AVIFAUNAL IMPACT ASSESSMENT

Hendrina North Grid Infrastructure, Mpumalanga Province
132kV Grid connection components

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EXECUTIVE SUMMARY

1. Background

This report presents the findings of an avifaunal impact assessment conducted during 2022 at the Hendrina North Grid Infrastructure (up to 132kV) subproject of the Hendrina North Complex. The Hendrina North Complex which is being developed by ENERTRAG South Africa (Pty) Ltd in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

The Hendrina North Complex can be divided into five (5) subprojects, namely:

- Hendrina North Wind Energy Facility (WEF) (up to 200MW);
- Hendrina South Wind Energy Facility (up to 200MW);
- Hendrina North Grid Infrastructure (up to 132kV);
- Hendrina South Grid Infrastructure (up to 132kV); and
- Green Hydrogen and Ammonia Facility.

This specialist report concerns the Hendrina North Grid Infrastructure (up to 132V), hereafter referred to as the Project, which is intersects eight farm properties (see Table 1 below). A 2km buffer zone around the Project has been set up as the project area of impact (PAOI), totalling 9546 ha (see Figure 1). The PAOI is located approximately 15km west of Hendrina, within the Steve Tshwete Local Municipality, in the Nkangala District Municipality, Mpumalanga Province. The Hendrina Power Station is located approximately 17km northwest of Hendrina, near the small town of Pullens Hope which is encompassed by the PAOI (Figure 1). The proposed powerline (≤132kV) to Hendrina Power Station will be ~20km long (depending on the exact route). A 500m corridor is proposed (250m from the centre lines).

2. Avifauna

The SABAP2 data indicates that a total of 186 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species, as well as all the species that were recorded during the pre-construction monitoring in the PAOI. Of these, 66 species are classified as powerline sensitive species and 10 of these are South African Red List species. Of the powerline sensitive species, 33 are likely to occur regularly in the PAOI.

3. Potential Impacts

The following potential impacts on powerline sensitive species have been identified:

3.1. Construction Phase

- Displacement due to disturbance associated with the construction of the onsite substation and grid connection power line.
- Displacement due to habitat transformation associated with the construction of the onsite substation and grid connection power line.

3.2. Operational Phase

- Collisions with the 132kV grid connection power line.
- Electrocutions within the onsite substation.

3.3. Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the onsite substation and grid connection power line.

3.4. Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the onsite substation and grid connection power line.
- Displacement due to habitat transformation associated with the substation and grid connection power line.
- Collisions with the overhead power line.
- Electrocutions within the onsite substation.

4. Mitigations

The mitigation measures that are proposed for the proposed Project are listed below.

4.1. Pre-construction phase

- The authorised alignment must be inspected by an avifaunal specialist by means of a “walk-through” inspection i.e., through a combination of satellite imagery supplemented with in situ inspections by vehicle and where necessary, on foot, once the tower positions have been finalised. The objective would be to demarcate the sections of the powerline that need to be fitted with Bird Flight Diverters.
- Conduct an inspection prior to the commencement of the construction, to identify Red List species that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed.

4.2. Construction phase

- Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).
- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Vegetation clearance should be limited to what is necessary.
- The mitigation measures proposed by the biodiversity specialist must be strictly enforced.

4.3. Operational phase

- The hardware within the proposed substation yard is too complex and the risk too low to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded by the maintenance staff once operational, site-specific mitigation (insulation) be applied reactively if need be. This is an acceptable approach because Red List powerline sensitive species are unlikely to frequent the substation, although some more common powerline sensitive species might well be present more often and exposed to the electrocution risk.

4.4. De-commissioning phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

5. Environmental sensitivities

The following specific environmental sensitivities were identified from an avifaunal perspective (see Figure 9 for the map of environmental sensitivities):

Very high sensitivity: drainage lines, dams, pans, and associated herbaceous wetlands.

Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety priority species, particularly waterbirds, as well as seven Red List species, namely:

1. Crane, Grey Crowned (Globally Endangered, Regionally Endangered)
2. Duck, Maccoa (Globally Endangered, Regionally Near Threatened)
3. Eagle, Martial (Globally Endangered, Regionally Endangered)
4. Falcon, Lanner (Globally Least Concern, Regionally, Vulnerable)
5. Flamingo, Greater (Globally Least Concern, Regionally Near Threatened)
6. Secretarybird (Globally Endangered, Regionally Vulnerable)
7. Stork, Yellow-billed (Globally Least Concern, Regionally Endangered)

Birds commuting between these areas will be at risk of collision with the earth-wire if they must cross over the grid connection. Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

High sensitivity: undisturbed natural grassland

The natural grassland is vital breeding, roosting and foraging habitat for a variety of Red List powerline sensitive species and will therefore be associated with significant flight activity. These include the following five Red List species:

1. Eagle, Martial (Globally Endangered, Regionally Endangered)

2. Falcon, Lanner (Globally Least Concern, Regionally Vulnerable)
3. Ibis, Southern Bald (Globally Vulnerable, Regionally Vulnerable)
4. Korhaan, Blue (Globally Near Threatened, Regionally Least Concern)
5. Secretarybird (Globally Endangered, Regionally Vulnerable)

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

Medium sensitivity: disturbed natural grassland/fallow agricultural land

Disturbed natural grassland and fallow agricultural land provide similar foraging, roosting, and potentially breeding opportunities for priority species which depend upon natural grassland, including the same five Red List species listed for natural undisturbed grassland.

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

6. ASSESSMENTS OF ALTERNATIVES

The preferred option from a bird impact perspective would the HD North Option 1 132kV, as it drastically reduces the length of powerline that need to be constructed, and intersects fewer environmentally sensitivity areas than would the HD North Option 2 132kV (see Figure 9).

Additionally, it would be preferable for the proposed substation to be slightly repositioned onto already transformed land, to minimise further loss of natural grassland habitats.

7. CONCLUSION AND IMPACT STATEMENT

According to the DFFE national screening tool, small sections of the habitat within the PAOI is classified as High sensitivity according to the Animal Species theme, due to the potential presence of species of conservation concern (SCCs), namely Yellow-billed Stork *Mycteria ibis* (Globally Least Concern, Regionally Endangered). Most the habitat within the PAOI is classified as **medium** sensitivity due the presence of other SCCs, namely, White-bellied Korhaan *Eupoditis senegalensis* (Globally Least Concern, Regionally Vulnerable), African Grass Owl *Tyto capensis* (Globally Least Concern, Regionally Vulnerable) and Caspian Tern *Hydroprogne caspia* (Globally Least Concern Regionally Vulnerable).

The classification of **High** sensitivity for Yellow-billed Stork is supported based on the habitat recorded during surveys, but in addition the PAOI as a whole should be reclassified as **High** based on the recorded presence of SCCs recorded in the PAOI during monitoring, namely Secretarybird (Globally Endangered, Regionally Vulnerable), Martial Eagle (Globally Endangered, Locally Endangered), Lanner Falcon (Locally Vulnerable), Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable), Blue Korhaan (Globally Near Threatened, Regionally Least Concern), and Grey Crowned Crane (Globally and Locally Endangered).

The proposed Project will have a range of pre-mitigation impacts from medium to high on priority avifauna, but it is expected to be reduced to acceptable low levels with appropriate mitigation. No fatal flaws were discovered during the investigations, therefore the authorisation of the project is supported, provided the recommendations in this report is strictly implemented.

CONTENTS

DETAILS OF THE SPECIALIST

Chris van Rooyen (Bird Specialist)

Chris has 25 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Jake Mulvaney (bird specialist)

Jake recently received a PhD in Zoology from Stellenbosch University and is the author of three academic papers involving bird population assessments and GIS modelling.

Albert Froneman (Bird and GIS Specialist)

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

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Table 1: FARM PROPERTIES WITHIN WHICH THE HENDRINA NORTH GRID INFRASTURE WILL FALL

Portion No.	Farm No.	Farm Name
12	153	Driefontein
37	153	Driefontein
2	153	Driefontein
17	153	Driefontein
14	151	Roodepoort
13	151	Roodepoort
2	151	Roodepoort
18	151	Roodepoort
1	151	Roodepoort
8	154	Boschmanskop
3	185	Haartebeestkuil
4	185	Haartebeestkuil
1	25	Broodsneyerplaats
0	162	Hendrina Power Station
0	186	Gloria
11	162	Hendrina Power Station
1	158	Aberdeen

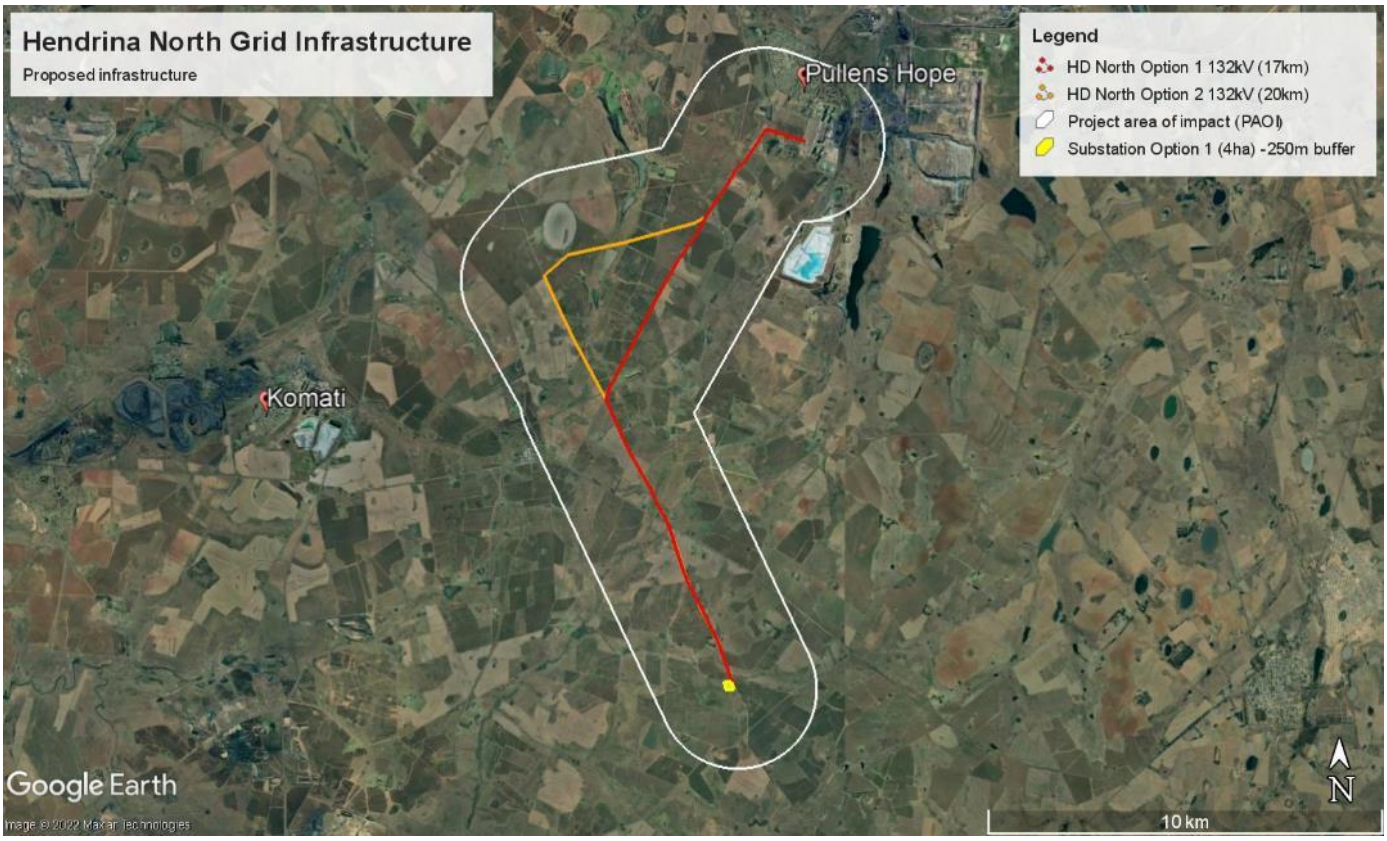


Figure 1: SITE LOCALITY AND PROPOSED INFRASTRUCTURE FOR THE NORTH GRID INFRASTURE.

1.1. Project description: Hendrina North Grid Infrastructure (up to 132kV)

The proposed Hendrina North Grid Infrastructure (up to 132kV) is required to connect the Hendrina North WEF to the National Grid, via the existing substation at the Komati Power Station. The Hendrina North WEF is the subject of a separate EIA Process.

The Applicant intends to develop the Project under a self-build agreement with Eskom. Once construction is complete it is anticipated that the Grid Infrastructure, and associated Environmental Authorisation, will be transferred to the Grid Operator (Eskom). Eskom will be the ultimate owner of the Grid Infrastructure and will be responsible for the operation, maintenance, and decommissioning (if applicable) thereof. The Project will make use of the Hendrina North WEF[1] Project laydown areas and construction camps (subject to a separate application for EA).

The proposed grid connection infrastructure will include the following components:

1.1.1. Onsite Substation

Onsite substation consisting of 33/132kV yard (to be owned by the applicant) and a 132kV switching station yard (to be owned by Eskom) (footprint up to 3ha). The substation will consist of:

- feeder bays, transformers, switching station electrical equipment (bus bars, metering equipment, switchgear, etc.), control building, workshop, telecommunication infrastructure, and access roads.

[1] *Note: The proposed Hendrina North WEF (DFFE Reference No. 14/12/16/3/3/2/2130) is subject to a separate EIA Process as contemplated in terms of the EIA Regulations 2014 (as amended), which is currently being undertaken separately from this BA process by another consultant.*

- The substation will include an area with a subterranean earthing mat onto which a concrete plinth will be constructed.

1.1.2. 132kV powerline

Up to 132kV powerline connecting the on-site substation at Hendrina North WEF to the Hendrina Power Station. Tower designs being considered for this development include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. Maximum tower height is expected to be approximately 25m.

Table 2: Technical details associated with proposed powerlines

Powerline capacity:	132kV powerlines (single circuit or double circuit)
Powerline corridor length	Approx. 17-20km (To be confirmed prior to construction)
Powerline corridors width	500m (250m on either side of centre line)
Powerline servitude	32m per 132kV powerline
Powerline pylons:	Monopole or Lattice pylons, or a combination of both where required
Powerline pylon height:	Maximum 40m height

1.1.3. Grid connection BA alternatives

The proposed grid connection infrastructure proposals include two (2) power line route alignment alternatives within a 500m wide corridor and a 33/132kV onsite substation (Figure 1). These alternatives will be considered and assessed as part of the BA process and will be amended or refined to avoid identified environmental sensitivities.

The two alternative grid connection solutions (within a 500m wide corridor) will include:

- Grid Connection Alternative 1 (Preferred):
  The proposed powerline will be approximately 17km long and will connect the Hendrina North WEF to the Hendrina Power Station. This is the landowners' preferred routing as the shorter span alternative intersects fewer existing roads and farm boundaries. The preferred pylon and powerline will be 132 kV Intermediate Self-Supporting single circuit or double circuit Monopole.
- Grid Connection Alternative 2:
  The proposed powerline will be approximately 20km and will connect the Hendrina North WEF to the Hendrina Power Station. This alternative follows an existing a dirt road until it meets the Eskom HENDRINA-ABINA 132kV powerline. It then follows the Eskom powerline into the Hendrina Power Station. The preferred pylon design will be 132 kV Intermediate Self-Supporting single circuit or double circuit Monopole.

The proposed substation will be located on Portion 3 of Hartebeestkuil 185IS. This site was identified as the only alternative due to the substation location needing to be centrally located, its location outside of identified wetlands and critical biodiversity areas, on undeveloped land (not within agriculture land as per land-owner request).

2) TERMS OF REFERENCE

The purpose of the specialist phase report is to determine the main issues and potential impacts of the proposed project/s based on existing information and field assessments. The terms of reference are as follows:

- Describe the affected environment from an avifaunal perspective.
- Discuss gaps in baseline data and other limitations and describe the expected impacts associated with the Project.

- Identify potential sensitive environments and receptors that may be impacted on by the proposed Project and the types of impacts (i.e., direct, indirect, and cumulative) that are most likely to occur.
- Determine the nature and extent of potential impacts during the construction, operational and decommissioning phases.
- Identify 'No-Go' areas, where applicable.
- Recommend mitigation measures to reduce the impact of the expected impacts.
- Provide an impact statement on whether the project should be approved or not.

3) OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following methodology was employed to conduct this study:

- Powerline sensitive species are defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town, as a means to ascertain which species occurs within the broader area of four pentad grid cells each within which the proposed projects are situated (see Figure 2). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 6 pentads which intersect with the development area, hereafter referred to as '**the broader area'**, namely (1) 2600_2930, (2) 2600_2935, (3) 2605_2930, (4) 2605_2935, (5) 2610_2930, (6) 2610_2935. From 2007-present, a total of 75 full protocol lists (i.e., surveys of at least two hours each) have been completed for this area. In addition, 34 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during the site surveys and general knowledge of the area and bird and habitat associations.
- The national threatened status of all powerline priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor et al., 2015), and the latest authoritative summary of southern African bird biology (Hockey et al., 2005).
- The global threatened status of all priority species was determined by consulting the (2022.1) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation habitat ecotypes within the PAOI was obtained from the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) BGIS map viewer (http://bgisviewer.sanbi.org/) (Mucina & Rutherford, 2006; SANBI, 2018). The PAOI is the area where the primary impacts on avifauna are expected and includes the land parcels where the project will be located.
- Avifaunal habitat usage within the PAOI by birds was informed by the Atlas of Southern African Birds 1 (SABAP 1) (Harrison et al., 1997a, 1997b).
- Land-cover and land-use within the PAOI was determined using the 2018 South African national land-cover surveys jointly conducted by the Department of Environmental Affairs, and the Department of Rural Development and Land Reform (DEA & DALRRD, 2019).
- The Important Bird Areas of Southern Africa (Marnewick et al., 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).

- Satellite imagery (Google Earth ©2022) was used to view the PAOI and broader area on a landscape level and to help identify sensitive bird habitat.
- The 2022 South Africa Protected Areas Database compiled by the Department of Environment, Forestry and Fisheries (DFFE) was used to identify Nationally Protected Areas, National Protected Areas Expansion Strategy (NPAES) near the PAOI (DFFE, 2022).
- The Department of Forestry, Fisheries and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the PAOI.
- Data collected during previous site visits to the broader area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- The following sources were used to determine the investigation protocol that is required for the site:
    - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
    - The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020).

- The sources of information on the avifaunal diversity and abundance at the PAOI was supplemented with the information gathered through an integrated pre-construction monitoring programme which was implemented at the Hendrina North Wind Energy Facility (WEF), and the field survey conducted in September 2022 for this proposed powerline.

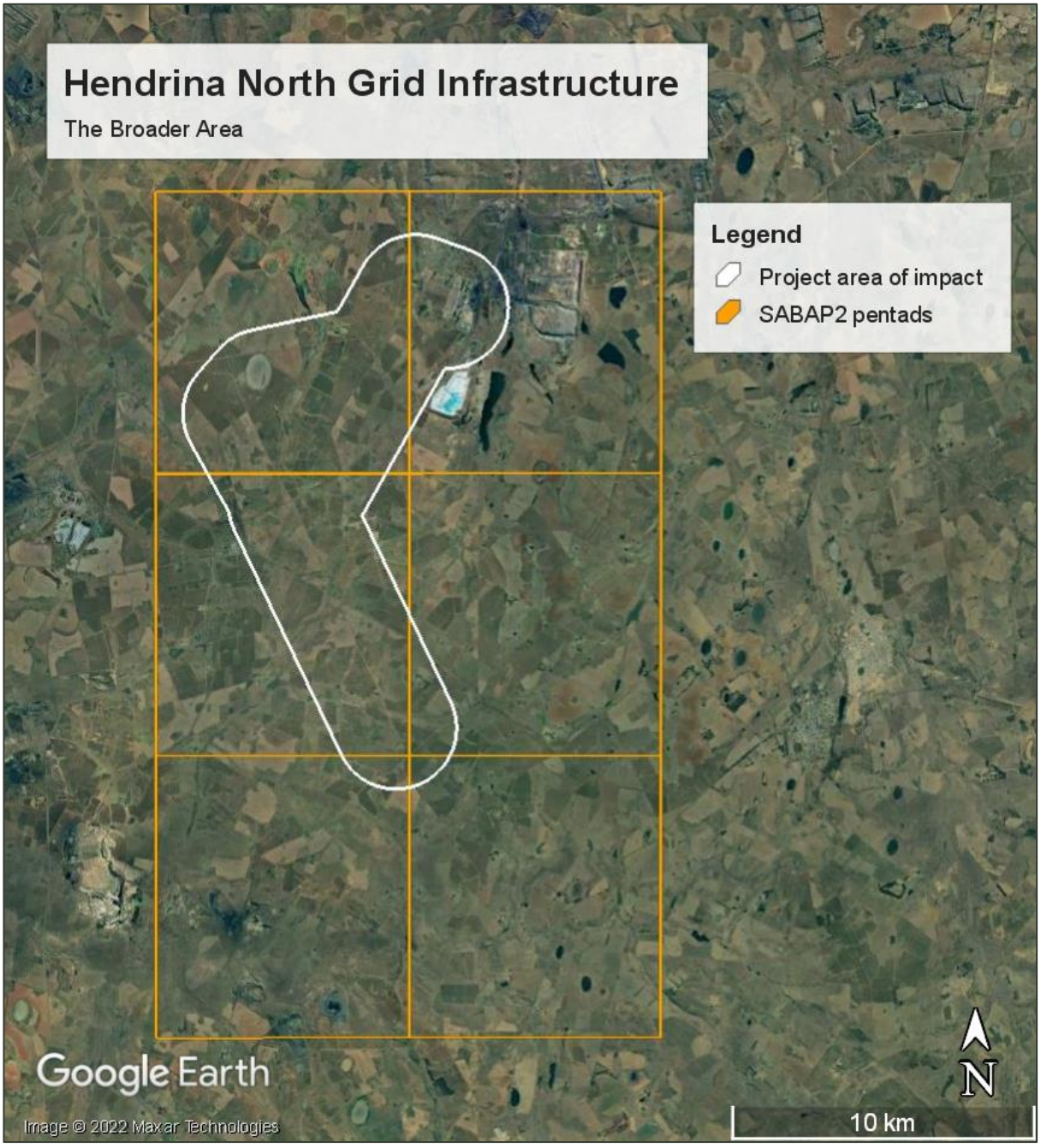


Figure 2: Area covered by the six SABAP2 pentads (orange squares), which constitutes the broader area surrounding the project area of impact (white polygon).

4) ASSUMPTIONS AND LIMITATIONS

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The focus of the study was primarily on the potential impacts of the proposed on-site substation and 132kV overhead power line on powerline sensitive species.

- The assessment of impacts is based on the baseline environment as it currently exists in the PAOI.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The PAOI was defined as a 2km zone around the proposed on-site substation and 132kV overhead power line.
- Information on the proposed grid connections of renewable energy projects within a 30km radius around the project was sourced from public documents available on the internet. In some instances, information was not readily available, or specifications may have changed, therefore the confidence in the information is moderate.

5) LEGISLATIVE CONTEXT

There is no legislation pertaining specifically to the impact of electrical grid infrastructure on avifauna. However, there is legislation aimed at the conservation of avifauna in general.

5.1. Agreements and conventions

Table 3 lists agreements and conventions which South Africa is party to, and which are relevant to the conservation of avifauna[2].

Table 3: Agreements and conventions to which South Africa abides, and which are relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland, and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global

[2] (BirdLife International (2021) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2021-09-20).

Convention name	Description	Geographic scope
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

5.2. National legislation

5.2.1. Constitution of the Republic of South Africa, 1996

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

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

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

  (i) prevent pollution and ecological degradation

  (ii) promote conservation

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

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

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out several guiding principles that apply to the actions of all organs of state that may significantly affect the environment.

Sustainable development (socially, environmentally, and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020). The Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species was published on 30 October 2020. This protocol applies also for the assessment of impacts caused by power lines on avifauna.

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

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

5.3. Provincial Legislation

The current legislation applicable to the conservation of fauna and flora in Mpumalanga is the Mpumalanga Nature Conservation Act 10 of 1998. It consolidated and amended the laws relating to nature conservation within the province and provides for matters connected therewith. All birds are classified as Protected Game (Section 4 (1) (b)), except those listed in Schedule 3, which are classified as Ordinary Game (Section 4 (1)(c)).

6) BASELINE ASSESSMENT

6.1. Important Bird Areas

The PAOI is not located in an Important Bird Area (IBA). The nearest IBA to the PAOI is the Amersfoort-Bethal-Carolina IBA (SA018), located approximately 6.3km east of the site. The key species within this IBA is the Botha's Lark (Globally Endangered, Regionally Endangered); however, this species was neither detected within the SABAP2 monitoring

broader area of PAOI, nor during the four seasons of pre-construction monitoring at the Hendrina North WEF which included large parts of the PAOI.

Additional trigger species for the Amersfoort-Bethal-Carolina IBA include highly mobile powerline sensitive species which may utilise the PAOI for dispersal, foraging, roosting, or nesting purposes given the shared grassland ecotypes between the PAOI and the IBA, and so these species could be impacted by the project. Such trigger species include:

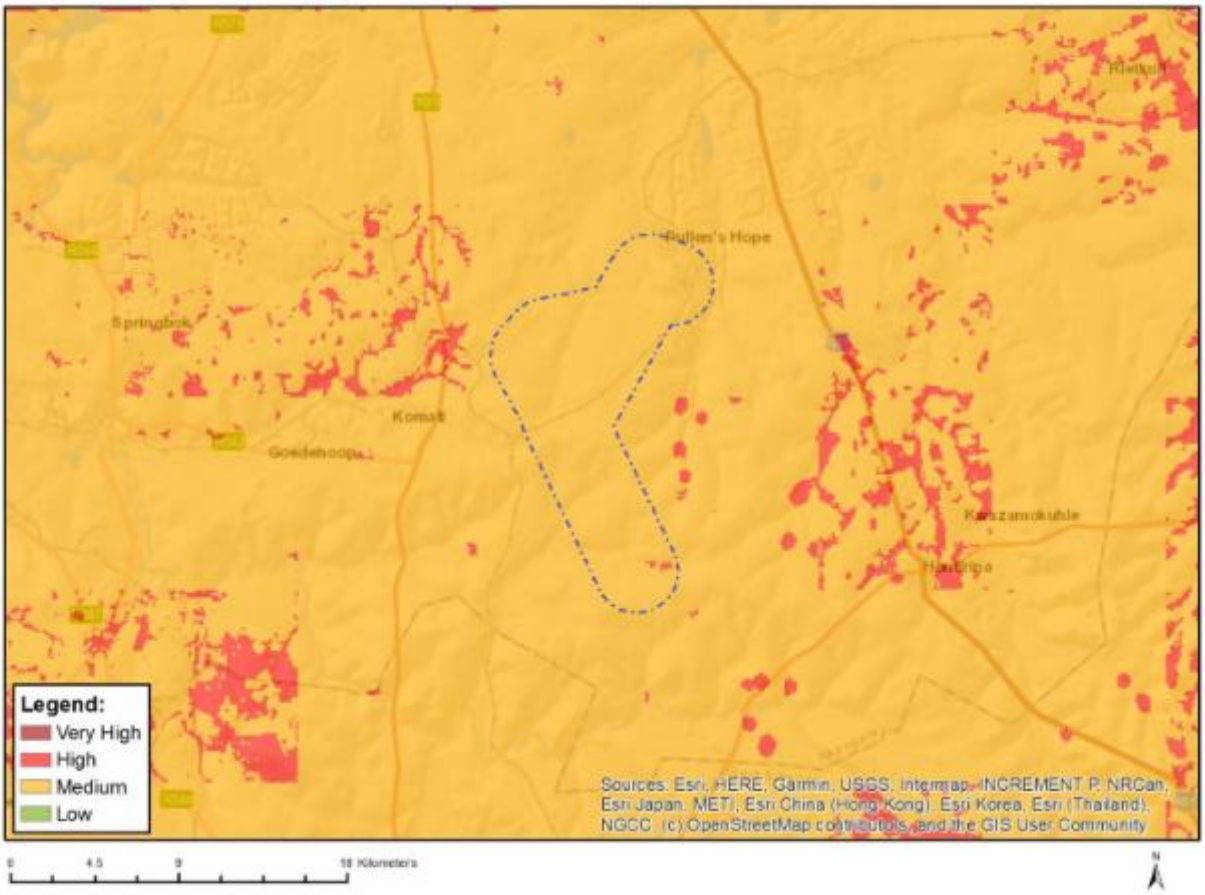
- Secretarybird (Globally Endangered, Regionally Vulnerable)
- Denham's Bustard (Globally Near Threatened, Regionally Vulnerable)
- Martial Eagle (Globally Endangered, Regionally Endangered)
- Lanner Falcon (Globally Least Concern, Regionally Vulnerable)
- Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable)

6.2. DFFE National Screening Tool

According to the DFFE national screening tool (see Figure 3), the small sections of the habitat within the PAOI is classified as **high** sensitivity according to the Animal Species theme, due to the potential presence of species of conservation concern (SCCs), namely Yellow-billed Stork *Mycteria ibis* (Globally Least Concern, Regionally Endangered). Most the habitat within the PAOI is classified as **medium** sensitivity due the presence of other SCCs, namely, White-bellied Korhaan *Eupoditis senegalensis* (Globally Least Concern, Regionally Vulnerable), African Grass Owl *Tyto capensis* (Globally Least Concern, Regionally Vulnerable) and Caspian Tern *Hydroprogne caspia* (Globally Least Concern Regionally Vulnerable).

The classification of **High** sensitivity for Yellow-billed Stork is supported based on the habitat recorded during surveys, but in addition the PAOI as a whole should be reclassified as **High** based on the recorded presence of SCCs recorded in the PAOI during monitoring, namely Secretarybird (Globally Endangered, Regionally Vulnerable), Martial Eagle (Globally Endangered, Locally Endangered), Lanner Falcon (Locally Vulnerable), Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable), Blue Korhaan (Globally Near Threatened, Regionally Least Concern), and Grey Crowned Crane (Globally and Locally Endangered).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Mycteria ibis
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Tyto capensis
Medium	Aves-Hydroprogne caspia
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi

Figure 3: The National Web-Based Environmental Screening Tool map of the PAOI, indicating sensitivities for the Animal Species theme. The classification is correct based on the presence of several Red List SCCs at the site.

6.3. Protected Areas

According to the South African Protected Areas database (SAPAD), the closest protected area is the Heyns Private Nature Reserve, which is located approximately 12km north-east of the PAOI. No further information could be obtained about the nature reserve. However, from an avifaunal perspective the state of the habitat and land use at the development areas is more important than the legal status. The habitat at the reserve has already been impacted by mining, which would have had a negative impact on the avifauna.

