Appendix H.4

AVIFAUNAL ASSESSMENT

AVIFAUNAL SPECIALIST REPORT

Scoping and Environmental Impact Assessment (EIA)

For the Proposed Development of the Igolide Wind Energy Facility and associated infrastructure, near Fochville, Gauteng Province

Report prepared for: WSP Group Africa (Pty) Ltd 33 Sloane Street Bryanston 2191 South Africa	*Report prepared by:* AfriAvian Environmental P.O Box 2676, Fourways 2055 South Africa

September 2023

Executive Summary

The proposed Igolide Wind Energy Facility ("WEF") (hereafter "Project) will be operated under a Special Purpose Vehicle (SPV), Igolide Wind (Pty) Ltd (the "Proponent"). The Proponent aims to bid the Project into the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) or a similar procurement programme under the Integrated Resource Plan (IRP).

The proposed Project will be developed within a project area of approximately 680 hectares (ha). Within this project area, the extent of the Project Footprint will be approximately 50 ha. The Project is located approximately 6km northeast of Fochville, within the Merafong City Local Municipality in the Gauteng Province.

The proposed WEF will be constructed on the following farm portions:

- Portion 14 of Farm 147 Kraalkop
- Portion 20 of Farm 147 Kraalkop
- Portion RE/22 of Farm 147 Kraalkop
- Portion 8 of Farm 356 Leeuwpoort
- Portion 57 of Farm 356 Leeuwpoort
- Portion 65 of Farm 356 Leeuwpoort
- Portion 66 of Farm 356 Leeuwpoort

This report serves as the Avifaunal Impact Assessment Report prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed Project.

Avifauna

A total of 307 species could potentially occur within the Broader Area where the Project Site is located (see **Appendix E**). Of these, 32 are classified as priority species for wind energy developments. Of these 32 priority species, 11 have a medium to high likelihood of occurring regularly in the Project Area of Influence (PAOI). Of the 32 priority species, 12 (38%) were recorded during the on-site field surveys. Ten (10) priority species recorded in the Broader Area are also Species of Conservation Concern (SCC). Two (2) SCC were recorded during the on-site surveys, namely Secretarybird (Globally Endangered and Regionally Vulnerable) and Lanner Falcon (Regionally Vulnerable). There is also confirmed habitat for African Grass Owl (Regionally Vulnerable) within the PAOI.

Identification of Potential Impacts/Risks on Priority Avifauna

The potential impacts identified during the study are listed below.

<u>Construction Phase</u>

- Total or partial displacement due to noise disturbance and habitat transformation associated with the construction of the wind turbines and associated infrastructure.

<u>Operational Phase</u>

- Total or partial displacement due to habitat transformation associated with the presence of the wind turbines and associated infrastructure.
- Collisions with the wind turbines.
- Electrocutions at the on-site substation and on the overhead sections of the internal 33kV network.
- Collisions with overhead sections of the internal 33kV network.

<u>Decommissioning Phase</u>

- Total or partial displacement due to disturbance associated with the decommissioning of the wind turbines and associated infrastructure.

<u>Cumulative Impacts</u>

- Total or partial displacement due to disturbance and habitat transformation associated with the construction and decommissioning of the wind energy facilities and associated infrastructure.
- Displacement due to habitat transformation associated with the presence of the wind turbines.
- Collisions with the wind turbines.
- Collisions with the internal 33kV network.
- Electrocutions at the on-site substations and on the internal 33kV network.

<u>Sensitivities identified by the National Web-Based Environmental Screening Tool</u>

The PAOI contains confirmed habitat for Species of Conservation Concern (SCC), primarily for African Grass Owl and Secretarybird (Globally Endangered and Regionally Vulnerable), as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). During the on-site surveys, two SCC were recorded. These SCC were: Lanner Falcon (Regionally Vulnerable), and Secretarybird (Globally Endangered and Regionally Vulnerable).

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the PAOI, the classification of **High Sensitivity** for avifauna is advocated for the Igolide WEF.

<u>Specialist Sensitivity Analysis and Verification</u>

- ***Very High Sensitivity: All Infrastructure Exclusion Zone – No Go Areas***

Included are areas that have been identified as suitable habitat for African Grass Owl (Regionally Vulnerable). Key wetlands used by African Grass Owl were identified from a presence locality dataset provided by Craig Whittington-Jones (Ornithologist: Gauteng Department of Agriculture and Rural Development) and supplemented with personal records of African Grass Owl breeding sites. Roadkill and marginal/stochastic sites were disregarded for this analysis, with an emphasis being placed on records noted as confirmed or suspected breeding sites, as well as sites noted to host the species consistently, but where breeding was unconfirmed. A systematic GIS grid was then used to generate positive training data samples from these sites representing suitable breeding wetlands for African Grass Owl. Please refer to **Appendix H** for a full description of the habitat suitability modelling methodology.

- ***Very High Sensitivity: Turbine Exclusion Zone***

Drainage lines, wetlands, dams: A wind turbine exclusion zone (including the rotor swept area) should be implemented within a 50m buffer around the centre line of the drainage lines, wetlands, and dams; and a 200m buffer around the identified African Grass Owl habitat. Wetlands (including dam margins) are important breeding, roosting, and foraging habitat for a variety of Species of Conservation Concern (SCC), most notably for African Grass Owl (Regionally Vulnerable), Greater Flamingo (Regionally Near Threatened), Maccoa Duck (Globally Vulnerable, Regionally Near Threatened), and Yellow-billed Stork (Regionally Endangered). These SCC have all been recorded in the Broader Area through the Southern African Bird Atlas Project (SABAP2). It should also be noted that any road and/or grid line crossings across these features should be restricted to what is unavoidable.

- ***High Sensitivity: Limited Infrastructure Zone***

High Sensitivity grassland: Natural grassland. Development in the remaining natural grassland in the PAOI must be limited as far as possible. Where possible, infrastructure must be located near margins, with the shortest routes taken from the existing roads. The natural grassland is a vital breeding, roosting, and foraging habitat for a variety of SCC. These include African Grass-owl (Globally Least Concern, Regionally Vulnerable), and Secretarybird (Globally Endangered, Regionally Vulnerable).

Impact Assessment Summary

The overall impact significance is provided in the table below, in terms of pre- and post-mitigation.

Executive Summary Table: Overall Average Impact Significance (Pre- and Post-Mitigation)

Phase	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Construction	Moderate	Low
Operational	Moderate	Low
Decommissioning	Moderate	Low

Conclusions

The proposed Igolide WEF will have a medium impact on avifauna that, in most instances, could be reduced to a low impact through the appropriate mitigation measures. The current proposed 10-turbine layout assessed in this report avoids all the recommended avifaunal turbine exclusion zones and is therefore deemed acceptable. **<u>The development is supported, provided the mitigation measures listed in this report (Section 7.8 and Appendix I) are strictly applied and adhered to. See Figure 13, Section 5.6 for a map of the exclusion areas.</u>**

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List of Abbreviations

BLSA	BirdLife South Africa
DFFE	Department of Forestry, Fisheries and Environment
NEMA	National Environmental Management Act 107 of 1998 (as amended)
REDZ	Renewable Energy Development Zone
S&EIA	Scoping and Environmental Impact Assessment
SABAP	Southern African Bird Atlas Project
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
WEF	Wind Energy Facility

Table 1: Definitions of key terminology in this impact assessment report

Definitions	
Wind Priority Species	Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Ralston-Paton *et al*., 2017; Retief *et al*., 2012).
Broader Area	The area encompassed by the four pentads where the Project Site is located.
Project Site	The area covered by the land parcels where the project will be located, totalling approximately 680 hectares. This is where the actual development will be located, i.e., the footprint containing the wind turbines and associated infrastructure.
Project Area of Impact (PAOI)	The primary impact zone of the wind energy facility, encompassing the project footprint (where the turbines are located) and a 1km buffer around it.
Pentad	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km.

1. Project Description

The proposed Igolide Wind Energy Facility ("WEF") (hereafter "Project) will be operated under a Special Purpose Vehicle (SPV), Igolide Wind (Pty) Ltd (the "Proponent"). The Proponent aims to bid the Project into the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) or a similar procurement programme under the Integrated Resource Plan (IRP).

The proposed Project will be developed within a project area of approximately 680 hectares (ha). Within this project area, the extent of the Project footprint will be approximately 50 ha. The Project is located approximately 6km northeast of Fochville, within the Merafong City Local Municipality in the Gauteng Province.

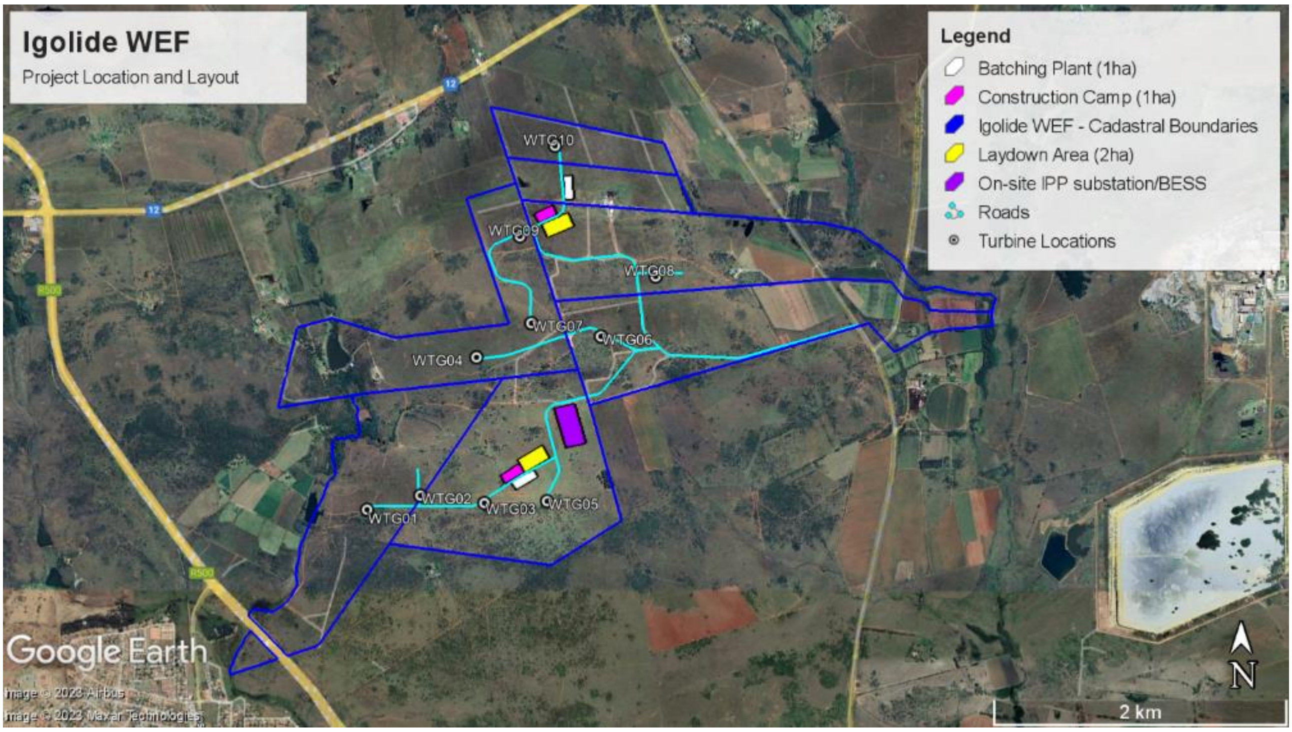

Figure 1: Igolide WEF Locality Map.

The proposed WEF will be constructed on the following farm portions:

- Portion 14 of Farm 147 Kraalkop
- Portion 20 of Farm 147 Kraalkop
- Portion RE/22 of Farm 147 Kraalkop
- Portion 8 of Farm 356 Leeuwpoort
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- Portion 66 of Farm 356 Leeuwpoort

This report serves as the Avifaunal Impact Assessment Report input that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed Project.

The key project details for the Igolide WEF and associated infrastructure are in Table 2 below:

Table 2: Key project details for the Igolide WEF and associated infrastructure

Facility Name:	Igolide Wind Energy Facility (WEF)
Applicant:	Igolide Wind (Pty) Ltd
Municipalities:	Merafong City Local Municipality in the Gauteng Province of South Africa
Extent:	680ha
Footprint:	50ha
Capacity:	Up to 100MW
No. of turbines:	10
Turbine hub height:	Up to 200m
Rotor Diameter:	Up to 200m
Tip Height:	Up to 300m
Foundation:	Approximately 25m diameter x 3m deep – 500 m^3 – 650m^3 concrete. The volume to be excavated will be approximately 2 200m^3, in sandy soils due to access requirements and safe slope stability requirements.
Turbine Hardstand:	Hardstand does not require concrete. Area required will be approximately 1 ha per turbine.
Tower Type	Steel or concrete towers can be utilised at the site. Alternatively, the towers can be of a hybrid nature, comprising concrete towers and top steel sections.
On-site IPP substation and battery energy storage system (BESS):	The total footprint for the on-site substation, including the BESS, will be up to 2.5ha in extent. The on-site IPP portion substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building, telecommunication infrastructure, and other substation components, as required. A 500m buffer around the on-site IPP substation has been identified to ensure flexibility in routing the power line. The BESS storage capacity will be up to 100MW/400 megawatt-hour (MWh) with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology; however, the specific technology will only be determined following Engineering, Procurement, and Construction ("EPC") procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers. The BESS components will arrive on site pre-assembled.
Grid (to form part of a separate application for EA)	A single or double circuit 132kV overhead power line and 132kV switching station (with a footprint of 1.5ha, to be located adjacent to the on-site IPP substation) to feed the electricity generated by the proposed

	WEF into Eskom's Midas Main Transmission Substation via a 11km overhead line. A corridor of up to 250m in width (125m on either side of the centre line) has been identified for the placement of the up to 132kV single or double circuit power line to allow for avoidance of sensitive environmental features (where possible).
Cables:	The medium voltage collector system will comprise cables up to and including 33kV that run underground, except where a technical assessment suggests that overhead lines are required, connecting the turbines to the on-site IPP substation.
Operations and Maintenance (O&M) building and storerooms:	The Operations and Maintenance ("O&M") building footprint will be located near the on-site substation. Typical areas include: - Operations building – 20m x 10m = 200m^2 - Workshop and stores area – of ~300m^2 - Refuse area for temporary waste storage and conservancy tanks to service ablution facility. The total combined area of the buildings will not exceed 5 000m^2.
Construction camps:	The construction camp will house the contractor offices, ablution facilities, mess area, etc., and will have a footprint of 1ha. The construction camp will be demolished after commercial operations date and the area rehabilitated.
Temporary laydown or staging areas:	The laydown area will be used for the storage of equipment or components that will be incorporated into the facility (such as electrical cables) as well as non-facility related equipment and components such as shipping frames, concrete shuttering, etc. The laydown area will also be used for the storage (and filling of vehicles) of diesel fuel. The laydown area will have a footprint of up to 2ha, which could increase to 3ha for concrete towers, should they be required. The laydown area will be demolished after commercial operations date and the area rehabilitated.
Cement Batching Plant (temporary):	The cement batching plant will be used to mix and blend cement, water, sand, and aggregates to form quality concrete to be used for foundations. The cement batching plant will have a footprint of 1ha.
Access and Internal Roads:	Access and internal roads will have a width of 8 - 10m, increasing up to 20m for turning circle/bypass areas to allow for larger component transport. The access and internal roads will be placed within a corridor of up to 20m width to accommodate cable trenches, stormwater channels and turning circle/bypass areas of up to 20m. Existing access roads will be used where possible to minimise impact. Where required, the width of the existing roads will be widened to ensure the passage of vehicles.
Supporting Infrastructure:	- Fencing; - Lighting; - Lightning protection;

	- Telecommunication infrastructure; - Stormwater channels; - Water pipelines; - Offices; - Operational and control centre; - Operations and maintenance area / warehouse / workshop; - Ablution facilities; - Gatehouse; - Security building; - Visitor's centre; and - Substation building.
Site coordinates (centre point)	26°27'2.44"S / 27°30'58.82"E
Affected farm portion/s	- Portion 14 of Farm 147 Kraalkop - Portion 20 of Farm 147 Kraalkop - Portion RE/22 of Farm 147 Kraalkop - Portion 8 of Farm 356 Leeuwpoort - Portion 57 of Farm 356 Leeuwpoort - Portion 65 of Farm 356 Leeuwpoort - Portion 66 of Farm 356 Leeuwpoort

2. Legislative Context

2.1. Agreements and Conventions

Table 3 below lists agreements and conventions which South Africa is party to, and which is directly relevant to the conservation of avifauna (BirdLife International 2021).

Table 3: below lists agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna[1].

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	Regional

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

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

2.3. National Legislation

2.3.1. 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.

2.3.2. The National Environmental Management Act 107 of 1998, as amended (NEMA)

The National Environmental Management Act 107 of 1998, as amended, (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 or basic 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.

The Protocol for the specialist assessment and minimum report content requirements for environmental impacts avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020) is applicable in the case of wind developments.

2.3.3. 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 (as amended) (NEMBA) 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.

2.3.4. Provincial Legislation

The current legislation applicable to the conservation of fauna and flora in Gauteng is the Gauteng Nature Conservation Bill, 2014. The purpose of the Bill is to provide for the sustainable utilization and protection of biodiversity within Gauteng; to provide for the protection of wild and the management of alien animals; protected plants; aquatic biota and aquatic systems; to provide for the protection of invertebrates and the management of alien invertebrates; to provide for professional hunters, hunting outfitters and trainers; to provide for the preservation of caves, cave formations, cave biota and karst systems; to provide for the establishment of zoos; to provide for the powers and establishment of Nature Conservators; to provide for administrative matters and general powers; and to provide for matters connected therewith.

3. Assumptions and Limitations

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

- The SABAP2 data is regarded as an adequate indicator of the avifauna which could occur at the PAOI, and it was further supplemented by data collected during the on-site surveys.
- The focus of the study was on the potential impacts of the proposed WEF on wind energy priority species.
- Priority species for wind developments were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Ralston-Paton *et al*., 2017; Retief *et al*., 2012).
- Despite the growing body of peer reviewed literature investigating the collision risks of birds with wind turbines and overhead power lines in South Africa (Section 6), relevant information for many individual species remains limited. The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: “to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.”
- The assessment of impacts is based on the baseline environment as it currently exists at the PAOI.
- Conclusions drawn in this study are based on experience of the specialists on the species found on site 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 **Broader Area** is defined as the area encompassed by the four pentads where the project is located (**Figure 2**).
- The **Project Area of Impact** (PAOI) is defined as the area where the primary impacts on avifauna are expected.
- The **Project Site** is the where the actual development will be located, i.e., the footprint containing the wind turbines and associated infrastructure.

4. Description of Methodology

4.1. Scope and Objectives of This Specialist Input to The EIA Report

The purpose of the report is to determine the main issues and potential impacts of the proposed project/s on avifauna, through a combination of desktop analysis and field work. The report was prepared to provide inputs to the Draft EIA Report for the projects as required by the EIA Regulations promulgated in terms of the National Environmental Management Act 107 of 1998, as amended, (NEMA).

4.2. Details of Specialists

This specialist assessment has been undertaken by Albert Froneman and Megan Loftie-Eaton of AfriAvian Environmental (Formerly Chris van Rooyen Consulting). Albert Froneman, is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400177/09 in the field of Zoological Science. Megan Loftie-Eaton is also registered with SACNASP in the field of Ecology (Registration Number 135161). Curriculum Vitae are included in Appendix A of this specialist input report.

4.3. Terms of Reference

The terms of reference for this impact assessment report 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 solar facilities and associated infrastructure
- Identify potential sensitive environments and receptors that may be impacted on by the proposed facility
- Determine the nature and extent of potential impacts
- Identify ‘No-Go’ areas, where applicable
- Identification and assessment of the potential impacts of the proposed development on avifauna including cumulative impacts.
- Provision of sufficient mitigation measures to include in the Environmental Management Programme (EMPr).

- Conclusion with an impact statement whether the wind energy facility is fatally flawed or may be authorised.

4.4.Approach and Methodology

The following methods were used to compile this report:

- Bird distribution data of the Second Southern African Bird Atlas (SABAP2) was obtained from the University of Cape Town, to ascertain which species occur within the Broader Area of four pentad grid cells within which the proposed Project is located (**Figure 2**). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 9 km. From 2007–present, a total of 551 full protocol lists (i.e., surveys of at least two hours each) have been completed for this area. In addition, 133 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (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 (2022.2) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the PAOI was obtained from the First Atlas of Southern African Birds (SABAP1) (Harrison *et al*., 1997a, 1997b) and 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.
- 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 ©2023) was used to view the PAOI and Broader Area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Ralston-Paton *et al*., 2017; Retief *et al*., 2012).
- 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 as far as habitat classes and the occurrence of priority species are concerned was also considered.
- The following sources were used to determine the investigation protocol that is required for the site:
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
  - BirdLife South Africa's (BLSA) 'Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa' (Jenkins *et al*., 2015) – hereafter referred to as the 'Windfarm Guidelines' – were consulted to determine the level of survey effort that is required.
- The main source of information on the avifaunal diversity and abundance at the PAOI and Broader Area is an integrated pre-construction monitoring programme which was implemented at the Project Site during 2020 – 2022 over a period of four seasons. Four sets of surveys were conducted.

