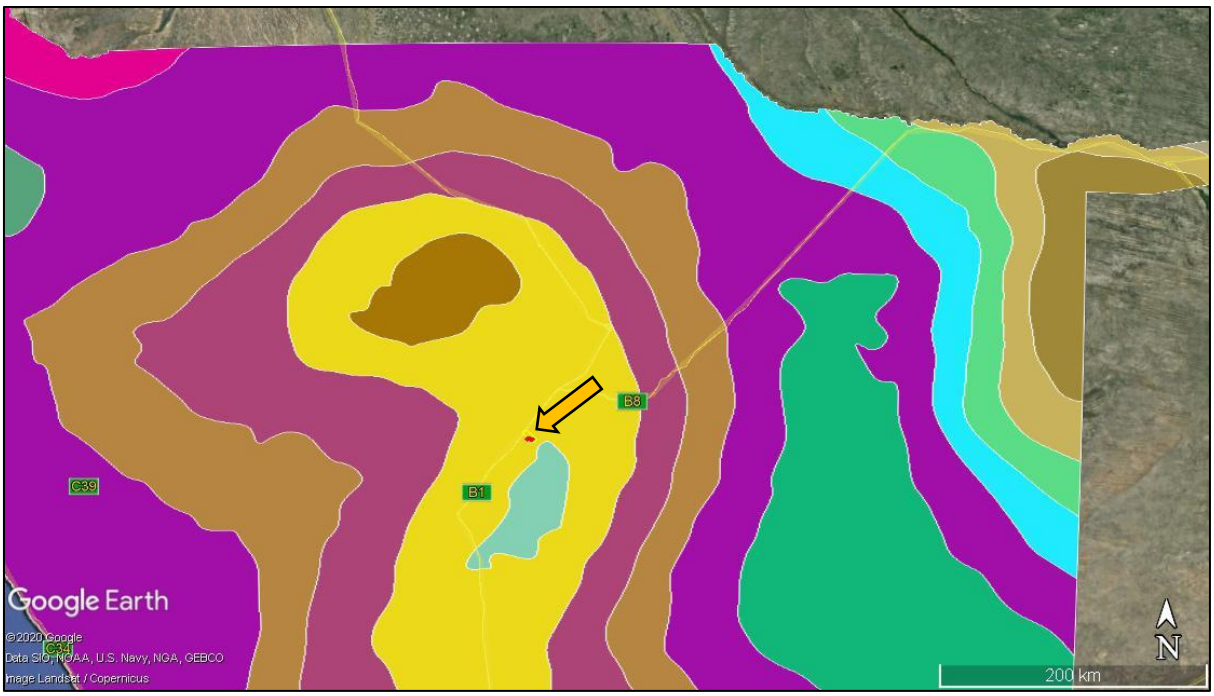


Figure 19. Bird diversity in the study area is regarded as relatively high (7 on a scale of 8) (Mendelsohn et al. 2002; based on a Google Earth map, EIS 2020).

4.2.2 Red Data status

The overall checklist for the study area (Appendix 1) includes 18 species (9%) that are threatened in Namibia (Brown et al. 2017). This represents 25% of the 71 species that are on the Namibian Red Data List. Eleven of these species are also Globally Threatened (IUCN 2019).

For the study area, these 18 Red-listed species are as follows:

- White-backed Vulture (Critically Endangered, also Globally Critically Endangered)
- Cape Vulture (Critically Endangered, also Globally Endangered; now rare in Namibia)
- Blue Crane (Critically Endangered, also Globally Vulnerable; now rare in Namibia outside the Etosha National Park and Omadhiya Lakes areas)

- Lappet-faced Vulture (Endangered, also Globally Endangered)
- Martial Eagle (Endangered, also Globally Vulnerable)
- Bateleur (Endangered, also Globally Near Threatened)
- Tawny Eagle (Endangered)
- Saddle-billed Stork (Endangered)

- Lesser Flamingo (Vulnerable, also Globally Near Threatened)
- Secretarybird (Vulnerable, also Globally Vulnerable)
- Greater Flamingo (Vulnerable)
- Great White Pelican (Vulnerable)

- Kori Bustard (Near Threatened, also Globally Near Threatened)
- Red-footed Falcon (Near Threatened, also Globally Near Threatened)
- Bar-tailed Godwit (Near Threatened, also Globally Near Threatened)
- Black-necked Grebe (Near Threatened)
- Rüppell's Parrot (Near Threatened)
- Marabou Stork (Near Threatened)

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 threatened birds in Namibia (Simmons et al. 2015).

The Waterberg area is well known for its populations of several species of threatened vultures, and is an epi-centre for the remaining small population of Cape Vultures in Namibia (Simmons et al. 2015).

4.2.3 Endemism

The checklist for the study area includes at least four 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 will be 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 four recorded Namibian near-endemic species are as follows:

- Rüppell's Parrot
- Damara (Red-billed) Hornbill
- Monteiro's Hornbill
- Carp's Tit

The recorded level of endemism in the study area is considered relatively moderate (Figure 20); however, this group of birds is likely to be under-atlassed (poorly documented), and several other near-endemic species may potentially be found in the area, on closer investigation, e.g. Bare-cheeked Babbler, White-tailed Shrike, Hartlaub's Spurfowl, Rockrunner, Violet Woodhoopoe.

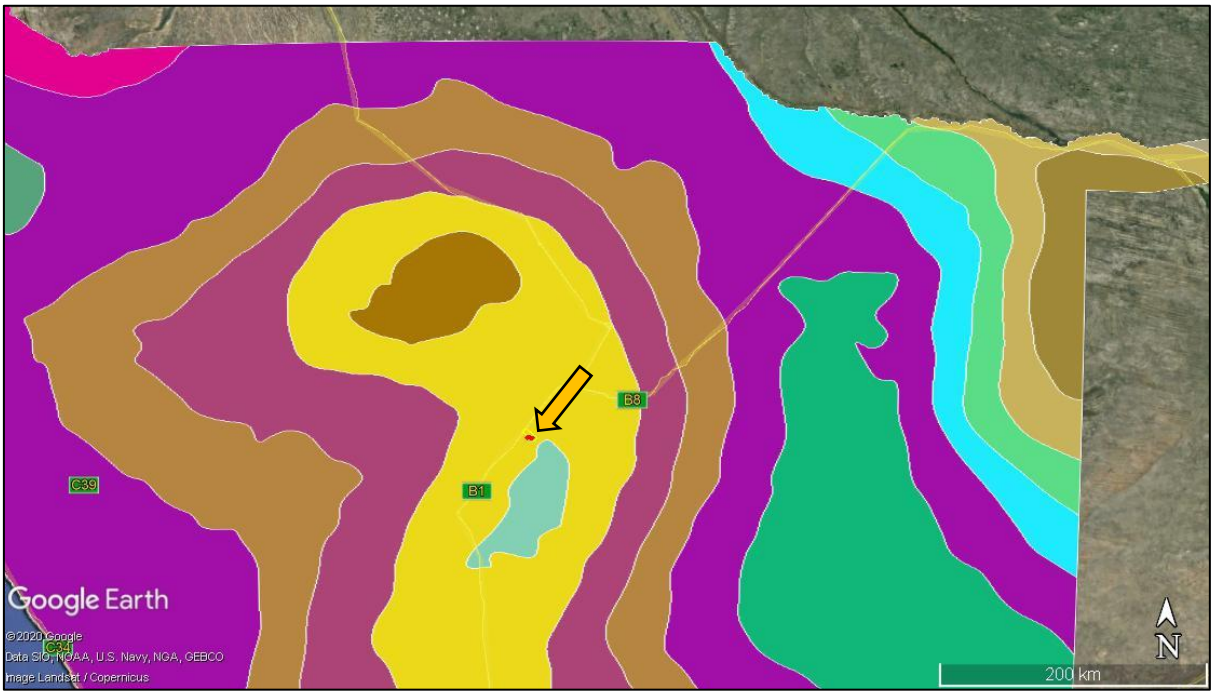


Figure 20. Bird endemism in the study area is regarded as relatively moderate (2-3 on a scale of 5) (Mendelsohn et al. 2002; based on a Google Earth map, EIS 2019).

4.2.4 Migrant status (Red Data species) and nomadism

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

- Greater Flamingo (intra-African migrant)
- Lesser Flamingo (intra-African migrant)
- Red-necked Falcon (Palearctic-breeding migrant)
- Bar-tailed Godwit (Palearctic-breeding migrant)

Several other (Red Data) species are nomadic or make extensive movements, including the vulture species and waterbirds.

Nomadic/migrant habits result in high mobility and consequently increase the risk of impacts such as collisions on overhead structures (e.g. for Great White Pelican). 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. The largest numbers of birds are potentially found in the area between October and April, when summer migrant species may be present.

Species such as flamingos are known to move extensively. They move inland from the coast after good rains, in order to breed, e.g. in Botswana and, occasionally, Etosha National Park. Details of their flight paths on such migratory routes in Namibia are not confirmed.

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.

4.2.5 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 21. The sensitivity in the western part of the study area is relatively higher (16 species) in relation to surrounding QDSs (7-10 species). However, these data will be supplemented by more recent SABAP2 records. The distribution of several key sensitive species is shown in Figure 22-24.