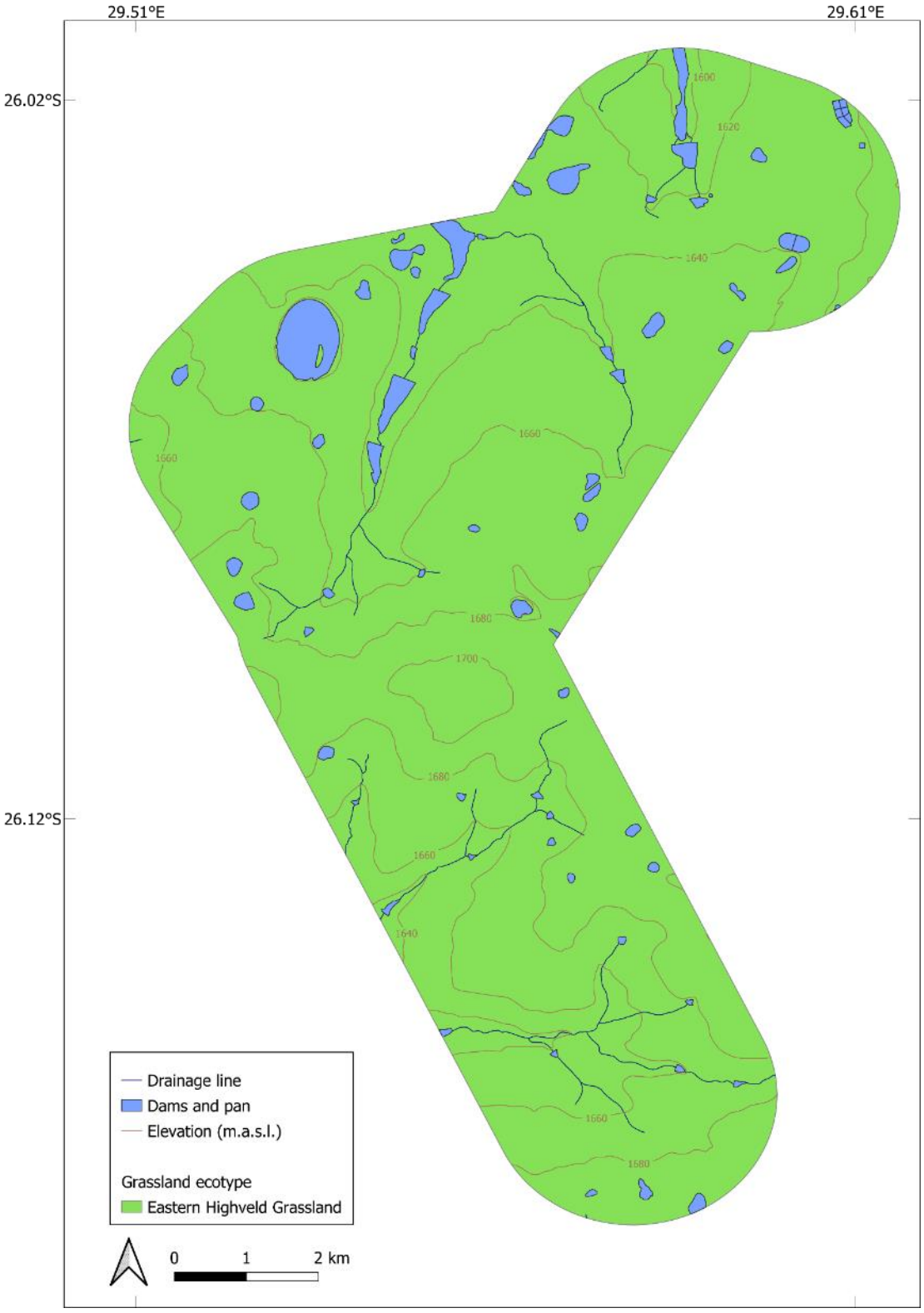


Figure 4: Topography, drainage lines and water bodies (Chief Directorate: National GeoSpatial Information, 2017) and the distriubtion of grassland vegeation ecotype within the PAOI (SANBI, 2018).

6.4. Physical landscape, climate, and vegetation ecotypes

The Hendrina North Grid is situated in the Eastern Highveld Grassland (Gm12) vegetation ecotype within the Mesic Highveld Grassland Bioregion of the South African Grassland Biome (SANBI, 2018) – see Figure 4. This grassland ecotype is defined by a short, closed grassland cover comprising a typical Highveld grass species assemblage (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya* etc.) over sandstone-derived soils of the Karoo supergroup (Mucina et al., 2006). Climax plant communities are dominated by *Themeda triandra* sward, although these are often severely grazed to form a short lawn (Mucina et al., 2006).

This vegetation type covers 12669 km^2 over Mpumalanga and Gauteng (SANBI, 2018), at altitudes ranging 1520-1780 m above sea level (Mucina et al., 2006), although occasionally as low as 1300 m. Eastern Highveld Grassland is classified as Vulnerable (SANBI, 2013), although this ecotype – and the Hendrina North Grid by extension – does not fall within a Centre of Endemism (Van Wyk & Smith, 2001).

The Hendrina North Grid has a temperate climate with continental seasonality, experiencing warm, wet summers and mildly cold, dry winters. The mean temperatures range 17°C (January) to 3°C (July). The mean annual precipitation is 482 mm (https://www.meteoblue.com/, accessed October 2022), notably lower than the average for the Eastern Highveld Grassland (726 mm). Rainfall is lowest in July (1.74 mm), and highest in December (161 mm).

The proposed Hendrina North Grid transects gently topography of gently undulating grasslands and farmlands with low hills and pan depression, ranging 1592-1708m in altitude (Figure 4). There are several minor drainage lines which intersect the PAOI, with north-flowing tributaries associated with Woes-alleenspruit (a tributary of Klein-Olifantsrivier) in the north, and south-flowing tributaries of Olifantsriver in the south (Figure 4). There are numerous artificial dams associated with these drainage systems, as well as several natural pans (Figure 4-5).

6.5. Bird habitats

While the dominant vegetation, topography, and hydrology largely explain the distribution and abundance of the bird species within the PAOI, it is also important to examine the modifications which have changed the natural landscape, and which may impact the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as land use and man-made infrastructure.

Most the native grassland biome within the PAOI has been replaced by commercial crop agriculture (see Figure 5), and remnant grassland tracts are utilised for livestock grazing. Agricultural activity and its relevance to local avifauna is detailed in section 6.5.4. The PAOI also includes the town of Pullen's Hope as associated residential areas in the northern sections (see Figure 5), as a well as large industrial area comprising the Hendrina Power Station (see Figure 1 and Figure 5). Additionally, commercial Mining activity is practiced in the northeast of the PAOI - east of Pullen's Hope (see Figure 1 and Figure 5) – as well as 8 km west of the PAOI, near Komati (see Figure 1). This mining activity has resulted in opencast quarries, material waste dumps, and flooded mine pits within the PAOI (see Figure 5) that have likely impacted the grassland and riparian/aquatic ecology within the PAOI.

Finally, several high voltage powerlines intersect the PAOI, most of which originating from the Hendrina Power Station (see Figure 5). These include the six 132kV powerlines: the Hendrina-Optimum1 132kV, the Hendrina-Optimum2 132kV, the Hendrina-Witkloof 132kV, the Hendrina-Aberdeen Traction 132kV, the Hendrina-Sar Botha 132kV, and the

Aberdeen Traction-Ysterkop 132kV. Additionally, there are five 400kV powerlines: the Hendrina-Kriel 1 400kV, the Hendrina-Vulcan 1 400kV, the Hendrina-Vulcan 2 400kV, the Hendrina-Gumeni 1 400kV, the Arnot-Hendrina 1 400kV, and the Camden-Duvha 1 400kV. The relevance of powerlines to priority species are detailed in Section 6.5.6.

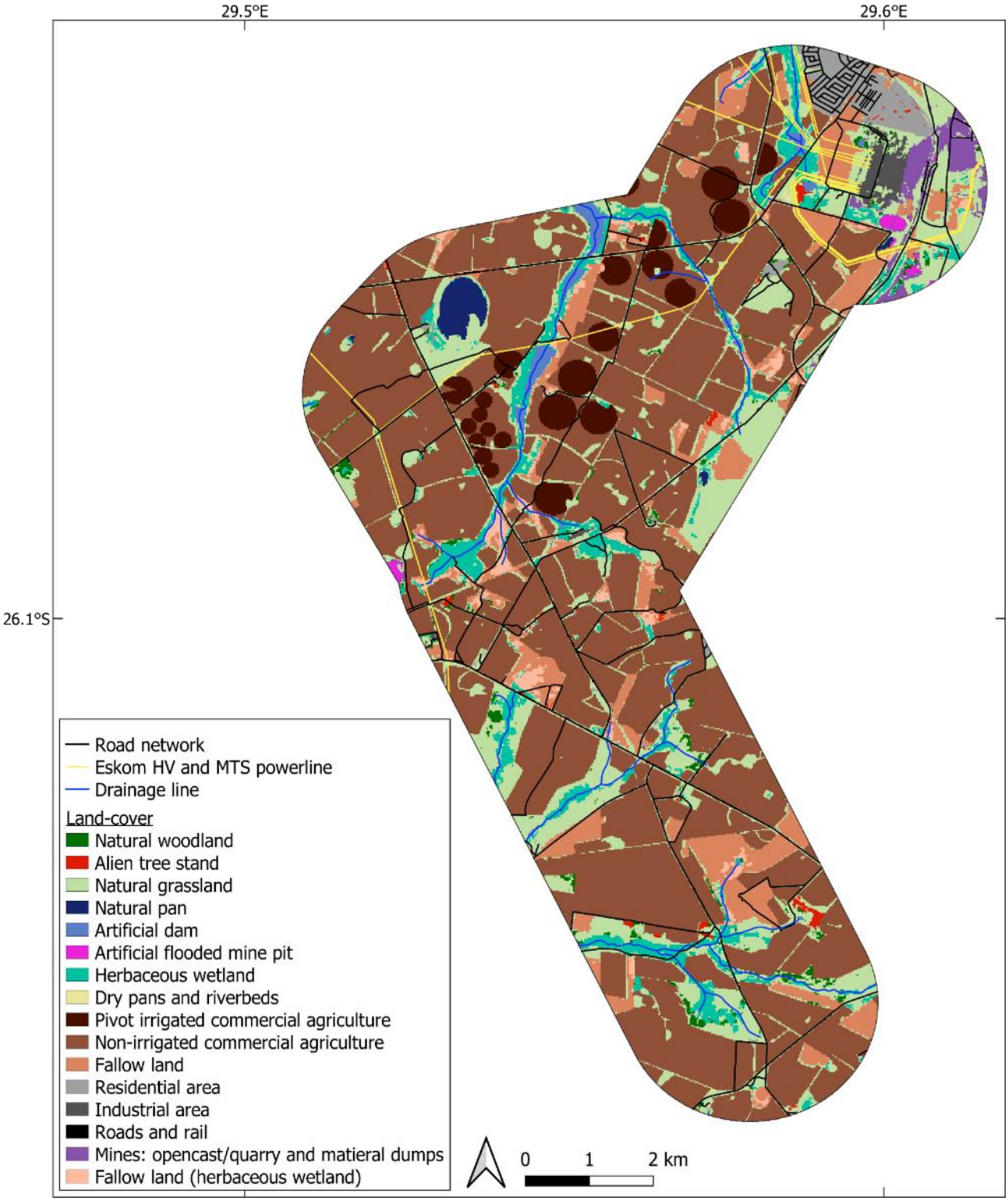


Figure 5: Land-cover and land-use within the Hendrina North Complex project area of impact, according to the 2018 national surveys conducted by the Department of Environmental Affairs and the Department of Agriculture, Land Reform, and Rural Development (DEA & DALRRD, 2019).

The following six habitat classes were identified as relevant to priority bird species in the PAOI (see Appendix 2 for examples of the habitat classes):

6.5.1. Grassland

The native grassland biome, detailed in Section 6.4, has largely been replaced by commercial agriculture, with remnant grassland tracts occurring fragmentedly across the PAOI (see Figure 5), typically adjacent to drainage lines. These grasslands within the PAOI range from rank vegetation bordering herbaceous wetlands (detailed in Section 6.5.2), and dense stands of relatively high grasses in less disturbed areas, to short grasslands in heavily grazed areas.

The following twenty-one powerline sensitive species are likely to regularly utilise the natural grasslands in the PAOI:

1. Bustard, Denham's
2. Buzzard, Common
3. Buzzard, Jackal
4. Crow, Pied
5. Eagle, Black-chested Snake
6. Eagle, Long-crested
7. Eagle-Owl, Spotted
8. Egret, Western Cattle
9. Falcon, Amur
10. Falcon, Lanner
11. Guineafowl, Helmeted
12. Harrier, Montagu's
13. Harrier-Hawk, African
14. Heron, Black-headed
15. Ibis, Southern Bald
16. Kestrel, Greater
17. Kestrel, Rock
18. Korhaan, Blue
19. Owl, Marsh
20. Secretarybird
21. Stork, White

The following three additional powerline sensitive species could occasionally use the natural grasslands in the PAOI:

1. Eagle, Martial
2. Heron, Black-crowned Night
3. Owl, Western Barn

6.5.2. Drainage lines and wetlands

Fairly extensive herbaceous wetlands (marshlands/vleis) mainly surrounding drainage lines (and dams and pans) within the PAOI, interrupting the grassland-cropland mosaic (see Figure 5).

The following twenty-one powerline sensitive species are likely to regularly utilise the wetlands in the PAOI:

1. Crane, Grey Crowned
2. Duck, Fulvous Whistling
3. Duck, White-faced Whistling
4. Duck, Yellow-billed
5. Egret, Great
6. Egret, Intermediate
7. Egret, Little
8. Goose, Egyptian
9. Goose, Spur-winged
10. Hamerkop
11. Heron, Black-headed
12. Heron, Grey
13. Ibis, African Sacred
14. Ibis, Glossy
15. Ibis, Hadada
16. Kite, Black-winged
17. Moorhen, Common
18. Owl, Marsh
19. Shoveler, Cape
20. Spoonbill, African

21. Teal, Red-billed

The following five additional powerline sensitive species could occasionally use the wetlands in the PAOI:

1. Duck, African Black
2. Heron, Black-crowned Night
3. Heron, Purple
4. Heron, Squacco
5. Swamphen, African

6.5.3. Dams and pans

The PAOI contains many earth-embankment dams located along drainage lines. Additionally, there are also several small pans which are a potential drawcard for many powerline-sensitive species. Lesser and Greater Flamingos could use pans for foraging and roosting. Large raptors could use the dams and pans for bathing and drinking.

The following thirty powerline sensitive species are likely to regularly utilise the dams and pans in the PAOI:

1. Coot, Red-knobbed
2. Cormorant, Reed
3. Cormorant, White-breasted
4. Darter, African
5. Duck, Fulvous Whistling
6. Duck, White-faced Whistling
7. Duck, Yellow-billed
8. Eagle, African Fish
9. Eagle, Black-chested Snake
10. Eagle, Long-crested
11. Egret, Great
12. Egret, Intermediate
13. Falcon, Lanner
14. Flamingo, Greater
15. Flamingo, Lesser
16. Goose, Egyptian
17. Goose, Spur-winged
18. Grebe, Great Crested
19. Grebe, Little
20. Hamerkop
21. Heron, Grey
22. Kite, Black-winged
23. Moorhen, Common
24. Pochard, Southern
25. Secretarybird
26. Shoveler, Cape
27. Spoonbill, African
28. Stork, Yellow-billed
29. Teal, Cape
30. Teal, Red-billed

The following eleven additional powerline sensitive species could occasionally use the dams and pans in the PAOI:

1. Duck, African Black
2. Duck, Knob-billed
3. Duck, Maccoa

4. Duck, White-backed
5. Eagle, Martial
6. Grebe, Black-necked
7. Heron, Black-crowned Night
8. Heron, Goliath
9. Heron, Purple
10. Heron, Squacco
11. Shelduck, South African
1. Shelduck, South African

6.5.4. Agricultural lands

The dominant land-use within the PAOI is commercial crop agriculture of maize, peanuts, sunflowers, and soya beans, with livestock farming (sheep, cattle, and pigs) also present (see Figure 5). Some fields are lying fallow or are in the process of being re-vegetated by grass.

The following eleven powerline sensitive species are likely to regularly utilise the dams and pans in the PAOI:

1. Crane, Grey Crowned
2. Crow, Pied
3. Egret, Western Cattle
4. Falcon, Amur
5. Falcon, Lanner
6. Goose, Egyptian
7. Goose, Spur-winged
8. Guineafowl, Helmeted
9. Heron, Black-headed
10. Ibis, Hadada
11. Ibis, Southern Bald

The following two additional powerline sensitive species could occasionally use the dams and pans in the PAOI:

1. Eagle, Martial
2. Owl, Western Barn

6.5.5. Alien trees and (native woodland)

The PAOI contains restricted tree cover. Typical of Eastern Highveld Grassland, sporadic natural woody vegetation (very small tracts of woodland and thicket) are present over rocky outcrops and occasionally along the drainage lines (see Figure 5). Additionally, alien tree species have also become established within the PAOI,

particularly *Eucalyptus*, Australian *Acacia* (Wattle), and *Salix* (Willow) species. Alien trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have alien trees growing alongside, some of which were originally planted to protect earth-embankment dams. Alien trees both supplement the indigenous tree cover for priority species, as well as proving novel nesting and roosting opportunities.