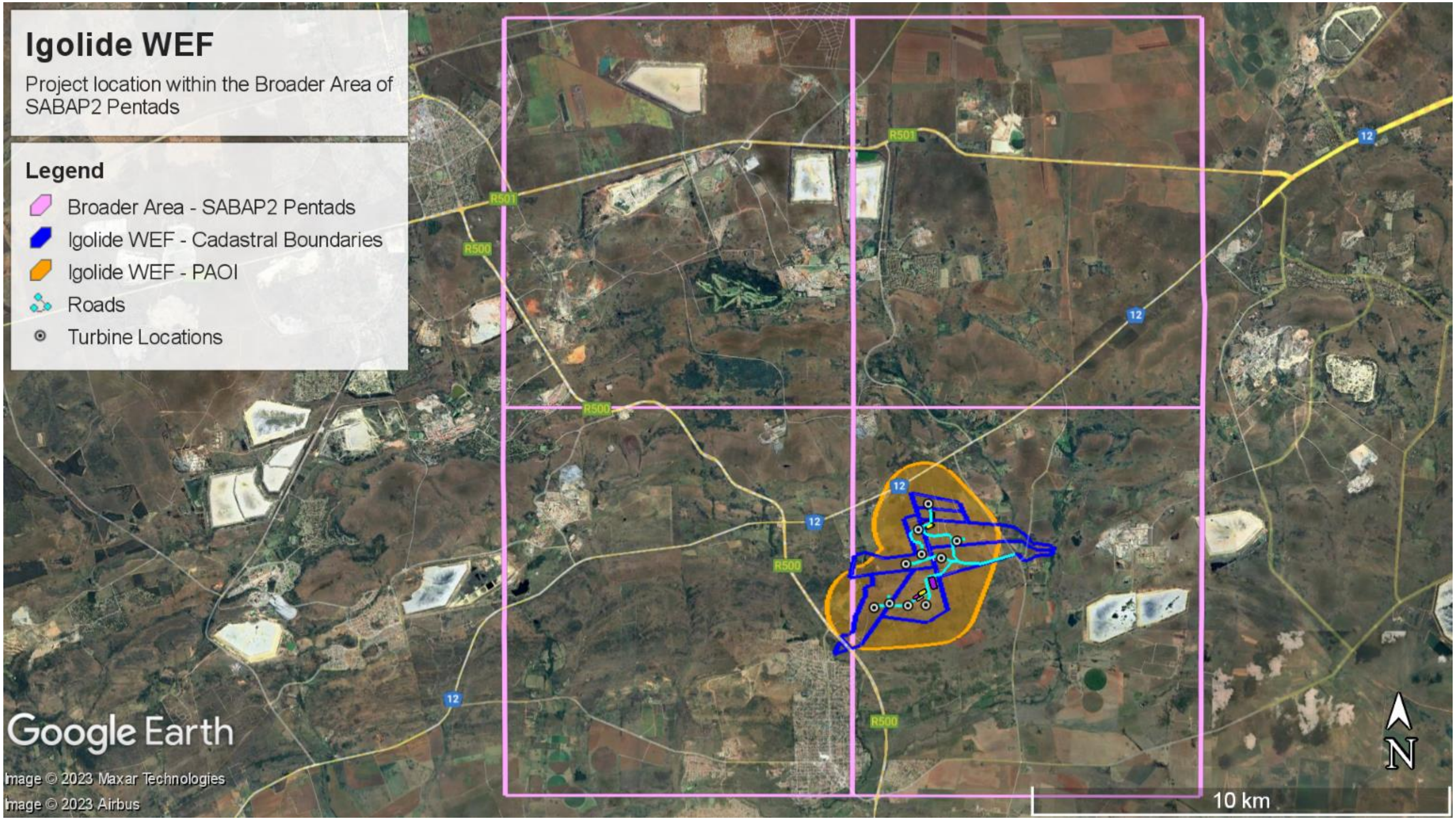

Figure 2: Project location of the four SABAP2 Pentads within the Broader Area.

4.5. Information Sources

The following data sources were used to compile this report:

Table 4: Data sources employed in the scoping report for the proposed Igolide WEF

Data / Information	Source	Date	Type	Description
South African Protected Areas Database (SAPAD)	Department of Forestry, Fisheries, and the Environment (DFFE)	2022, Q3	Spatial	Spatial delineation of protected areas in South Africa. Updated quarterly
First Atlas of Southern African Birds (SABAP1)	University of Cape Town	1987-1991	Spatial, reference	SABAP1, which took place from 1987-1991.
Southern African Bird Atlas Project 2 (SABAP2)	University of Cape Town	May 2023	Spatial, database	SABAP2 is the follow-up project to the SABAP1. The second bird atlas project started on 1 July 2007 and is still growing. The project aims to map the distribution and relative abundance of birds in southern Africa.
National Vegetation Map	South African National Biodiversity Institute (SANBI) (BGIS)	2018	Spatial	The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map, and sample the vegetation of South Africa, Lesotho, and Swaziland.
Red Data Book of Birds of South Africa, Lesotho, and Swaziland	BirdLife South Africa	2015	Reference	The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between BirdLife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI.
IUCN Red List of Threatened Species (2022.1)	IUCN	2022.1	Online reference source	Established in 1964, the International Union for Conservation of Nature's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.
Important Bird and Biodiversity Areas of South Africa	BirdLife South Africa	2015	Reference work	Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified nationally through multi-stakeholder processes using globally standardized, quantitative, and scientifically agreed criteria.
Strategic Environmental Assessment	Department of Environmental Affairs, 2015. Strategic	2015	SEA	The SEA identifies areas where large scale wind and solar energy facilities can be developed in terms

Data / Information	Source	Date	Type	Description
for wind and solar photovoltaic energy in South Africa	Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.			of Strategic Infrastructure Project (SIP) and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs).
The National Screening Tool	Department of Forestry, Fisheries and Environment	May 2023	Spatial	The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to apply for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.
National Protected Areas and National Protected Areas Expansion Strategy (NPAES)	DFFE	2016	Spatial	The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion.
Protocol for the specialist assessment and minimum report content requirements for environmental impacts om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).	NEMA	2020	Legislation	This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on avifaunal species associated with the development of onshore wind energy generation facilities, where the electricity output is 20 megawatts or more, which require environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations8
Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa (2015). Jenkins, A., van Rooyen, C. S., Smallie, J. J., Anderson, M. D., & Smit, A. H.	BirdLife South Africa	2015	Guidelines	These guidelines were developed to ensure that any negative impacts on threatened, or potentially threatened bird species are identified and effectively mitigated using structured, methodical. and scientific methods. The guidelines prescribe the best practice approach to gathering bird data at proposed utility-scale wind energy plants, primarily for the purposes of accurate and effective impact assessment.

Data / Information	Source	Date	Type	Description
Guidelines for the Implementation of the Terrestrial Flora & Terrestrial Fauna Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020)	South African National Biodiversity Institute (SANBI) (BGIS)	2022.v3.1	Guidelines	The purpose of the Species Environmental Assessment Guideline is to provide background and context to the assessment and minimum reporting criteria contained within the Terrestrial Animal and Plant Species Protocols; as well as to provide guidance on sampling and data collection methodologies for the different taxonomic groups that are represented in the respective protocols. This guideline is intended for specialist studies undertaken for activities that have triggered a listed and specified activity in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as identified by the EIA Regulations, 2014 (as amended) and Listing Notices 1-3.
Results of the pre-construction monitoring according to the best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa. Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015.	Chris van Rooyen Consulting	June 2020 – January 2022.		The data set consists of the results of the pre-construction monitoring conducted over four seasons between June 2020 and January 2022. Data was collected by means of transect counts, vantage point watches and focal point inspections

5. Description of Baseline Environment – including Sensitivity Mapping

5.1. Biomes and Vegetation Types

The PAOI is situated along an ecotone between the Savanna and Grassland Biomes but falls mainly within the Grassland Biome (Mucina & Rutherford 2006) (**Figure 3**). According to the 2018 SANBI Vegetation Map, the PAOI falls within the Central Bushveld Bioregion (northern half of PAOI) and the Mesic Highveld Grassland Bioregion (southern half of PAOI) (**Figure 4**). The natural vegetation at the PAOI consists predominantly of Gauteng Shale Mountain Bushveld and Rand Highveld Grassland.

The typical landscape associated with Rand Highveld Grassland is highly variable, containing extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes.

Most of the grasses on the plains belong to the genera *Themeda*, *Eragrostis*, *Heteropogon* and *Elionurus*. A high diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges consist of open woodlands with *Protea caffra* subsp. *caffra*, *Protea welwitschii*, *Senegalia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* is most prominent (Mucina and Rutherford 2006). The Gauteng Shale Mountain Bushveld is represented by woody vegetation and a grass dominated herbaceous layer. Depending on local conditions, trees form semi-open to closed thickets or woodlands, and can range from short deciduous bush cover to a medium-tall +5m tree cover of mostly *Senegalia sp.* and *Vachellia sp.* trees.

Fochville, which is the closest town to the PAOI, has a temperate climate. Summers are warm and winters are cold and dry. The mean annual rainfall is around 600–800 mm, most of which falls in the summer months. The mean annual temperature is around 20C° (Schulze, 2009).

The First Southern African Bird Atlas Project (SABAP1) recognises six primary vegetation divisions (biomes) within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. Using this classification system, the natural vegetation in the PAOI is classified as Grassland (Harrison *et al*. 1997).

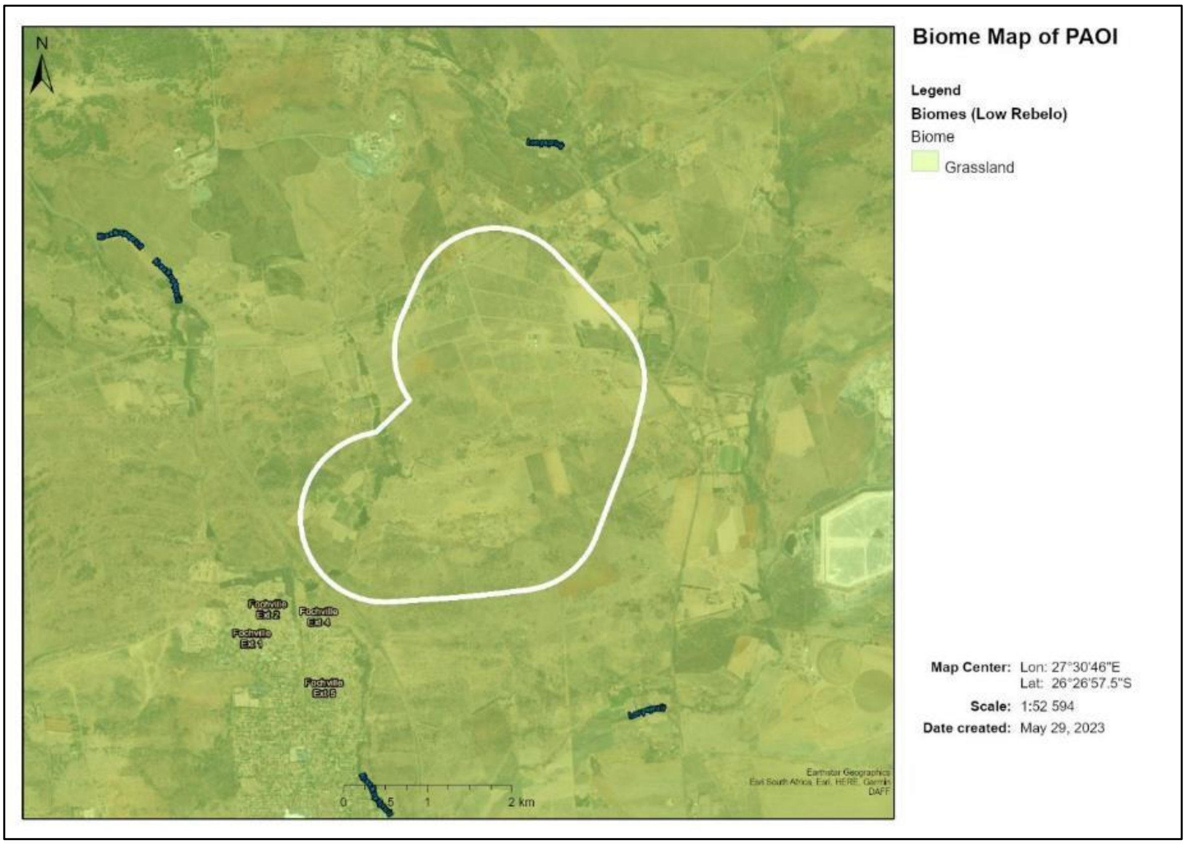

Figure 3: The Igolide WEF PAOI (outlined in white) falls within the Grassland Biome.

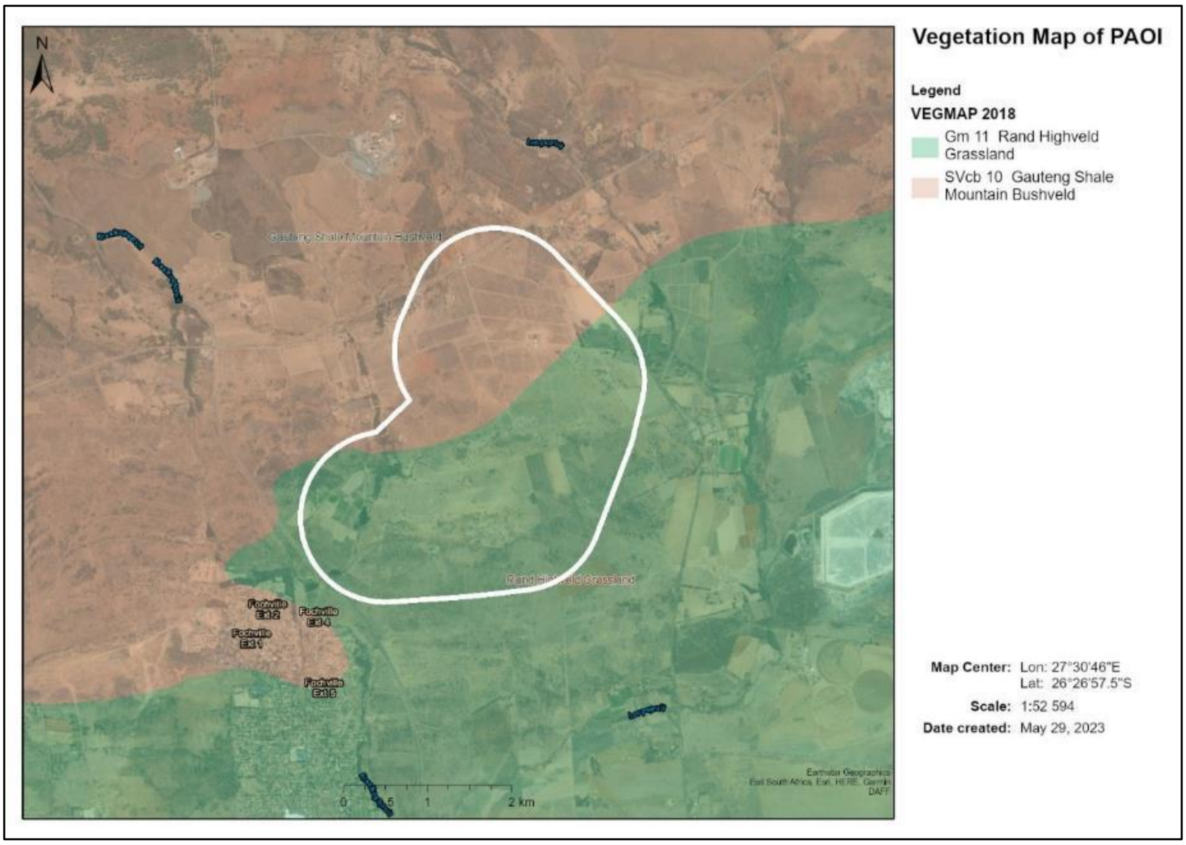

Figure 4: Vegetation Map of the Igolide WEF PAOI (outlined in white).

5.2. Habitat Classes and Land-use within the PAOI

The proposed Igolide WEF PAOI is situated on the gently undulating plains of the Gauteng Highveld countryside. The avian habitat features in the Igolide WEF were identified as:

(i) Natural Grassland
(ii) Disturbed Grassland (including fallow agriculture fields)
(iii) Open Woodland
(iv) Drainage Lines and Wetlands
(v) Dams
(vi) Agriculture
(vii) High Voltage Power lines

5.2.1. Natural Grassland

This habitat feature is described above under Section 5.1 (Figure 5).

Figure 5: Natural Grassland habitat at the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.2. Disturbed Grassland

The PAOI contains fallow land and old agricultural fields that have converted back to grassland. Vegetative composition is generally characterised by lower cover and is comprised of pioneer grass, forbs, and other herbaceous plant species. Avian use is generally limited to habitat generalist species.

Figure 6: Disturbed grassland habitat at the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.3. Open Woodland

The PAOI contains Gauteng Shale Mountain Bushveld which is represented by woody vegetation (trees and shrubs) and a grass-dominated herbaceous layer (**Figure 7**). Depending on local conditions, trees form semi-open to closed thickets or woodlands, and can range from short deciduous bush cover to a medium-tall *Senegalia sp.* and *Vachellia sp.* trees.

Figure 7: Open woodland habitat within the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.4. Drainage Lines and Wetlands

Drainage lines and wetlands are important habitats, especially for several priority species. Raptors may also use these areas to hunt other bird species and the African Grass Owl could potentially be attracted to some of the grass in the wetland areas. There are drainage lines with associated wetlands and farm dams that transect the PAOI. The Broader Area also contains several drainage lines, seeps, and wetlands (**Figure 8**).

Figure 8: Drainage line within the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.5. Dams

Surface water is important to several avifauna for drinking, bathing, and foraging. There are six dams located within the PAOI (**Figure 9**).

Figure 9: Large dam within the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.6. Agriculture

Agricultural activity present within the PAOI comprises cultivated commercial annuals crops (DEA & DALRRD, 2020), predominately dedicated towards planted pastures (**Figure 10**). Avian species richness in these areas is likely to be low. However, periods of ploughing, seeding, and harvesting are likely to create foraging opportunities for certain avian species.

Figure 10: Agricultural activities, cultivated land, within the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.2.7 High Voltage Power lines

High voltage power lines are present along the eastern border of the PAOI (**Figure 11**). Birds often use HV power lines as perching and/or roosting sites, and some birds may even construct their nests on HV power line structures (e.g., Pied Crow).

Figure 11: High voltage overhead power line within the PAOI.

Priority species that could utilise this habitat are listed in Table 5.

5.3. Protected areas in/around the PAOI

5.3.1. Important Bird Areas (IBAs)

The PAOI does not fall within an Important Bird Area (IBA). The closest IBA, the Suikerbosrand Nature Reserve (SA022), lies 63km east of the Igolide WEF PAOI. It is not expected that the avifauna in the Suikerbosrand Nature Reserve (SA022) will be impacted by the development due to the distance from the PAOI.

5.3.2. National Protected Areas and National Protected Areas Expansion Strategy (NPAES) Focus Areas

The PAOI does not fall within a protected area or an NPAES focus area.

5.3.3. The Renewable Energy Development Zones (REDZ)

The PAOI is not located in a REDZ.

5.4. Avifauna within the PAOI

A total of 307 species could potentially occur within the Broader Area where the Project Site is located (see **Appendix E**). Of these, 32 are classified as priority species for wind energy developments. Of these 32 priority species, 11 have a medium to high likelihood of occurring regularly in the Project Area of Influence (PAOI). Of the 32 priority species, 12 (37%) were recorded during the on-site field surveys. Ten (10) of the priority species recorded in the Broader Area are also Species of Conservation Concern (SCC). Two (2) SCC were recorded during the on-site surveys, namely Secretarybird (Globally Endangered and Regionally Vulnerable) and Lanner Falcon (Regionally Vulnerable). There is also confirmed habitat for the African Grass Owl (Regionally Vulnerable) within the PAOI.

See **Appendix E** for a list of species potentially occurring within the Broader Area. The likelihood of priority species occurring in the PAOI, habitat classes, and potential long-term impacts of the proposed WEF are listed in **Table 5** below.

Table 5: Priority species which could occur in the PAOI, habitat classes within the PAOI, and the potential impacts of the Igolide WEF on avifauna.