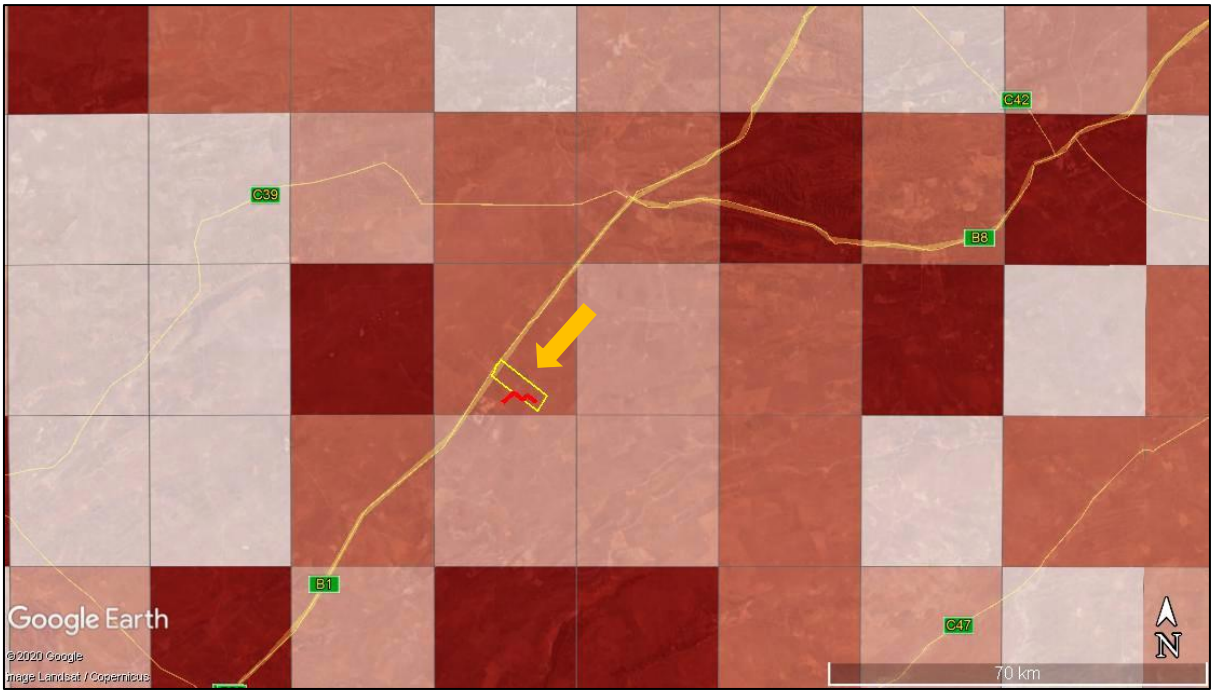


Figure 21. Relative occurrence of power line-sensitive Red Data species in the greater study area (based on SABAP1 data; range of sensitivity from low [light] to high [dark]; EIS 2020).

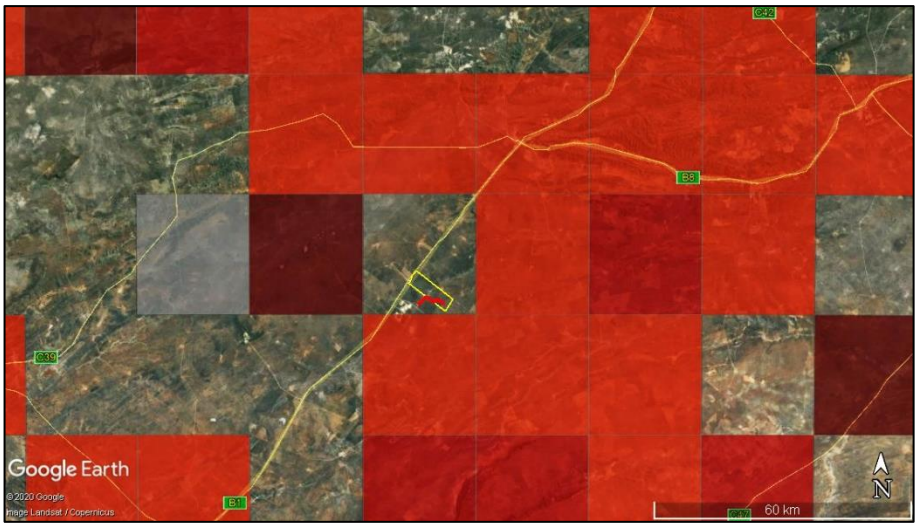


Figure 22. Reporting rates for White-backed Vulture in the greater study area (SABAP1: EIS 2020).

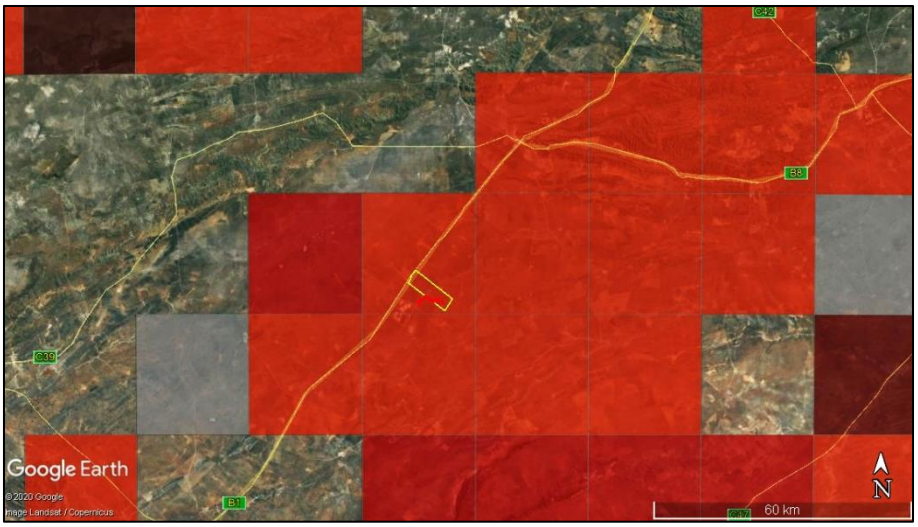


Figure 23. Reporting rates for Lappet-faced Vulture in the greater study area (SABAP1: EIS 2020).

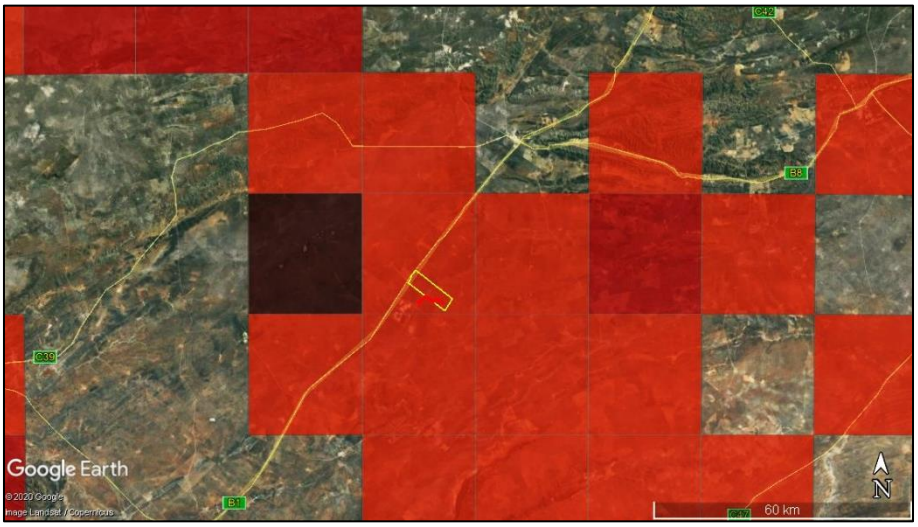


Figure 24. Reporting rates for Kori Bustard in the greater study area (SABAP1: EIS 2020).

Power line incidents on record for Namibia

The NamPower/Namibia Nature Foundation Strategic Partnership (https://www.nnf.org.na/index.php/projects.html#nampower-nnf-strategic-partnership) has documented wildlife and power line incidents from 2006 to the end of 2017, involving some 732 animals, mostly birds and mostly collisions, but also electrocutions (EIS 2020). Due to the difficulty of obtaining records in bush-encroached areas (especially in the northern and north-eastern parts of the country, including in the study area), 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 (30%; Figure 25), including Kori Bustards. A further 11% have involved raptors, mainly vultures as well as eagles, snake-eagles and owls; and 10% 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 (20 individuals) have comprised electrocution on low-voltage distribution structures; however, collisions are also 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 26 (NamPower/NNF Strategic Partnership database, EIS 2020). However, this part of Namibia is probably under-sampled (see above); and a number of collision and electrocution incidents on low-voltage distribution structures have been reported elsewhere in the country.

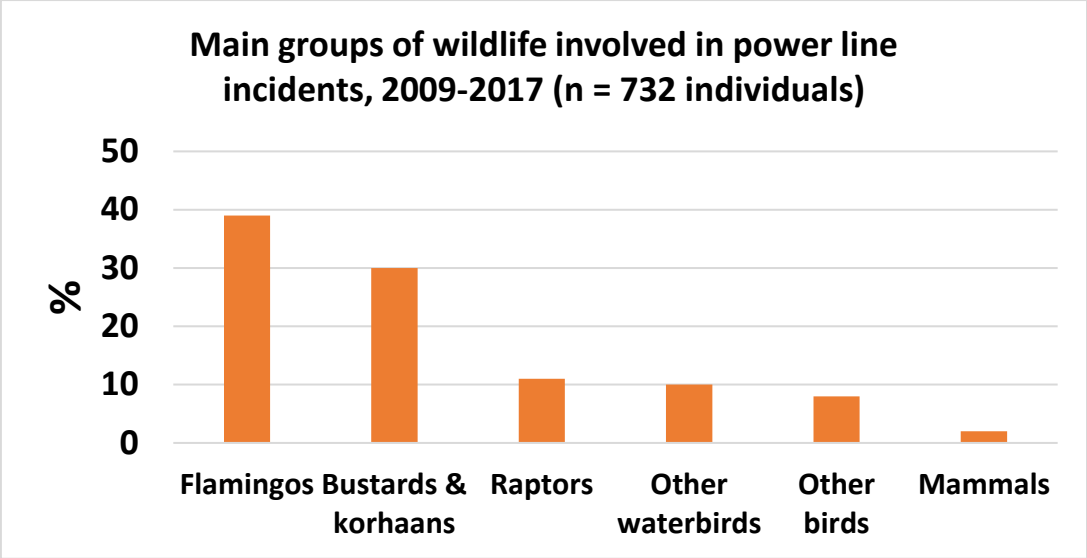


Figure 25. Numbers of birds and other wildlife involved in power line incidents in Namibia, 2006-2017 (n = 732 individuals; NamPower/NNF Strategic Partnership data 2017; EIS 2020).