The following twenty-four powerline sensitive species are likely to regularly utilise the native and alien tree cover in the PAOI:

1. Cormorant, White-breasted
2. Crane, Grey Crowned
3. Crow, Pied
4. Eagle, African Fish
5. Eagle, Black-chested Snake
6. Eagle, Long-crested
7. Eagle-Owl, Spotted
8. Egret, Little
9. Egret, Western Cattle
10. Falcon, Amur
11. Falcon, Lanner
12. Guineafowl, Helmeted
13. Harrier-Hawk, African
14. Heron, Black-headed
15. Heron, Grey
16. Ibis, African Sacred
17. Ibis, Hadada
18. Ibis, Southern Bald
19. Kestrel, Greater
20. Kestrel, Rock
21. Secretarybird
22. Sparrowhawk, Black
23. Spoonbill, African
24. Stork, White

The following two additional powerline sensitive species could occasionally use the native and alien tree cover in the PAOI:

1. Eagle, Martial
2. Heron, Black-crowned Night

6.5.6. High voltage lines

Numerous high voltage powerlines intersect the PAOI, and several reticulation lines – most of which originating from the Hendrina Power Station (see Figure 5). These include the six 132kV powerlines: the Hendrina-Optimum1 132kV, the Hendrina-Optimum2 132kV, the Hendrina-Witkloof 132kV, the Hendrina-Aberdeen Traction 132kV, the Hendrina-Sar Botha 132kV, and the Aberdeen Traction-Ysterkop 132kV. Additionally, there are five 400kV powerlines: the Hendrina-Kriel 1 400kV, the Hendrina-Vulcan 1 400kV, the Hendrina-Vulcan 2 400kV, the Hendrina-Gumeni 1 400kV, the Arnot-Hendrina 1 400kV, and the Camden-Duvha 1 400kV.

The following eleven powerline sensitive species are likely to regularly perch, and roost on the transmission towers and powerlines in the PAOI:

1. Egret, Little

2. Falcon, Amur
3. Falcon, Lanner
4. Goose, Egyptian
5. Guineafowl, Helmeted
6. Heron, Black-headed
7. Ibis, Hadada
8. Ibis, Southern Bald
9. Kestrel, Greater
10. Kestrel, Rock
11. Stork, White

The following one additional powerline sensitive species could occasionally perch, and roost on the transmission towers and powerlines in the PAOI:

1. Eagle, Martial

See Appendix 2 for photographic record of habitat features in the PAOI and immediate surroundings.

7) AVIFAUNA

7.1. South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 186 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species, as well as all the species that were recorded during the pre-construction monitoring at the Hendrina North WEF which includes a large portion of the PAOI. Of these, 66 species are classified as powerline sensitive species (see definition of powerline sensitive species in section 3) and 10 of these are South African Red List species. Of the powerline sensitive species, 33 are likely to occur regularly in the PAOI (see Table 44).

Table 4 lists all the powerline sensitive species that are likely to occur regularly and the possible impact on the respective species by the proposed Project. The following abbreviations and acronyms are used:

- LC = Least Concern NT = Near Threatened VU = Vulnerable EN = Endangered

Table 4: Powerline sensitive species potentially occurring <u>regularly</u> in the PAOI (Red List species are shaded).

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Recorded during monitoring	Grassland	Drainage lines and wetlands	Pans and dams	Agriculture	Alien trees	High voltage lines	Displacement - habitat transformation	Displacement - disturbance	Substation - electrocution	Powerline - collision
Bustard, Denham's	*Neotis denhami*	4.00	2.94	NT	VU	x	x						x	x		x
Buzzard, Common	*Buteo buteo*	22.67	2.94	LC	LC	x	x			x	x	x			x	
Buzzard, Jackal	*Buteo rufofuscus*	0.00	2.94	LC	LC	x	x			x	x	x			x	
Coot, Red-knobbed	*Fulica cristata*	78.67	26.47	LC	LC	x			x							x
Cormorant, Reed	*Microcarbo africanus*	73.33	20.59	LC	LC	x			x							x
Cormorant, White-breasted	*Phalacrocorax lucidus*	26.67	14.71	LC	LC	x			x		x					x
Crane, Grey Crowned	*Balearica regulorum*	0.00	2.94	EN	EN	x		x		x	x		x	x	x	x
Crow, Pied	*Corvus albus*	14.67	2.94	LC	LC	x	x			x	x	x			x	
Darter, African	*Anhinga rufa*	26.67	5.88	LC	LC	x			x							x
Duck, Fulvous Whistling	*Dendrocygna bicolor*	1.33	0.00	LC	LC	x		x	x							x
Duck, White-faced Whistling	*Dendrocygna viduata*	9.33	2.94	LC	LC	x		x	x							x
Duck, Yellow-billed	*Anas undulata*	81.33	17.65	LC	LC	x		x	x							x
Eagle, African Fish	*Haliaeetus vocifer*	5.33	0.00	LC	LC	x			x		x				x	
Eagle, Black-chested Snake	*Circaetus pectoralis*	6.67	0.00	LC	LC	x	x		x		x	x			x	
Eagle, Long-crested	*Lophaetus occipitalis*	4.00	2.94	LC	LC	x	x		x		x	x			x	
Eagle-Owl, Spotted	*Bubo africanus*	2.67	0.00	LC	LC	x	x				x			x	x	x
Egret, Great	*Ardea alba*	5.33	2.94	LC	LC	x		x	x							x
Egret, Intermediate	*Ardea intermedia*	30.67	5.88	LC	LC	x		x	x							x
Egret, Little	*Egretta garzetta*	17.33	5.88	LC	LC	x	x				x	x			x	

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Recorded during monitoring	Grassland	Drainage lines and wetlands	Pans and dams	Agriculture	Alien trees	High voltage lines	Displacement - habitat transformation	Displacement - disturbance	Substation - electrocution	Powerline - collision
Egret, Western Cattle	*Bubulcus ibis*	62.67	17.65	LC	LC	x	x			x	x				x	x
Falcon, Amur	*Falco amurensis*	5.33	0.00	LC	LC	x	x			x	x	x			x	
Falcon, Lanner	*Falco biarmicus*	4.00	0.00	LC	VU	x	x		x	x	x	x		x	x	
Flamingo, Greater	*Phoenicopterus roseus*	22.67	2.94	LC	NT	x			x							x
Flamingo, Lesser	*Phoeniconaias minor*	9.33	0.00	NT	NT	x			x							x
Goose, Egyptian	*Alopochen aegyptiaca*	88.00	23.53	LC	LC	x		x	x	x		x			x	x
Goose, Spur-winged	*Plectropterus gambensis*	58.67	0.00	LC	LC	x		x	x	x						x
Grebe, Great Crested	*Podiceps cristatus*	10.67	2.94	LC	LC	x			x							x
Grebe, Little	*Tachybaptus ruficollis*	61.33	14.71	LC	LC	x			x							x
Guineafowl, Helmeted	*Numida meleagris*	54.67	14.71	LC	LC	x	x			x	x	x		x	x	
Hamerkop	*Scopus umbretta*	9.33	5.88	LC	LC	x		x	x						x	x
Harrier, Montagu's	*Circus pygargus*	1.33	0.00	LC	LC	x	x								x	
Harrier-Hawk, African	*Polyboroides typus*	5.33	0.00	LC	LC	x	x				x				x	
Heron, Black-headed	*Ardea melanocephala*	65.33	11.76	LC	LC	x	x	x		x	x	x			x	x
Heron, Grey	*Ardea cinerea*	36.00	8.82	LC	LC	x		x	x		x					x
Ibis, African Sacred	*Threskiornis aethiopicus*	45.33	5.88	LC	LC	x		x			x				x	x
Ibis, Glossy	*Plegadis falcinellus*	24.00	5.88	LC	LC	x		x								x
Ibis, Hadada	*Bostrychia hagedash*	86.67	14.71	LC	LC	x		x		x	x	x			x	x
Ibis, Southern Bald	*Geronticus calvus*	2.67	0.00	VU	VU	x	x			x	x	x			x	x
Kestrel, Greater	*Falco rupicoloides*	1.33	0.00	LC	LC	x	x				x	x			x	
Kestrel, Rock	*Falco rupicolus*	4.00	0.00	LC	LC	x	x				x	x			x	

Species name	Scientific name	Full protocol	Ad hoc protocol	Global status	Regional status	Recorded during monitoring	Grassland	Drainage lines and wetlands	Pans and dams	Agriculture	Alien trees	High voltage lines	Displacement - habitat transformation	Displacement - disturbance	Substation - electrocution	Powerline - collision
Kite, Black-winged	*Elanus caeruleus*	82.67	20.59	LC	LC			x	x							x
Korhaan, Blue	*Eupodotis caerulescens*	20.00	0.00	NT	LC	x	x						x	x		x
Moorhen, Common	*Gallinula chloropus*	21.33	5.88	LC	LC			x	x							
Owl, Marsh	*Asio capensis*	20.00	0.00	LC	LC	x	x	x					x	x	x	x
Pochard, Southern	*Netta erythrophthalma*	21.33	2.94	LC	LC	x			x							x
Secretarybird	*Sagittarius serpentarius*	8.00	0.00	EN	VU	x	x		x		x		x	x		x
Shoveler, Cape	*Spatula smithii*	52.00	5.88	LC	LC	x		x	x							x
Sparrowhawk, Black	*Accipiter melanoleucus*	12.00	0.00	LC	LC	x					x				x	
Spoonbill, African	*Platalea alba*	32.00	20.59	LC	LC	x		x	x		x					x
Stork, White	*Ciconia ciconia*	5.33	0.00	LC	LC	x	x				x	x				x
Stork, Yellow-billed	*Mycteria ibis*	4.00	0.00	LC	EN	x			x							x
Teal, Cape	*Anas capensis*	16.00	0.00	LC	LC				x							x
Teal, Red-billed	*Anas erythrorhyncha*	58.67	11.76	LC	LC	x		x	x							x

7.2. Pre-construction monitoring

Bird counts were conducted in representative habitat in the PAOI and immediate environment in the following sampling periods:

1) 04 – 15 July 2020
2) 29 October – 03 November 2020
3) 09 February, 15 – 19 February, 09 – 11 March 2021
4) 30 April – 11 May 2022
5) 27 September 2022

Table 5: Powerline sensitive species recorded during surveys in the PAOI and immediate environment

Species name	**Scientific name**
Bustard, Denham's	*Neotis denhami*
Buzzard, Common	*Buteo buteo*
Buzzard, Jackal	*Buteo rufofuscus*
Coot, Red-knobbed	*Fulica cristata*
Cormorant, Reed	*Microcarbo africanus*
Cormorant, White-breasted	*Phalacrocorax lucidus*
Crane, Grey Crowned	*Balearica regulorum*
Crow, Pied	*Corvus albus*
Darter, African	*Anhinga rufa*
Duck, Fulvous Whistling	*Dendrocygna bicolor*
Duck, White-faced Whistling	*Dendrocygna viduata*
Duck, Yellow-billed	*Anas undulata*
Eagle, African Fish	*Haliaeetus vocifer*
Eagle, Black-chested Snake	*Circaetus pectoralis*
Eagle, Long-crested	*Lophaetus occipitalis*
Eagle-Owl, Spotted	*Bubo africanus*
Egret, Great	*Ardea alba*
Egret, Intermediate	*Ardea intermedia*
Egret, Little	*Egretta garzetta*
Egret, Western Cattle	*Bubulcus ibis*
Falcon, Amur	*Falco amurensis*
Falcon, Lanner	*Falco biarmicus*
Flamingo, Greater	*Phoenicopterus roseus*
Flamingo, Lesser	*Phoeniconaias minor*
Goose, Egyptian	*Alopochen aegyptiaca*
Goose, Spur-winged	*Plectropterus gambensis*
Grebe, Great Crested	*Podiceps cristatus*
Grebe, Little	*Tachybaptus ruficollis*
Guineafowl, Helmeted	*Numida meleagris*

Species name	Scientific name
Hamerkop	*Scopus umbretta*
Harrier, Montagu's	*Circus pygargus*
Harrier-Hawk, African	*Polyboroides typus*
Heron, Black-headed	*Ardea melanocephala*
Heron, Grey	*Ardea cinerea*
Ibis, African Sacred	*Threskiornis aethiopicus*
Ibis, Glossy	*Plegadis falcinellus*
Ibis, Hadada	*Bostrychia hagedash*
Ibis, Southern Bald	*Geronticus calvus*
Kestrel, Greater	*Falco rupicoloides*
Kestrel, Rock	*Falco rupicolus*
Korhaan, Blue	*Eupodotis caerulescens*
Owl, Marsh	*Asio capensis*
Pochard, Southern	*Netta erythrophthalma*
Secretarybird	*Sagittarius serpentarius*
Shoveler, Cape	*Spatula smithii*
Sparrowhawk, Black	*Accipiter melanoleucus*
Spoonbill, African	*Platalea alba*
Stork, White	*Ciconia ciconia*
Stork, Yellow-billed	*Mycteria ibis*
Teal, Red-billed	*Anas erythrorhyncha*

8) IMPACT ASSESSMENT

8.1. General

Negative impacts on avifauna by electricity infrastructure generally take two main forms namely electrocution and collisions (Hobbs & Ledger, 1986b, 1986a; Jenkins et al., 2010; Kruger, 1999; Kruger & Van Rooyen, 1998; Ledger, 1983, 1984; Ledger et al., 1992; Ledger & Annegarn, 1981; van Rooyen, 2004; Van Rooyen, 2000; van Rooyen, 2000; Van Rooyen & Taylor, 1999; Verdoorn, 1996). Displacement due to habitat destruction and disturbance associated with the construction of the electricity infrastructure is another impact that could potentially impact on avifauna.

8.2. Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen, 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed 132kV grid connection, the electrocution risk is envisaged to be negligible because of the clearance distances between the live and earthed components inherent in the design of such powerlines.

The 132kV grid connection power line should not pose an electrocution threat to the powerline sensitive species which are likely to occur in the PAOI and immediate surrounding environment.

Electrocutions within the proposed on-site substation yard are possible but should not affect the more sensitive Red List bird species, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting. Species that are more vulnerable to this impact are corvids, owls, and certain species of waterbirds.

The following eleven powerline sensitive species which occur regularly in the PAOI are potentially vulnerable to electrocution impacts in the substation:

1) Hamerkop
2) Harrier, Montagu's
3) Harrier-Hawk, African
4) Heron, Black-headed
5) Ibis, African Sacred
6) Ibis, Hadada
7) Ibis, Southern Bald
8) Kestrel, Greater
9) Kestrel, Rock
10) Owl, Marsh
11) Sparrowhawk, Black

8.3. Collisions

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

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

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk. These birds must fly fast to remain airborne,

and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles. Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision. Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often. Juvenile birds have often been reported as being more collision-prone than adults.

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

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

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

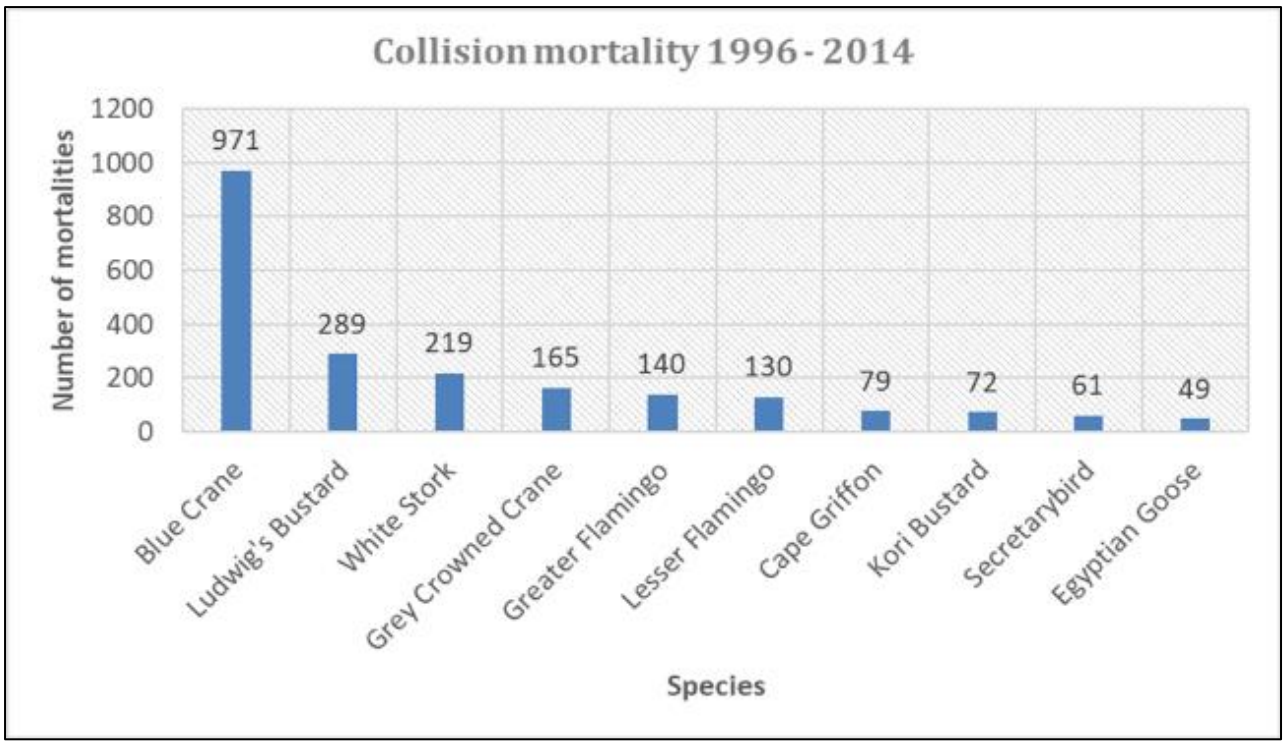


Figure 6: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data).