Global and Regional (South African) Red List status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least concern

Species name	Scientific name	SABAP2 Reporting Rate %		Global Conservation Status	Regional Conservation Status	Recorded during monitoring	Likelihood of regular occurrence at PAOI	Primary grassland	Secondary grassland	Open woodland	Drainage lines and wetlands	Dams	Agriculture	HV lines	Collision with turbines	Displacement - habitat transformation	Displacement - disturbance (breeding)	Electrocution MV lines	Collision powerlines
		Full protocol	Ad hoc protocol																
African Fish Eagle	*Haliaeetus vocifer*	1,45	0,75	-	-		M				x	x			x			x	
African Grass Owl	*Tyto capensis*	0,00	0,75	-	VU		L	x			x				x	x	x	x	x
African Harrier-Hawk	*Polyboroides typus*	0,73	0,75	-	-		L			x		x			x	x	x	x	
African Hawk-eagle	*Aquila spilogaster*	0,36	0,00	-	-		L			x		x			x	x		x	
Amur Falcon	*Falco amurensis*	1,63	2,26	-	-	x	M	x	x	x			x	x	x	x		x	
Black Harrier	*Circus maurus*	0,18	0,00	EN	EN		L	x							x	x		x	
Black Kite	*Milvus migrans*	0,00	0,75	-	-		L			x		x	x		x	x	x	x	
Black Sparrowhawk	*Accipiter melanoleucus*	1,45	0,00	-	-	x	M			x					x	x	x	x	
Black-chested Snake Eagle	*Circaetus pectoralis*	0,18	0,00	-	-		L	x	x	x		x	x	x	x	x	x	x	
Black-winged Kite	*Elanus caeruleus*	47,19	13,53	-	-	x	H	x	x	x			x	x	x	x	x	x	
Black-winged Pratincole	*Glareola nordmanni*	0,18	0,00	NT	NT		L	x	x		x		x		x				
Booted Eagle	*Hieraaetus pennatus*	0,36	0,75	-	-		L	x	x	x		x		x	x	x		x	
Cape Vulture	*Gyps coprotheres*	0,18	0,00	VU	EN		L	x	x	x		x		x	x	x		x	x
Common Buzzard	*Buteo buteo*	7,80	2,26	-	-	x	M	x	x	x		x	x	x	x	x		x	
Greater Flamingo	*Phoenicopterus roseus*	0,00	0,75	-	NT		L					x			x				x
Greater Kestrel	*Falco rupicoloides*	1,09	0,75	-	-		L	x	x					x	x	x	x	x	
Jackal Buzzard	*Buteo rufofuscus*	0,54	0,75	-	-		L	x	x	x		x	x	x	x	x	x	x	
Lanner Falcon	*Falco biarmicus*	0,36	0,75	-	VU	x	M	x	x	x		x	x	x	x	x	x	x	
Lesser Kestrel	*Falco naumanni*	1,27	0,00	-	-		L	x	x				x	x	x	x		x	
Long-crested Eagle	*Lophaetus occipitalis*	0,73	0,75	-	-		L	x		x		x		x	x	x	x	x	
Marsh Owl	*Asio capensis*	1,27	1,50	-	-	x	M	x			x				x	x	x	x	x

Species name	Scientific name	SABAP2 Reporting Rate %		Global Conservation Status	Regional Conservation Status	Recorded during monitoring	Likelihood of regular occurrence	Primary grassland	Secondary grassland	Open woodland	Drainage lines and wetlands	Dams	Agriculture	HV lines	Collision with turbines	Displacement - habitat	Displacement - disturbance	Electrocution MV lines	Collision powerlines
Martial Eagle	*Polemaetus bellicosus*	0,00	0,75	EN	EN		L	x	x	x		x		x	x	x		x	
Melodious Lark	*Mirafra cheniana*	0,18	0,75	-	-	x	L	x	x						x	x	x		
Northern Black Korhaan	*Afrotis afraoides*	54,08	4,51	-	-	x	H	x	x						x	x	x		x
Pale Chanting Goshawk	*Melierax canorus*	3,81	0,75	-	-	x	M	x	x	x		x		x	x	x	x	x	
Secretarybird	*Sagittarius serpentarius*	0,18	0,00	EN	VU	x	L	x	x	x		x			x	x	x		x
Spotted Eagle-Owl	*Bubo africanus*	11,98	0,75	-	-	x	H	x	x	x		x	x		x	x	x	x	x
Verreaux's Eagle	*Aquila verreauxii*	3,09	2,26	-	VU		L	x	x	x		x		x	x	x		x	
Verreaux's Eagle-Owl	*Bubo lacteus*	0,00	0,75	-	-		L			x		x			x	x	x	x	
Western Osprey	*Pandion haliaetus*	0,18	0,75	-	-		L					x			x			x	
White Stork	*Ciconia ciconia*	1,63	1,50	-	-	x	M	x	x				x		x	x			x
Yellow-billed Stork	*Mycteria ibis*	0,00	0,75	-	EN		L				x	x			x				x

5.5. Identification of Environmental Sensitivities

The PAOI and immediate environment is classified as **Medium Sensitivity** for bird species according to the Terrestrial Animal Species Theme (**Figure 12**). The Medium sensitivity classification is linked to the potential occurrence of African Grass Owl *Tyto capensis* (Regionally Vulnerable), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable). The PAOI contains confirmed habitat for Species of Conservation Concern (SCC), primarily for African Grass Owl and Secretarybird (Globally Endangered and Regionally Vulnerable), as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). During the on-site surveys, two SCC were recorded. These SCC were: Lanner Falcon (Regionally Vulnerable), and Secretarybird (Globally Endangered and Regionally Vulnerable).

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the PAOI, the classification of **High Sensitivity** for avifauna is advocated for the Igolide WEF.

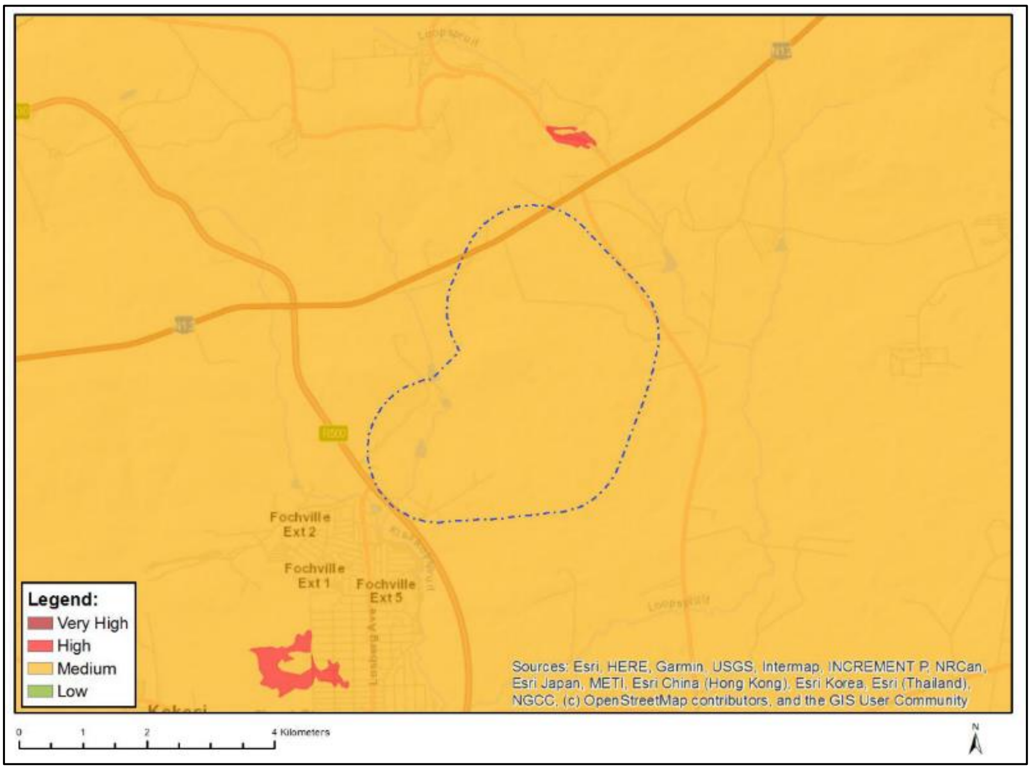

Figure 12: The National Web-Based Environmental Screening Tool map of the PAOI, indicating sensitivities for the Terrestrial Animal Species theme. The Medium sensitivity classification is linked to African Grass Owl *Tyto capensis*, White-bellied Bustard *Eupodotis senegalensis*, and Caspian Tern *Hydroprogne caspia*.

5.6. Specialist Sensitivity Analyses and Verification

5.6.1 Very High Sensitivity: All Infrastructure Exclusion Zone - No Go Areas

Included are areas that have been identified as suitable habitat for African Grass Owls (Regionally Vulnerable). Key wetlands used by African Grass Owl were identified from a presence locality dataset provided by Craig Whittington-Jones and supplemented with personal records of African Grass Owl breeding sites. Roadkill and marginal/stochastic sites were disregarded for this analysis, with an emphasis being placed on records noted as confirmed or suspected breeding sites, as well as sites noted to host the species consistently, but where breeding was unconfirmed. A systematic GIS grid was then used to generate positive training data samples from these sites representing suitable breeding wetlands for African Grass Owl. Please refer to **Appendix H** for a full description of the habitat suitability modelling methodology.

5.6.2. Very High Sensitivity: Turbine Exclusion Zone

Drainage lines, wetlands, dams: A wind turbine exclusion zone (including the rotor swept area) should be implemented within a 50m buffer around the centre line of the drainage lines, wetlands, and dams; and a 200m buffer around the identified African Grass Owl habitat. Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety of Species of Conservation Concern (SCC), most notably for African Grass Owl (Regionally Vulnerable), Greater Flamingo (Regionally Near Threatened), Maccoa Duck (Globally Vulnerable, Regionally Near Threatened), and Yellow-billed Stork (Regionally Endangered). These SCC have all been recorded in the Broader Area through the Southern African Bird Atlas Project (SABAP2). It should also be noted that any road and/or grid line crossings across these features should be restricted to what is unavoidable.

5.6.3. High Sensitivity: Limited Infrastructure Zone

High Sensitivity grassland: Natural grassland. Development in the remaining natural grassland in the PAOI must be limited as far as possible. Where possible, infrastructure must be located near margins, with the shortest routes taken from the existing roads. The grassland is a potential breeding, roosting and foraging habitat for a variety of SCC. These include African Grass Owl (Globally Least Concern, Regionally Vulnerable), and Secretarybird (Globally Endangered, Regionally Vulnerable).

Figure 13 below is a sensitivity map, indicating sensitivity areas identified for development.

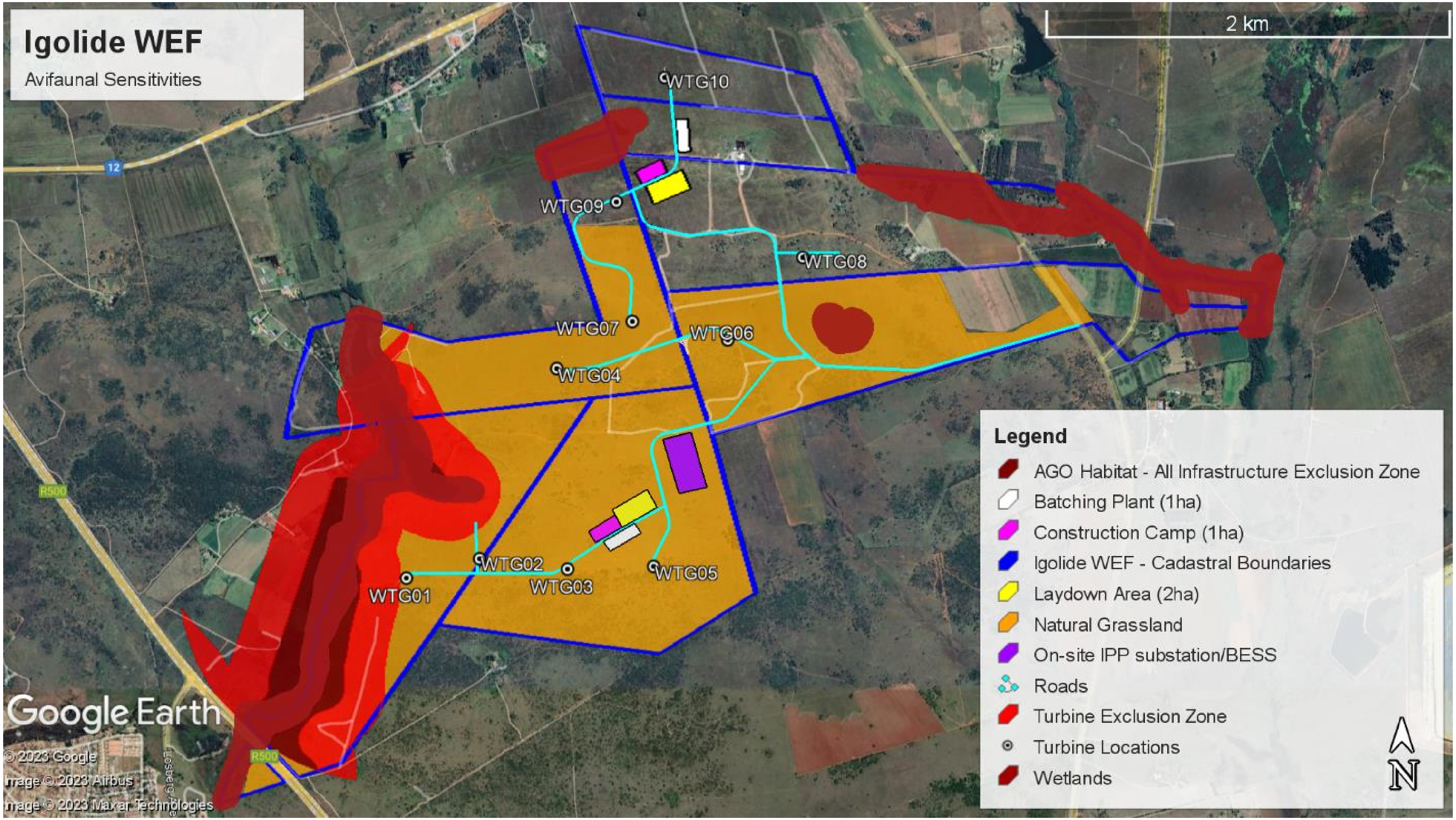

Figure 13: Avifaunal Sensitivities Map for the Igolide WEF. Wind turbine exclusion zones indicated in red.

5.7. Sensitivity Analysis Summary Statement

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the PAOI, a classification of **High sensitivity** for avifauna is suggested for the Igolide WEF.

5.8. Results of Pre-Construction Monitoring

The monitoring protocol for the WEF site was designed according to the following set of guidelines:

- Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa. Hereafter referred to as the wind guidelines.

The results of the pre-construction monitoring are detailed in the sections below. The monitoring surveys were conducted in the following periods:

- Survey 1: 21 – 26 June 2020
- Survey 2: 6 – 8 December 2020
- Survey 3: 5 – 9 July 2021
- Survey 4: 11 – 14 January 2022

Refer to **Appendix F** for details on the pre-construction monitoring protocol.

5.8.1 Transect Counts

The results of the transect counts in the Project Site are presented in **Table 6** below.

Table 6: Transect count results after four surveys.

Turbine Site	
Species Composition	
All Species	135
Priority Species	6 (4%)
Non-Priority Species	129
Total Count	
Drive Transect	3675
Walk Transect	1294
Grand Total	4969
Control Site	
Species Composition	
All Species	73
Priority Species	2 (3%)
Non-Priority Species	71
Total Count	
Drive Transect	1986
Grand Total	1986

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transects counts across all four seasons (**Figures 14 and 15**).

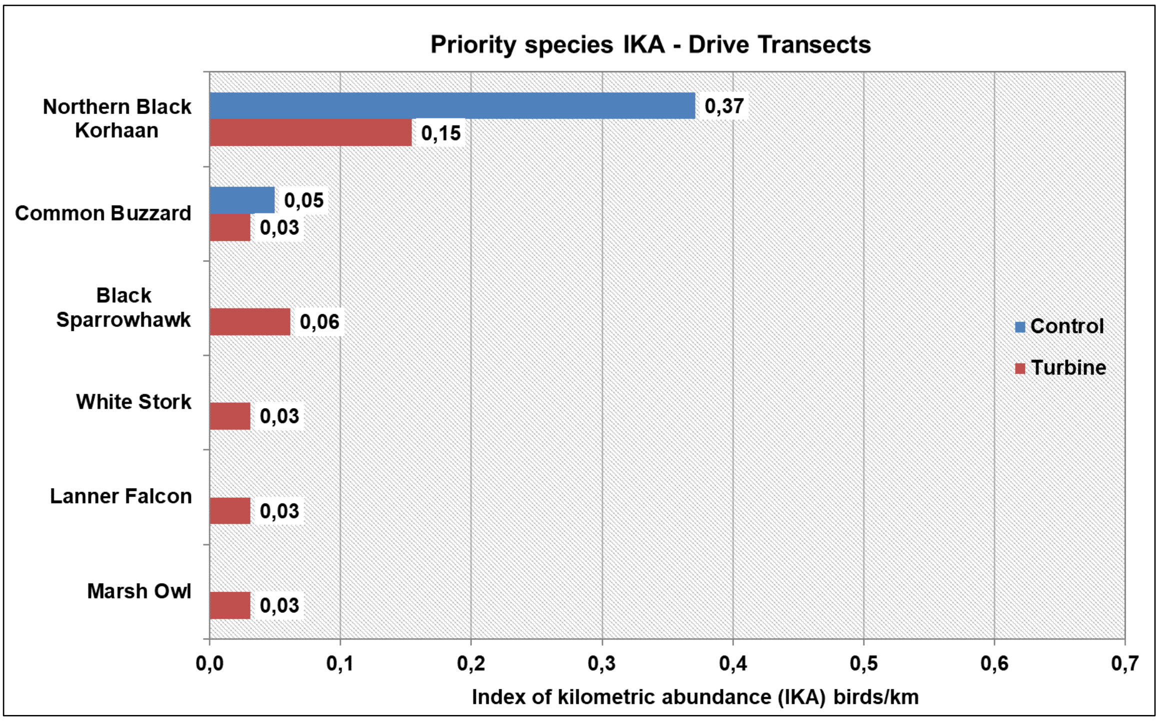

Figure 14: Index of kilometric abundance of priority species recorded at the WEF and control site during drive transect surveys across all four seasons.

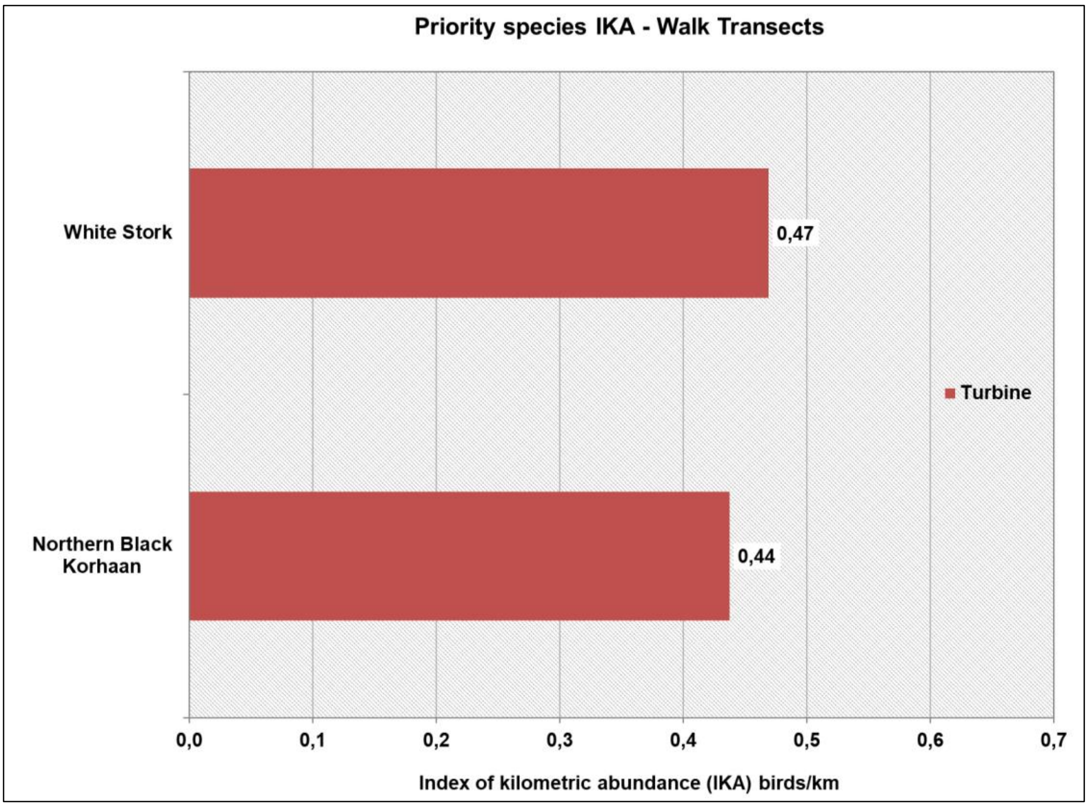

Figure 15: Index of kilometric abundance of priority species recorded at the WEF site during walk transect surveys across all four seasons.

5.8.2 Focal Points

A focal point (FP) for potential significant avifaunal concentration was identified - a dam in the stream located along the western boundary of the proposed development area. Bird presence and abundance were recorded at the focal point during each seasonal visit.

No priority species were recorded during the four surveys at the dam that served as a focal point.

5.8.3 Incidental Counts

Table 7 provides an overview of the incidental sightings of priority species recorded during the four surveys.

Table 7: Incidental Sightings of Priority Species.

Common Name	Scientific Name	V1	V2	V3	V4	Grand Total
Black Sparrowhawk	*Accipiter melanoleucus*	-	1	-	-	1
Black-winged Kite	*Elanus caeruleus*	-	-	1	-	1
Northern Black Korhaan	*Afrotis afraoides*	1	1	4	12	18
Spotted Eagle-Owl	*Bubo africanus*	1	-	-	-	1

5.8.4 Vantage Point Observations

A total of 48 hours of vantage point watches were completed at one vantage point (12 hours per survey) to record flight patterns of priority species at the Project Site. During the four survey periods the duration of priority species flights amounted to 35 minutes and 39 seconds. A total of 18 individual flights were recorded. The passage rate for priority species was 0.38 birds/hour[2]. This amounts to approximately 5 birds per day.[3] See **Figure 16** below for the duration and altitude of flights for each recorded priority species[4].

[2] A distinction was drawn between passages and flights. A passage may consist of several flights e.g., every time an individual bird changes height or mode of flight; this was recorded as an individual flight, although it still forms part of the same passage.
[3] Assuming 13 hours daylight averaged over all four seasons.
[4] Flight duration was calculated by multiplying the flight time with the number of individuals in the flight e.g., if the flight time was 30 seconds and it contained two individuals, the flight duration was 30 seconds x 2 = 60 seconds.