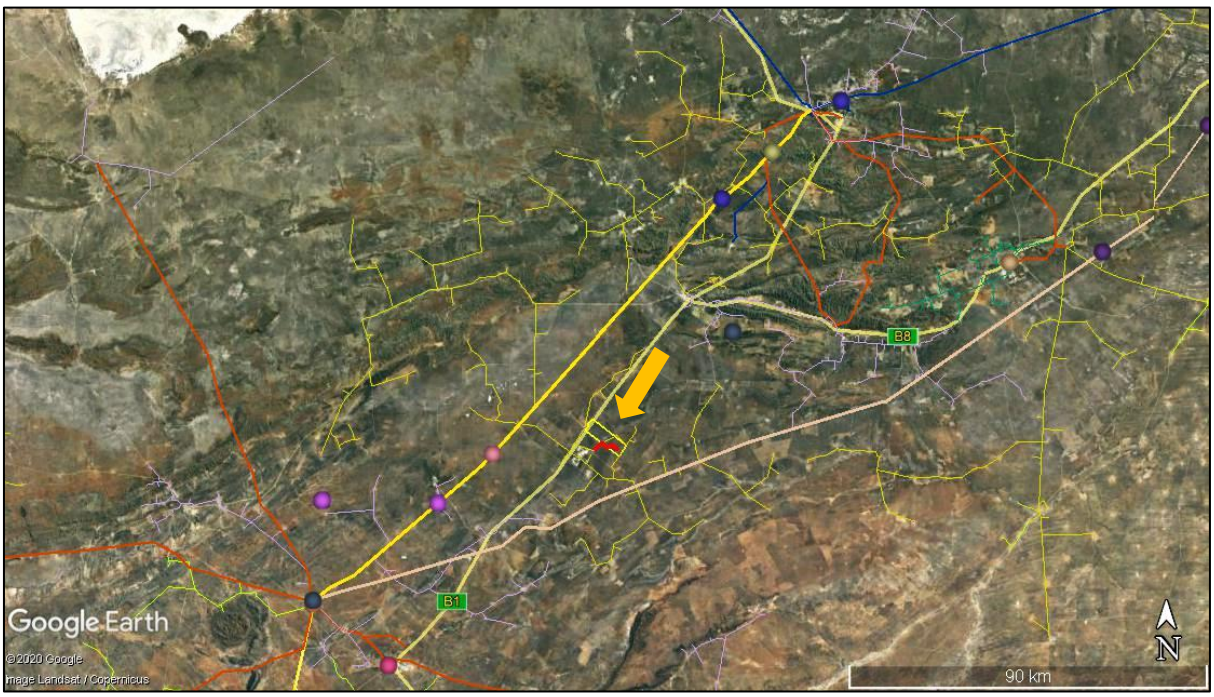


Figure 26. Power line incidents on record for the greater study area in the north of Namibia (flamingo incidents indicated by pink dots [top right]) (NamPower/NNF Strategic Partnership database; EIS 2020).

4.2.6 Potential flight paths

Satellite tracking of seven Cape Vultures in the Waterberg area in 2004-2005 (Mendelsohn, Brown, Mendelsohn, Diekmann 2005; Mendelsohn & Diekmann 2009) shows that the birds concentrated their movements and foraging to the west of the Waterberg Plateau Park, although ranging widely with very large home ranges of up to 25,000 km^2. The flight paths that were tracked also cover the study area (Figure 27). Based on 7,300 individual locations, five adult males were shown to spend the majority of their time on freehold farms. The vultures generally foraged at heights of around 250-350 m, although flying at lower altitudes at times, including at the start of the day's foraging trips and earlier in the day when thermals were weaker.

Provisional tracking data for 2004-2005 (Mendelsohn & Diekmann 2009; Figure 27) clearly indicate that these vultures have used the existing 220 kV Gerus-Otjikoto power line regularly as a perch/ roost. At that stage the power line was single, comprising the self-support steel lattice structure (see previous avifauna study, ACS for ECC 2020). This perching behaviour on tall structures could potentially increase the collision risk, by bringing the bird flight paths close to the power line.

Although the above data pertain specifically to the Cape Vulture (now very rare in Namibia), these patterns are regarded as fairly typical of White-backed Vulture and other vulture species that are found in association with the Cape Vulture. High nesting densities of White-backed Vulture (namely 0.38 nests per km^2) have been recorded during a microlight survey on farms near the Waterberg area (south-east of the present study area), covering an area of approximately 150 km^2 (Doulton & Diekmann 2006).

A further group of potential flight paths for waterbirds is associated with the various aquatic habitats in the area, comprising mainly ephemeral pans, including those in the upper reaches of the Ugab River system, as well as those on the farms and B2Gold nature reserve (see above), and the mine's sewage pond and tailings dam and the drainage line in the agricultural site (Figure 28). Such flight paths are likely to be varying, depending on conditions. Kori Bustards are also likely to make short, nomadic movements in open habitats, or light shrubland.

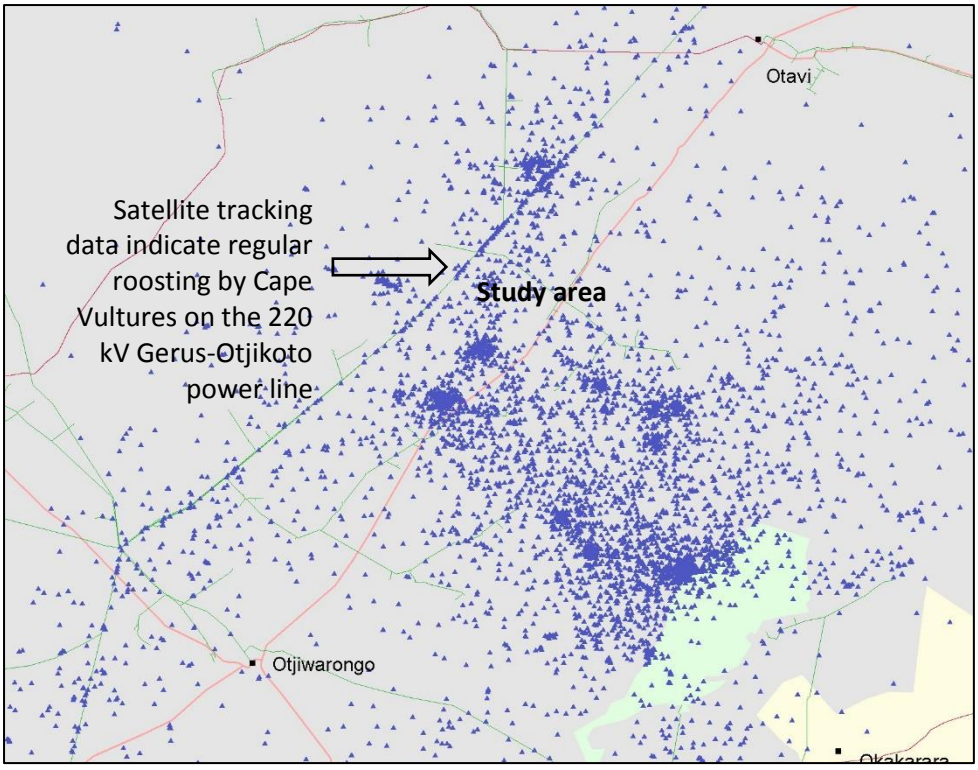


Figure 27. Regular roosting by Cape Vultures on the 220 kV Gerus-Otjikoto power line in 2004-2005, as indicated by satellite tracking (Mendelsohn & Diekmann 2009) .

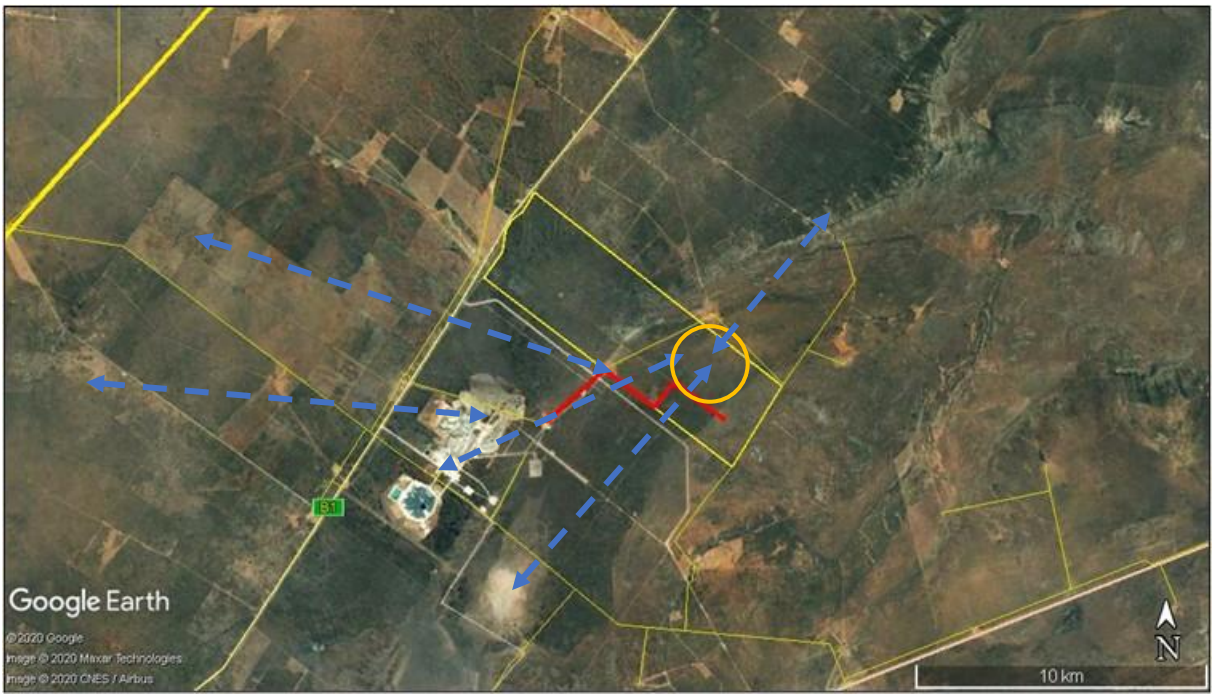


Figure 28. Some potential flight paths for birds (including vultures, bustards and waterbirds) among various habitats in the vicinity of the proposed power line route (red) and pivot area (orange; based on a Google Earth map, EIS 2020).