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

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins et al., 2010; Martin et al., 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (Alonso & Alonso, 1999; Barrientos et al., 2011; Bernardino et al., 2018; Jenkins et al., 2010; Koops & De Jong, 1982; Sporer et al., 2013), including to some extent for bustards (Barrientos et al., 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos et al. (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos et al. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin et al., 2010).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three up to 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different

marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw et al., 2017).

The following eighteen powerline sensitive which occur regularly in the PAOI are potentially vulnerable to powerline collision impacts:

1) Hamerkop
2) Heron, Black-headed
3) Heron, Grey
4) Ibis, African Sacred
5) Ibis, Glossy
6) Ibis, Hadada
7) Ibis, Southern Bald
8) Kite, Black-winged
9) Korhaan, Blue
10) Owl, Marsh
11) Pochard, Southern
12) Secretarybird
13) Shoveler, Cape
14) Spoonbill, African
15) Stork, White
16) Stork, Yellow-billed
17) Teal, Cape
18) Teal, Red-billed

8.4. Displacement due to habitat destruction

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

- Site clearance and preparation
- Construction of the infrastructure (i.e., the on-site substation and overhead power line)
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site
- Removal of vegetation for the proposed on-site substation and overhead power line, stockpiling of topsoil and cleared vegetation
- Excavations for infrastructure

These activities could impact on birds breeding, foraging, and roosting in or in proximity of the proposed substation and/or powerline through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the Project is unavoidable. The loss of habitat for powerline sensitive species due to direct habitat transformation associated with the construction of the proposed Project is likely to be moderate due to the small size of the footprint, but ideally high-quality grassland should be avoided if possible.

The following five powerline sensitive species which occur regularly in the PAOI are potentially vulnerable to displacement due to habitat transformation:

1) Bustard, Denham's
2) Crane, Grey Crowned
3) Korhaan, Blue
4) Owl, Marsh
5) Secretarybird

8.5. Displacement due to disturbance

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities near breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. Terrestrial species and owls are most likely to be affected by displacement due to disturbance in the PAOI.

The following eight powerline sensitive species which occur regularly in the PAOI are potentially vulnerable to displacement due to disturbance:

1) Bustard, Denham's
2) Crane, Grey Crowned
3) Eagle-Owl, Spotted
4) Falcon, Lanner
5) Guineafowl, Helmeted
6) Korhaan, Blue
7) Owl, Marsh
8) Secretarybird

9. IMPACT RATING AND MANAGEMENT ACTIONS

9.1. Potential impacts

The following potential impacts on powerline sensitive species have been identified:

9.1.1. Construction Phase

- Displacement due to disturbance associated with the construction of the onsite substation and grid connection power line.
- Displacement due to habitat transformation associated with the construction of the onsite substation and grid connection power line.

9.1.2. Operational Phase

- Collisions with the up to 132kV grid connection power line.
- Electrocutions within the onsite substation.

9.1.3. Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the onsite substation and grid connection power line.

9.1.4. Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the onsite substation and grid connection power line.
- Displacement due to habitat transformation associated with the onsite substation and grid connection power line.
- Collisions with the overhead power line.
- Electrocutions within the substation.

10. IMPACT RATING

See Appendix 3 for the assessment criteria employed to assess the impacts of the proposed Project.

Tables 6 contains a summary of the impact assessment and proposed mitigation measures for the identified impacts:

Table 6: Environmental impact ratings and mitigation recommendations for the construction, operation, decommissioning phases of the Hendrina North Infrastructure, as well as the cumulative impacts this project and related developments within a 30km radius on priority species avifauna.

HENDRINA NORTH 132kV GRID CONNECTION																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Noise pollution and environmental disruption from construction activity	Displacement of priority species from breeding/feeding/roosting areas	1	4	2	3	1	3	33	-	Medium	Conduct a walkthrough inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed.	1	2	1	2	1	2	14	-	Low

HENDRINA NORTH 132kV GRID CONNECTION																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species. Dust suppression must be administered regularly based on visual inspection by ECO Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.									
Habitat transformation resulting from the 132kV powerline and associated infrastructure	Displacement of priority species from breeding/feeding/roosting areas	1	3	1	2	3	3	33	-	Medium	Vegetation clearance should be limited to what is necessary. The mitigation measures proposed by the biodiversity specialist must be strictly enforced. Maximum use should be made of existing access roads and the construction of new roads	1	3	1	2	2	2	18	-	Low

HENDRINA NORTH 132kV GRID CONNECTION																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											should be kept to a minimum.									
Operational Phase																				
Bird mortality and injury resulting from collisions with the 132kV powerline	Population reduction of priority species	3	4	2	3	3	3	45	-	High	The authorised alignment must be inspected by an avifaunal specialist by means of a “walk-through” inspection i.e. through a combination of satellite imagery supplemented with in situ inspections by vehicle and where necessary, on foot, once the pole positions have been finalised. The objective would be to demarcate the sections of the powerline that need to be fitted with Bird Flight Diverters Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).	3	2	1	2	3	2	22	-	Low

HENDRINA NORTH 132kV GRID CONNECTION																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Electrocution of priority species in the onsite sub-station	Population reduction of priority species	2	2	2	2	3	2	22	-	Low	The hardware within the proposed substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List powerline sensitive species are unlikely to frequent the substation.	2	1	1	1	3	1	8	-	Low
Decommissioning Phase																				
Noise pollution and environmental disruption during the decommissioning phase.	Total/partial displacement of priority species from breeding/feeding/roosting areas	1	4	2	3	1	3	33	-	Medium	Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species. Measures to control noise and dust should be applied according to	1	2	1	2	1	2	14	-	Low

HENDRINA NORTH 132kV GRID CONNECTION																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											current best practice in the industry. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.									
Cumulative impact of each project phase																				
Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes, namely population declines and displacement of priority bird species	3	4	2	3	3	3	45	-	High	Combined mitigation measures against each environmental parameter associated with the construction, operation, and decommissioning phases of the project.	3	2	1	2	3	2	22	-	Low

11. CUMULATIVE IMPACTS

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

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

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

When considered in isolation, the Hendrina North Grid Infrastructure is expected to have a low impact on the priority avifauna (see Section 10, Table 6) following recommended mitigation measures (detailed in Section 12); without appropriate mitigations measures, this development poses a moderately high impact risk on priority avifauna (see Section 10, Table 6).

However, the potentially low impact of this development should be contextualised alongside related local/regional developments. According to the official database of DFFE and other documents in the public domain, there are currently at least four planned wind and solar energy facilities within a 30km radius around the proposed development (see Figure 5). These are the following:

- Solar photovoltaic power plant at ESKOM Duvha power station (DFFE Reg Nr. 14/12/16/3/3/2/759)
- Halfgewonnen Solar PV facility (DFFE Reg Nr. 14/12/16/3/3/2/2068)
- Hendrina South Wind Energy Facility (DFFE Reg Nr.14/12/16/3/3/2/2131)
- Arnot Solar PV facility (DFFE Reg Nr. 14/12/16/3/3/2/760)

The combined length of the grid connections for the proposed Arnot and Halfgewonnen PV facilities and Hendrina South Wind Energy Facility renewable energy projects listed above is approximately 26km. The PV plant at the Duvha Power Station will be on the premises of power station. The proposed Hendrina North grid connection will be a maximum of 20km long. The existing high voltage lines in the 30km radius around the proposed Hendrina North grid connection extend for several hundred kilometres (see Figure 7).

The Hendrina North Grid Infrastructure represents a comparatively **Low** contribution towards the total length of high voltage power lines within a 30km radius. However, this project will increase the density of planned and existing high voltage lines within a 30km radius, and this cumulative effect represents a potentially **Moderate** impact risk to priority avifauna.

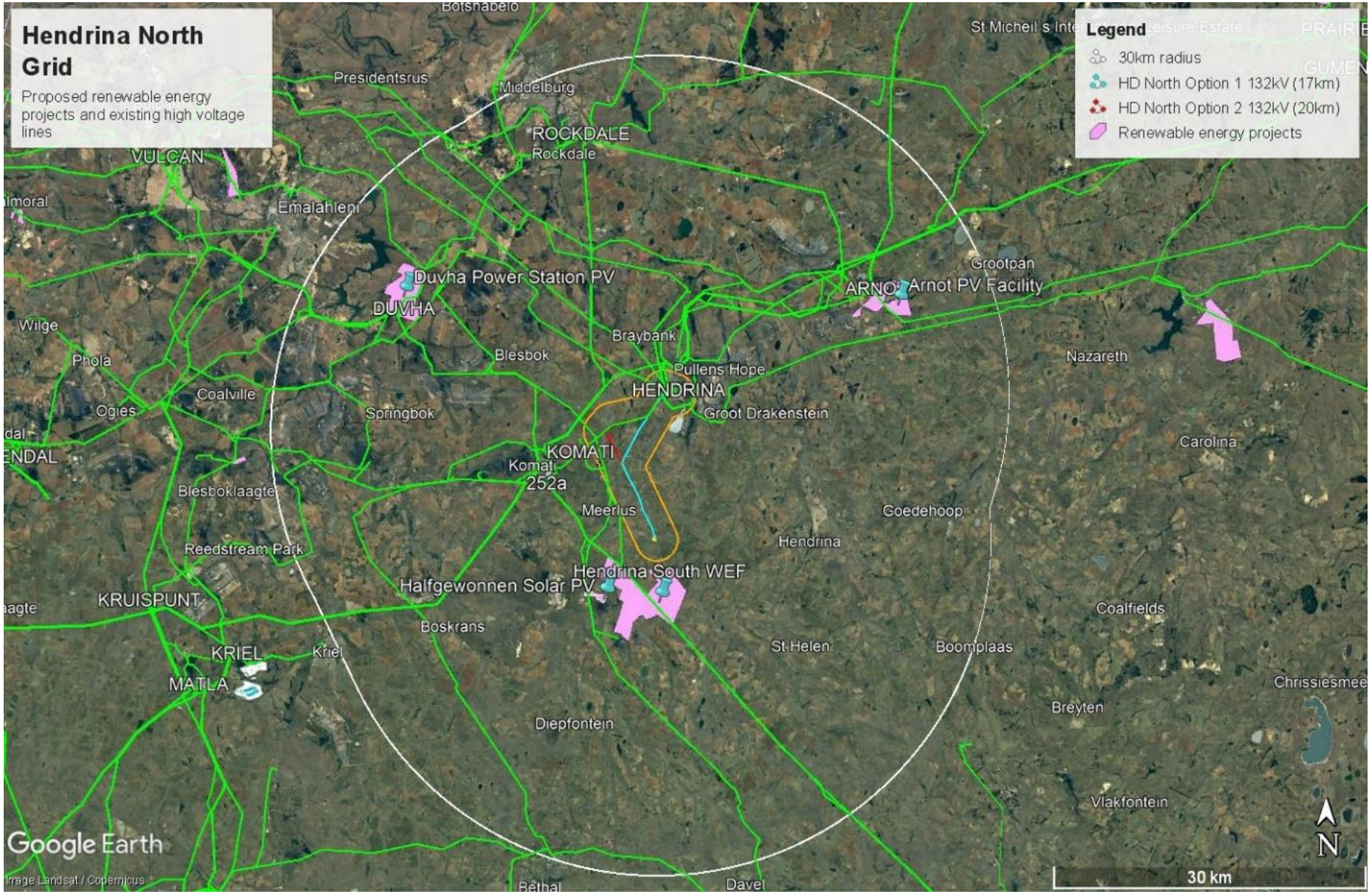


Figure 7: Proposed renewable energy projects within 30km of the proposed Hendrina North WEF, and existing high voltage lines (green lines) (Source: DFFE database 2022).

12. MITIGATION MEASURES

The impact significance without mitigation measures is assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the proposed Project. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in Figure 8.

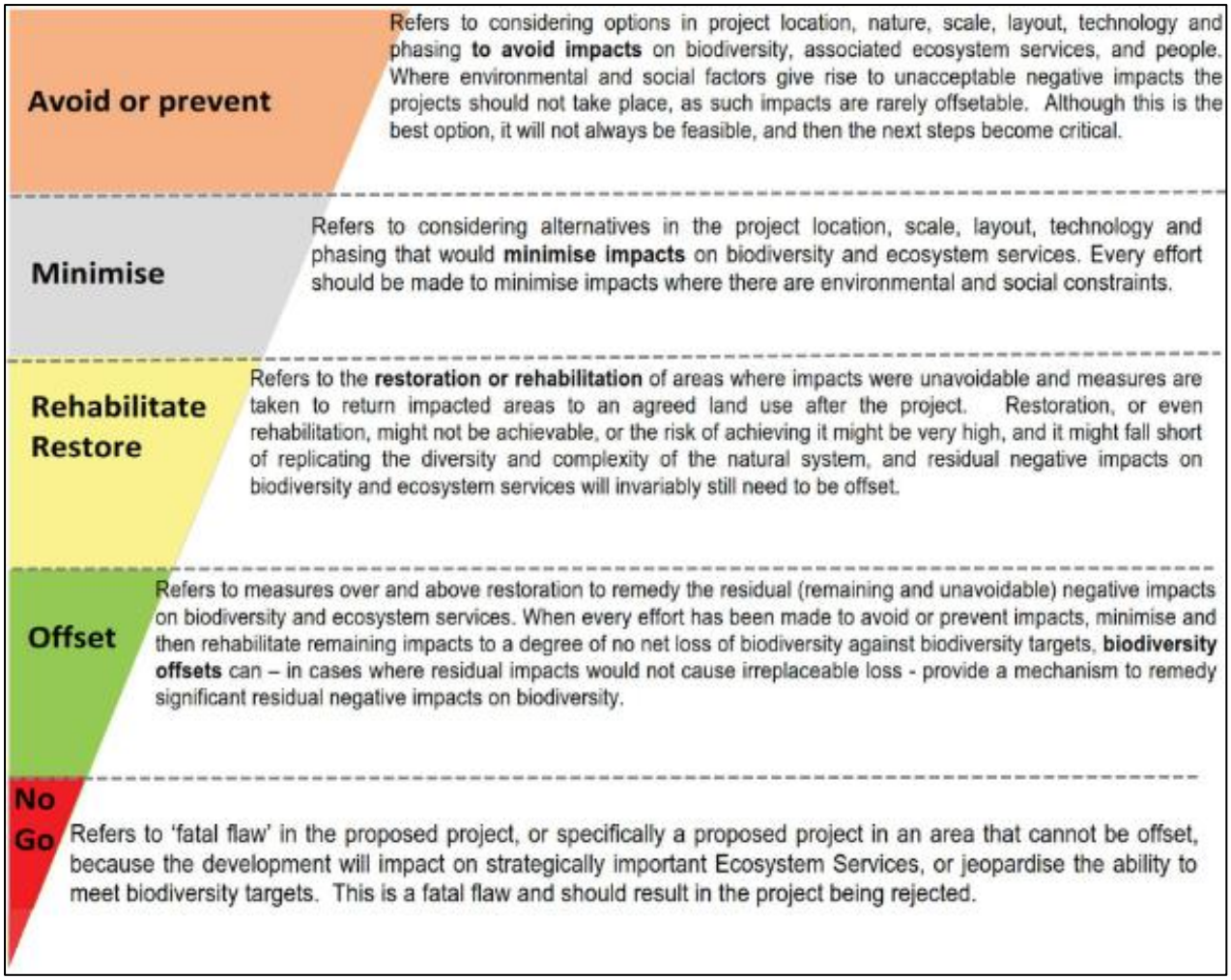


Figure 8: Mitigation Sequence/Hierarchy

The mitigation measures that are recommended for the proposed Project is listed below.