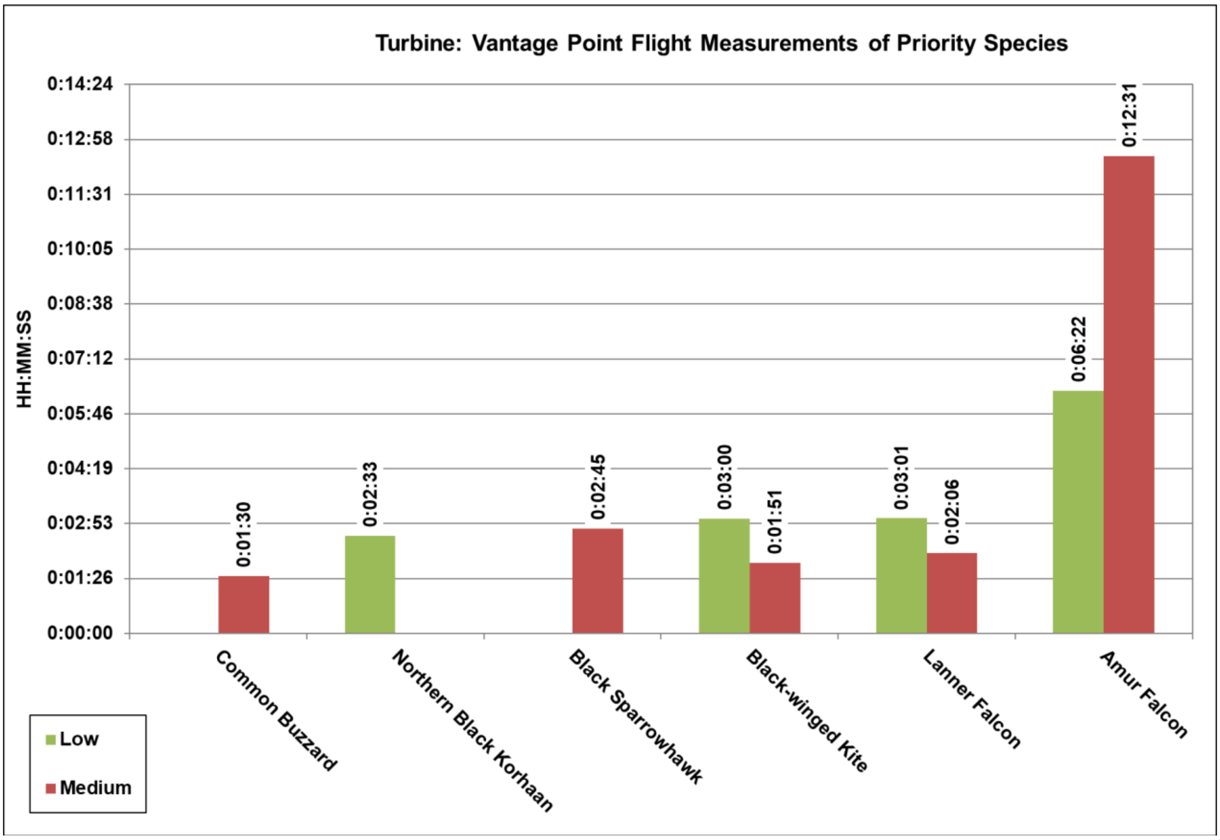

Figure 16: Flight durations and altitudes recorded for priority species at the Project Site after four surveys (48 hours of observation).

5.8.5 Site Specific Collision Risk Ratings

To determine which priority species are most at risk of turbine collisions, a site-specific rating was calculated. Values for each priority species was calculated considering the following factors:

- The duration of rotor altitude flights (medium height flights);
- The susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief et al., 2012); and
- The number of turbines.

The collision risk ratings provide an estimate of which of the species that were recorded on the proposed development site are most at risk of collisions with the turbines as a result of their size, behaviour and flight times recorded in the rotor blade zone. The formula used is as follows1:

Duration of rotor altitude flights (as a fraction of 24 hours) x collision ratings in the Avian Wind Farm Sensitivity Map x number of turbines ÷100.

The results are presented in Error! Reference source not found.**8** and Error! Reference source not found.**17** below.

Table 8: Site Specific Collision Risk Rating.

Species	Duration of All Flights (HH:MM: SS)	Collision Rating	# turbines	Risk Rating
Common Buzzard	0:01:30	75	10	0,01
Northern Black Korhaan	0:02:33	60	10	0,01
Black Sparrowhawk	0:02:45	55	10	0,01
Black-winged Kite	0:04:51	57	10	0,02
Lanner Falcon	0:05:07	85	10	0,03
Amur Falcon	0:18:53	75	10	0,10

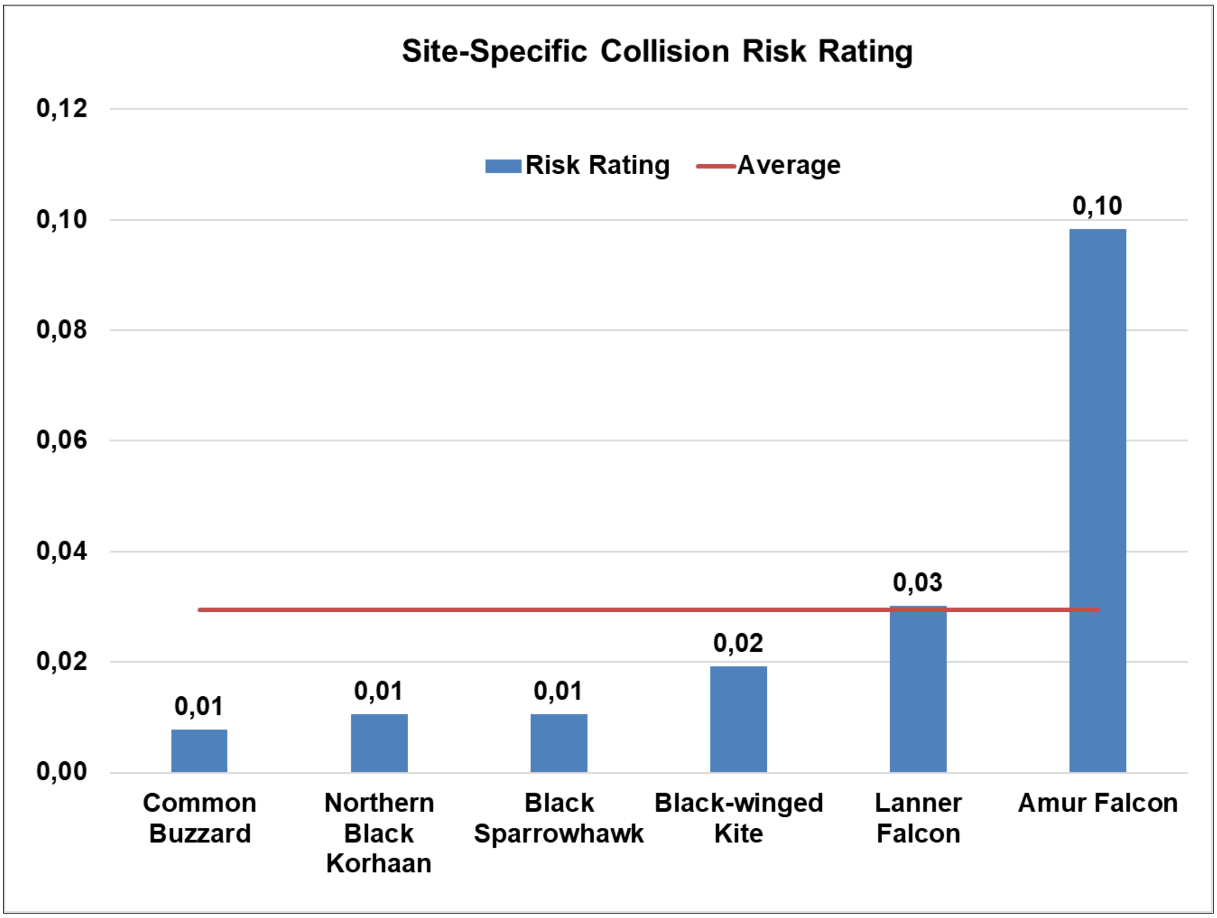

Figure 17: Site specific collision risk rating for priority species. The red line indicates the average collision risk rating for priority species at the Project Site, based on recorded flight behaviour after four surveys.

5.8.6 Flight Lines of Priority Species

Flight lines of priority species were recorded at the WEF site during Vantage Point watches for each of the four surveys. The recorded flight lines for priority species after four surveys are shown in **Figure 18.**

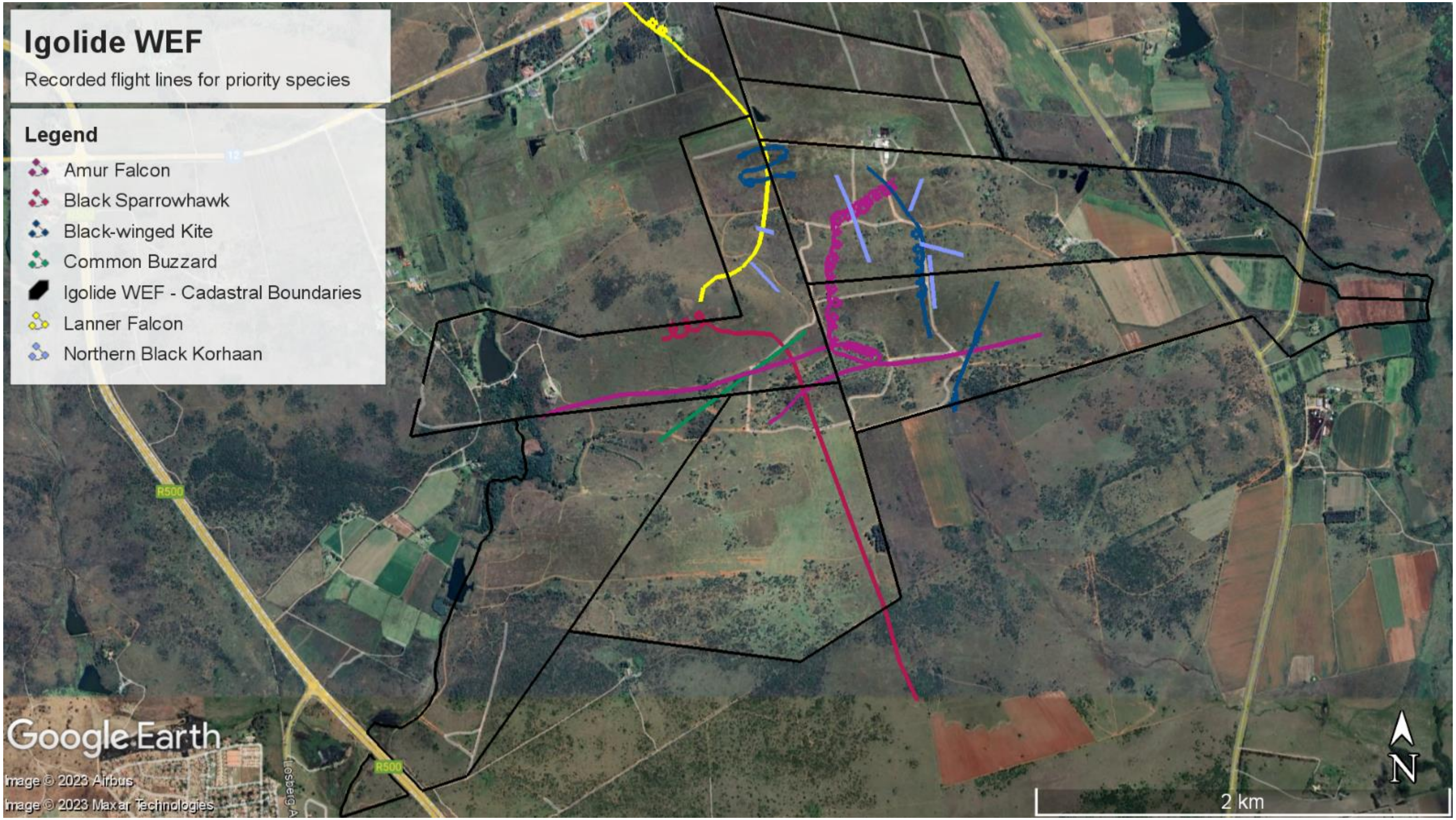

Figure 18: Recorded flight lines for priority species after four surveys.

6. Identification of Impacts

The potential impacts identified during the study are listed below.

6.1 Construction Phase

- Total or partial displacement due to noise disturbance and habitat transformation associated with the construction of the wind turbines and associated infrastructure.

6.2 Operational Phase

- Total or partial displacement due to habitat transformation associated with the presence of the wind turbines and associated infrastructure.
- Collisions with the wind turbines.
- Electrocutions at the on-site substation and on the overhead sections of the internal 33kV network.
- Collisions with overhead sections of the internal 33kV network.

6.3 Decommissioning Phase

- Total or displacement due to disturbance associated with the decommissioning of the wind turbines and associated infrastructure.

6.4 Cumulative Impacts

- Total or partial displacement due to disturbance and habitat transformation associated with the construction and decommissioning of the WEF and associated infrastructure.
- Total or partial displacement due to habitat transformation associated with the operation of the wind turbines.
- Collisions with the wind turbines.
- Electrocutions and collisions with the on-site substations and internal 33kV network.

7. Impact Assessment

The impacts wind farms have on bird populations are dependent upon a range of factors, including the specification of the development, the local/regional topography, the habitats affected, the abundance, species diversity, and characteristics of birds present.

Potential impacts can be:

- discrete – acting in isolation of other impacts (i.e., priority species response to wind farms are idiosyncratic).
- cumulative – exacerbating other the severity of other impacts (i.e., wind turbines and overhead power lines may pose similar collision risks to a given bird population).
- counter-active – reducing the severity of other impacts (i.e., bird population reduction through habitat loss lowers collision mortality rates)

The multi-faceted impacts that wind farms have on bird populations necessitates that new developments should be assessed on a case-by-case basis. The major concerns surrounding the impacts of wind farms on birds are detailed below:

- Mortality due to collisions with the wind turbines
- Displacement due to disturbance during construction and operation of the wind farm
- Displacement due to habitat change and loss at the wind farm
- Mortality due to electrocution and collisions with the medium voltage overhead lines

It should be noted that environmental impact assessments are localised to the present-day pre-construction conditions of a given development site. Impacts to the regional landscape are not considered as the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is, however, highly unlikely that the land use will change in the near future due to climatic limitations.

7.1. Construction Phase – displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general, it is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development site [Fox *et al*. (2006) as cited by Drewitt & Langston (2006)], with a further 3-14% of airspace altered by turbines (Marques *et al*., 2020). The effects of habitat loss could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat transformation following the development of the Altamont Pass Wind Farm in California led to increased mammal prey availability for some species of raptor, such as higher abundance of Pocket Gophers *Thomomys bottae* burrows around turbine bases), although this may also have increased collision risk [Thelander *et al*., (2003) as cited by Drewitt & Langston (2006)].

Despite overall habitat loss resulting from wind farm development being limited, the associated infrastructure such as roads and power lines fragment previously continuous tracts of habitat. Beyond the increased mortality risks to local bird populations posed by such infrastructure, the resulting habitat fragmentation can degrade adjacent habitats, potentially changing the way birds interact within the immediate environment (Fletcher et al., 2018). It remains disputed whether habitat fragmentation is always an environmental detriment (Fahrig et al., 2019), yet the effects of this landscape change have been observed in bird species vulnerable to wind farms. Lane et al. (2001) noted that Great Bustard *Otis tarda* flocks in Spain were significantly larger further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard *Neotis ludwigii* in South Africa generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes in South Africa select nesting sites away from roads.

The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab et al., 2011). It has been shown that fragmentation of natural grassland in Gauteng (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Allan et al., 1997).

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in **Table 10 in Section 7.8** below.

7.2. Operation Phase – total or partial displacement of avifauna due to habitat transformation associated with the operation of the wind turbines and associated infrastructure.

This impact relates to the total or partial displacement of avifauna due to habitat transformation associated with the presence of the horizontal-axis wind turbines and associated infrastructure. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

The displacement of birds away from areas in and around wind farms due to visual intrusion and airspace disturbance can be considered functional habitat loss. This disturbance can be detrimental to migratory bird population if wind farms disrupt migration routes (Marques et al., 2020, 2021).

The population displacement effect of wind turbines is observable across avian taxonomic orders and has been better studied in raptors (Accipitriformes and Falconiformes), land fowl (Galliformes), shorebirds (Charadriiformes), waterfowl (Anseriformes), and songbirds (Passeriformes) (Marques et al., 2021).

Three types of avoidance have been described (Cook et al., 2018; May, 2015):

- Macro-avoidance' or displacement, whereby the density of birds reduced around a wind farm due to long-term disturbance (Desholm & Kahlert, 2005; Furness et al., 2013; Plonczkier & Simms, 2012; Villegas-Patraca et al., 2014; Walker et al., 2005).
- 'Meso-avoidance' or anticipatory/evasion, whereby flying birds anticipate a perceived threat from a wind farm, or segments thereof and alter their fltheseaths to avoid theses threats (Desholm & Kahlert, 2005; Healy & Braithwaite, 2010; Mueller & Fagan, 2008)
- 'Micro-avoidance' or escape, whereby birds in close proximity to the rotor swept zone perform last-second evasion maneuvers, possibly reflexively, away from the rotors (Everaert, 2014; Frid & Dill, 2002; Mueller & Fagan, 2008).

This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (Scottish Natural Heritage, 2010).

Displacement may occur during both the construction and operation phases of wind farms, manifesting from turbines themselves through visual, noise and vibration impacts, as well as vehicle and personnel movements related to site construction and maintenance (Campedelli et al., 2014; May, 2015). Disturbance magnitude varies across sites and species, necessitating assessments on a site-by-site basis (Dohm et al., 2019; Drewitt & Langston, 2006). A recent meta-analysis study found that of long-term studies into avian displacement around wind farms found that half ~50% of studies reported limited displacement from wind turbines, 46%

reported a decrease in some bird populations, and 7.7% found an increased abundance of certain species around wind farms (Marques et al., 2021). Unfortunately, few studies provide comprehensive before- and-after and control-impact (BACI) assessments, limiting current insights.

The operational phase is thought to impose the greatest displacement threat to bird populations, although these impacts may be temporary (Dohm et al., 2019; Pearce-Higgins et al., 2012). Local raptor populations around wind farms may rebound within 7-8 years post-construction (Dohm et al., 2019). Bustards may retain high affinity for historic lek sites (courtship display areas) on wind farms, as has been document in Great Bustard in Spain (A. Camiña, *personal communications*, 17 November 2012) and Denham's Bustard in South Africa (Ralston-Paton et al., 2017). It should be noted that Great Bustard elsewhere in Europe can be displaced by 0.6km [Wurm & Kollar (2000), as quoated by Raab et al. (2009)] to 1km (Langgemach, 2008) of an operational wind farm, although Denham's Bustards populations do not appear to be displaced by wind farms in South Africa (Ralston-Paton et al., 2017). It should be noted that for raptors and large terrestrial species, site-fidelity and species longevity may mask short- and medium-term impacts that wind farms may have on these species, and that the true impact severity may only manifest in the long-term – such as through diminishing recruitment of new individuals over the course of multiple generations (Ferrer et al., 2012; Santos et al., 2020).

The limited research into shorter-lived bird species around wind farms may offer insights into the long-term response of birds more generally. Leddy et al., (1999) reported increased densities of breeding grassland passerines with increased distance (>80m) from wind turbines, and review study by (Hötker et al. (2006) found that the minimum avoidance distances of eleven breeding passerines species ranged 14–93m of wind turbines. However, Hale et al. (2014) and Stevens et al. (2013) found limited evidence for permanent displacement of grassland passerines in North America. Passerine resilience to wind farms is further observed in the UK in species such Skylark (despite some evidence of turbine avoidance) (Pearce-Higgins et al., 2012), and Thekla Lark populations in Southern Spain (Farfán et al., 2009). Across nine wind farms in Scotland, seven out of twelve bird species across a range of taxa exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with demonstrable turbine avoidance behaviour in a further two species (Pearce-Higgins et al., 2009). No species preferentially occurred close to the turbines, and breeding pair densities decreased 15-53% within 500m of wind turbines for several species. Follow-up monitoring reported breeding densities of certain species (such as Red Grouse) recovered post-construction, whereas others (such as Snipe and Curlew) did not. Conversely, breeding densities of certain species (such as Skylark and Stonechat) increased on wind farms during construction.

Species response to wind farm construction and operation appears highly idiosyncratic, and although the local populations of many bird species may recover, the long-term impacts of wind farms on bird populations remains to be better elucidated.

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at the end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and highly likely probability, which will render the impact significance as high without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to moderate.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in Table 10 in Section 7.8 below.

7.3. Operation Phase – bird mortality and injury from collisions with the wind turbines[5]

This impact relates to bird mortalities because of potential collisions with the wind turbines. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur et al., 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a major ecological drawback to wind energy (Drewitt & Langston, 2006).

Collisions with wind turbines kill fewer birds than collisions with other man-made infrastructure, such as power lines, buildings, or even traffic (Erickson et al., 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0-40 deaths per turbine per year (Sovacool, 2013). Bird mortality rates vary across sites, as do the number of sensitive bird species impacted (Hull et al., 2013; May, 2015). Estimated mortalities are likely lower than the true number of bird deaths from wind farm infrastructure, given that studies may fail to account for detection biases caused by scavenging, search efficiency and search radius (Bernardino et al., 2013; Erickson et al., 2005; Huso et al., 2015, 2021). Additionally, even for low mortality rates, collisions with wind turbines may disproportionately affect certain species. For long-lived species with low reproductivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (Carrete et al., 2009; De Lucas et al., 2008; Drewitt & Langston, 2006). The situation is even more critical for species of conservation concern and those with restricted distributions, which sometimes are most at risk (Osborn et al., 1998).