4.3 Species at risk

As mentioned above, risk assessment and mitigation efforts are directed towards those species that have a high biological significance, i.e. primarily Red Data species and/or species endemic or near-endemic to Namibia, as well as Red Data migrant species. Risk likelihood of these species to impacts is based further on relative abundance in the study area in the form of SABAP reporting rates: mainly SABAP1, but with confirmation by SABAP2 data/personal observations/local reporting, where available; and on representation in terms of existing power line incidents reported in the area and elsewhere in Namibia.

Twenty-one species are considered potentially at risk from the proposed development. These species are summarised in Table 7.

Table 7. Priority bird species that are regarded as potentially at risk from the proposed 11 kV distribution power line (see below for key; see also Appendix 1)

Common names	RDB / END	RES	Habitat	SABAP1 EIS	SABAP1 BVDB	SABAP2/ pers obs	Risk & pot
Species with the potential to be impacted by power lines							
Bateleur	EN, G NT	Res	T	X	X	?	C (M), E (L)
Bustard, Kori	NT, G NT	Res, mov	T	X	X	X	D (M), C (M)
Crane, Blue	CE, G VU (rare)	Res, mov	T	X	X		C (VL)
Eagle, Martial	EN, G VU	Res	T		X	X	D (L), C (M), E (M)
Eagle, Tawny	EN	Res	T	X	X	X	D (L), C (M), E (M)
Falcon, Red-footed	NT, G NT	Pal mig	T	X	X	X	C (M), E (M)
Flamingo, Greater	VU	Res, intra-Afr mig, nom	A	X	X	X juv	C (M)
Flamingo, Lesser	VU, G NT	Res, intra-Afr mig, nom	A		X	Rep	C (M)
Godwit, Bar-tailed	NT, G NT	Pal mig	A	X	X		C (L)
Grebe, Black-necked	NT	Res, nom	A	X	X	X	C (M)
Hornbill, Damara (Red-billed)	NE Nam	Res, nom	T		X		D (M), C (M), E (M)
Hornbill, Monteiro's	NE Nam	Res, nom	T			X	D (M), C (M), E (M)
Parrot, Rüppell's	NT; NE Nam	Res, nom	T		X		D (M), C (M), E (M)
Pelican, Great White	VU	Res. nom	A	X	X	Rep	C (M), E (L)
Secretarybird	VU, G VU	Nom	T	X	X	X	D (L), C (M), E (M)
Stork, Marabou	NT	Res	(A)			Rep	C (M), E (M)
Stork, Saddle-billed	EN	Res	A	X	X		C (L), E (L)
Tit, Carp's	NE Nam	Res	T		X		D (VL), C (VL)
Vulture, Cape	CR, G EN (rare)	Res but with large-scale movements	T			X	C (VL), E (VL)
Vulture, Lappet-faced	EN, G EN		T	X	X	X; rep nest	D (L), C (M), E (M)
Species with the potential to impact on power line structures through their nesting activities							
Crow, Cape	LC	Res	T	X	X		N (L)
Crow, Pied	LC	Res, mov	T			X	N (L)
Weaver, Red-billed Buffalo	LC	Res, mov	T	X	X	X old nests	N (L)
Weaver, Sociable	LC	Res, mov	T			X old nests	N (L)

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: 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

HABITAT: A = aquatic; T = terrestrial

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

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

SABAP2/pers obs: Southern African Bird Atlas Project 2 data, available on http://sabap2.adu.org.za; combined with personal observations September/October 2019

Risk: C = collision, D = disturbance/habitat destruction, E = electrocution (either directly; or indirectly, through "streamers" of excrement), N = potential impacts on power line structures due to nesting activities

Pot: Potential for impacts H = high, M = medium, L = low, VL = very low

The 21 species considered to have the potential to be impacted by power line structures (including 18 Red Data species, four Namibian near-endemic species and four with migrant status; Table 7), are as follows:

- *Raptors (8)*
  White-backed Vulture (Critically Endangered, also Globally Critically Endangered)
  Cape Vulture (Critically Endangered, also Globally Endangered; now rare in Namibia)
  Lappet-faced Vulture (Endangered, also Globally Endangered)
  Martial Eagle (Endangered, also Globally Vulnerable)
  Bateleur (Endangered, also Globally Near Threatened)
  Tawny Eagle (Endangered)
  Secretarybird (Vulnerable, also Globally Vulnerable)
  Red-footed Falcon (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)
- *Large terrestrial (cursorial) species (2)*
  Blue Crane (Critically Endangered, also Globally Vulnerable; now rare in Namibia)
  Kori Bustard (Near Threatened, also Globally Near Threatened)
- *Aquatic species (7)*
  Saddle-billed Stork (Endangered)
  Lesser Flamingo (Vulnerable, also Globally Near Threatened; intra-African migrant)
  Greater Flamingo (Vulnerable) (intra-African migrant)
  Great White Pelican (Vulnerable)
  Bar-tailed Godwit (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)
  Black-necked Grebe (Near Threatened)
  Marabou Stork (Near Threatened)
- *Other smaller birds/Namibian near-endemic species (4)*
  Rüppell's Parrot (Near Threatened)
  Damara (Red-billed) Hornbill
  Monteiro's Hornbill
  Carp's Tit

All the above 21 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 (directly, or by means of streamers of excrement).

Red-billed Buffalo-Weaver and Sociable Weaver have a low potential to impact on the power supply through their nesting activities on power line structures. Cape Crow and Pied Crow both occur in the area also have a low potential to impact on the power supply.

5 Impact assessment

5.1 Impact description

5.1.1 Introduction

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, Kennedy, Savidge 2007; Jenkins, Smallie, Diamond 2010; Prinsen, Smallie, Boere, Pires 2011; Pallett, Osborne 2015; Simmons 2015; Scottish Natural Heritage 2016; Bernardino et al. 2018, 2019; Shaw, Reid, Schutgens, Jenkins, Ryan 2018; D'Amico, Martins, Álvarez-Martínez, Porto, Rafael Barrientos, Moreira 2019).

Note that impacts on avifauna are related to the specific power line structure (including associated structures such as strain poles, bend points, transformers etc.), rather than to voltage. The potential for impacts on low-voltage distribution structures should therefore not be under-estimated.

Four potential impacts have been identified for the project. These impacts are outlined below and assessed in Table 8.

5.1.2 Physical disturbance of birds and habitat destruction/modification

During the construction phase of a project, physical disturbance to birds, as well as habitat destruction and/or modification, will take place. Birds may be disturbed while going about their daily activities such as feeding, roosting and, in particular, breeding.

During the construction phase, vehicle and human activity on the site is at a peak. Poaching of birds (and eggs) and road mortalities are a potential threat. Once operational, the amount of disturbance should decrease.

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 in the vicinity.

The results of disturbance/habitat destruction are mainly indirect, and include:

- Displacement of birds from areas suitable for them before development, either temporarily or permanently
- A reduction in bird breeding success
- Permanent modification/destruction of sensitive habitats
- Unnatural mortalities of birds, caused by road collisions or poaching

Priority bird species in the study area that may potentially be impacted by disturbance and/or habitat destruction during construction of the new power line include:

- Nesting raptors, in particular White-backed Vulture and Lappet-faced Vulture
- The ground-nesting Kori Bustard
- Other nesting species, including the near-endemic Damara (Red-billed) Hornbill and Monteiro's Hornbill, and Rüppell's Parrot

5.1.3 Collision of birds on power line structures

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, ridges or agricultural habitats. Collisions may also take place on stay wires (which will be included on certain poles on the

proposed structure), 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.

Recent research has highlighted the fact that the most susceptible species 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 unfavourable conservation status (D'Amico et al. 2019). The collision risk is believed to be increased by factors that include a large wingspan and low manoeuvrability, nomadic/ migrant habits, flying in low light (e.g. flamingos and other waterbirds), courtship behaviour, juvenile inexperience and predation. The collision risk may also be increased under adverse weather conditions, e.g. strong wind, dust (e.g. from the mine site during east winds) and rain.

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

A collision is a direct impact that could potentially result in:

- Bird injuries and/or mortalities

Priority bird species in the study area that may potentially be impacted by collision include:

- All of the priority bird species identified in the present study, including eight raptors (White-backed Vulture and Lappet-faced Vulture (both nesting in the area), Cape Vulture [very low potential], Bateleur, Martial Eagle, Tawny Eagle, Red-footed Falcon, Secretarybird); two large terrestrial (cursorial) species (Kori Bustard; Blue Crane [but very low potential]); seven aquatic species (Greater Flamingo, Lesser Flamingo, Great White Pelican, Marabou Stork, Saddle-billed Stork, Black-necked Grebe, Bar-tailed Godwit); and four other smaller near-endemic species (Damara [Red-billed] Hornbill, Monteiro's Hornbill, Rüppell's Parrot, Carp's Tit)

Areas/structures that are potentially more sensitive in terms of being associated with bird collisions on power lines include flight paths around:

- Areas with large trees, used for nesting by vultures and other raptors
- Open areas along fence-lines/roadways/power line servitudes, used by Kori Bustard
- Areas near water points accessible to birds, and other (ephemeral) aquatic habitats, when they hold water

5.1.4 Electrocution of birds on power line structures

An electrocution occurs when a bird is perched or attempts to perch on an electrical structure (e.g. pole, transformer) and causes an electrical short circuit by physically bridging the air gap between live components (including "jumpers") and/or between live and earthed components.

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

Electrocutions of large raptors, mainly vultures and also eagles, are possible on the proposed HLPCD structure, should the birds perch or attempt to perch on the insulators and simultaneously touch a conductor and the (earthed) pole. As Lappet-faced Vultures have a wingspan of 2.8 m; Cape Vultures 2.6 m; and White-backed Vultures 2.2 m, there is a considerable risk of electrocution on this structure. The risk is increased by the gregarious nature of the vultures, where one or more birds may attempt to perch on the same spot; or if the bird is wet.