12.1. Pre-construction phase

- Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed.
- The authorised alignment must be inspected by an avifaunal specialist by means of a "walk-through" inspection i.e., through a combination of satellite imagery supplemented with in situ inspections by vehicle and where necessary, on foot, once the pole positions have been finalised. The objective would be to demarcate the sections of the powerline that need to be fitted with Bird Flight Diverters.

12.2. Construction phase

- Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).
- Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed.

- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Vegetation clearance should be limited to what is necessary.
- The mitigation measures proposed by the biodiversity specialist must be strictly enforced.

12.3. Operational phase

- The hardware within the proposed substation yard is too complex and the risk too low to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded by the maintenance staff once operational, site-specific mitigation (insulation) be applied reactively if need be. This is an acceptable approach because Red List powerline sensitive species are unlikely to frequent the substation, although some more common powerline sensitive species might well be present more often and exposed to the electrocution risk.

12.4. De-commissioning phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

13. ENVIRONMENTAL SENSITIVITIES

The following specific environmental sensitivities were identified from an avifaunal perspective (see Figure 9 for the map of environmental sensitivities):

Very high sensitivity: drainage lines, dams, pans, and associated herbaceous wetlands.

Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety priority species, particularly waterbirds, as well as seven Red List species, namely:

8. Crane, Grey Crowned (Globally Endangered, Regionally Endangered)
9. Duck, Maccoa (Globally Endangered, Regionally Near Threatened)
10. Eagle, Martial (Globally Endangered, Regionally Endangered)
11. Falcon, Lanner (Globally Least Concern, Regionally, Vulnerable)

12. Flamingo, Greater (Globally Least Concern, Regionally Near Threatened)
13. Secretarybird (Globally Endangered, Regionally Vulnerable)
14. Stork, Yellow-billed (Globally Least Concern, Regionally Endangered)

Birds commuting between these areas will be at risk of collision with the earth-wire if they must cross over the grid connection. Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

High sensitivity: undisturbed natural grassland

The natural grassland is vital breeding, roosting and foraging habitat for a variety of Red List powerline sensitive species and will therefore be associated with significant flight activity. These include the following five Red List species:

1. Eagle, Martial (Globally Endangered, Regionally Endangered)
2. Falcon, Lanner (Globally Least Concern, Regionally Vulnerable)
3. Ibis, Southern Bald (Globally Vulnerable, Regionally Vulnerable)
4. Korhaan, Blue (Globally Near Threatened, Regionally Least Concern)
5. Secretarybird (Globally Endangered, Regionally Vulnerable)

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

Medium sensitivity: disturbed natural grassland/fallow agricultural land

Disturbed natural grassland and fallow agricultural land provide similar foraging, roosting, and potentially breeding opportunities for priority species which depend upon natural grassland, including the same five Red List species listed for natural undisturbed grassland.

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

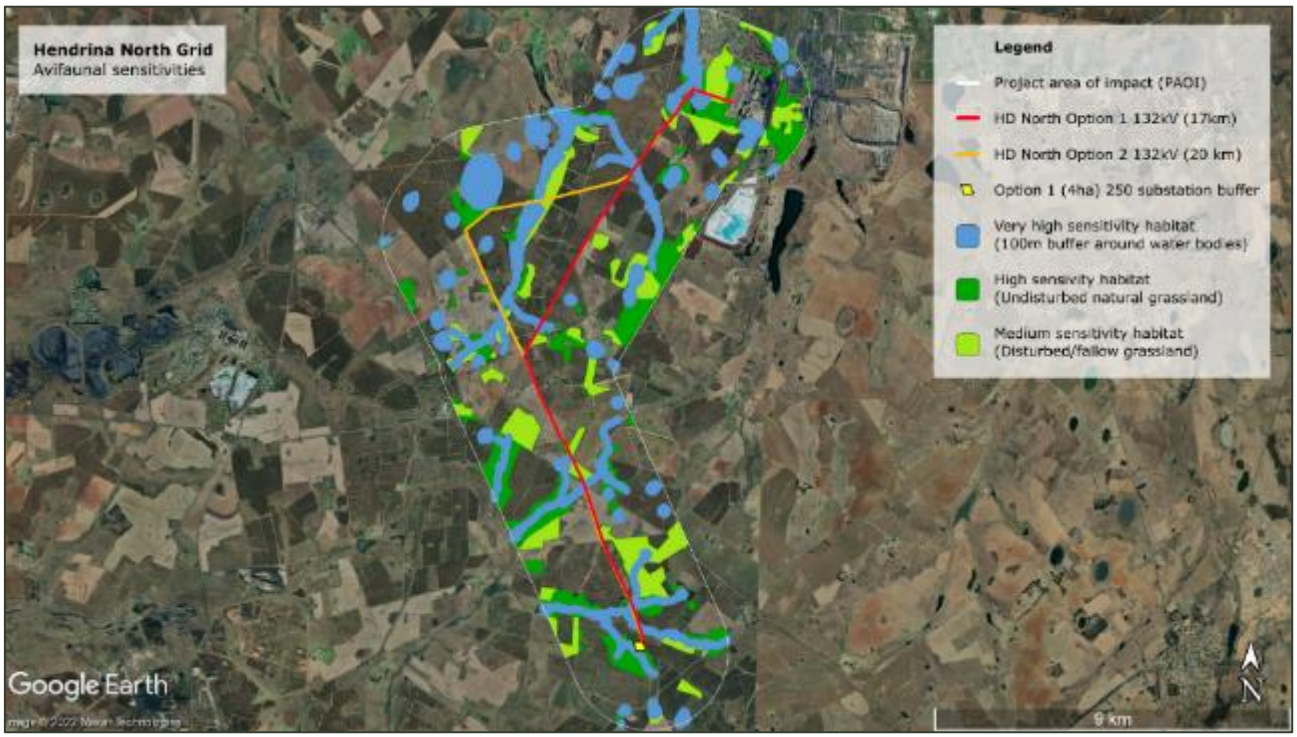


Figure 9: Map of the environmental sensitivities associated with the PAOI of the Hendrina North Grid Infrastructure, with the proposed infrastructural development overlaid.

ASSESSMENT OF ALTERNATIVES

The preferred option from a bird impact perspective would the HD North Option 1 132kV, as it drastically reduces the length of powerline that need to be constructed, and intersects fewer environmentally sensitivity areas than would the HD North Option 2 132kV (see Figure 9).

Additionally, it would be preferable for the proposed substation to be slightly reposition onto already transformed land, to minimise further loss of natural grassland habitats.

14. ENVIRONMENTAL MANAGEMENT PROGRAMME

Please see Appendix 4 for the monitoring requirements to be included in the EMPr for the grid project.

15. CONCLUSIONS AND IMPACT STATEMENT

According to the DFFE national screening tool, small sections of the habitat within the PAOI is classified as High sensitivity according to the Animal Species theme, due to the potential presence of species of conservation concern (SCCs), namely Yellow-billed Stork *Mycteria ibis* (Globally Least Concern, Regionally Endangered). Most the habitat within the PAOI is classified as **medium** sensitivity due the presence of other SCCs, namely,

White-bellied Korhaan *Eupoditis senegalensis* (Globally Least Concern, Regionally Vulnerable), African Grass Owl *Tyto capensis* (Globally Least Concern, Regionally Vulnerable) and Caspian Tern *Hydroprogne caspia* (Globally Least Concern Regionally Vulnerable).

The classification of **High** sensitivity for Yellow-billed Stork is supported based on the habitat recorded during surveys, but in addition the PAOI as a whole should be reclassified as **High** based on the recorded presence of SCCs recorded in the PAOI during monitoring, namely Secretarybird (Globally Endangered, Regionally Vulnerable), Martial Eagle (Globally Endangered, Locally Endangered), Lanner Falcon (Locally Vulnerable), Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable), Blue Korhaan (Globally Near Threatened, Regionally Least Concern), and Grey Crowned Crane (Globally and Locally Endangered).

The proposed Project will have a range of pre-mitigation impacts from medium to high on priority avifauna, but it is expected to be reduced to acceptable low levels with appropriate mitigation. No fatal flaws were discovered during the investigations, therefore the authorisation of the project is supported, provided the recommendations in this report is strictly implemented.

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE BROADER AREA

NT = Near threatened, VU = Vulnerable, EN = Endangered, LC = Least Concern

Species name	Scientific name	Full protocol	Ad hoc protocol	Regional status	Global status
Bokmakierie	*Telophorus zeylonus*	2.67	0.00	LC	LC
Hamerkop	*Scopus umbretta*	9.33	5.88	LC	LC
Neddicky	*Cisticola fulvicapilla*	2.67	0.00	LC	LC
Quailfinch	*Ortygospiza atricollis*	49.33	0.00	LC	LC
Ruff	*Calidris pugnax*	12.00	0.00	LC	LC
Secretarybird	*Sagittarius serpentarius*	8.00	0.00	VU	EN
Avocet, Pied	*Recurvirostra avosetta*	16.00	0.00	LC	LC
Barbet, Black-collared	*Lybius torquatus*	9.33	2.94	LC	LC
Barbet, Crested	*Trachyphonus vaillantii*	5.33	0.00	LC	LC
Bee-eater, European	*Merops apiaster*	2.67	0.00	LC	LC
Bishop, Southern Red	*Euplectes orix*	93.33	14.71	LC	LC
Bishop, Yellow	*Euplectes capensis*	1.33	0.00	LC	LC
Bishop, Yellow-crowned	*Euplectes afer*	24.00	0.00	LC	LC
Bulbul, Dark-capped	*Pycnonotus tricolor*	16.00	2.94	LC	LC
Bustard, Denham's	*Neotis denhami*	4.00	2.94	VU	NT
Buzzard, Common	*Buteo buteo*	22.67	2.94	LC	LC
Buzzard, Jackal	*Buteo rufofuscus*	0.00	2.94	LC	LC
Canary, Black-throated	*Crithagra atrogularis*	74.67	32.35	LC	LC
Canary, Cape	*Serinus canicollis*	52.00	2.94	LC	LC
Canary, Yellow	*Crithagra flaviventris*	32.00	5.88	LC	LC
Canary, Yellow-fronted	*Crithagra mozambica*	2.67	0.00	LC	LC
Chat, Ant-eating	*Myrmecocichla formicivora*	65.33	14.71	LC	LC
Cisticola, Cloud	*Cisticola textrix*	28.00	0.00	LC	LC
Cisticola, Desert	*Cisticola aridulus*	1.33	0.00	LC	LC
Cisticola, Levaillant's	*Cisticola tinniens*	92.00	38.24	LC	LC
Cisticola, Pale-crowned	*Cisticola cinnamomeus*	16.00	0.00	LC	LC
Cisticola, Wailing	*Cisticola lais*	2.67	0.00	LC	LC
Cisticola, Wing-snapping	*Cisticola ayresii*	45.33	14.71	LC	LC
Cisticola, Zitting	*Cisticola juncidis*	44.00	5.88	LC	LC
Coot, Red-knobbed	*Fulica cristata*	78.67	26.47	LC	LC
Cormorant, Reed	*Microcarbo africanus*	73.33	20.59	LC	LC
Cormorant, White-breasted	*Phalacrocorax lucidus*	26.67	14.71	LC	LC
Crake, Black	*Zapornia flavirostra*	2.67	0.00	LC	LC
Crane, Grey Crowned	*Balearica regulorum*	0.00	2.94	EN	EN
Crow, Pied	*Corvus albus*	14.67	2.94	LC	LC

Cuckoo, Diederik	*Chrysococcyx caprius*	10.67	0.00	LC	LC
Darter, African	*Anhinga rufa*	26.67	5.88	LC	LC
Dove, Cape Turtle	*Streptopelia capicola*	96.00	32.35	LC	LC
Dove, Laughing	*Spilopelia senegalensis*	84.00	41.18	LC	LC
Dove, Namaqua	*Oena capensis*	16.00	0.00	LC	LC
Dove, Red-eyed	*Streptopelia semitorquata*	74.67	29.41	LC	LC
Dove, Rock	*Columba livia*	25.33	5.88	LC	LC
Duck, African Black	*Anas sparsa*	1.33	2.94	LC	LC
Duck, Fulvous Whistling	*Dendrocygna bicolor*	1.33	0.00	LC	LC
Duck, Knob-billed	*Sarkidiornis melanotos*	1.33	0.00	LC	LC
Duck, Maccoa	*Oxyura maccoa*	13.33	0.00	NT	EN
Duck, White-backed	*Thalassornis leuconotus*	8.00	2.94	LC	LC
Duck, White-faced Whistling	*Dendrocygna viduata*	9.33	2.94	LC	LC
Duck, Yellow-billed	*Anas undulata*	81.33	17.65	LC	LC
Eagle, African Fish	*Haliaeetus vocifer*	5.33	0.00	LC	LC
Eagle, Black-chested Snake	*Circaetus pectoralis*	6.67	0.00	LC	LC
Eagle, Long-crested	*Lophaetus occipitalis*	4.00	2.94	LC	LC
Eagle, Martial	*Polemaetus bellicosus*	1.33	0.00	EN	EN
Eagle-Owl, Spotted	*Bubo africanus*	2.67	0.00	LC	LC
Egret, Great	*Ardea alba*	5.33	2.94	LC	LC
Egret, Intermediate	*Ardea intermedia*	30.67	5.88	LC	LC
Egret, Little	*Egretta garzetta*	17.33	5.88	LC	LC
Egret, Western Cattle	*Bubulcus ibis*	62.67	17.65	LC	LC
Falcon, Amur	*Falco amurensis*	5.33	0.00	LC	LC
Falcon, Lanner	*Falco biarmicus*	4.00	0.00	VU	LC
Finch, Red-headed	*Amadina erythrocephala*	1.33	0.00	LC	LC
Fiscal, Southern	*Lanius collaris*	80.00	26.47	LC	LC
Flamingo, Greater	*Phoenicopterus roseus*	22.67	2.94	NT	LC
Flamingo, Lesser	*Phoeniconaias minor*	9.33	0.00	NT	NT
Flycatcher, Fiscal	*Melaenornis silens*	1.33	0.00	LC	LC
Francolin, Grey-winged	*Scleroptila afra*	5.33	0.00	LC	LC
Francolin, Orange River	*Scleroptila gutturalis*	13.33	0.00	LC	LC
Francolin, Red-winged	*Scleroptila levaillantii*	4.00	0.00	LC	LC
Goose, Egyptian	*Alopochen aegyptiaca*	88.00	23.53	LC	LC
Goose, Spur-winged	*Plectropterus gambensis*	58.67	0.00	LC	LC
Grassbird, Cape	*Sphenoeacus afer*	2.67	0.00	LC	LC
Grebe, Black-necked	*Podiceps nigricollis*	9.33	0.00	LC	LC
Grebe, Great Crested	*Podiceps cristatus*	10.67	2.94	LC	LC
Grebe, Little	*Tachybaptus ruficollis*	61.33	14.71	LC	LC
Greenshank, Common	*Tringa nebularia*	10.67	2.94	LC	LC
Guineafowl, Helmeted	*Numida meleagris*	54.67	14.71	LC	LC
Gull, Grey-headed	*Chroicocephalus cirrocephalus*	8.00	0.00	LC	LC
Harrier, Montagu's	*Circus pygargus*	1.33	0.00	LC	LC
Harrier-Hawk, African	*Polyboroides typus*	5.33	0.00	LC	LC
Heron, Black-crowned Night	*Nycticorax nycticorax*	2.67	0.00	LC	LC