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[5] This section is based largely on a (2014) review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira, Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. *Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies*. Biological Conservation 179 (2014) 40– 52.

High bird mortality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles *Aquila chrysaetos*, Tarifa in Southern Spain for Griffon vultures *Gyps fulvus*, Smøla in Norway for White-tailed eagles *Haliaatus albicilla*, and the port of Zeebrugge in Belgium for *Larus* gulls and *Sterna* terns (Barrios & Rodríguez, 2004; Drewitt & Langston, 2006; Huso et al., 2015; Stienen et al., 2008; Thelander et al., 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for many fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull et al., 2013; Marques et al., 2014) An understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures. In southern Africa, vultures – followed by larger eagle species – are highlighted as being especially susceptible to collisions with wind turbines (McClure et al., 2021).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and highly likely probability, which will render the impact significance as high without the implementation of mitigation measures. The impact will be reduced to low with the implementation of mitigation measures. The severity of impact for this risk will vary according to species- and site-specific factors, as detailed in Sections 6.5.1 and Sections 6.5.2.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in Table 10 in Section 7.8 below.

7.3.1 Species-specific Factors

- ***Morphological Features***

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. Janss (2000) identified weight, wing length, tail length and total bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wingspan squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas et al., 2008; Herrera-Alsina et al., 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture *Gyps fulvus*, seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards *Buteo buteo* and Short-toed Eagles *Circaetus gallicus*, and this pattern is not related with their local abundance (Barrios

& Rodríguez, 2004; De Lucas et al., 2008). High wing-loading is associated with low flight maneuverability (De Lucas et al., 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

Information on the wing loading of the priority species potentially occurring regularly at the Igolide Wind Energy Facility was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that regularly occurring priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are korhaans, making them less maneuverable (Keskin et al., 2019).

- ***Visual Perception***

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt & Langston, 2006; Erickson et al., 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Guichard, 2017; Krijgsveld et al., 2009; May et al., 2015; Mitkus et al., 2018). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin et al., 2010; McIsaac, 2001; Mitkus et al., 2018). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin et al., 2010, 2012; Mitkus et al., 2018). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps spp.) cranes and bustards (Martin, 2011; Martin et al., 2010, 2012; Martin & Katzir, 1999). Furthermore, for some species, their high-resolution vision areas are often found in the lateral fields of view, rather than frontally (Martin, 2011; Martin et al., 2010, 2012; O'Rourke et al., 2010; Päckert et al., 2012). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin et al., 2010).

Some of the regularly occurring priority species at the Project Site have high-resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the korhaans and storks. The exceptions to this are the priority raptors which all have wider binocular fields, although as pointed out by Martin et al. (2010), this does not necessarily result in these species being able to avoid obstacles better.

- ***Phenology***

Turbine collision mortalities within raptors may be higher for resident than for migratory birds of the same species/taxon group. This disparity is possible due to resident birds frequenting areas occupied by wind farms more readily that migratory birds, which typically cross these wind farms *en route* to destinations further afield (Krijgsveld et al., 2009). However, factors like bird behaviour remain relevant. Katzner et al. (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes.

South Africa is at the end of the migration path for summer migrants; therefore, the phenomenon of migratory flyways where birds are concentrated in large numbers for a limited period (Martín et al., 2018), such as the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the landscape. The migratory priority species which could occur regularly at the PAOI with some regularity (e.g., Amur Falcon, Common Buzzard, White Stork) will behave much the same as the resident birds once they arrive in the area.

- ***Bird Behaviour***

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight (hanging in the wind with almost motionless wings), which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed Hawks *Buteo jamaicensis* at APWRA, California (Hoover & Morrison, 2005), and could also be a factor in contributing to the high collision rate for Jackal Buzzards in South Africa (Ralston-Patton & Camagu, 2019). The hovering behaviour exhibited by Common Kestrels *Falco tinnunculus* when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios & Rodríguez, 2004). This may also explain the high mortality rate of Rock Kestrels *Falco rupicolus* at wind farms in South Africa (Ralston-Patton & Camagu, 2019). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird’s position (Hoover & Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld et al., 2009; Smallwood et al., 2009). In the case of raptors, aggressive interactions may play an important role in turbine fatalities, in that birds involved in these interactions are momentarily distracted, putting them at risk. At least one eye-witness account of a Martial Eagle getting killed by a turbine in South Africa in this fashion is on record (Simmons & Martins, 2016).

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (Carrete et al., 2012; Janss, 2000), and territoriality and courtship displays may override aversion to wind turbines (Walker et al., 2005). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña, personal communications, 12 April 21012). Similarly, in South Africa, very few bustard collisions with wind turbines have been reported to date, all Ludwig's Bustards (Ralston-Patton & Camagu, 2019). No Denham's Bustards *Neotis denhami* turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

Relative to this wind farm, flocking behavior (Amur Falcon) and display activity (Northern Black Korhaan) could place these species at risk of turbine collisions.

- ***Avoidance Behaviour***

See Section 6.4. for further details on avoidance behaviour.

It is anticipated that most birds at the PAOI will avoid the wind turbines, as is generally the case at all wind farms (Scottish Natural Heritage, 2010). Exceptions already mentioned are raptors that engage in hunting behaviour which may serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and intraspecific aggressive interaction. It is unlikely that the entire regional/local population of each priority species present around the proposed WEF will engage in complete meso- and macro-avoidance strategies of the wind energy infrastructure.

- ***Bird Abundance***

Some authors suggest that fatality rates are related to bird abundance, density, or site utilization rates (Carrete et al., 2012; Kitano & Shiraki, 2013; Smallwood & Karas, 2009), while others highlight as birds utilize territories in non-random ways, and so mortality rates do not depend on bird abundance alone (Ferrer et al., 2012; Hull et al., 2013). Instead, fatality rates depend on other factors such as discriminatory use of specific areas within a wind farm (De Lucas et al., 2008). For example, at Smøla, Norway, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl et al., 2013). In the APWRA, California, Golden Eagles, Red-tailed Hawks and American Kestrels *Falco spaverius* have higher collision fatality rates than Turkey Vultures *Cathartes aura* and Common Raven *Corvus corax*, even though the latter are more abundant in the area (Smallwood et al., 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas et al., 2008). Should there be good rainfall at the site; flocks of Amur Falcon could be expected at the site, which may heighten the risk of collisions.

7.3.2. Site-specific Factors

- ***Landscape Features***

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly. Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios & Rodríguez, 2004; Drewitt & Langston, 2008; Healy & Braithwaite, 2010; Katzner et al., 2012; Thelander et al., 2003). In South Africa, Verreaux's Eagle *Aquila verreauxii* is expected to incur higher fatality rates from at higher elevations and along steeper slopes (Murgatroyd et al., 2021). In Lesotho, Bearded Vultures *Gypaetus barbatus* preferentially forage upper mountain slopes and high ridges which are favourable sites for wind turbine construction (Rushworth & Krüger, 2014).

In APWRA, California, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander et al., 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano & Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

Landscape features are unlikely to play a significant role at the Igolide WEF site as the proposed development is located on a flat area.

- ***Flight Paths***

The foraging behaviour of breeding, or otherwise territorial, raptors is often constrained to the vicinity nearest to the nest/home range (Watson et al., 2018). For example, in Scotland 98% of Golden Eagle *Aquila chrysaetos* movements were registered at ranges less than 6 km from the nest, and the core areas were located within a 2-3 km radius (McGrady et al., 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas close to ridges, can be used to predict the areas used by the species to forage (McLeod et al., 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright et al., 2006, 2008).

There are relatively few telemetry studies the foraging behaviour of breeding raptors in South Africa. Breeding Verreaux's Eagles largely forage within 3.7km of their nest (Brink, 2020), with turbine collision risk potential falling substantially further away from the nest, becoming a negligible concern after 8km (Murgatroyd et al., 2021). Breeding African Crowned Eagles demonstrate more restrictive foraging behaviour largely confined to 1.62km of their nest, whereas breeding Martial Eagle *Polemaetus bellicosus* forage generally forage within 5.39km of their nests (Brink, 2020). Male Black Sparrowhawks *Accipiter* *melanoleucus* have been observed to display year-round territoriality, mostly foraging within 2.27 (breeding) and 2.43km (non-breeding) of the nest (Brink, 2020; Sumasgutner et al., 2016). The home range size for foraging female Long-crested Eagles *Lophaetus occipitalis* in KwaZulu-Natal undergo substantial contractions to within a close vicinity of the nest (<25ha for one observed female) during the breeding season (Maphalala et al., 2020). Breeding Black Harrier *Circus maurus* pairs forage further afield (within 7.1–33.4km of their nests) (Garcia-Heras et al., 2019), as do Bearded Vultures (10km of their nests), and especially Lappet-faced Vultures (110.98km of their nest) (Brink, 2020).

No raptor nests have been recorded prior to, or during Site Sensitivity Verification field surveys. The most likely flight concentration of priority species at the proposed WEF site would be associated with drainage lines, wetlands, and dams.

- ***Food Availability***

Factors that increase the use of a certain area or that attract birds, like food availability; also play a role in collision risk. For example, the high density of raptors at the APWRA, California, and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover & Morrison, 2005; Smallwood et al., 2009). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld et al., 2009; Smallwood et al., 2009). It is suggested that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the availability of food (Smallie, 2015).

Depending on the availability of insect prey in the natural grassland at the proposed Igolide WEF site, flocks of Amur Falcons and White Stork of varying sizes might be present in the summer months.

7.4. Operation Phase – electrocution of priority species in the on-site substations and internal 33kV network

This impact deals with the potential electrocution of priority species in the on-site substations and any overhead sections of the 33kV power lines. This impact is rated as negative, with a local spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

Electrocution refers to instances where birds perch, or attempt to perch, upon electrical structure in a manner that physically bridges the air gap between live components and/or live and earthed components, causing a fatal electrical short circuit through the birds (Bevanger, 1994; van Rooyen, 2000). The electrocution risk is largely determined by the design of the electrical hardware, with medium voltage electricity poles posing a potential electrocution risk to raptors (Cole & Dahl, 2013; Haas et al., 2006; Loss et al., 2014).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence but unlikely probability, which will result in an impact significance of moderate, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e., reactive insulation of electrical hardware), the significance of the impact is reduced to very low.

The raptors that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in Table 10 in Section 7.8 below.

7.5. Operation Phase – collision of priority species with the internal 33kV network

A related concern to that addressed in Section 6.6 is bird collisions with medium voltage overhead power lines. Overhead line collisions are arguably the greatest threat posed by overhead 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 (Shaw et al., 2010; van Rooyen, 2004). These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (van Rooyen, 2004).

Power line collisions are generally accepted as a key threat to bustards (Barrientos et al., 2012; Jenkins et al., 2010; Raab et al., 2009, 2011; Shaw, 2013). In one study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw, 2013). Ludwig’s Bustard *Neotis ludwigii* was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig’s Bustard population, with Kori Bustards *Ardeotis kori* also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan *Eupodotis vigorsii* was also recorded, but to a much lesser extent than Ludwig’s Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw, 2013).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo (Shaw et al., 2018). Marking was highly effective for Blue Cranes *Grus paradisea*, 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., 2018).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence but unlikely probability, which will result in an impact significance of moderate, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e., marking of line with bird flight diverters), the significance of the impact is reduced to low.

The species that could be most affected by this impact are listed in **Table 5**. The recommended mitigation measures are detailed in **Table 10 in Section 7.8** below.

7.6. Decommissioning Phase - displacement due to disturbance associated with the decommissioning of the wind turbines and associated infrastructure.

The noise and movement associated with the potential decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and highly likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low.

The species that could be most affected by this impact are listed in **Table 5**. The recommended mitigation measures are detailed in **Table 10 in Section 7.8** below.

7.7. Cumulative Impacts

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy projects within a 30 km radius that have received an EA at the time of starting the environmental impact process, as well as the proposed Igolide WEF Project. There is currently only one (1) renewable energy project authorised within a 30 km radius of the proposed Igolide WEF. This project was identified using the DFFE’s Renewable Energy EIA Application Database for South Africa (2023, Q1) in conjunction with information provided by Independent Power Producers (IPPs) operating in the broader region. It should be noted that this list is based on information available at the time of writing this report and as such there may be other renewable energy projects proposed within the 30 km radius. The localities of renewable projects (affected properties) which are authorised are displayed in **Figure 19**.

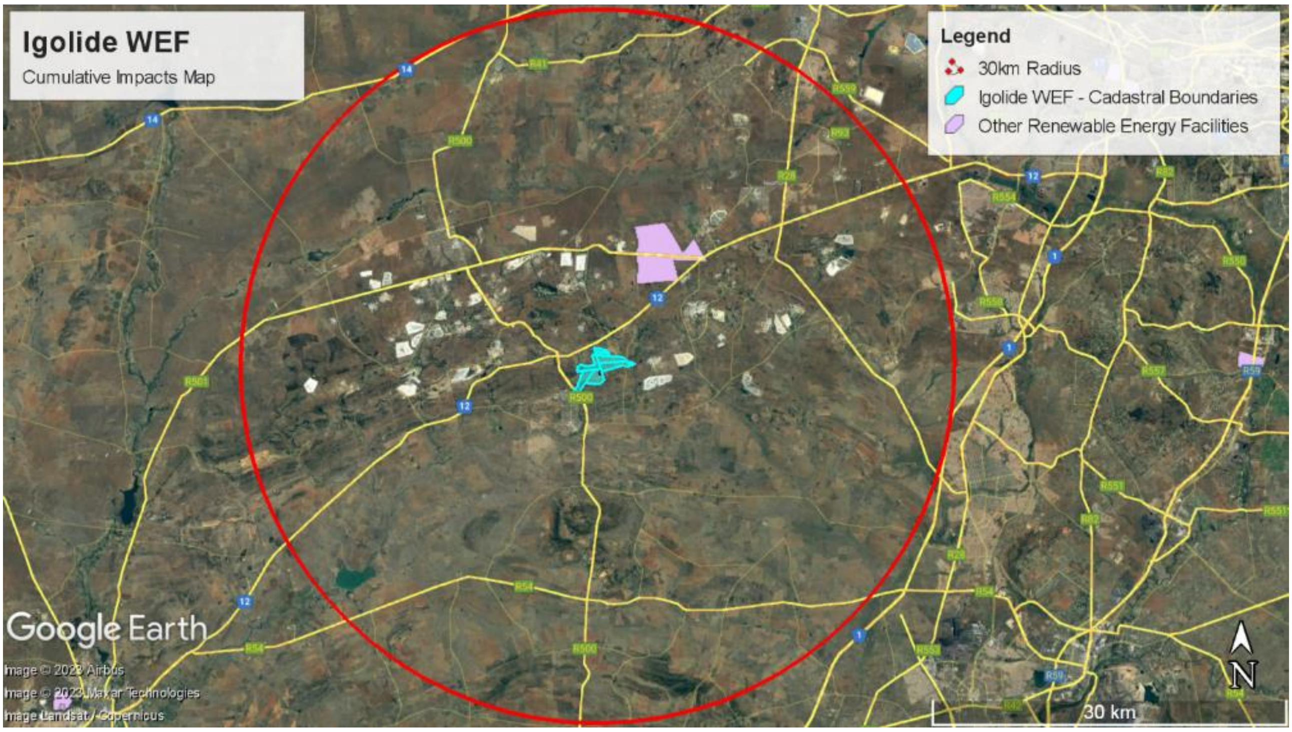

Figure 19: Regional EA applications for renewable energy projects located within a 30 km radius of the proposed Igolide WEF (Source: DFFE – Q1, 2023).

The total affected land parcel area taken up by other authorised renewable energy projects within a 30 km radius is approximately 19 km² (1900 ha). The total land parcel area affected by the Igolide Wind Energy Facility equates to approximately 6.8 km² (680 ha). The combined land parcel area affected by authorised renewable energy developments within a 30 km radius of similar habitat around the proposed Igolide Wind Energy Facility, inclusive of the Igolide Wind Energy Facility, thus equals approximately 25.8 km² (2580 ha). Of this, the proposed Igolide WEF project constitutes ~26%. The cumulative impact of the proposed Igolide WEF is thus anticipated to be **low to moderate** after mitigation.

The total area within a 30km radius around the proposed projects equates to about 2827.4 km² of similar habitat. The total combined size of the land parcels potentially affected by renewable energy projects will equate to ~0.9% of the available habitat in a 30km radius. The actual physical footprint of the renewable energy facilities will be smaller than the land parcel areas themselves. Furthermore, each of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction. The cumulative impact of all the proposed renewable energy projects is estimated to be **low to moderate**.

7.8. Environmental Impact Scores and Impact Mitigation Recommendations

Assessment scores of expected environmental impacts from the proposed Igolide WEF within the PAOI are detailed below in **Table 9.**

Mitigation recommendations for each expected environmental impact are detailed below in **Table 10**.

Table 9: Assessment of pre-mitigation environmental impacts of the Igolide WEF during construction, operation, and decommissioning phases

Phase	Impact	Consequence	Status	Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Occurrence Probability (P)	Impact Significance (S)
Construction	Noise pollution and environmental disruption from construction activity	Displacement of priority species from breeding/feeding/roosting areas	Negative (-ve)	High (4)	Site only (1)	Recoverable (3)	Short-term 0-5 years (2)	Definite (5)	Moderate (50)
Operation	Habitat transformation resulting from the wind turbines and associated infrastructure	Displacement of priority species from breeding/feeding/roosting areas	Negative (-ve)	Medium (3)	Local (2)	Reversible (1)	Long term Project life (4)	Highly probable (4)	Moderate (40)
Operation	Bird mortality and injury resulting from collisions with the wind turbines.	Population reduction of priority species	Negative (-ve)	Medium (3)	International (migrants) (5)	Reversible (1)	Long term Project life (4)	Highly probable (4)	Moderate (52)
Operation	Electrocution of priority species on the on-site sub-stations and internal 33kV network.	Population reduction of priority species	Negative (-ve)	Medium (3)	International (migrants) (5)	Reversible (1)	Long term Project life (4)	Highly probable (4)	Moderate (52)
Operation	Collisions of priority species with the internal 33kV network.	Population reduction of priority species	Negative (-ve)	Medium (3)	International (migrants) (5)	Reversible (1)	Long term Project life (4)	Highly probable (4)	Moderate (52)
Decommission	Noise pollution and environmental disruption during the decommissioning phase.	Total/partial displacement of priority species from breeding/feeding/roosting areas	Negative (-ve)	High (4)	Site only (1)	Recoverable (3)	Short-term 0-5 years (2)	Definite (5)	Moderate (50)

Table 10: Proposed mitigation measures for the environmental disturbances identified in Table 9.

<table>
<tr><th>Phase</th><th>Impact</th><th>Consequence</th><th>Initial impact score</th><th>Post-mitigation impact score</th><th>Mitigation Measures</th><th>Confidence level</th></tr>
<tr><td rowspan="6">Construction</td><td rowspan="6">Noise pollution and habitat loss during construction</td><td rowspan="6">Total/partial displacement of priority species from breeding/feeding/ roosting areas</td><td rowspan="6">Moderate</td><td rowspan="6">Low</td><td>No turbines should be constructed in the turbine exclusion buffer zones as indicated in the sensitivity map in Figure 13.</td><td rowspan="6">High</td></tr>
<tr><td>Restrict construction to the immediate infrastructural footprint. Access to remaining areas should be strictly controlled to minimise disturbance of priority species. This recommendation especially applies within the very high and high sensitivity areas depicted in the sensitivity map in Figure 13 (Section 5.6).</td></tr>
<tr><td>Minimise removal of natural vegetation and rehabilitate natural vegetation post-construction where possible.</td></tr>
<tr><td>Prioritise upgrading existing roads (where the requisite roads authority permission has been issued) over constructing new roads.</td></tr>
<tr><td>Apply noise and dust control measures according to best practice in the industry</td></tr>
<tr><td>Strictly implement the recommendations of ecological and botanical specialists to reduce the level of habitat loss.</td></tr>
<tr><td rowspan="2">Operation</td><td rowspan="2">Habitat transformation resulting from the wind turbines and associated infrastructure</td><td rowspan="2">Total/partial displacement of priority species from breeding/feeding/ roosting areas</td><td rowspan="2">Moderate</td><td rowspan="2">Low</td><td>No turbines should be constructed in the turbine exclusion buffer zones as indicated in the sensitivity map in Figure 13.</td><td rowspan="2">High</td></tr>
<tr><td>Restrict construction to the immediate infrastructural footprint where possible. Access to remaining areas should be strictly controlled to minimise disturbance of priority species. This recommendation especially applies within the very high and high sensitivity areas depicted in the sensitivity map in Figure 13.</td></tr>
</table>

Phase	Impact	Consequence	Initial impact score	Post-mitigation impact score	Mitigation Measures	Confidence level
					Once operational, vehicle and pedestrian access to the site should be controlled and restricted to the facility footprint as much as possible to prevent unnecessary destruction of vegetation.	
					Formal live-bird monitoring should commence following initial turbine operation, as per the Best Practice Guidelines (Jenkins et al. 2015), to determine the extent to which priority species displacement has occurred. Operational monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated every five years thereafter for the operational lifetime of the facility.	
Operation	Bird mortality and injury resulting from collisions with the wind turbines.	Population reduction of priority species	Moderate	Low	No turbines should be constructed in the turbine exclusion buffer zones as indicated in the sensitivity map in **Figure 13**.	High
					Formal live-bird monitoring and carcass searches should be conducted in the operational phase, as per the Best Practice Guidelines at the time (Jenkins et al. 2015) to assess collision rates.	
					If estimated annual collision rates indicate unacceptable mortality levels of priority species exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts (e.g., BLSA), additional measures must be implemented, such as shut down on demand or other proven measures (if available at the time).	
Operation	Electrocution of	Population	Moderate	Low	Use underground cabling as much as is practically possible.	High

Phase	Impact	Consequence	Initial impact score	Post-mitigation impact score	Mitigation Measures	Confidence level
	priority species on the on-site sub-stations and internal 33kV network.	reduction of priority species			Where the use of overhead lines is unavoidable, raptor-friendly pole design should be used, with appropriate mitigation measures for complicated pole structures (e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformer), as recommended by the Avifaunal Specialist. Apply insulation reactively in the substation if significant electrocutions of SCC are recorded.	
Operation	Collisions of priority species with the internal 33kV network.	Population reduction of priority species	Moderate	Low	Use underground cabling as much as is practically possible. All above-ground internal medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the applicable Eskom standard.	High
Decommissioning	Noise pollution and environmental disruption during the decommissioning phase.	Total/partial displacement of priority species from breeding/feeding/ roosting areas	Moderate	Low	Restrict dismantling to the immediate infrastructural footprint where possible. Access to remaining areas should be strictly controlled to minimise disturbance of priority species. This recommendation especially applies within the very high and high sensitivity areas depicted in the sensitivity map in **Figure 13.** Apply noise and dust control measures according to best practice in the industry Prioritise the use of existing access roads during the decommissioning phase and avoid construction of new roads where feasible. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.	High

7.9. Impact Statement

The overall impact significance is provided in this section, in terms of pre- and post-mitigation.