An electrocution is a direct impact that could potentially result in:

- Bird injuries and/or mortalities

Priority bird species in the study area that may potentially be impacted by electrocution in the above way (i.e. by direct contact, or by streamers) include:

- At least six large raptors, namely: White-backed Vulture, Lappet-faced Vulture, Cape Vulture, Martial Eagle, Tawny Eagle and Bateleur
- Waterbirds
- Smaller birds, including near-endemic Rüppell's Parrot, Damara (Red-billed) Hornbill, Monteiro's Hornbill

Areas/structures that are potentially more sensitive to bird electrocutions include:

- Poles, transformers and other structures adjacent to areas used regularly by vultures/raptors, including breeding sites on large trees, and water points

5.1.5 Impacts on the power supply due to bird nesting and other activities

Bird nesting activity on power line structures has the potential to cause flash-overs between live components.

Should environmental conditions be suitable (e.g. sufficient food/nesting material after rain, and accessible water), Sociable Weavers and Red-billed Buffalo-Weaver have the potential to engage in persistent nest building on power line structures in the study area. This may potentially cause flash-overs (and even fires), especially during wet weather, requiring intensive management by power utilities.

Crow nests on power line structures may also contain pieces of wire, which could cause outages. Both Pied Crow and Cape Crow have been recorded in the study area.

The potential for any of the above four species to impact negatively on the proposed power supply structures is considered relatively low, however, and this impact is not discussed further.

5.2 Impact assessment

Four main potential impacts have been identified for the project. These impacts are outlined above and the three main impacts are assessed in Table 8, according to the methodology described in Section 2.2 above.

Table 8. Assessment of impacts on avifauna of the proposed 11 kV distribution power line.

Impact	Sensitivity & value	Nature of impact	Magnitude of change	Level of certainty	Significance rating	
					Pre-mitigation	Post-mitigation
A. Impacts on biodiversity						
1. Physical disturbance of birds and habitat destruction/modification during the construction of power lines	High	Negative Indirect/(direct) International Medium-term Temporary Likely	Minor	Medium	Moderate (6)	Minor (3)
2. Collision of birds on power line structures	High	Negative Direct International Short-term Permanent Certain/likely	Moderate	High / Medium	Major (9)	Minor (3)
3. Electrocution of birds on power line structures	High	Negative Direct International Short-term Permanent Likely	Moderate	High/ Medium	Major (9)	Minor (3)
TOTAL					**24**	**9**
B. Impacts on the power supply						
4. Impacts on the power supply due to bird nesting and other activities	(Low)	Negative Direct Local Short-term Temporary/Reversible Likely	Negligible	Low	Low (1)	-
TOTAL					**1**	**-**

Summary of impact assessment

The assessment of potential impacts from the development may be summarised as follows:

1. Physical disturbance of birds and habitat destruction/modification during the construction of power lines:

Sensitivity and value high; magnitude of change minor; significance rating moderate, reduced to minor by mitigation

2. Collision of birds on power line structures:

Sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation

3. Electrocution of birds on power line structures

Sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation

4. Impacts on the power supply due to bird nesting and other activities

Sensitivity and value low (nuisance factor to human activities); magnitude of change negligible; significance rating low, no mitigation recommended

Although the proposed power line structure could have potential impacts, it is believed that these risks can be addressed by means of mitigation. If any new power lines are added in the future, the impacts would need to be reassessed.

5.3 Cumulative impacts

Although recorded mortalities may be in low numbers, the cumulative impacts of any negative interactions over the entire lifespan of the power line are an important consideration, viewed in association with the increase in power lines and other linear infrastructure in the study area, and the increasing effects of other human activities. In particular, cumulative impacts of other power lines in the area (e.g. the similar Cenored lines) should also be taken into account.

Sensitive species that are already under threat, including Red Data and endemic species, as well as nomads/migrants are at particular risk to such cumulative effects. In particular, the mounting threats to vulture populations throughout the region are well documented (e.g. Simmons et al. 2015 and references therein); these include poisoning (indirect and targetted); bush encroachment and its negative effect on the ability of vultures to find food; and trade in vulture parts for traditional medicine.

6. Recommendations for mitigation and monitoring

6.1 Mitigation

Mitigation measures are aimed at avoiding, minimising or rehabilitating negative impacts or enhancing potential benefits. The significance of potential impacts without and with mitigation is also provided (see Table 8 above).

Mitigation/management options are recommended below.

Ground survey and design stage

6.1.1 Routing and burying of the power line

The primary mitigation is the choice of route options and alternatives for a power line; if possible, areas where impacts on birds are likely to take place should be avoided.

- The power line route will run mostly along existing servitudes, rather than in new areas. No change in the proposed power line route is indicted.
- In view of the cumulative impacts of overhead structures in the area, the relatively short length of the proposed power line, and its proposed routing that includes along sections of already disturbed servitudes/roads (see above), the possibility of burying the power line is strongly recommended, should this be possible within practical and financial constraints. Apart from some initial, short-term disturbance, this would eliminate all of the other impacts.

Construction stage

6.1.2 Physical disturbance of birds and habitat destruction/modification

- Before construction starts (or burying of the power line), the proposed power line route should be inspected for any signs of bird nesting activity. Disturbance of nesting birds, in particular large raptors/vultures, or Kori Bustards, should be avoided.
- Where possible, the unnecessary destruction of habitat (including large trees) or degradation of the environment, including sensitive habitats such as water points and ephemeral pan areas, should be avoided.
- 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 mortalities. At the same time, the need for reporting power line incidents should be stressed, and reporting procedures clarified (see Monitoring below).
- Anti-poaching measures should be strictly enforced, with zero tolerance, and this should be emphasised during induction to contractors; offenders should be prosecuted.

6.1.3 Collision of birds on power line structures

- Proactive marking of the entire length of the power line is recommended in order to increase visibility.
  - At least the top conductor should be marked, along the full length of each span. Should monitoring indicate sections of power line that remain problematic in terms of repeated incidents, further mitigation should be investigated.
- Recommended devices to use include the following, all made by Preformed Line Products (PLP; Figure 29):
  - Bird Flight Diverter (BFD), alternating black and white. The larger SWAN-FLIGHT Diverter (SFD) could also be considered; alternating with

  - The Viper Live Bird Flapper ("Viper")
- The marking distance between devices should be 5-10 m, with offset designs/colours.
- 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 nocturnal fliers such as flamingos or grebes). The need for fitting additional mitigation for collisions on stay wires (e.g. with vibration dampers) or on any other structures should likewise be based on monitoring results.
- The new storage dam on site should be covered if possible (e.g. by means of shadecloth), to decrease its attractiveness to waterbirds.

6.1.4 Electrocution of birds on power line structures

- The earth wire on each power line poles should stop 300 mm below the lowest phase to provide an "air space safety gap", in order to reduce electrocution risk; this procedure is known as "gapping" (Figure 30). The gap should be wide enough to avoid being permanently active, but close enough to allow lightning strikes to bridge it. This mitigation should be fitted to all wooden and (especially) any steel A-frame poles.
- Transformer/switchgear structures should be designed in such a way that they are not attractive as bird perches/nesting sites; selected live components should be insulated (e.g. using PVC piping or low-density polyethylene pipe [LDPE]; Figure 31).
- The stay wires should also be "gapped" by the use of an insulator (see Figure 6).
- On strain structures where "jumper" wires are used in a horizontal configuration, the two outer jumpers should be suspended below the cross arm and the third/centre jumper should be insulated, or offset; or all jumpers insulated (Figure 32).
- Should bird electrocutions take place after the above mitigation, safe alternative perching areas/perching platforms may be provided, e.g. a simple, inexpensive T-piece bird perch that could be placed on top of the pole at the bend point (Figure 33). Ideally, the perch should be higher than the pole and at least 90 cm higher than the nearest conductor; and in this case 120 cm higher, as vultures occur. If possible, the size should allow for two vultures to perch side by side. Additional perches should fitted above transformer structures.
- NamPower could be contacted for details of the above mitigation measures.

6.1.5 . Impacts on the power supply due to bird nesting and other activities

- No mitigation is recommended at this stage, but monitoring is essential to identify (potential) problem areas (see 6.2 Monitoring below).
- Should any nesting activity cause disruptions of the power supply, consult with the Ministry of Environment & Tourism (MET) in order to discourage and manage such activities, e.g. by removing nests after the nesting season (if applicable).
- Ensure effective waste management, to discourage an increase in scavenging species such as Pied Crow.

Operational stage

- See monitoring below (6.2).

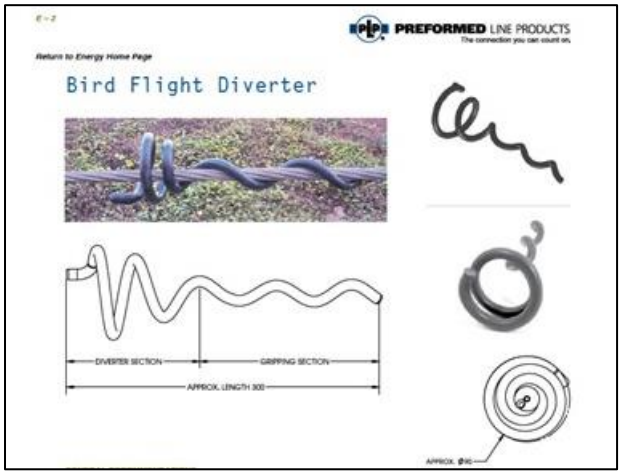


Figure 29 a-c. Examples of power line marking devices, used as a mitigation for bird collisions (all made by Preformed Line Products [PLP]): a. Bird Flight Diverter (BFD); b. SWAN-FLIGHT Diverter (SFD); and c. Viper Live Bird Flapper (Viper).