Heron, Black-headed	*Ardea melanocephala*	65.33	11.76	LC	LC
Heron, Goliath	*Ardea goliath*	6.67	0.00	LC	LC
Heron, Grey	*Ardea cinerea*	36.00	8.82	LC	LC
Heron, Purple	*Ardea purpurea*	13.33	8.82	LC	LC
Heron, Squacco	*Ardeola ralloides*	5.33	8.82	LC	LC
Ibis, African Sacred	*Threskiornis aethiopicus*	45.33	5.88	LC	LC
Ibis, Glossy	*Plegadis falcinellus*	24.00	5.88	LC	LC
Ibis, Hadada	*Bostrychia hagedash*	86.67	14.71	LC	LC
Ibis, Southern Bald	*Geronticus calvus*	2.67	0.00	VU	VU
Kestrel, Greater	*Falco rupicoloides*	1.33	0.00	LC	LC
Kestrel, Rock	*Falco rupicolus*	4.00	0.00	LC	LC
Kingfisher, Malachite	*Corythornis cristatus*	4.00	0.00	LC	LC
Kingfisher, Pied	*Ceryle rudis*	13.33	2.94	LC	LC
Kite, Black-winged	*Elanus caeruleus*	82.67	20.59	LC	LC
Korhaan, Blue	*Eupodotis caerulescens*	20.00	0.00	LC	NT
Lapwing, African Wattled	*Vanellus senegallus*	34.67	5.88	LC	LC
Lapwing, Blacksmith	*Vanellus armatus*	93.33	35.29	LC	LC
Lapwing, Crowned	*Vanellus coronatus*	68.00	14.71	LC	LC
Lark, Eastern Clapper	*Mirafra fasciolata*	4.00	0.00	LC	LC
Lark, Red-capped	*Calandrella cinerea*	70.67	8.82	LC	LC
Lark, Rufous-naped	*Mirafra africana*	6.67	0.00	LC	LC
Lark, Spike-heeled	*Chersomanes albofasciata*	26.67	2.94	LC	LC
Longclaw, Cape	*Macronyx capensis*	88.00	26.47	LC	LC
Martin, Banded	*Riparia cincta*	36.00	2.94	LC	LC
Martin, Brown-throated	*Riparia paludicola*	56.00	14.71	LC	LC
Martin, Rock	*Ptyonoprogne fuligula*	6.67	0.00	LC	LC
Moorhen, Common	*Gallinula chloropus*	21.33	5.88	LC	LC
Moorhen, Lesser	*Paragallinula angulata*	4.00	0.00	LC	LC
Mousebird, Speckled	*Colius striatus*	4.00	0.00	LC	LC
Myna, Common	*Acridotheres tristis*	28.00	14.71	LC	LC
Owl, Marsh	*Asio capensis*	20.00	0.00	LC	LC
Owl, Western Barn	*Tyto alba*	2.67	0.00	LC	LC
Pigeon, Speckled	*Columba guinea*	60.00	14.71	LC	LC
Pipit, African	*Anthus cinnamomeus*	77.33	5.88	LC	LC
Pipit, Nicholson's	*Anthus nicholsoni*	1.33	0.00	LC	LC
Pipit, Plain-backed	*Anthus leucophrys*	1.33	0.00	LC	LC
Plover, Common Ringed	*Charadrius hiaticula*	2.67	0.00	LC	LC
Plover, Kittlitz's	*Charadrius pecuarius*	18.67	5.88	LC	LC
Plover, Three-banded	*Charadrius tricollaris*	50.67	5.88	LC	LC
Pochard, Southern	*Netta erythrophthalma*	21.33	2.94	LC	LC
Prinia, Black-chested	*Prinia flavicans*	65.33	8.82	LC	LC
Prinia, Tawny-flanked	*Prinia subflava*	6.67	8.82	LC	LC
Quail, Common	*Coturnix coturnix*	38.67	8.82	LC	LC
Quelea, Red-billed	*Quelea quelea*	69.33	20.59	LC	LC
Rail, African	*Rallus caerulescens*	2.67	0.00	LC	LC

Robin-Chat, Cape	*Cossypha caffra*	24.00	2.94	LC	LC
Sandpiper, Common	*Actitis hypoleucos*	2.67	0.00	LC	LC
Sandpiper, Curlew	*Calidris ferruginea*	4.00	0.00	LC	NT
Sandpiper, Marsh	*Tringa stagnatilis*	2.67	0.00	LC	LC
Sandpiper, Wood	*Tringa glareola*	14.67	2.94	LC	LC
Shelduck, South African	*Tadorna cana*	10.67	0.00	LC	LC
Shoveler, Cape	*Spatula smithii*	52.00	5.88	LC	LC
Snipe, African	*Gallinago nigripennis*	30.67	0.00	LC	LC
Sparrow, Cape	*Passer melanurus*	88.00	32.35	LC	LC
Sparrow, House	*Passer domesticus*	17.33	2.94	LC	LC
Sparrow, Southern Grey-headed	*Passer diffusus*	42.67	2.94	LC	LC
Sparrowhawk, Black	*Accipiter melanoleucus*	12.00	0.00	LC	LC
Spoonbill, African	*Platalea alba*	32.00	20.59	LC	LC
Spurfowl, Swainson's	*Pternistis swainsonii*	76.00	14.71	LC	LC
Starling, Pied	*Lamprotornis bicolor*	40.00	5.88	LC	LC
Starling, Red-winged	*Onychognathus morio*	1.33	0.00	LC	LC
Starling, Wattled	*Creatophora cinerea*	2.67	2.94	LC	LC
Stilt, Black-winged	*Himantopus himantopus*	29.33	8.82	LC	LC
Stint, Little	*Calidris minuta*	8.00	0.00	LC	LC
Stonechat, African	*Saxicola torquatus*	92.00	32.35	LC	LC
Stork, White	*Ciconia ciconia*	5.33	0.00	LC	LC
Stork, Yellow-billed	*Mycteria ibis*	4.00	0.00	EN	LC
Sunbird, Amethyst	*Chalcomitra amethystina*	1.33	0.00	LC	LC
Sunbird, Malachite	*Nectarinia famosa*	1.33	0.00	LC	LC
Swallow, Barn	*Hirundo rustica*	44.00	8.82	LC	LC
Swallow, Greater Striped	*Cecropis cucullata*	37.33	23.53	LC	LC
Swallow, South African Cliff	*Petrochelidon spilodera*	37.33	0.00	LC	LC
Swallow, White-throated	*Hirundo albigularis*	28.00	8.82	LC	LC
Swamphen, African	*Porphyrio madagascariensis*	4.00	0.00	LC	LC
Swift, African Black	*Apus barbatus*	1.33	0.00	LC	LC
Swift, African Palm	*Cypsiurus parvus*	4.00	5.88	LC	LC
Swift, Little	*Apus affinis*	29.33	8.82	LC	LC
Swift, White-rumped	*Apus caffer*	28.00	0.00	LC	LC
Teal, Cape	*Anas capensis*	16.00	0.00	LC	LC
Teal, Red-billed	*Anas erythrorhyncha*	58.67	11.76	LC	LC
Tern, Whiskered	*Chlidonias hybrida*	30.67	5.88	LC	LC
Tern, White-winged	*Chlidonias leucopterus*	4.00	2.94	LC	LC
Thick-knee, Spotted	*Burhinus capensis*	26.67	0.00	LC	LC
Thrush, Groundscraper	*Turdus litsitsirupa*	1.33	0.00	LC	LC
Thrush, Karoo	*Turdus smithi*	1.33	0.00	LC	LC
Thrush, Olive	*Turdus olivaceus*	1.33	0.00	LC	LC
Wagtail, Cape	*Motacilla capensis*	73.33	26.47	LC	LC
Warbler, African Reed	*Acrocephalus baeticatus*	10.67	2.94	LC	LC
Warbler, Lesser Swamp	*Acrocephalus gracilirostris*	16.00	11.76	LC	LC
Warbler, Little Rush	*Bradypterus baboecala*	2.67	0.00	LC	LC

Warbler, Willow	*Phylloscopus trochilus*	1.33	2.94	LC	LC
Waxbill, Blue	*Uraeginthus angolensis*	0.00	2.94	LC	LC
Waxbill, Common	*Estrilda astrild*	58.67	14.71	LC	LC
Waxbill, Orange-breasted	*Amandava subflava*	40.00	2.94	LC	LC
Weaver, Southern Masked	*Ploceus velatus*	96.00	23.53	LC	LC
Weaver, Village	*Ploceus cucullatus*	1.33	0.00	LC	LC
Wheatear, Capped	*Oenanthe pileata*	38.67	5.88	LC	LC
Wheatear, Mountain	*Myrmecocichla monticola*	0.00	2.94	LC	LC
White-eye, Cape	*Zosterops virens*	6.67	0.00	LC	LC
Whydah, Pin-tailed	*Vidua macroura*	64.00	23.53	LC	LC
Widowbird, Fan-tailed	*Euplectes axillaris*	40.00	0.00	LC	LC
Widowbird, Long-tailed	*Euplectes progne*	73.33	5.88	LC	LC
Widowbird, Red-collared	*Euplectes ardens*	1.33	0.00	LC	LC
Widowbird, White-winged	*Euplectes albonotatus*	13.33	0.00	LC	LC
Wood Hoopoe, Green	*Phoeniculus purpureus*	1.33	2.94	LC	LC
Wryneck, Red-throated	*Jynx ruficollis*	2.67	0.00	LC	LC

APPENDIX 2: HABITAT FEATURES AT THE PAOI

Grassland

Figure S1: Undisturbed grassland within the PAOI

Figure S2: Remnant grassland within the PAOI preserved along a drainage line

Drainage lines and wetlands

Figure S3: Well-established herbaceous wetland (vlei) along a drainage line in the PAOI.

Figure 10: Herbaceous wetland alongside a dam in the PAOI.

Figure S5: Aerial view of a drainage line (with artificial dams adjoining) in the PAOI.

Dams and pans

Figure 11: Aerial view of an artificial dam in the PAOI.

Figure S7: Ground view of a large natural pan within the PAOI.

Agricultural land

Figure S8: Recently sown maize field within the PAOI.

Figure 12: Aerial view of an agricultural field.

Figure S11: Cattle grazing in natural grassland within the PAOI.

Alien trees (and natural woodland)

Figure S12: Alien trees near an earth-embankment dam and residential area within the PAOI.

Figure S13: Several stands of alien trees near a drainage line within the PAOI.

High voltage powerlines

Figure S14: The Hendrina Power Station, situated within the PAOI.

Figure S15: High voltage powerlines within the PAOI.

APPENDIX 3: ASSESSMENT CRITERIA

The impact assessment followed criteria stipulated by the SiVest environment impact Assessment methodology, as provided below:

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

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

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

APPENDIX 4: ENVIRONMENTAL MANAGEMENT PLAN

Management Plan for the Pre-Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed.	1. Walk-through by avifaunal specialist to record any Red Lis species nests.	1. Once-off	1. Developer
Avifauna: Mortality due to collision with the overhead power line					
Mortality of avifauna due to collisions with the overhead power line.	Reduction of avian collision mortality	Demarcate sections of the overhead power line to be marked with Eskom approved Bird Flight Diverters (BFDs).	1. Walk-through by avifaunal specialist. 2. Fit Bird Flight Diverters on the earth-wire at the demarcated sections of the OHL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).	1. Once-off 2. Once-off	1. Developer 2. Contractor and ECO

Environmental Management Programme (EMPr) for the Construction Phase

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

EMPr for the Operational Phase

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

EMPr for the Decommissioning Phase

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

APPENDIX 5: SITE SENSITIVITY VERIFICATION

Introduction

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020 is applicable in the case of solar PV developments.

The details of the site sensitivity verification are noted below:

Date of Site Visits	8 - 9 June 2022
Supervising Specialist Name	Albert Froneman
Professional Registration Number	MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09)
Specialist Affiliation / Company	Chris van Rooyen Consulting

Methodology

The following methodology was employed to conduct this study:

- Powerline sensitive species are defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town, as a means to ascertain which species occurs within the broader area of four pentad grid cells each within which the proposed projects are situated (see Figure 2). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 6 pentads which intersect with the development area, hereafter referred to as '**the broader area'**, namely (1) 2600_2930, (2) 2600_2935, (3) 2605_2930, (4) 2605_2935, (5) 2610_2930, (6) 2610_2935. From 2007-present, a total of 75 full protocol lists (i.e., surveys of at least two hours each) have been completed for this area. In addition, 34 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during the site surveys and general knowledge of the area.
- The national threatened status of all powerline priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor et al., 2015), and the latest authoritative summary of southern African bird biology (Hockey et al., 2005).

- The global threatened status of all priority species was determined by consulting the (2022.1) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation habitat ecotypes within the PAOI was obtained from the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) BGIS map viewer (http://bgisviewer.sanbi.org/) (Mucina & Rutherford, 2006; SANBI, 2018). The PAOI is the area where the primary impacts on avifauna are expected and includes the land parcels where the project will be located.
- Avifaunal habitat usage within the PAOI by birds was informed by the Atlas of Southern African Birds 1 (SABAP 1) (Harrison et al., 1997a, 1997b).
- Land-cover and land-use within the PAOI was determined using the 2018 South African national land-cover surveys jointly conducted by the Department of Environmental Affairs, and the Department of Rural Development and Land Reform (DEA & DALRRD, 2019).
- The Important Bird Areas of Southern Africa (Marnewick et al., 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2022) was used to view the PAOI and broader area on a landscape level and to help identify sensitive bird habitat.
- The 2022 South Africa Protected Areas Database compiled by the Department of Environment, Forestry and Fisheries (DFFE) was used to identify Nationally Protected Areas, National Protected Areas Expansion Strategy (NPAES) near the PAOI (DFFE, 2022).
- The Department of Forestry, Fisheries and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the PAOI.
- Data collected during previous site visits to the broader area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- The following sources were used to determine the investigation protocol that is required for the site:
    - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
    - The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020).
- The sources of information on the avifaunal diversity and abundance at the PAOI was supplemented with the information gathered through an integrated pre-construction monitoring programme which was implemented at the PAOI.

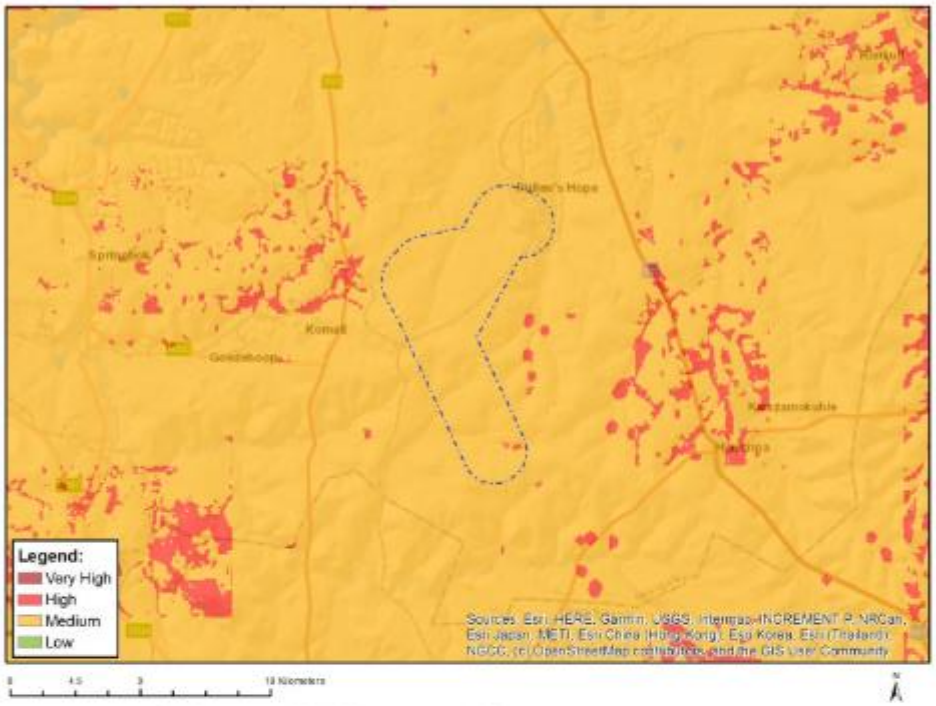
Results of site assessment

According to the DFFE national screening tool, small sections of the habitat within the PAOI is classified as High sensitivity according to the Animal Species theme, due to the potential presence of species of conservation concern (SCCs), namely Yellow-billed Stork Mycteria ibis (Globally Least Concern, Regionally Endangered). Most the habitat within the PAOI is classified as **medium** sensitivity due the presence of other SCCs, namely, White-bellied Korhaan *Eupoditis senegalensis* (Globally Least Concern, Regionally Vulnerable), African Grass Owl *Tyto capensis* (Globally Least Concern, Regionally Vulnerable) and Caspian Tern *Hydroprogne caspia* (Globally Least Concern Regionally Vulnerable).