Table 11: Summary of avifaunal impact significances anticipated for the proposed Igolide WEF

Phase	Overall Impact Significance (Pre-Mitigation)	Overall Impact Significance (Post Mitigation)
Construction	Moderate	Low
Operational	Moderate	Low
Decommissioning	Moderate	Low

8. Post-Construction Monitoring

Procedures and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of NEMA came into force in March 2020. According to these regulations, a detailed post-construction monitoring programme must be included as part of the bird specialist study. See **Appendix G** for a proposed programme.

9. Conclusions

The proposed Igolide WEF will have a medium impact on avifauna which, in all instances, could be reduced to a low impact through the appropriate mitigation measures. The current proposed 10-turbine layout which was assessed in this report avoids all the recommended avifaunal turbine exclusion zones and is therefore deemed acceptable. **The development is supported, provided the mitigation measures listed in this report (Section 7.8 and Appendix I) are strictly applied and adhered to. See Figure 13, Section 5.6 for a map of the exclusion areas.**

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Appendix A – Specialist Expertise

Curriculum Vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	25 years

Key Qualifications

Albert Froneman **(**Pr.Sci.Nat) has more than 18 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present, he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Key Project Experience

Renewable Energy Facilities – avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oyster Bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskolakte Wind Energy Project – 12-months preconstruction avifaunal

monitoring project

7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Utrecht Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Facility (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
28. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
29. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
30. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
31. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
32. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
33. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
34. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
35. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)

36. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
37. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
38. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
39. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
40. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
41. Gauteng & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
42. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
43. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
44. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
45. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
46. Pofadder Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
47. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
48. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
49. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assessment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour.
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Power Line EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality

12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Gauteng
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Gauteng
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports
19. Avifaunal Impact Scoping & EIA Study - Renosterberg Wind Farm and Solar site
20. Bird Impact Assessment Study - Proposed 60-year Ash Disposal Facility near to the Kusile Power Station
21. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Gauteng
22. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
23. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
24. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
25. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
26. Avifaunal Specialist Study – Rooikat Hydro Electric Dam – Hope Town, Northern Cape
27. The Stewards Pan Reclamation Project – Bird Impact Assessment study
28. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production

12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Ohrigstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA – GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map production
37. City of Tshwane – New bulk feeder pipeline projects x3 Map production
38. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
39. ESKOM Geluk Rural Power Line GIS & Mapping
40. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
41. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
42. ESKOM Lephalale CNC – GIS Specialist & Mapping
43. ESKOM Marken CNC – GIS Specialist & Mapping
44. ESKOM Lethabong substation and power lines – GIS Specialist & Mapping
45. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping

Professional affiliations

South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.

Curriculum Vitae: Megan Loftie-Eaton

FORMAL EDUCATION

UNIVERSITY OF CAPE TOWN – (PhD – Biological Sciences)

- Completed PhD in Biological Sciences, Animal Demography Unit, Department of Biological Sciences, UCT (December 2018) Thesis: The impacts of bush encroachment on bird distributions in the Savanna Biome of South Africa

UNIVERSITY OF CAPE TOWN – (MSc - Zoology)

- Completed MSc in Zoology, Animal Demography Unit, Department of Biological Sciences, UCT (June 2014)

UNIVERSITY OF ALBERTA – (BSc in Environmental and Conservation Sciences)

- Completed with Distinction. June 2011

PROFESSIONAL REGISTRATIONS AND INDUSTRY AFFILIATIONS

- **Professional Natural Scientist in Ecology (Member #135161)** registered with the South African Council for Natural Scientific Professions (SACNASP)
- **Environmental Assessment Practitioner (Number 2021/3690)** registered with the Environmental Assessment Practitioners Association of South Africa (EAPASA)
- **Member** of the Zoological Society of Southern Africa (ZSSA)

EXPERIENCE AND QUALIFICATIONS

2022-2023:

- Environmental Assessment Practitioner for Resource Management Services, Durbanville
- Avifaunal Impact Assessment assistant with Chris van Rooyen Consulting
- Citizen Science Projects Coordinator and Social Media Manager at The Biodiversity and Development Institute

2021:

- Environmental Assessment Practitioner for Resource Management Services, Durbanville (Part-time)
- Completed Avifaunal Impact Assessment for Robben Island Museum (Blue Stone Quarry Wall Restoration)
- Conducted avifaunal field work for proposed wind farms near Laingsburg, Karoo
- OdonataMAP (African Atlas of Odonata) Project Coordinator and Social Media Manager at The Biodiversity and Development Institute (contracted by the Freshwater Research Centre)
- Senior Environmental Consultant with Terramanzi Group Pty Ltd.
- SACNASP Registered Professional Natural Scientist in Ecology (Member #135161)

2020:

- Senior Environmental Consultant with Terramanzi Group Pty Ltd.
- Completed Global Environmental Management - an online course authorized by Technical University of Denmark (DTU) and offered through Coursera

- Ecologist and Researcher (contracted by Hoedspruit Hub) for Kruger To Canyons Biosphere Reserve, conducting sustainable agriculture research in the village of Phiring, Limpopo as part of the "Agroecology as a Climate Change Adaptation Strategy" output of the Dinkwanyane Water Stewardship Project

2019:
- Participated in the Karkloof 50 Miler trail run, where I placed third, and raised funds (R30,000) for ReWild NPC (a wildlife rehabilitation and conservation organization)
- OdonataMAP (African Atlas of Odonata) Project Coordinator at The Biodiversity and Development Institute (contracted by the Freshwater Research Centre)
- Ecologist and Researcher and Social Media Manager at Hoedspruit Hub
- Communications, Social Media, and Citizen Science Project Coordinator at The Biodiversity & Development Institute - ongoing
- Organized, planned, and orchestrated the Hoedspruit Hub’s Open Day event
- Obtained qualification for NQF Level 5, Unit Standard 115753, Conduct Outcomes-based Assessment through Ndzalama Training (Pty) Ltd

2017-2018:
- Completed contract projects for the Hoedspruit Hub’s Agroecology Division in partnership with Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ). I built, installed, and provided training materials for pollinator stations, artificial bat roosts and earthworm composting bins
- Awarded PhD in Biological Sciences, University of Cape Town (December 2018)
- Ecologist for WildArk on Pridelands Conservancy (Hoedspruit, Limpopo), conducting biodiversity surveys and ecological monitoring, as well as creating content for WildArk’s social media
- Project coordinator and communications officer of the Atlas of African Odonata (OdonataMAP), Animal Demography Unit (funded by JRS Biodiversity Foundation).
- Facilitated and assessed a four-day Ecology Course for students at Tsakane Conservation in Balule Nature Reserve (Limpopo Province, South Africa) as part of the EcoLife student programme (University of Pretoria)
- Presented several biodiversity mapping and bird atlasing workshops (SABAP2, Southern African Bird Atlas Project) across South Africa, Nigeria, Tanzania, and Europe (Poland, Finland, Germany)

2016-2018:
- Presented and assessed bird atlasing (http://sabap2.adu.org.za/) and BioMAPping (http://vmus.adu.org.za) workshops to field guide students at Bushwise Field Guide Training Academy, Limpopo Province, South Africa
- Attended a Snake Awareness and Venomous Snake Handling Course as well as an Introductory Course to Scorpions (accredited by FGASA and HPCSA), hosted by the African Snakebite Institute in Hoedspruit (12-13 November 2016)

2014‒2018:
- Completed doctoral (PhD) studies in Biological Sciences at the University of Cape Town (Animal Demography Unit). Research title: The impacts of bush encroachment on bird distributions in the savanna biome of South Africa
- Project coordinator and communications officer of the Atlas of African Lepidoptera (LepiMAP): LepiMAP is a project aimed at determining the distribution and conservation priorities of butterflies and moths on the African continent. It is a joint project of the Animal Demography Unit (Department of Biological Sciences, University of Cape Town) and LepSoc, The Lepidopterists' Society of Africa

- BirdMAP Assistant: helping with the Animal Demography Unit's bird atlas project in African countries north of South Africa, assisting the project teams in Kenya, Nigeria, Zimbabwe, Namibia, Zambia and Rwanda with everything from observer queries to social media aspects

2014:

- Obtained MSc in Zoology through the Department of Biological Sciences, University of Cape Town. Thesis title: Geographic Range Dynamics of South Africa's Bird Species. PDF of thesis: http://adu.org.za/pdf/Loftie-Eaton_M_2014_MSc_thesis.pdf.
- Attended an International Wildlife Trapping Course in Hoedspruit, South Africa to learn about humane live capture methods of mammals for research purposes

2013:

- Started coordinating LepiMAP, The Atlas of African Lepidoptera
- Obtained FGASA (Field Guides Association of Southern Africa) Level One Nature Guide qualification (membership number 18574) through Ulovane Environmental Training in South Africa. Obtained First Aid Level One qualification

2011–2018:

- Social Media Manager for the Animal Demography Unit
- Data technician for the ADU's Virtual Museum. I am on the Expert Panel for the MammalMAP, FrogMAP, ReptileMAP, and BirdPix citizen science projects. The Expert Panel has the important task of identifying the records submitted to the Virtual Museum

2011:

- Assistant Researcher on the African Penguin EarthWatch Research Team on Robben Island, South Africa. Conducted population surveys on penguins and other seabirds to determine their breeding success and survival - http://earthwatch.org/expeditions/south-african-penguins
- Obtained BSc in Environmental and Conservation Sciences, with Distinction, through the Faculty of Agriculture, Life and Environmental Sciences, University of Alberta, Edmonton, Canada. Major: Conservation Biology.

Appendix B – Specialist Statement of Independence

Appendix C – Site Sensitivity Verification

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). The Protocol for the specialist assessment and minimum report content requirements for environmental impacts avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020) is applicable in the case of wind developments.

The details of the site sensitivity verification (SSV) are noted below:

Date of Site Visits	11 – 14 January 2022 05 – 09 July 2021 06 – 08 December 2020 22 – 23 June 2020
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

C1. Methodology

The following methods were used to compile this report:

- Bird distribution data of the Second Southern African Bird Atlas (SABAP2) was obtained from the University of Cape Town, to ascertain which species occur within the Broader Area of four pentad grid cells within which the proposed Project is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 9 km. From 2007–present, a total of 551 full protocol lists (i.e., surveys of at least two hours each) have been completed for this area. In addition, 133 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (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 (2022.2) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the PAOI was obtained from the First Atlas of Southern African Birds (SABAP1) (Harrison et al., 1997a, 1997b) and 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.
- 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 ©2023) was used to view the PAOI and Broader Area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Ralston-Paton et al., 2017; Retief et al., 2012).
- 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:
    - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
    - BirdLife South Africa’s (BLSA) ‘Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa’ (Jenkins et al., 2015) – hereafter referred to as the ‘Windfarm Guidelines’ – were consulted to determine the level of survey effort that is required.

- The main source of information on the avifaunal diversity and abundance at the PAOI and Broader Area is an integrated pre-construction monitoring programme which was implemented at the Project Site during 2020 – 2022 over a period of four seasons. Four sets of surveys have been conducted.

C2. Results of Site Assessment

The PAOI is situated along an ecotone between the Savanna and Grassland Biomes but falls mainly within the Grassland Biome (Mucina & Rutherford 2006). According to the 2018 SANBI Vegetation Map the PAOI falls within the Central Bushveld Bioregion (northern half of PAOI) and the Mesic Highveld Grassland Bioregion (southern half of PAOI). The natural vegetation at the PAOI consists predominantly of Gauteng Shale Mountain Bushveld and Rand Highveld Grassland.

The typical landscape associated with Rand Highveld Grassland is highly variable, containing extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most of the grasses on the plains belong to the genera *Themeda*, *Eragrostis*, *Heteropogon* and *Elionurus*. A high diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges consist of open woodlands with *Protea caffra* subsp. *caffra*, *Protea welwitschii*, *Senegalia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* is most prominent (Mucina and Rutherford (2006). The Gauteng Shale Mountain Bushveld is represented by woody vegetation and a grass dominated herbaceous layer. Depending on local conditions, trees form semi-open to closed thickets or woodlands, and can range from short deciduous bush cover to a medium-tall +5m tree cover of mostly *Senegalia sp.* and *Vachellia sp.* trees.

Fochville, which is the closest town to the PAOI, has a temperate climate. Summers are warm and winters are cold and dry. The mean annual rainfall is around 600–800 mm, most of which falls in the summer months. The mean annual temperature is around 20C° (Schulze, 2009).

The proposed Igolide WEF PAOI is situated within gently undulating plains of the Gauteng Highveld countryside. The avian habitat types in the Igolide WEF were identified as:

(i) Natural Grassland

(ii) Disturbed Grassland

(iii) Open Woodland
(iv) Drainage Lines and Wetlands
(v) Dams
(vi) Agriculture
(vii) High Voltage Power lines

The PAOI and immediate environment is classified as **Medium** sensitivity for bird species according to the Terrestrial Animal Species Theme (**Figure C.1**). The Medium sensitivity classification is linked to the potential occurrence of African Grass Owl *Tyto capensis* (Regionally Vulnerable), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable).

The PAOI contains confirmed habitat for Species of Conservation Concern (SCC), namely African Grass Owl and Secretarybird (Globally Endangered and Regionally Vulnerable), as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). During the on-site surveys, two SCC were also recorded. These SCC were: Lanner Falcon (Regionally Vulnerable), and Secretarybird (Globally Endangered and Regionally Vulnerable).

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the PAOI, the classification of **High** sensitivity for avifauna is suggested for the Igolide WEF.

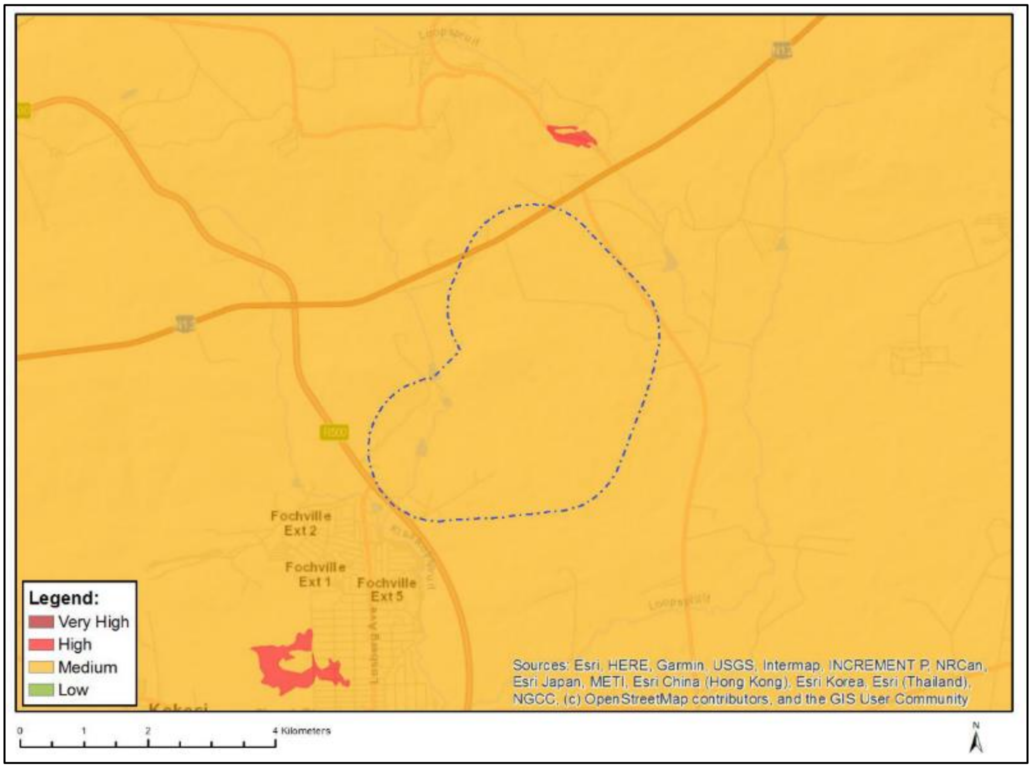

Figure C.1: The National Web-Based Environmental Screening Tool map of the PAOI, indicating sensitivities for the Terrestrial Animal Species theme. The Medium sensitivity classification is linked to African Grass Owl *Tyto capensis*, White-bellied Bustard *Eupodotis senegalensis*, and Caspian Tern *Hydroprogne caspia*.

Appendix D – Impact Assessment Methodology

Appendix 2 of GNR 982, as amended, requires the identification of the significance of potential impacts during scoping. To this end, an impact screening tool has been used in the scoping phase. The screening tool is based on two criteria, namely probability (Figure D1); and consequence (Figure D2), where the latter is based on general consideration to the intensity, extent, and duration.

SCORE	DESCRIPTOR
4	**Definite**: The impact will occur regardless of any prevention measures
3	**Highly Probable**: It is most likely that the impact will occur
2	**Probable**: There is a good possibility that the impact will occur
1	**Improbable:** The possibility of the impact occurring is very low

Figure D1: Probability scores and descriptors

SCORE	NEGATIVE	POSITIVE
4	Very severe: An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated.	Very beneficial: A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit.
3	Severe: A long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming or some combination of these.	Beneficial: A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these.
2	Moderately severe: A medium to long term impacts on the affected system(s) or party (ies) that could be mitigated.	Moderately beneficial: A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way.
1	Negligible: A short to medium term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary.	Negligible: A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.

Figure D2: Consequence score descriptions

The impact assessment includes:

- Impact magnitude
- Impact extent
- Impact reversibility
- Impact duration
- Probability of impact occurrence
- Impact significance

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Figure D3: Impact assessment scoring metric used in this scoping report.

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect, and cumulative:

- Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably near future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

The impact assessment methodology includes the following aspects:

Nature of impact/risk - The type of effect that a proposed activity will have on the environment.

- Impact status - whether the impact/risk on the overall environment will be:
  - Positive - environment overall will benefit from the impact/risk
  - Negative - environment overall will be adversely affected by the impact/risk; or
  - Neutral - environment overall not be affected.
- Impact spatial extent – The size of the area that will be affected by the impact/risk:
  - Site specific
  - Local (<10 km from site)
  - Regional (<100 km of site)
  - National; or
  - International (e.g. Greenhouse Gas emissions or migrant birds).
- Impact reversibility - the ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change:

  - Reversible (recovery without pro-active rehabilitation)
  - Recoverable (recovery with pro-active rehabilitation)
  - Irreversible (not possible despite action)

- Impact duration – the timeframe during which the impact/risk will be experienced:
  - Very short term (instantaneous);
  - Short term (0-5 year);
  - Medium term (5- 15 years);
  - Long term (the impact will cease after the operational life of the activity (i.e., the impact or risk will occur for the project duration)); or
  - Permanent/indefinite (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e., the impact will occur beyond the project decommissioning)).
- Probability of impact occurrence:
  - Improbable (little to no chance of occurring)
  - Low Probability (<30% chance of occurring)
  - Probable (30-50% chance of occurring)
  - Highly Probability (51 – 90% chance of occurring); or
  - Definite (>90% chance of occurring regardless of prevention measures).
- Impact significance – the product of the impact occurrence probability with the sum of impact magnitude, extent, duration, and reversibility

  $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$:

IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Figure D4: Impact significance rating

- Significance – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);

- Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
- Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
- High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and
- Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e., the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5
- Low = 4
- Moderate = 3
- High = 2
- Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- Low
- Medium
- High.