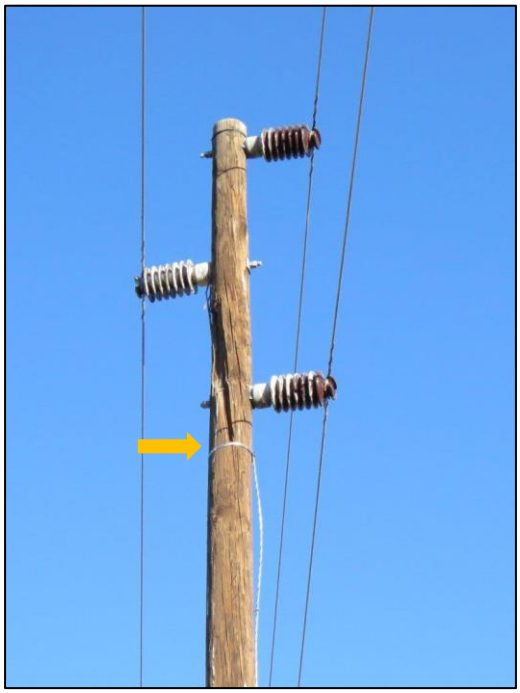


Figure 30. Example of "gapping" of a pole earth wire to reduce contact of the wire with the ground, except during lighting strikes. The arrow indicates the upper limit of the earth wire.

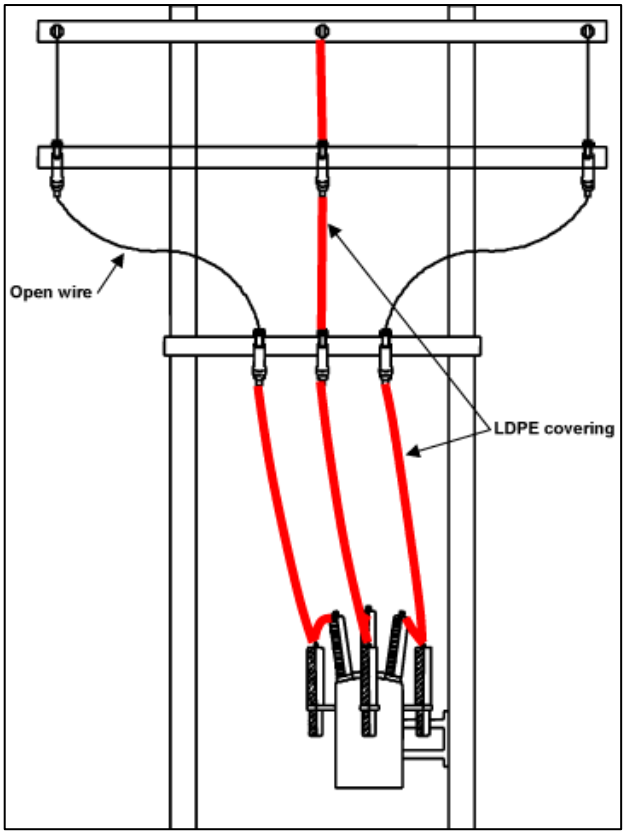


Figure 31. Example of use of Low Density Polyethylene (LDPE) pipe on jumpers to insulate selected live components of transformers and switch gears.

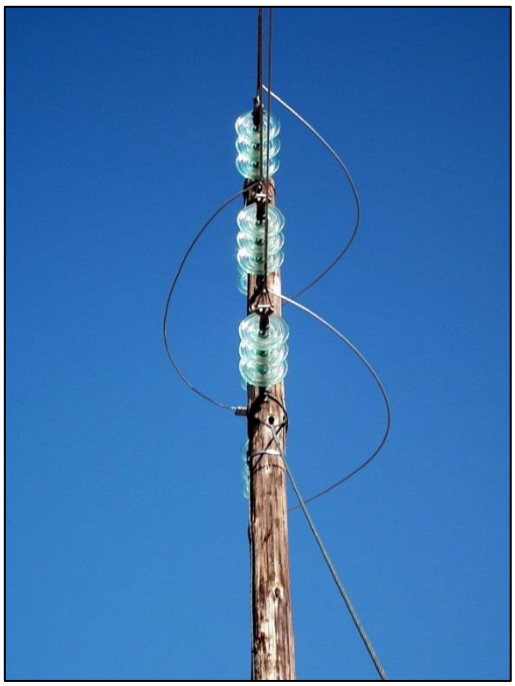


Figure 32. Offset "jumper" wires as a mitigation for electrocution.

Figure 33. Example of mitigation for electrocution in the form of a simple "T-piece" fitted to the top of an HLPCD pole; ideally, the perch should be higher than the pole, and the distance between the perch and the nearest conductor 90 cm; and 120 cm if vultures occur.

6.2 Monitoring

The following monitoring initiatives are to be conducted by B2Gold, in collaboration with and with the support of other partners (e.g. NamPower/NNF Strategic Partnership; (https://www.nnf.org.na/index.php/projects.html#nampower-nnf-strategic-partnership). Note that, should Kori Bustards or any other sensitive species start to visit the area regularly, or vulture numbers and nesting in the area increase at any stage, the need for monitoring for power line incidents would increase proportionately.

Should the power line be constructed above-ground:

- 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. The NamPower/NNF Strategic Partnership can be contacted (see above) to advise on methodology and provide further training if required.
- Pay particular attention to sensitive areas such as those closest to water sources. Also inspect 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.
- Monitor numbers and nesting activity by species such as Pied Crows; also monitor the management of food/vegetable wastes regularly to avoid an increase in their numbers.
- Set up a reporting channel, and clarify monitoring and reporting procedures 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 carcass (including head and beak), structure and general habitat; forward a copy of each incident report to the NamPower/NNF Strategic Partnership for further investigation.
- 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.

Should the power line be buried:

- Monitoring of any above-ground components should take place as above.

7 Conclusions

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 55 km north-west of the Waterberg Plateau Park, with the Etosha National Park 135 km further to the north-west. Both national parks are also classed as Important Bird Areas, or places of international significance for the conservation of birds at the Global, Regional or Sub-regional level.

The study area falls within the Tree-and-shrub Savanna biome, with heavily bush-encroached Thornbush Shrubland, dominated by *Acacia* tree and bush species. Three main avifauna habitats in the area include farmland on the plains; (mainly ephemeral) aquatic habitats; and the agricultural irrigated habitats that will be created. On farmland, larger trees (mainly *Acacia luederitzii*) provide nesting habitats for large raptors, including at least eight known active nests for White-backed Vultures; the more open habitats are used by Kori Bustard; and accessible watering points are used by many kinds of birds. The group of aquatic habitats includes a system of shallow ephemeral pans, and earth dams, that are reported to hold water regularly during the rainy season, when many waterbirds may move into the area. On the adjacent B2Gold Mine property, a large ephemeral pan on the nature reserve section is also reported to hold water during the rainy season, while a large (perennial) sewage pond and tailings dam are situated on or near the main entrance road to the mine; these habitats also attract a variety of waterbirds.

A relatively high diversity of bird species has been recorded in the study area and surrounds, with a total of 217 species, or 32% of the 676 species currently recorded in Namibia; however, the birdlife of the area is not well documented in parts. The field trip for the previous study also took place under drought conditions, when the bird diversity observed was fairly low. To address these limitations, data from several sources were combined for an overall checklist.

The checklist includes 18 species (9% of the total) that are threatened in Namibia (and comprising 25% of the 71 species on the Namibian Red Data List); eleven of the 18 species are also Globally Threatened. In particular, the adjacent Waterberg area is well known for its populations of several species of threatened vultures and other raptors. Satellite tracking data indicate that Cape Vultures (now rare) have regularly visited the study area in the past, and perched/roosted on the existing 220 kV Gerus-Otjikoto power line in the past, a behaviour that could increase the risk of collisions on power lines.

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-one species are considered to have the potential to be impacted by power line structures (including 18 Red Data species, four Namibian near-endemic species and four with migrant status), namely:

- *Raptors (8)*
  White-backed Vulture (Critically Endangered, also Globally Critically Endangered)
  Cape Vulture (Critically Endangered, also Globally Endangered; now rare in Namibia)
  Lappet-faced Vulture (Endangered, also Globally Endangered)
  Martial Eagle (Endangered, also Globally Vulnerable)
  Bateleur (Endangered, also Globally Near Threatened)
  Tawny Eagle (Endangered)
  Secretarybird (Vulnerable, also Globally Vulnerable)
  Red-footed Falcon (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)
- *Large terrestrial (cursorial) species (2)*

Blue Crane (Critically Endangered, also Globally Vulnerable; now rare in Namibia)
Kori Bustard (Near Threatened, also Globally Near Threatened)

- *Aquatic species (7)*
  Saddle-billed Stork (Endangered)
  Lesser Flamingo (Vulnerable, also Globally Near Threatened; intra-African migrant)
  Greater Flamingo (Vulnerable) (intra-African migrant)
  Great White Pelican (Vulnerable)
  Bar-tailed Godwit (Near Threatened, also Globally Near Threatened; Palearctic-breeding migrant)
  Black-necked Grebe (Near Threatened)
  Marabou Stork (Near Threatened)
- *Other smaller birds/Namibian near-endemic species (4)*
  Rüppell's Parrot (Near Threatened)
  Damara (Red-billed) Hornbill
  Monteiro's Hornbill
  Carp's Tit

The impacts of power line structures on avifauna and recommended mitigation measures are well documented, both globally and for the southern African subregion. Three main potential impacts have been identified for the project.

- *Physical disturbance of birds and habitat destruction/modification during the construction of power lines*

During the construction phase of a project, physical disturbance to birds, as well as habitat destruction and/or modification, will take place. Birds may be disturbed while going about their daily activities such as feeding, roosting and, in particular, breeding.

Groups/habitats at particular risk to these impacts include nesting White-backed Vulture and Lappet-faced Vulture, and other raptors nesting in large trees; the ground-nesting Kori Bustard; and nesting near-endemic species.

This impact is assessed as follows: sensitivity and value high; magnitude of change minor; significance rating moderate, reduced to minor by mitigation.

- *Collision of birds on power line structures*

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 until it is too late to take evasive action.

The species most susceptible 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 unfavourable conservation status. The collision risk is believed to be increased by factors such as a large wingspan and low manoeuvrability, limited frontward vision when flying in some species, nomadic/migrant habits, flying in low light (e.g. flamingos and other waterbirds), courtship behaviour, juvenile inexperience, and predation; and flying under adverse weather conditions. Collisions may take place on overhead cables as well as on stay wires and other associated structures.

All the above 21 priority bird species are potentially at risk to collisions on power line structures. Areas of particular concern include flight paths around areas with large trees, used for nesting by vultures and other raptors; open areas along fence-lines/roadways/power line servitudes, used by Kori Bustard; and areas around water points accessible to birds, and other (ephemeral) aquatic habitats, when they hold water.