The classification of **High** sensitivity for Yellow-billed Stork is supported based on the habitat recorded during surveys, but in addition the PAOI as a whole should be reclassified as **High** based on the recorded presence of SCCs recorded in the PAOI during monitoring, namely Secretarybird (Globally Endangered, Regionally Vulnerable), Martial Eagle (Globally Endangered, Locally Endangered), Lanner Falcon (Locally Vulnerable), Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable), Blue Korhaan (Globally Near Threatened, Regionally Least Concern), and Grey Crowned Crane (Globally and Locally Endangered).

The proposed Project will have a range of pre-mitigation impacts from medium to very high on priority avifauna, but it is expected to be reduced to acceptable low levels with appropriate mitigation. No fatal flaws were discovered during the investigations, therefore the authorisation of the project is supported, provided the recommendations in this report is strictly implemented.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Mycteria ibis
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Tyto capensis
Medium	Aves-Hydroprogne caspia
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi

Figure 13: The National Web-Based Environmental Screening Tool map of the PAOI, indicating sensitivities for the Animal Species theme. The classification is correct based on the presence of several Red List SCCs at the site.

Avifauna

The SABAP2 data indicates that a total of 186 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species, as well as all the species that were recorded during the pre-construction monitoring in the PAOI. Of these, 66 species are classified as powerline sensitive species (see definition of powerline sensitive species in section 3) and 10 of these are South African Red List species. Of the powerline sensitive species, 33 are likely to occur regularly in the PAOI

Eight Red List species of conservation concern (SCC) were recorded during the site surveys:

1. Crane, Grey Crowned (Globally Endangered, Regionally Endangered)
2. Falcon, Lanner (Globally Least Concern, Regionally, Vulnerable)
3. Flamingo, Greater (Globally Least Concern, Regionally Near Threatened)
4. Flamingo, Lesser (Globally Near Threatended, Regionally Near Threatened)
5. Ibis, Southern Bald (Globally Vulnerable, Regionally Vulnerable)
6. Korhaan, Blue (Globally Near Threatened, Regionally Least Concern)
7. Secretarybird (Globally Endangered, Regionally Vulnerable)
8. Stork, Yellow-billed (Globally Least Concern, Regionally Endangered)

1.1 Receiving environment

The Hendrina North Grid is situated in the Eastern Highveld Grassland (Gm12) vegetation ecotype within the Mesic Highveld Grassland Bioregion of the South African Grassland Biome (SANBI, 2018). This grassland ecotype is defined by a short, closed grassland cover comprising a typical Highveld grass species assemblage (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya* etc.) over sandstone-derived soils of the Karoo supergroup (Mucina et al., 2006). Climax plant communities are dominated by *Themeda triandra* sward, although these are are often severely grazed to form a short lawn (Mucina et al., 2006).

This vegetation type covers 12669 km^2 over Mpumalanga and Gauteng (SANBI, 2018), at altitudes ranging 1520-1780 m above sea level (Mucina et al., 2006), although occasionally as low as 1300 m. Eastern Highveld Grassland is classified as Vulnerable (SANBI, 2013), although this ecotype – and the Hendrina North Grid by extension – does not fall within a Centre of Endemism (Van Wyk & Smith, 2001).

The Hendrina North Grid has a temperate climate with continental seasonality, experiencing warm, wet summers and mildly cold, dry winters. The mean temperatures range 17°C (January) to 3°C (July). The mean annual precipitation is 482 mm (https://www.meteoblue.com/, accessed October 2022), notably lower than the average for the Eastern Highveld Grassland (726 mm). Rainfall is lowest in July (1.74 mm), and highest in December (161 mm).

The proposed Hendrina North Grid transects gently topography of gently undulating grasslands and farmlands with low hills and pan depression, ranging 1592-1708m in altitude. There are several minor drainage lines which intersect the PAOI, with north-flowing tributaries associated with Woes-alleenspruit (a tributary of Klein-olifantsrivier) in the north, and south-flowing tributaries of Olifantsriver in the south. There are numerous artificial dams associated with these drainage systems, as well as several natural pans.

While the dominant vegetation, topography, and hydrology largely explain the distribution and abundance of the bird species within the PAOI, it is also important to examine the modifications which have changed the natural landscape, and which may impact the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as land use and man-made infrastructure.

Most the native grassland biome within the PAOI has been replaced by commercial crop agriculture, and remnant grassland tracts are utilised for livestock grazing. Agricultural activity and its relevance to local avifauna is detailed below. The PAOI also includes the town of Pullen's Hope as associated residential areas in the northern sections, as a well as large industrial area comprising the Hendrina Power Station. Additionally, commercial Mining activity is

practiced in the northeast of the PAOI - east of Pullen's Hope – as well as 8 km west of the PAOI, near Komati. This mining activity has resulted in opencast quarries, material waste dumps, and flooded mine pits within the PAOI that have likely impacted the grassland and riparian/aquatic ecology within the PAOI. Finally, several high voltage powerlines intersect the PAOI, most of which originating from the Hendrina Power Station. These include the six 132kV powerlines: the Hendrina-Optimum1 132kV, the Hendrina-Optimum2 132kV, the Hendrina-Witkloof 132kV, the Hendrina-Aberdeen Traction 132kV, the Hendrina-Sar Botha 132kV, and the Aberdeen Traction-Ysterkop 132kV. Additionally, there are five 400kV powerlines: the [30] 400kV, the [146] 400kV, the [147] 400kV, the [148] 400kV, and the [295] 400kV. The relevance of powerlines to priority species are detailed below.

The following six habitat classes were identified as relevant to priority bird species in the PAOI:

1. Grassland
2. Drainage lines and wetlands
3. Dams and pans
4. Agricultural lands
5. Alien trees (and natural woodland)
6. High voltage powerlines

Grasslands

The native grassland biome, as detailed above, has largely been replaced by commercial agriculture, with remnant grassland tracts occurring fragmentedly across the PAOI, typically adjacent to drainage lines. These grasslands within the PAOI range from rank vegetation bordering herbaceous wetlands (detailed below), and dense stands of relatively high grasses in less disturbed areas, to short grasslands in heavily grazed areas.

The following twenty-two powerline sensitive species are likely to regularly utilise the natural grasslands in the PAOI:

22. Bustard, Denham's
23. Buzzard, Common
24. Buzzard, Jackal
25. Crow, Pied
26. Eagle, Black-chested Snake
27. Eagle, Long-crested
28. Eagle-Owl, Spotted
29. Egret, Western Cattle
30. Falcon, Amur
31. Falcon, Lanner
32. Guineafowl, Helmeted
33. Harrier, Montagu's
34. Harrier-Hawk, African
35. Heron, Black-headed
36. Ibis, Southern Bald
37. Kestrel, Greater
38. Kestrel, Rock
39. Korhaan, Blue
40. Owl, Marsh
41. Secretarybird
42. Stork, White

The following three additional powerline sensitive species could occasionally use the natural grasslands in the PAOI:

4. Eagle, Martial
5. Heron, Black-crowned Night
6. Owl, Western Barn

Drainage lines and wetlands

Fairly extensive herbaceous wetlands (marshlands/vleis) mainly surrounding drainage lines (and dams and pans) within the PAOI, interrupting the grassland-cropland mosaic.

The following twenty powerline sensitive species are likely to regularly utilise the wetlands in the PAOI:

22. Crane, Grey Crowned
23. Duck, Fulvous Whistling
24. Duck, White-faced Whistling
25. Duck, Yellow-billed
26. Egret, Great
27. Egret, Intermediate
28. Egret, Little
29. Goose, Egyptian
30. Goose, Spur-winged
31. Hamerkop
32. Heron, Black-headed
33. Heron, Grey
34. Ibis, African Sacred
35. Ibis, Glossy
36. Ibis, Hadada
37. Kite, Black-winged
38. Moorhen, Common
39. Owl, Marsh
40. Shoveler, Cape
41. Spoonbill, African
42. Teal, Red-billed

The following five additional powerline sensitive species could occasionally use the wetlands in the PAOI:

6. Duck, African Black
7. Heron, Black-crowned Night
8. Heron, Purple
9. Heron, Squacco
10. Swamphen, African

Dams and pans

The PAOI contains many earth-embankment dams located along drainage lines. Additionally, there are also several small pans which are a potential drawcard for many powerline-sensitive species. Lesser and Greater

Flamingos could use pans for foraging and roosting. Large raptors could use the dams and pans for bathing and drinking.

The following thirty powerline sensitive species are likely to regularly utilise the dams and pans in the PAOI:

31. Coot, Red-knobbed
32. Cormorant, Reed
33. Cormorant, White-breasted
34. Darter, African
35. Duck, Fulvous Whistling
36. Duck, White-faced Whistling
37. Duck, Yellow-billed
38. Eagle, African Fish
39. Eagle, Black-chested Snake
40. Eagle, Long-crested
41. Egret, Great
42. Egret, Intermediate
43. Falcon, Lanner
44. Flamingo, Greater
45. Flamingo, Lesser
46. Goose, Egyptian
47. Goose, Spur-winged
48. Grebe, Great Crested
49. Grebe, Little
50. Hamerkop
51. Heron, Grey
52. Kite, Black-winged
53. Moorhen, Common
54. Pochard, Southern
55. Secretarybird
56. Shoveler, Cape
57. Spoonbill, African
58. Stork, Yellow-billed
59. Teal, Cape
60. Teal, Red-billed

The following eleven additional powerline sensitive species could occasionally use the dams and pans in the PAOI:

12. Duck, African Black
13. Duck, Knob-billed
14. Duck, Maccoa
15. Duck, White-backed
16. Eagle, Martial
17. Grebe, Black-necked
18. Heron, Black-crowned Night
19. Heron, Goliath
20. Heron, Purple
21. Heron, Squacco
22. Shelduck, South African

Agricultural lands

The dominant land-use within the PAOI is commercial crop agriculture of maize, peanuts, sunflowers, and soya beans, with livestock farming (sheep, cattle, and pigs) also present. Some fields are lying fallow or are in the process of being re-vegetated by grass.

The following eleven powerline sensitive species are likely to regularly utilise the dams and pans in the PAOI:

12. Crane, Grey Crowned
13. Crow, Pied
14. Egret, Western Cattle
15. Falcon, Amur
16. Falcon, Lanner
17. Goose, Egyptian
18. Goose, Spur-winged
19. Guineafowl, Helmeted
20. Heron, Black-headed
21. Ibis, Hadada
22. Ibis, Southern Bald

The following two additional powerline sensitive species could occasionally use the dams and pans in the PAOI:

3. Eagle, Martial
4. Owl, Western Barn

Alien trees (and natural woodland)

The PAOI contains restricted tree cover. Typical of Eastern Highveld Grassland, sporadic natural woody vegetation (very small tracts of woodland and thicket) are present over rocky outcrops and occasionally along the drainage lines. Additionally, alien tree species have also become established within the PAOI, particularly *Eucalyptus*, Australian *Acacia* (Wattle), and *Salix* (Willow) species. Alien trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have alien trees growing alongside, some of which were originally planted to protect earth-embankment dams. Alien trees both supplement the indigenous tree cover for priority species, as well as proving novel nesting and roosting opportunities.

The following twenty-four powerline sensitive species are likely to regularly utilise the native and alien tree cover in the PAOI:

25. Cormorant, White-breasted
26. Crane, Grey Crowned
27. Crow, Pied
28. Eagle, African Fish
29. Eagle, Black-chested Snake
30. Eagle, Long-crested
31. Eagle-Owl, Spotted
32. Egret, Little
33. Egret, Western Cattle
34. Falcon, Amur
35. Falcon, Lanner
36. Guineafowl, Helmeted
37. Harrier-Hawk, African
38. Heron, Black-headed

39. Heron, Grey
40. Ibis, African Sacred
41. Ibis, Hadada
42. Ibis, Southern Bald
43. Kestrel, Greater
44. Kestrel, Rock
45. Secretarybird
46. Sparrowhawk, Black
47. Spoonbill, African
48. Stork, White

The following two additional powerline sensitive species could occasionally use the native and alien tree cover in the PAOI:

3. Eagle, Martial
4. Heron, Black-crowned Night

High voltage powerlines

Numerous high voltage powerlines intersect the PAOI, and several reticulation lines – most of which originating from the Hendrina Power Station. These include the six 132kV powerlines: the Hendrina-Optimum1 132kV, the Hendrina-Optimum2 132kV, the Hendrina-Witkloof 132kV, the Hendrina-Aberdeen Traction 132kV, the Hendrina-Sar Botha 132kV, and the Aberdeen Traction-Ysterkop 132kV. Additionally, there are five 400kV powerlines: the [30] 400kV, the [146] 400kV, the [147] 400kV, the [148] 400kV, and the [295] 400kV

The following eleven powerline sensitive species are likely to regularly perch, and roost on the transmission towers and powerlines in the PAOI:

12. Egret, Little
13. Falcon, Amur
14. Falcon, Lanner
15. Goose, Egyptian
16. Guineafowl, Helmeted
17. Heron, Black-headed
18. Ibis, Hadada
19. Ibis, Southern Bald
20. Kestrel, Greater
21. Kestrel, Rock
22. Stork, White

The following one additional powerline sensitive species could occasionally perch, and roost on the transmission towers and powerlines in the PAOI:

2. Eagle, Martial

Environmental sensitivities

The following specific environmental sensitivities were identified from an avifaunal perspective:

Very high sensitivity: drainage lines, dams, pans, and associated herbaceous wetlands.

Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety priority species, particularly waterbirds, as well as seven Red List species, namely:

15. Crane, Grey Crowned (Globally Endangered, Regionally Endangered)
16. Duck, Maccoa (Globally Endangered, Regionally Near Threatened)
17. Eagle, Martial (Globally Endangered, Regionally Endangered)
18. Falcon, Lanner (Globally Least Concern, Regionally, Vulnerable)
19. Flamingo, Greater (Globally Least Concern, Regionally Near Threatened)
20. Secretarybird (Globally Endangered, Regionally Vulnerable)
21. Stork, Yellow-billed (Globally Least Concern, Regionally Endangered)

Birds commuting between these areas will be at risk of collision with the earth-wire if they must cross over the grid connection. Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

High sensitivity: undisturbed natural grassland

The natural grassland is vital breeding, roosting and foraging habitat for a variety of Red List powerline sensitive species and will therefore be associated with significant flight activity. These include the following five Red List species:

6. Eagle, Martial (Globally Endangered, Regionally Endangered)
7. Falcon, Lanner (Globally Least Concern, Regionally Vulnerable)
8. Ibis, Southern Bald (Globally Vulnerable, Regionally Vulnerable)
9. Korhaan, Blue (Globally Near Threatened, Regionally Least Concern)
10. Secretarybird (Globally Endangered, Regionally Vulnerable)

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

Medium sensitivity: disturbed natural grassland/fallow agricultural land

Disturbed natural grassland and fallow agricultural land provide similar foraging, roosting, and potentially breeding opportunities for priority species which depend upon natural grassland, including the same five Red List species listed for natural undisturbed grassland.

Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

Conclusions

The classification of **High** sensitivity for Yellow-billed Stork is supported based on the habitat recorded during surveys, but in addition the PAOI as a whole should be reclassified as **High** based on the recorded presence of SCCs recorded in the PAOI during monitoring, namely Secretarybird (Globally Endangered, Regionally Vulnerable), Martial Eagle (Globally Endangered, Locally Endangered), Lanner Falcon (Locally Vulnerable), Southern Bald Ibis (Globally Vulnerable, Regionally Vulnerable), Blue Korhaan (Globally Near Threatened, Regionally Least Concern), and Grey Crowned Crane (Globally and Locally Endangered).