Appendix E – Species List for the Broader Area

Species name	Scientific name	SABAP2 Reporting Rate %		Global Conservation Status	Regional Conservation Status
		Full protocol	Ad hoc protocol		
Abdim's Stork	Ciconia abdimii	0,00	0,75	-	NT
Acacia Pied Barbet	Tricholaema leucomelas	70,24	2,26	-	-
African Black Duck	Anas sparsa	21,60	1,50	-	-
African Crake	Crecopsis egregia	0,73	0,00	-	-
African Darter	Anhinga rufa	28,31	0,75	-	-
African Firefinch	Lagonosticta rubricata	6,35	0,75	-	-
African Fish Eagle	*Haliaeetus vocifer*	1,45	0,75	-	-
African Grass Owl	*Tyto capensis*	0,00	0,75	-	VU
African Green Pigeon	Treron calvus	0,54	0,00	-	-
African Grey Hornbill	Lophoceros nasutus	5,63	0,75	-	-
African Harrier-Hawk	*Polyboroides typus*	0,73	0,75	-	-
African Hawk-eagle	*Aquila spilogaster*	0,36	0,00	-	-
African Hoopoe	Upupa africana	84,57	6,77	-	-
African Olive Pigeon	Columba arquatrix	2,18	0,75	-	-
African Palm Swift	Cypsiurus parvus	81,67	5,26	-	-
African Paradise Flycatcher	Terpsiphone viridis	31,22	3,76	-	-
African Pipit	Anthus cinnamomeus	49,91	3,76	-	-
African Red-eyed Bulbul	Pycnonotus nigricans	90,38	9,02	-	-
African Reed Warbler	Acrocephalus baeticatus	13,61	0,75	-	-
African Sacred Ibis	Threskiornis aethiopicus	26,32	3,01	-	-
African Snipe	Gallinago nigripennis	23,59	0,00	-	-
African Spoonbill	Platalea alba	7,08	0,75	-	-
African Stonechat	Saxicola torquatus	79,31	5,26	-	-
African Swamphen	Porphyrio madagascariensis	6,72	1,50	-	-
African Wattled Lapwing	Vanellus senegallus	19,78	1,50	-	-
African Yellow Warbler	Iduna natalensis	0,18	0,00	-	-
Alpine Swift	Tachymarptis melba	0,54	0,00	-	-
Amethyst Sunbird	Chalcomitra amethystina	64,79	3,76	-	-
Amur Falcon	*Falco amurensis*	1,63	2,26	-	-
Ant-eating Chat	Myrmecocichla formicivora	3,09	0,75	-	-
Arrow-marked Babbler	Turdoides jardineii	0,18	0,75	-	-
Ashy Tit	Melaniparus cinerascens	18,33	1,50	-	-
Banded Martin	Riparia cincta	0,73	0,00	-	-

Barn Swallow	Hirundo rustica	45,01	6,77	-	-
Bar-throated Apalis	Apalis thoracica	46,82	2,26	-	-
Black Crake	Zapornia flavirostra	9,80	0,75	-	-
Black Harrier	*Circus maurus*	0,18	0,00	EN	EN
Black Heron	Egretta ardesiaca	0,73	0,75	-	-
Black Kite	*Milvus migrans*	0,00	0,75	-	-
Black Sparrowhawk	*Accipiter melanoleucus*	1,45	0,00	-	-
Black-backed Puffback	Dryoscopus cubla	6,72	1,50	-	-
Black-chested Prinia	Prinia flavicans	90,38	5,26	-	-
Black-chested Snake Eagle	*Circaetus pectoralis*	0,18	0,00	-	-
Black-collared Barbet	Lybius torquatus	90,74	10,53	-	-
Black-crowned Night Heron	Nycticorax nycticorax	2,36	0,75	-	-
Black-crowned Tchagra	Tchagra senegalus	0,00	0,75	-	-
Black-faced Waxbill	Brunhilda erythronotos	25,41	0,00	-	-
Black-headed Heron	Ardea melanocephala	30,31	1,50	-	-
Black-headed Oriole	Oriolus larvatus	2,54	0,75	-	-
Blacksmith Lapwing	Vanellus armatus	93,10	11,28	-	-
Black-throated Canary	Crithagra atrogularis	88,75	5,26	-	-
Black-winged Kite	*Elanus caeruleus*	47,19	13,53	-	-
Black-winged Pratincole	*Glareola nordmanni*	0,18	0,00	NT	NT
Black-winged Stilt	Himantopus himantopus	0,91	0,75	-	-
Blue Waxbill	Uraeginthus angolensis	64,61	6,02	-	-
Blue-billed Teal	Spatula hottentota	0,18	0,00	-	-
Bokmakierie	Telophorus zeylonus	79,31	5,26	-	-
Booted Eagle	*Hieraaetus pennatus*	0,36	0,75	-	-
Bronze Mannikin	Spermestes cucullata	58,80	5,26	-	-
Brown-backed Honeybird	Prodotiscus regulus	14,88	0,00	-	-
Brown-crowned Tchagra	Tchagra australis	44,10	0,75	-	-
Brown-hooded Kingfisher	Halcyon albiventris	29,40	0,75	-	-
Brown-throated Martin	Riparia paludicola	9,07	0,75	-	-
Brubru	Nilaus afer	50,45	0,75	-	-
Buffy Pipit	Anthus vaalensis	11,62	0,75	-	-
Burchell's Coucal	Centropus burchellii	6,90	0,75	-	-
Cape Bunting	Emberiza capensis	26,86	0,00	-	-
Cape Grassbird	Sphenoeacus afer	0,18	0,00	-	-
Cape Longclaw	Macronyx capensis	60,44	4,51	-	-
Cape Penduline Tit	Anthoscopus minutus	0,91	0,00	-	-
Cape Robin-Chat	Cossypha caffra	92,56	8,27	-	-
Cape Shoveler	Spatula smithii	0,36	0,75	-	-
Cape Sparrow	Passer melanurus	95,46	9,77	-	-
Cape Starling	Lamprotornis nitens	90,56	14,29	-	-
Cape Teal	Anas capensis	0,00	0,75	-	-
Cape Turtle Dove	Streptopelia capicola	87,66	13,53	-	-
Cape Vulture	*Gyps coprotheres*	0,18	0,00	VU	EN
Cape Wagtail	Motacilla capensis	88,75	2,26	-	-
Cape Weaver	Ploceus capensis	11,25	0,75	-	-
Cape White-eye	Zosterops virens	92,38	8,27	-	-
Capped Wheatear	Oenanthe pileata	10,34	0,00	-	-
Cardinal Woodpecker	Dendropicos fuscescens	35,93	3,76	-	-
Chestnut-backed Sparrow-Lark	Eremopterix leucotis	0,54	0,00	-	-

Chestnut-vented Warbler	Curruca subcoerulea	73,50	0,75	-	-
Chinspot Batis	Batis molitor	59,17	6,02	-	-
Cinnamon-breasted Bunting	Emberiza tahapisi	22,87	0,75	-	-
Cloud Cisticola	Cisticola textrix	17,06	0,00	-	-
Common Buttonquail	Turnix sylvaticus	1,81	0,75	-	-
Common Buzzard	*Buteo buteo*	7,80	2,26	-	-
Common Greenshank	Tringa nebularia	0,54	0,75	-	-
Common House Martin	Delichon urbicum	9,62	1,50	-	-
Common Moorhen	Gallinula chloropus	66,79	2,26	-	-
Common Myna	Acridotheres tristis	94,01	15,79	-	-
Common Ostrich	Struthio camelus	3,99	3,76	-	-
Common Quail	Coturnix coturnix	0,73	0,00	-	-
Common Sandpiper	Actitis hypoleucos	0,00	0,75	-	-
Common Scimitarbill	Rhinopomastus cyanomelas	28,68	1,50	-	-
Common Waxbill	Estrilda astrild	41,38	2,26	-	-
Common Whitethroat	Curruca communis	0,54	0,00	-	-
Coqui Francolin	Peliperdix coqui	9,26	0,75	-	-
Crested Barbet	Trachyphonus vaillantii	93,47	11,28	-	-
Crimson-breasted Shrike	Laniarius atrococcineus	44,10	0,75	-	-
Crowned Lapwing	Vanellus coronatus	96,55	12,78	-	-
Cuckoo Finch	Anomalospiza imberbis	0,91	0,00	-	-
Curlew Sandpiper	Calidris ferruginea	0,18	0,75	NT	LC
Cut-throat Finch	Amadina fasciata	0,18	0,75	-	-
Dark-capped Bulbul	Pycnonotus tricolor	81,67	6,77	-	-
Desert Cisticola	Cisticola aridulus	21,78	0,75	-	-
Diederik Cuckoo	Chrysococcyx caprius	38,29	1,50	-	-
Dusky Indigobird	Vidua funerea	0,36	0,00	-	-
Dusky Lark	Pinarocorys nigricans	0,00	0,75	-	-
Eastern Clapper Lark	Mirafra fasciolata	11,43	0,75	-	-
Egyptian Goose	Alopochen aegyptiaca	51,36	4,51	-	-
European Bee-eater	Merops apiaster	37,93	4,51	-	-
European Honey-buzzard	Pernis apivorus	0,91	0,00	-	-
European Roller	Coracias garrulus	0,00	0,75	-	NT
Fairy Flycatcher	Stenostira scita	13,61	0,75	-	-
Familiar Chat	Oenanthe familiaris	13,79	2,26	-	-
Fiery-necked Nightjar	Caprimulgus pectoralis	0,00	0,75	-	-
Fiscal Flycatcher	Melaenornis silens	81,49	7,52	-	-
Gabar Goshawk	Micronisus gabar	5,99	0,00	-	-
Garden Warbler	Sylvia borin	2,54	0,00	-	-
Giant Kingfisher	Megaceryle maxima	1,81	0,75	-	-
Glossy Ibis	Plegadis falcinellus	22,69	1,50	-	-
Golden-breasted Bunting	Emberiza flaviventris	1,45	0,00	-	-
Golden-tailed Woodpecker	Campethera abingoni	21,05	0,00	-	-
Goliath Heron	Ardea goliath	0,36	0,75	-	-
Great Crested Grebe	Podiceps cristatus	0,00	0,75	-	-
Great Egret	Ardea alba	0,91	0,75	-	-
Great Reed Warbler	Acrocephalus arundinaceus	2,54	0,75	-	-
Great Spotted Cuckoo	Clamator glandarius	0,73	0,75	-	-
Greater Double-collared Sunbird	Cinnyris afer	2,72	0,75	-	-
Greater Flamingo	*Phoenicopterus roseus*	0,00	0,75	-	NT

Greater Honeyguide	Indicator indicator	5,44	1,50	-	-
Greater Kestrel	*Falco rupicoloides*	1,09	0,75	-	-
Greater Striped Swallow	Cecropis cucullata	68,60	8,27	-	-
Green Wood Hoopoe	Phoeniculus purpureus	82,76	8,27	-	-
Green-winged Pytilia	Pytilia melba	36,66	0,75	-	-
Grey Go-away-bird	Corythaixoides concolor	61,89	4,51	-	-
Grey Heron	Ardea cinerea	13,79	0,75	-	-
Grey-headed Bushshrike	Malaconotus blanchoti	18,15	3,01	-	-
Groundscraper Thrush	Turdus litsitsirupa	0,36	0,75	-	-
Hadada Ibis	Bostrychia hagedash	94,74	14,29	-	-
Hamerkop	Scopus umbretta	19,24	1,50	-	-
Helmeted Guineafowl	Numida meleagris	82,03	14,29	-	-
Horus Swift	Apus horus	0,36	0,75	-	-
House Sparrow	Passer domesticus	88,20	12,78	-	-
Hybrid Red-eyed/Dark-capped Bulbul	Pycnonotus nigricans/tricolor	2,00	0,00	-	-
Icterine Warbler	Hippolais icterina	1,63	0,75	-	-
Indian Peafowl	Pavo cristatus	0,36	1,50	-	-
Intermediate Egret	Ardea intermedia	0,18	0,75	-	-
Jackal Buzzard	*Buteo rufofuscus*	0,54	0,75	-	-
Jacobin Cuckoo	Clamator jacobinus	1,45	0,75	-	-
Jameson's Firefinch	Lagonosticta rhodopareia	20,15	1,50	-	-
Kalahari Scrub Robin	Cercotrichas paena	68,42	1,50	-	-
Karoo Thrush	Turdus smithi	88,93	11,28	-	-
Kittlitz's Plover	Charadrius pecuarius	0,00	0,75	-	-
Klaas's Cuckoo	Chrysococcyx klaas	5,26	1,50	-	-
Kurrichane Thrush	Turdus libonyana	6,53	2,26	-	-
Lanner Falcon	*Falco biarmicus*	0,36	0,75	-	VU
Lark-like Bunting	Emberiza impetuani	0,91	0,00	-	-
Laughing Dove	Spilopelia senegalensis	97,82	26,32	-	-
Lazy Cisticola	Cisticola aberrans	0,18	0,75	-	-
Lesser Grey Shrike	Lanius minor	3,27	0,75	-	-
Lesser Honeyguide	Indicator minor	17,60	1,50	-	-
Lesser Kestrel	*Falco naumanni*	1,27	0,00	-	-
Lesser Striped Swallow	Cecropis abyssinica	0,36	1,50	-	-
Lesser Swamp Warbler	Acrocephalus gracilirostris	60,62	0,75	-	-
Levaillant's Cisticola	Cisticola tinniens	69,15	3,76	-	-
Lilac-breasted Roller	Coracias caudatus	0,18	0,75	-	-
Little Bee-eater	Merops pusillus	12,70	0,75	-	-
Little Bittern	Ixobrychus minutus	2,72	0,00	-	-
Little Egret	Egretta garzetta	9,26	0,75	-	-
Little Grebe	Tachybaptus ruficollis	39,02	1,50	-	-
Little Rush Warbler	Bradypterus baboecala	23,05	0,00	-	-
Little Sparrowhawk	Accipiter minullus	1,45	0,75	-	-
Little Swift	Apus affinis	66,97	3,76	-	-
Long-billed Crombec	Sylvietta rufescens	5,08	0,00	-	-
Long-crested Eagle	*Lophaetus occipitalis*	0,73	0,75	-	-
Long-tailed Paradise Whydah	Vidua paradisaea	12,16	0,75	-	-
Long-tailed Widowbird	Euplectes progne	37,93	6,77	-	-
Maccoa Duck	Oxyura maccoa	0,00	0,75	EN	NT
Malachite Kingfisher	Corythornis cristatus	9,44	0,75	-	-

Malachite Sunbird	Nectarinia famosa	5,63	1,50	-	-
Mallard	Anas platyrhynchos	47,91	0,75	-	-
Marsh Owl	*Asio capensis*	1,27	1,50	-	-
Marsh Sandpiper	Tringa stagnatilis	0,18	0,75	-	-
Marsh Warbler	Acrocephalus palustris	0,36	0,00	-	-
Martial Eagle	*Polemaetus bellicosus*	0,00	0,75	EN	EN
Melodious Lark	*Mirafra cheniana*	0,18	0,75	-	-
Mocking Cliff Chat	Thamnolaea cinnamomeiventris	2,54	1,50	-	-
Mountain Wheatear	Myrmecocichla monticola	44,28	2,26	-	-
Namaqua Dove	Oena capensis	5,99	2,26	-	-
Natal Spurfowl	Pternistis natalensis	6,35	0,00	-	-
Neddicky	Cisticola fulvicapilla	86,39	3,01	-	-
Nicholson's Pipit	Anthus nicholsoni	4,54	0,00	-	-
Northern Black Korhaan	*Afrotis afraoides*	54,08	4,51	-	-
Orange River Francolin	Scleroptila gutturalis	13,79	1,50	-	-
Orange River White-eye	Zosterops pallidus	14,70	0,75	-	-
Orange-breasted Bushshrike	Chlorophoneus sulfureopectus	0,73	0,75	-	-
Orange-breasted Waxbill	Amandava subflava	7,62	1,50	-	-
Ovambo Sparrowhawk	Accipiter ovampensis	1,81	0,75	-	-
Pale Chanting Goshawk	*Melierax canorus*	3,81	0,75	-	-
Pearl-breasted Swallow	Hirundo dimidiata	0,18	0,00	-	-
Pied Avocet	Recurvirostra avosetta	0,36	0,75	-	-
Pied Crow	Corvus albus	57,53	14,29	-	-
Pied Kingfisher	Ceryle rudis	14,70	0,75	-	-
Pied Starling	Lamprotornis bicolor	9,26	5,26	-	-
Pink-billed Lark	Spizocorys conirostris	0,91	0,00	-	-
Pin-tailed Whydah	Vidua macroura	64,79	7,52	-	-
Plain-backed Pipit	Anthus leucophrys	15,97	0,75	-	-
Purple Heron	Ardea purpurea	25,77	1,50	-	-
Purple Indigobird	Vidua purpurascens	5,81	0,00	-	-
Quailfinch	Ortygospiza atricollis	18,51	1,50	-	-
Rattling Cisticola	Cisticola chiniana	24,86	0,75	-	-
Red-backed Shrike	Lanius collurio	21,96	0,75	-	-
Red-billed Firefinch	Lagonosticta senegala	6,35	0,00	-	-
Red-billed Quelea	Quelea quelea	78,22	4,51	-	-
Red-billed Teal	Anas erythrorhyncha	21,42	1,50	-	-
Red-breasted Swallow	Cecropis semirufa	0,00	0,75	-	-
Red-capped Lark	Calandrella cinerea	17,24	4,51	-	-
Red-chested Cuckoo	Cuculus solitarius	19,78	0,75	-	-
Red-chested Flufftail	Sarothrura rufa	0,91	0,75	-	-
Red-collared Widowbird	Euplectes ardens	88,02	6,77	-	-
Red-eyed Dove	Streptopelia semitorquata	95,64	16,54	-	-
Red-faced Mousebird	Urocolius indicus	94,01	11,28	-	-
Red-headed Finch	Amadina erythrocephala	82,40	6,02	-	-
Red-knobbed Coot	Fulica cristata	69,33	3,01	-	-
Red-throated Wryneck	Jynx ruficollis	25,23	0,00	-	-
Red-winged Starling	Onychognathus morio	7,26	1,50	-	-
Reed Cormorant	Microcarbo africanus	66,79	3,76	-	-
Rock Dove	Columba livia	12,16	1,50	-	-
Rock Kestrel	Falco rupicolus	0,36	0,75	-	-

Rock Martin	Ptyonoprogne fuligula	51,72	4,51	-	-
Rose-ringed Parakeet	Psittacula krameri	0,18	0,00	-	-
Ruff	Calidris pugnax	0,18	0,75	-	-
Rufous-cheeked Nightjar	Caprimulgus rufigena	1,27	0,75	-	-
Rufous-naped Lark	Mirafra africana	57,71	6,77	-	-
Sabota Lark	Calendulauda sabota	14,70	1,50	-	-
Scaly-feathered Weaver	Sporopipes squamifrons	6,35	0,75	-	-
Secretarybird	*Sagittarius serpentarius*	0,18	0,00	EN	VU
Sedge Warbler	Acrocephalus schoenobaenus	0,36	0,75	-	-
Shaft-tailed Whydah	Vidua regia	4,17	0,00	-	-
Shikra	Accipiter badius	0,18	0,75	-	-
Short-toed Rock Thrush	Monticola brevipes	0,36	0,00	-	-
South African Cliff Swallow	Petrochelidon spilodera	7,80	0,00	-	-
South African Shelduck	Tadorna cana	4,54	0,75	-	-
Southern Boubou	Laniarius ferrugineus	7,80	1,50	-	-
Southern Fiscal	Lanius collaris	91,83	12,78	-	-
Southern Grey-headed Sparrow	Passer diffusus	80,76	4,51	-	-
Southern Masked Weaver	Ploceus velatus	98,37	18,05	-	-
Southern Pied Babbler	Turdoides bicolor	0,18	0,00	-	-
Southern Pochard	Netta erythrophthalma	0,36	0,75	-	-
Southern Red Bishop	Euplectes orix	94,74	17,29	-	-
Speckled Mousebird	Colius striatus	81,31	6,02	-	-
Speckled Pigeon	Columba guinea	93,28	16,54	-	-
Spike-heeled Lark	Chersomanes albofasciata	11,43	3,01	-	-
Spotted Eagle-Owl	*Bubo africanus*	11,98	0,75	-	-
Spotted Flycatcher	Muscicapa striata	21,23	0,00	-	-
Spotted Thick-knee	Burhinus capensis	58,80	2,26	-	-
Spur-winged Goose	Plectropterus gambensis	19,24	0,75	-	-
Squacco Heron	Ardeola ralloides	3,45	0,75	-	-
Streaky-headed Seedeater	Crithagra gularis	52,45	3,01	-	-
Striated Heron	Butorides striata	2,72	0,00	-	-
Striped Pipit	Anthus lineiventris	2,72	0,00	-	-
Swainson's Spurfowl	Pternistis swainsonii	67,33	4,51	-	-
Swallow-tailed Bee-eater	Merops hirundineus	0,54	0,00	-	-
Tawny-flanked Prinia	Prinia subflava	57,17	2,26	-	-
Temminck's Courser	Cursorius temminckii	0,73	0,75	-	-
Thick-billed Weaver	Amblyospiza albifrons	64,61	6,02	-	-
Three-banded Plover	Charadrius tricollaris	28,31	0,75	-	-
Verreaux's Eagle	*Aquila verreauxii*	3,09	2,26	-	VU
Verreaux's Eagle-Owl	*Bubo lacteus*	0,00	0,75	-	-
Village Indigobird	Vidua chalybeata	5,99	0,00	-	-
Village Weaver	Ploceus cucullatus	0,36	0,00	-	-
Violet-backed Starling	Cinnyricinclus leucogaster	2,00	0,75	-	-
Violet-eared Waxbill	Granatina granatina	6,90	0,75	-	-
Wailing Cisticola	Cisticola lais	37,75	0,75	-	-
Wattled Starling	Creatophora cinerea	55,72	2,26	-	-
Western Barn Owl	Tyto alba	9,80	0,75	-	-
Western Cattle Egret	Bubulcus ibis	61,71	9,02	-	-
Western Osprey	*Pandion haliaetus*	0,18	0,75	-	-
Whiskered Tern	Chlidonias hybrida	1,63	0,00	-	-

White Stork	*Ciconia ciconia*	1,63	1,50	-	-
White-backed Duck	Thalassornis leuconotus	0,00	0,75	-	-
White-backed Mousebird	Colius colius	39,93	3,76	-	-
White-bellied Sunbird	Cinnyris talatala	78,77	6,02	-	-
White-breasted Cormorant	Phalacrocorax lucidus	6,53	0,75	-	-
White-browed Sparrow-Weaver	Plocepasser mahali	98,55	24,06	-	-
White-faced Whistling Duck	Dendrocygna viduata	8,35	2,26	-	-
White-fronted Bee-eater	Merops bullockoides	4,90	0,75	-	-
White-rumped Swift	Apus caffer	66,06	6,77	-	-
White-throated Robin-Chat	Cossypha humeralis	0,18	0,00	-	-
White-throated Swallow	Hirundo albigularis	52,81	2,26	-	-
White-winged Widowbird	Euplectes albonotatus	34,30	2,26	-	-
Willow Warbler	Phylloscopus trochilus	23,41	0,75	-	-
Wing-snapping Cisticola	Cisticola ayresii	1,63	0,75	-	-
Wood Sandpiper	Tringa glareola	0,91	0,00	-	-
Yellow Canary	Crithagra flaviventris	59,89	0,75	-	-
Yellow-bellied Eremomela	Eremomela icteropygialis	8,35	0,00	-	-
Yellow-billed Duck	Anas undulata	61,71	3,01	-	-
Yellow-billed Kite	Milvus aegyptius	0,18	0,75	-	-
Yellow-billed Stork	*Mycteria ibis*	0,00	0,75	-	EN
Yellow-crowned Bishop	Euplectes afer	21,78	3,01	-	-
Yellow-fronted Canary	Crithagra mozambica	0,73	0,75	-	-
Yellow-throated Bush Sparrow	Gymnoris superciliaris	0,18	0,00	-	-
Zitting Cisticola	Cisticola juncidis	17,24	2,26	-	-

Appendix F – Pre-Construction Monitoring Protocol

The objective of the pre-construction monitoring at the proposed Igolide Wind Energy Facility (WEF) is to gather baseline data over a period of four seasons on the following aspects pertaining to avifauna at the development area:

- The abundance and diversity of birds to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species to assess the potential collision risk with the turbines.