This impact is assessed as follows: sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation.

- *Electrocution of birds on power line structures*

An electrocution occurs when a bird is perched or attempts to perch on an electrical structure (e.g. pole, transformer) and causes an electrical short circuit by physically bridging the air gap between live components and/or between live and earthed components. An electrocution could also be caused should a large bird perch on top of a pole and send down a "streamer" of excrement that could hit a conductor, thereby bridging the gap between an earthed and a live component.

Electrocutions of large raptors, mainly vultures, are possible on the proposed HLPCD structure, should the birds perch or attempt to perch on the insulators and simultaneously touch a conductor and the (earthed) pole. As Lappet-faced Vultures have a wingspan of 2.8 m; Cape Vultures 2.6 m; and White-backed Vultures 2.2 m, there is a considerable risk of electrocution on this structure. The risk is increased by the gregarious nature of the vultures, where one or more birds may attempt to perch on the same spot; or if the bird is wet.

Priority bird species in the study area that may potentially be impacted by electrocution in the above way include at least six large raptors, namely White-backed Vulture, Lappet-faced Vulture, Cape Vulture, Martial Eagle, Tawny Eagle and Bateleur. Tower structures adjacent to areas used regularly by vultures/raptors, including breeding sites on large trees, and water points would be more sensitive to such risks.

Electrocution of birds on power line structures is assessed as follows: sensitivity and value high; magnitude of change moderate; significance rating major, reduced to minor by mitigation.

- *Impacts on the power supply due to bird nesting and other activities*

Bird nesting and other activities on power line structures have the potential to cause flash-overs, with disruptions to the power supply. The risk is higher in wet weather.

The potential for species such as Sociable Weaver (and Red-Billed Buffalo Weaver), and Pied Crow and Cape Crow to impact negatively on the proposed power supply structures is considered relatively low, however.

This impact is assessed as follows: sensitivity and value low (nuisance factor to human activities); magnitude of change negligible; significance rating low, no mitigation recommended.

Although recorded mortalities may be in low numbers, the cumulative impacts of any negative interactions over the entire lifespan of the power line are an important consideration, viewed in association with the increase in power lines and other linear infrastructure in the study area, and the increasing effects of other human activities. Sensitive species that are already under threat, including Red Data and (near-)endemic species, as well as nomads/migrants are at particular risk to such cumulative effects. In particular, the mounting threats to vulture populations throughout the region are well documented; these include poisoning (both indirect and targetted); disturbance and loss of habitat; bush encroachment and its negative effect on the ability of vultures to find food; and trade in vulture parts for traditional medicine.

Mitigation measures are aimed at avoiding, minimising or rehabilitating negative impacts or enhancing potential benefits. The primary mitigation is the choice of route options and alternatives for a power line; if possible, areas where impacts on birds are likely to take place should be avoided.

In view of the cumulative impacts of overhead structures in the area, the relatively short length of the proposed power line, and its proposed routing that includes along sections of already disturbed servitudes/roads, the possibility of burying the power line is strongly recommended, should this be possible within practical and financial constraints. Apart from some initial, short-term disturbance, this would eliminate all of the other impacts.

Recommendations are also made to reduce the impacts of physical disturbance to birds and habitat destruction/modification during the construction of the power line. Should an overhead line be constructed, marking of the entire length of the power line to increase visibility is recommended, according to specified design. Detailed mitigation to reduce the impacts of electrocution is included.

Detailed monitoring initiatives are recommended that should be conducted by B2Gold, with the support of other partners.

Although the proposed power line structure could have potential impacts, it is believed that these risks can be addressed by means of mitigation. If any new power lines are added in the future, the impacts would need to be reassessed.

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Appendix 1: Checklist of bird species recorded in the B2Gold study area, Otjiwarongo

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

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 BVDB: 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

Oct 2019: personal observations September/October 2019

Common names	Scientific names	RDB / END	RES (RDB)	SABAP1 EIS	SABAP1 BVDB	SABAP2	Oct 2019
Avocet, Pied	*Recurvirostra avosetta*				X		
Babbler, Southern Pied	*Turdoides bicolor*			X	X	X	
Barbet, Acacia Pied	*Tricholaema leucomelas*			X	X	X	X
Bateleur	*Terathropius ecaudatus*	EN, G NT	Res	X	X		?
Batis, Chinspot	*Batis molitor*			X	X		
Batis, Pririt	*Batis pririt*			X	X	X	X
Bee-eater, European	*Merops apiaster*			X	X	X	
Bee-eater, Swallow-tailed	*Merops hirundineus*			X	X	X	
Brubru	*Nilaus afer*			X	X	X	
Bulbul, African Red-eyed	*Pycnonotus nigricans*			X	X	X	X
Bunting, Cinnamon-breasted	*Emberiza tahapisi*					X	
Bunting, Golden-breasted	*Emberiza flaviventris*			X	X	X	
Bustard, Kori	*Ardeotis kori*	NT, G NT	Res, move	X	X	X	X

Common names	Scientific names	RDB / END	RES (RDB)	SABAP1 EIS	SABAP1 BVDB	SABAP2	Oct 2019
Buttonquail, Kurrichane	*Turnix sylvaticus*					X	
Buzzard, Steppe (Common)	*Buteo vulpinus = buteo*			X		X	
Camaroptera, Grey-backed	*Camaroptera brevicaudata*					X	
Canary, Black-throated	*Crithagra atrogularis*			X		X	
Canary, Yellow	*Crithagra flaviventris*					X	
Chat, Ant-eating	*Myrmecocichla formicivora*				X		
Chat, Familiar	*Emarginata familiaris*					X	
Cisticola, Desert	*Cisticola aridulus*					X	?
Cisticola, Rattling	*Cisticola chiniana*				X	X	
Cisticola, Tinkling	*Cisticola rufilatus*					X	
Cisticola, Zitting	*Cisticola juncidis*					X	
Coot, Red-knobbed	*Fulica cristata*			X	X		
Courser, Bronze-winged	*Rhinoptilus chalcopterus*			X	X		
Courser, Double-banded	*Rhinoptilus africanus*			X			X
Courser, Temminck's	*Cursorius temminckii*			X	X	X	X
Crane, Blue	*Anthropoides paradiseus (Grus paradisea)*	CE, G VU	Res, move	X	X		
Crombec, Long-billed	*Sylvietta rufescens*			X	X	X	
Crow, Cape	*Corvus capensis*			X	X		
Crow, Pied	*Corvus albus*					X	
Cuckoo, African	*Cuculus gularis*				X	X	
Cuckoo, Black	*Cuculus clamosus*			X	X	X	
Cuckoo, Diederick	*Chrysococcyx caprius*				X		
Cuckoo, Great Spotted	*Clamator glandarius*			X	X	X	
Cuckoo, Jacobin	*Clamator jacobinus*				X	X	
Dove, Emerald-spotted Wood	*Turtur chalcospilos*			X	X	X	
Dove, Laughing	*Spilopelia senegalensis*			X	X	X	X

Common names	Scientific names	RDB / END	RES (RDB)	SABAP1 EIS	SABAP1 BVDB	SABAP2	Oct 2019
Dove, Namaqua	*Oena capensis*			X	X	X	
Dove, Ring-necked (Cape Turtle)	*Streptopelia capicola*			X	X	X	
Drongo, Fork-tailed	*Dicrurus adsimilis*			X	X	X	X
Eagle, African Hawk	*Aquila spilogaster*					X	
Eagle, Black-chested Snake	*Circaetus pectoralis*					X	Rep
Eagle, Brown Snake	*Circaetus cinereus*					X	
Eagle, Lesser Spotted	*Clanga pomarina*				X		
Eagle, Martial	*Polemaetus bellicosus*	EN, G VU	Res		X	X	
Eagle, Tawny	*Aquila rapax*	EN	Res	X	X	X	
Eagle, Wahlberg's	*Hieraaetus wahlbergi*				X		
Eagle-Owl, Spotted	*Bubo africanus*					X	Rep?
Egret, Little	*Egretta garzetta*						Rep
Egret, Western Cattle	*Bubulcus ibis*			X	X		
Eremomela, Yellow-bellied	*Eremomela icteropygialis*				X		
Eremomela, Burnt-necked	*Eremomela usticollis*				X		
Falcon, Red-footed	*Falco vespertinus*	NT, G NT	Pal mig	X	X	X	
Finch, Red-headed	*Amadina erythrocephala*			X	X	X	
Fiscal, Common (Southern)	*Lanius collaris*				X		
Flamingo, Greater	*Phoenicopterus roseus*	VU	IA mig	X	X		X juv
Flamingo, Lesser	*Phoeniconaias minor*	VU, G NT	IA mig		X		Rep
Flycatcher, African Paradise	*Terpsiphone viridis*					X	
Flycatcher, Marico	*Meleanornis mariquensis*			X		X	
Flycatcher, Spotted	*Muscicapa striata*					X	
Francolin, Crested	*Dendroperdix sephaena*			X		X	
Go-away-bird, Grey	*Corythaixoides concolor*			X	X	X	X
Godwit, Bar-tailed	*Limosa lapponica*	NT, G NT	Pal mig	X	X		

Common names	Scientific names	RDB / END	RES (RDB)	SABAP1 EIS	SABAP1 BVDB	SABAP2	Oct 2019
Goose, Egyptian	*Alopochen aegyptiaca*			X	X		Rep
Goshawk, Gabar	*Micronisus gabar*					X	
Goshawk, Southern Pale Chanting	*Melierax canorus*			X	X	X	X
Grebe, Black-necked	*Podiceps nigricollis*	NT	Nom	X	X		X
Grebe, Little	*Tachybaptus ruficollis*			X	X		
Greenshank, Common	*Tringa nebularia*				X	X	
Guineafowl, Helmeted	*Numida meleagris*			X	X	X	X
Gull, Grey-headed	*Chroicocephalus cirrocephalus*			X	X		Rep
Hamerkop	*Scopus umbretta*			X	X		Rep
Harrier-Hawk, African	*Polyboroides typus*				X		
Heron, Grey	*Ardea cinerea*			X	X		X
Honeyguide, Lesser	*Indicator minor*					X	
Hoopoe, African	*Upupa africana*			X	X	X	
Hoopoe, Green Wood	*Phoeniculus purpureus*				X		
Hornbill, African Grey	*Lophhoceros nasutus*			X	X	X	
Hornbill, Damara (Red-billed)	*Tockus damarensis*	NE Nam			X		
Hornbill, Monteiro's	*Tockus monteiri*	NE Nam				X	
Hornbill, (Southern) Red-billed	*Tockus erythrorhynchus*			X	X	X	X
Hornbill, Southern Yellow-billed	*Tockus leucomelas*			X	X	X	X
Jacana, African	*Actophilornis africanus*			X	X		
Kestrel, Greater	*Falco rupicoloides*			X	X		
Kestrel, Rock	*Falco rupicolus*			X		X	
Kingfisher, Pied	*Ceryle rudis*			X	X		
Kingfisher, Woodland	*Halcyon senegalensis*					X	Rep?
Kite, Black-shouldered (Black-winged)	*Elanus caeruleus*			X	X	X	
Kite, Yellow-billed	*Milvus aegyptius*					X	

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Korhaan, Northern Black	*Afrotis afraoides*					X	
Korhaan, Red-crested	*Lophotis ruficrista*			X	X	X	X
Korhaan, Southern Black	*Afrotis afra = afraoides*			X			
Lapwing, African Wattled	*Vanellus senegallus*			X	X	X	
Lapwing, Blacksmith	*Vanellus armatus*			X	X	X	
Lapwing, Crowned	*Vanellus coronatus*			X	X	X	X
Lark, Dusky	*Pinarocorys nigricans*			X	X		
Lark, Eastern Clapper	*Mirafra fasciolata*				X		
Lark, Fawn-coloured	*Calendulauda africanoides*					X	
Lark, Monotonous	*Mirafra passerina*				X	X	
Lark, Red-capped	*Calandrella cinerea*				X	X	
Lark, Rufous-naped	*Mirafra africana*			X	X		
Lark, Sabota	*Calendulauda sabota*			X		X	
Lovebird, Rosy-faced	*Agapornis roseicollis*			X	X		X
Martin, Banded	*Riparia cincta*					X	
Martin, Common House	*Delichon urbicum*					X	?
Martin, Rock	*Ptyonoprogne fuligula*				X	X	
Masked-weaver, Lesser	*Ploceus intermedius*					X	Nests
Masked-weaver, Southern	*Ploceus velatus*			X	X	X	
Moorhen, Common	*Gallinula chloropus*				X		
Mousebird, Red-faced	*Urocolius indicus*				X	X	
Mousebird, White-backed	*Colius colius*					X	
Nightjar, European	*Caprimulgus europaeus*					X	
Nightjar, Fiery-necked	*Caprimulgus pectoralis*				X	X	
Nightjar, Freckled	*Caprimulgus tristigma*				X	X	
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*				X		

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Openbill, African	*Anastomus lamelligerus*			X	X		
Oriole, African Golden	*Oriolus auratus*					X	
Ostrich, Common	*Struthio camelus*			X	X	X	
Owl, African Scops	*Otus senegalensis*			X	X	X	
Owl, (Western) Barn	*Tyto alba*			X	X	X	
Owl, Southern White-faced	*Ptilopsis granti*					X	
Owlet, Pearl-spotted	*Glaucidium perlatum*				X	X	
Parrot, Meyer's	*Poicephalus meyeri*				X		
Parrot, Rüppell's	*Poicephalus rueppellii*	NT; NE Nam	Res, nom		X		
Pelican, Great White	*Pelecanus onocrotalus*	VU	Res, nom	X	X		Rep
Pipit, African	*Anthus cinnamomeus*				X	X	
Plover, Kittlitz's	*Charadrius pecuarius*						Rep
Plover, Three-banded	*Charadrius tricollaris*			X	X		X
Plover, White-fronted	*Charadrius marginatus*				X		
Prinia, Black-chested	*Prinia flavicans*			X	X	X	
Puffback, Black-backed	*Dryoscopus cubla*			X	X		
Pytilia, Green-winged	*Pytilia melba*			X	X	X	
Quelea, Red-billed	*Quelea quelea*			X	X	X	
Robin, Kalahari Scrub	*Cercotrichas paena*			X		X	X
Robin, White-browed Scrub	*Cercotrichas leucophrys*			X		X	
Roller, European	*Coracias garrulus*			X	X		
Roller, Lilac-breasted	*Coracias caudatus*			X		X	X
Roller, Purple	*Coracias naevius*			X		X	
Ruff	*Philomachus pugnax*				X		
Sandgrouse, Burchell's	*Pterocles burchelli*				X		
Sandgrouse, Double-banded	*Pterocles bicinctus*			X	X		

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Sandgrouse, Namaqua	*Pterocles namaqua*				X	X	
Sandpiper, Marsh	*Tringa stagnatilis*				X		
Sandpiper, Wood	*Tringa glareola*					X	
Scimitarbill, Common	*Rhinopomastus cyanomelas*			X	X	X	
Secretarybird	*Sagittarius serpentarius*	VU, G VU	Nom	X	X	X	
Shelduck, South African	*Tadorna cana*						X
Shoveler, Cape	*Anas smithii*						Rep
Shikra	*Accipiter badius*			X	X	X	
Shrike, Crimson-breasted	*Laniarius atrococcineus*			X	X	X	X
Shrike, Lesser Grey	*Lanius minor*			X	X	X	
Shrike, Magpie	*Urolestes melanoleucus*			X	X	X	
Shrike, Red-backed	*Lanius collurio*			X	X	X	
Shrike, Southern White-crowned	*Eurocephalus anguitimens*			X	X		
Snipe, African	*Gallinago nigripennis*			X	X		
Sparrow, Great	*Passer motitensis*			X	X	X	
Sparrow, House	*Passer domesticus*				X		
Sparrow, Southern Grey-headed	*Passer diffusus*			X	X	X	
Sparrow-Lark, Chestnut-backed	*Eremopterix leucotis*				X		
Sparrow-Lark, Grey-backed	*Eremopterix verticalis*				X		
Sparrow-Weaver, White-browed	*Plocepasser mahali*			X	X	X	X
Spoonbill, African	*Platalea alba*				X		
Spurfowl, Red-billed	*Pternistis adspersus*			X		X	X
Spurfowl, Swainson's	*Pternistis swainsonii*			X		X	
Starling, Burchell's	*Lamprotornis australis*			X	X	X	
Starling, Cape (Glossy)	*Lamprotornis nitens*			X	X	X	X
Starling, Pale-winged	*Onychognathus nabouroup*			X	X		

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Starling, Violet-backed	*Cinnyricinclus leucogaster*					X	
Starling, Wattled	*Creatophora cinerea*				X	X	
Stilt, Black-winged	*Himantopus himantopus*				X		X
Stint, Little	*Calidris minuta*						Rep
Stork, Marabou	*Leptoptilos crumenifer*	NT	Res			X	Rep
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	EN	Res	X	X		
Stork, Yellow-billed	*Mycteria ibis*					X	
Sunbird, Dusky	*Cinnyris fuscus*			X			
Sunbird, Marico	*Cinnyris mariquensis*					X	X
Sunbird, Scarlet-chested	*Chalcomitra senegalensis*					X	
Sunbird, White-bellied	*Cinnyris talatala*					X	
Swallow, Barn	*Hirundo rustica*			X	X	X	?
Swallow, Greater Striped	*Cecropis cucullata*			X	X	X	
Swallow, Lesser Striped	*Cecropis abyssinica*				X	X	
Swallow, Red-breasted	*Cecropis semirufa*				X	X	
Swift, African Palm	*Cypsiurus parvus*			X	X	X	
Swift, Alpine	*Tachymarptis melba*			X	X		
Swift, Common	*Apus apus*			X	X	X	
Swift, Little	*Apus affinis*			X	X	X	
Swift, White-rumped	*Apus caffer*			X	X	X	
Tchagra, Brown-crowned	*Tchagra australis*			X	X	X	
Teal, Cape	*Anas capensis*				X		X
Teal, Red-billed	*Anas erythrorhyncha*			X	X		X
Thick-knee, Spotted	*Burhinus capensis*				X	X	
Thrush, Groundscraper	*Turdus litsipsirupa*			X		X	X
Thrush, Short-toed Rock	*Monticola brevipes*				X	X	

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Tit, Ashy	*Melaniparus cinerascens*				X	X	
Tit, Cape Penduline	*Anthoscopus minutus*				X	X	
Tit, Carp's	*Melaniparus carpi*	NE Nam			X		
Vulture, Cape	*Gyps coprotheres*	CR, G EN	Res but wide move-ments			X	
Vulture, Lappet-faced	*Torgos tracheliotos*	EN, G EN		X	X	X	Rep: nest
Vulture, White-backed	*Gyps africanus*	CR, G CR		X	X	X	X Nests
Wagtail, Cape	*Motacilla capensis*				X	X	
Warbler (Tit-babbler), Chestnut-vented	*Sylvia subcaerulea*			X	X	X	
Waxbill, Black-faced	*Estrilda erythronotos*			X	X	X	
Waxbill, Blue	*Uraeginthus angolensis*			X	X	X	
Waxbill, Violet-eared	*Granatina granatina*			X		X	
Weaver, Red-billed Buffalo	*Bubalornis niger*			X	X	X	Old nests
Weaver (Finch), Scaly-feathered	*Sporopipes squamifrons*			X	X	X	
Weaver, Sociable	*Philetairus socius*						X old nests
Wheatear, Capped	*Oenanthe pileata*				X		
White-Eye, African Yellow	*Zosterops senegalensis*			X	X		
Whydah, Long-tailed Paradise	*Vidua paradisaea*				X	X	
Whydah, Shaft-tailed	*Vidua regia*			X	X	X	
Woodpecker, Bearded	*Dendropicos namaquus*			X		X	
Woodpecker, Cardinal	*Dendropicos fuscesens*			X	X	X	
Woodpecker, Golden-tailed	*Campethera abingoni*					X	
Wren-Warbler, Barred	*Calamonastes fasciolatus*				X	X	
TOTAL 217				**121**	**157**	**146**	**(54)**