The monitoring protocol for the WEF site was designed according to the following set of guidelines:

- Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa. Hereafter referred to as the wind guidelines.

The results of the pre-construction monitoring are detailed in the sections below. The monitoring surveys were conducted in the following time periods:

- Survey 1: 21 – 26 June 2020
- Survey 2: 6 – 8 December 2020
- Survey 3: 5 – 9 July 2021
- Survey 4: 11 – 14 January 2022

Monitoring was conducted in the following manner:

- One drive transect was identified totalling 6.7km on the development area.
- One monitor travelling slowly (± 10km/h) in a vehicle records all birds on both sides of the transect. The observer stops at regular intervals to scan the environment with binoculars. The drive transect is counted three times per sampling session.
- In addition, 1 walk transect of 1km was identified at the development site and was counted 4 times per sampling season. All birds are recorded during walk transects.
- The following variables are recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Estimated distance from transect;
    - Wind direction;
    - Wind strength (estimated Beaufort scale);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);

- Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
- Co-ordinates (priority species only).

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

- One vantage point (VP) was identified from which most of the proposed development area can be observed, to record the flight altitude and patterns of priority species. The following variables are recorded for each flight:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Wind direction;
  - Wind strength (estimated Beaufort scale 1-7);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m);
  - Flight mode (soar; flap; glide; kite; hover); and
  - Flight time (in 15 second intervals).

The objective of vantage point counts is to measure the potential collision risk with the turbines. Priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms.

A focal point (FP) of significant avifaunal concentration was identified - a dam in the stream located along the western boundary of the proposed development area. Bird presence and abundance are recorded at the focal point during each seasonal visit.

Figure 1 below indicates the proposed development area where monitoring is taking place.

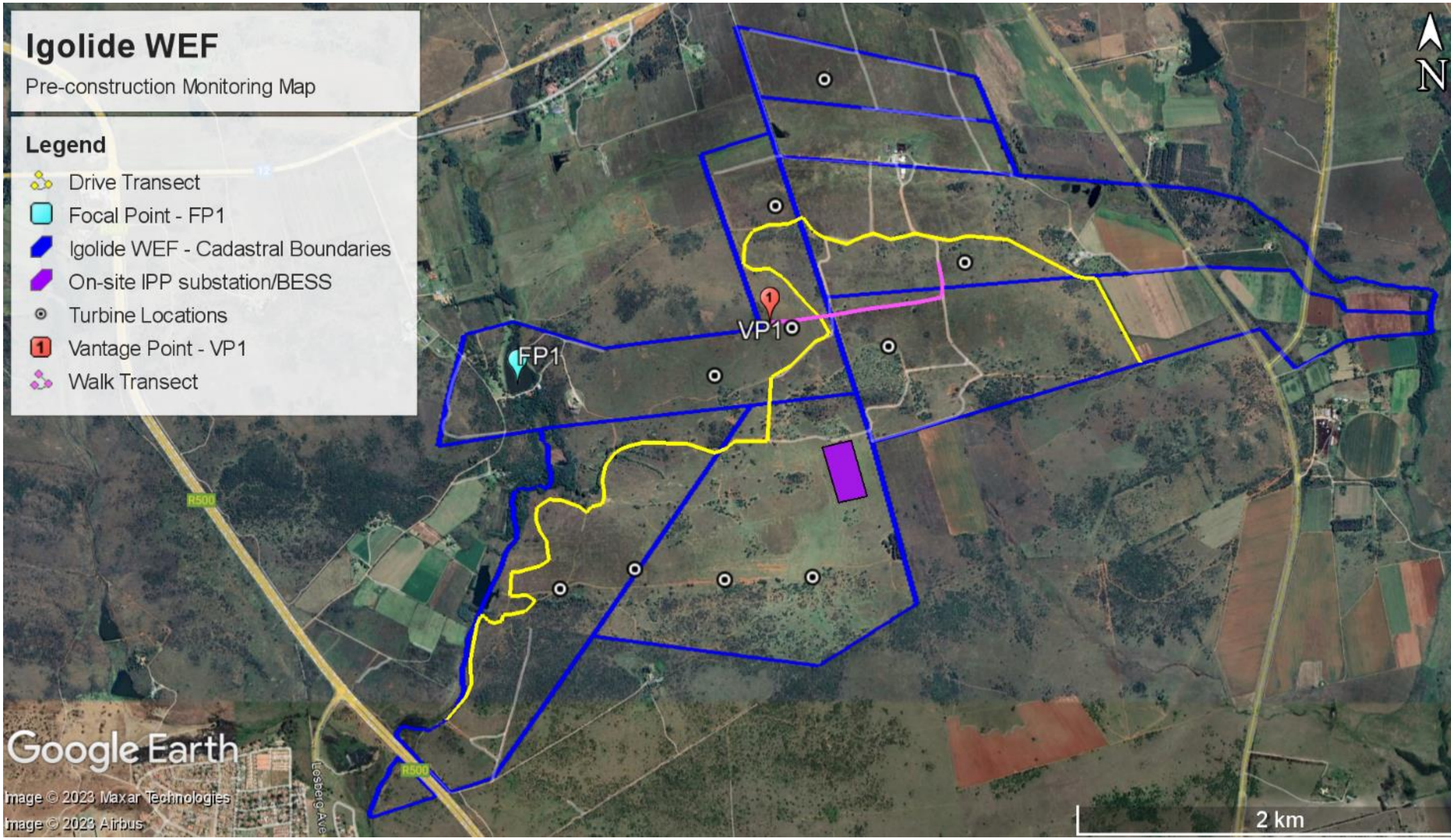
Igolide WEF
Pre-construction Monitoring Map
Legend
Drive Transect
Focal Point - FP1
Igolide WEF - Cadastral Boundaries
On-site IPP substation/BESS
Turbine Locations
Vantage Point - VP1
Walk Transect
VP1
FP1
R500
Losberg Ave
Google Earth
Image © 2023 Maxar Technologies
Image © 2023 Airbus
2 km
N

Figure 1:

Appendix G – Post-Construction Monitoring

1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed Igolide WEF must be conducted in accordance with the latest version of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy Project Sites in southern Africa* (Jenkins *et al*. 2011)[6].

2 AIM OF POST-CONSTRUCTION MONITORING

The avifaunal post construction monitoring aims to assess the impact of the wind farm by comparing pre- and post- construction monitoring data and to measure the extent of bird fatalities caused by the wind farm. Post-construction monitoring is therefore necessary to:

- Confirm as far as possible what the actual impacts of the wind farm are on avifauna; and
- Determine what mitigation is required if necessary (adaptive management).

The proposed post-construction monitoring can be divided into three categories:

- Habitat classification
- Quantifying bird numbers and movements (replicating baseline pre-construction monitoring)
- Quantifying bird mortalities.

Post-construction monitoring will aim to answer the following questions:

- How has the habitat available to birds in and around the wind farm changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has the wind farm affected priority species' breeding success?
- How many birds collide with the turbines? And are there any patterns to this?
- What mitigation is necessary to reduce the impacts on avifauna?

3 TIMING

[6] Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

Post-construction monitoring should commence as soon as possible after the first turbines become operational to ensure that the immediate effects of the facility on resident and passing birds are recorded, before they have time to adjust or habituate to the development. However, it should be borne in mind that it is also important to obtain an understanding of the impacts of the facility as they would be over the lifespan of the facility. Over time the habitat within the wind farm may change, birds may become habituated to, or learn to avoid the facility. It is therefore necessary to monitor over a longer period than just an initial one year.

4 DURATION

Monitoring should take place in Year 1 and 2 of the operational phase, and then repeated in Year 5 and every five years after that. After the first year of monitoring, the programme should be reviewed to incorporate significant findings that have emerged. This may entail the revision of the number of turbines to be searched, and the size of the search plots, depending on the outcome of the first year of monitoring. If significant impacts are observed and mitigation is required, the matter should be taken up with the operator to discuss potential mitigation. In such instances the scope of monitoring could be reduced to focus only on the impacts of concern.

5 HABITAT CLASSIFICATION

Any observed changes in bird numbers and movements at a wind farm may be linked to changes in the available habitat. The avian habitats available must be mapped at least once a year (at the same time every year), using the same methods which were used during pre-construction.

6 BIRD NUMBERS AND MOVEMENTS

To determine if there are any impacts relating to displacement and/or disturbance, all methods used to estimate bird numbers and movements during baseline monitoring must be applied as far as is practically possible in the same way to post-construction work to ensure maximum comparability of these two data sets. This includes sample counts of small terrestrial species, counts of large terrestrial species and raptors, focal site surveys and vantage point surveys according to the current best practice.

7 COLLISIONS

The collision monitoring must have three components:

- Experimental assessment of search efficiency and scavenging rates of bird carcasses on the site;
- Regular searches in the immediate vicinity of the wind farm turbines for collision casualties;

- Estimation of collision rates.

8 SEARCHER EFFICIENCY AND SCAVENGER REMOVAL

The value of surveying the area for collision victims is only valid if some measure of the accuracy of the survey method is developed. The probability of a carcass being detected and the rate of removal/decay of the carcass must be accounted for when estimating collision rates and when designing the monitoring protocol. This must be done in the form of searcher and scavenger trails twice a year.

9 COLLISION VICTIM SURVEYS

9.1 Aligning search protocols

The search protocol must be agreed upon between the bat and bird specialists to constitute an acceptable compromise between the current best practice guidelines for bird and bat monitoring.

Searches must begin as early in the mornings as possible to reduce carcass removal by scavengers. A carcass searcher must walk in straight line transects, 6 m apart, covering 3 m on each side. A team of searchers and one supervisor must be trained to implement the carcass searches. The searchers must have a vehicle available for transport per site. The supervisor must assist with the collation of the data at each site and provide the data to the specialist in electronic format on a weekly basis. The specialists must ensure that the supervisor is completely familiar with all the procedures concerning the management of the data. The following must be sent to the specialist on a weekly basis:

- Carcass fatality data (hardcopy and scans as well as data entered into Excel spreadsheets);
- Pictures of any carcasses, properly labeled;
- GPS tracks of the search plots walked; and
- Turbine search interval spreadsheets.

When a carcass is found, it must be bagged, labeled, and kept refrigerated for species confirmation when the specialist visits the site.

9.2 Estimation of collision rates

Observed mortality rates need to be adjusted to account for searcher efficiency and scavenger removal. There have been many different formulas proposed to estimate mortality rates. The available methodologies must be investigated, and an appropriate method will be applied. The current method which is used widely is the GenEst method.

10 DELIVERABLES

10.1 Annual report

An operational monitoring report must be completed at the end of each year of operational monitoring. As a minimum, the report must attempt to answer the following questions:

- How has the habitat available to birds in and around the wind farm changed?
- How has the number birds and species composition changed?
- How have the movements of priority species changed?
- How has the wind farm affected priority species' breeding success?
- What are the likely drivers of any changes observed?
- How many, and which species of birds collided with the turbines and
- Associated infrastructure? And are there any patterns to this?
- What is the significance of any impact observed?
- What mitigation measures are required to reduce the impacts?

10.2 Quarterly reports

Concise quarterly reports must be provided with basic statistics and any issues that need to be red flagged.

Appendix H – African Grass Owl Habitat Suitability Modelling

DATA ANALYSIS

We scripted and used an R workflow to prepare, pre-process and analyse remote sensing data acquired by the Sentinel 2 satellite platform (Copernicus 2023). A classification modelling framework, which included the use of an ensemble model, was used to assess habitat suitability for target species. An ensemble modelling approach incorporates the use of more than one classification algorithm, drawing on the strengths of each and resisting any inherent bias that could be present in a single model. This general modelling process has been previously used in multiple peer-reviewed avian habitat suitability studies (Colyn et al. 2020a; Colyn et al. 2020b; Colyn et al. 2020c). We used a stepwise variable selection technique to conduct a data driven process of variable selection. Variable selection includes the removal of highly correlated variables, thereby preventing autocorrelation and improving the interpretation of final model results (Vignali et al. 2020).

Key wetlands used by African Grass Owl were identified from a presence locality dataset provided by Craig Whittington-Jones and supplemented with personal records of African Grass Owl breeding sites. Roadkill and marginal/stochastic sites were disregarded for this analysis, with an emphasis being placed on records noted as confirmed or suspected breeding sites, as well as sites noted to host the species consistently, but where breeding was unconfirmed. A systematic GIS grid was then used to generate positive training data samples from these sites representing suitable breeding wetlands for African Grass Owl.

The modelling workflow included data partitioning, model training, variable selection, model testing, and model optimization through hyperparameter tuning and final model predictions. The occurrence data largely included presence data with absence data being limited geographically to certain areas of greater survey coverage. Subsequently, to supplement existing absence data additional pseudo-absence data was generated across the area of interest using the Dismo R package (Hijmans et al. 2022). We partitioned the overall occurrence and pseudo-absence dataset into training (80%) and testing (20%) subsets. Subsequently, we trained the primary models using the MaxEnt, Random Forest and ANN algorithms, followed by hyperparameter tuning and model optimization using the genetic algorithm (Vignali et al. 2020). Variable importance and partial dependence plots were generated for the final set of variables selected following initial model training and optimization. A final global model was trained using the entire training occurrence dataset for each species, and this model was then used to make predictions of habitat suitability within the local area of interest (i.e. proposed development footprint).

Model performance was assessed using the Receiver-operating characteristic (ROC) and associated area under the curve (AUC-ROC) value (Freeman and Moisen 2008). ROC plots compare the true positive and false positive rates and are commonly used as a metric of model performance in classification studies (Jimenez-Valverde 2012; Sofaer et al. 2018). I used the package PresenceAbsence (Freeman and Moisen 2008) to create ROC-AUC plots and generate threshold selection statistics. Threshold selection assesses the relationship between the predicted and observed values to generate thresholds that can be used to convert model outputs from a continuous format to a binary one.

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APPENDIX I – Environmental Management Plan

MANAGEMENT PLAN FOR THE PLANNING AND DESIGN PHASE

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: DISPLACEMENT DUE TO DISTIURBANCE AND HABITAT TRANSFORMATION					
Displacement of priority avifauna due to disturbance and habitat transformation	Prevent mortality of priority avifauna	1. No turbines should be constructed in the turbine exclusion buffer zones as indicated in the sensitivity map in **Figure 13.** 2. Restrict construction to the immediate infrastructural footprint. Access to remaining areas should be strictly controlled to minimise disturbance of priority species. This recommendation especially applies within the very high and high sensitivity areas depicted in the sensitivity map in **Figure 13 (Section 5.6)**. 3. Prioritise upgrading existing roads (where the requisite roads authority permission has been issued) over constructing new roads. 4. Strictly implement the recommendations of ecological and botanical specialists to reduce the level of habitat loss.	Design lay-out around the proposed buffer zones	Once-off during the planning phase.	Project Developer
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE TURBINES					
Mortality of priority avifauna due to collisions with the wind turbines	Prevent mortality of priority avifauna	1. No turbines should be constructed in the turbine exclusion buffer zones as indicated in the sensitivity map in **Figure 13 (Section 5.6).** 2. Formal live-bird monitoring should commence following initial turbine operation, as per the Best Practice Guidelines (Jenkins et al. 2015), to determine the extent to which priority species displacement has occurred. Operational monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated every five years thereafter for the operational lifetime of the facility.	Design lay-out around the proposed buffer zones.	1. Once-off during the planning phase. 2. As soon as the first turbines start turning.	Project Developer

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: MORTALITY DUE TO ELECTROCUTION					
Electrocution of avifauna on the internal 33kV network	Prevent mortality of priority avifauna	1. All medium voltage cables should be buried as far as practically possible. 2. A raptor-friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.	Design engineers to consult with avifaunal specialist on the final design of the poles.	Once-off during the planning phase.	Project Developer

MANAGEMENT PLAN FOR THE CONSTRUCTION PHASE (INCLUDING PRE- AND POST-CONSTRUCTION ACTIVITIES)

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 priority 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 practices during construction. The CEMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads as far as practically 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	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	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

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		recommendations in the botanical and biodiversity specialist reports pertaining to the limitation and rehabilitation of the footprint.	construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
AVIFAUNA: DISPLACEMENT DUE TO HABITAT TRANSFORMATION					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the wind turbines and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented according to the recommendations of the biodiversity/vegetation specialist.	1. Ensure that all the recommendations for mitigation from the biodiversity/vegetation specialist, including rehabilitation of disturbed areas, are strictly implemented.	1. Appointment of specialist to coordinate and monitor the rehabilitation of the vegetation.	1. Once-off	1. Wind farm operator
AVIFAUNA: MORTALITY DUE TO COLLISIONS ON THE 33KV NETWORK					
Bird collisions with the internal 33kV cables.	Prevent mortality of priority avifauna.	1. Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due to technical (not financial) constraints. 2. Bird flight diverters should be installed on all 33kV overhead lines on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark	Fit Eskom approved Bird Flight Diverters on the entire overhead section of the 33kV network.	1. Once-off	1. Contractor

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		and light backgrounds, respectively. These devices must be installed as soon as the conductors are strung			

MANAGEMENT PLAN FOR THE OPERATIONAL PHASE

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE WIND TURBINES					
Bird collisions with the wind turbines	Prevention of priority species collision mortality on the wind turbines.	1. Formal live-bird monitoring and carcass searches should be implemented at the start of the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al*. 2015) to assess collision rates. The exact time when operational monitoring should commence, will depend on the construction schedule, and should commence when the first turbines start operating. The Best Practice Guidelines require that, as an absolute minimum, operational monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated in year 5, and again every five years thereafter for the operational lifetime	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. Engage with the landowner to design and implement an effective system to locate a carcass promptly and ensure the immediate removal of the carcass before it can attract vultures. 4. Appoint a team of suitably qualified, trained, dedicated, and resourced team of observers to be present on site for all daylight hours throughout the year. It is absolutely	1. Once-off 2. Years 1, 2, 5 and every five years after that for the duration of the operational lifetime of the facility. 3. Before the first turbines start turning. 4. As and when required, within six months of threshold having been exceeded. 5. Quarterly and annually	1. Wind farm operator 2. Wind farm operator 3. Wind farm operator 4. Wind farm operator/avifaunal specialist 5. Wind farm operator/avifaunal specialist

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		of the facility. 2. Should any mortality of collision prone species of conservation concern (e.g. Secretarybird, Verreaux's Eagle) be recorded, an observer-led shutdown on demand (SDoD) programme should be considered for rapid implementation at the WEF, targeting these species. 3. Furthermore, if annual estimated collision rates of other species of conservation concern indicate unsustainable mortality levels of priority species, i.e. if natural background mortality together with the estimated mortality caused by turbine collisions exceeds a critical mortality threshold as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shutdown on demand. This must be undertaken in consultation with a qualified avifaunal specialist.	essential that passionate, hardworking staff is hired for this role. This team must be stationed at observation points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. 5. A full detailed method statement must be designed by an avifaunal specialist prior to the commercial operations date (COD) and must be in place by the time that the wind farm starts operating. 6. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.		

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: MORTALITY DUE TO COLLISIONS AND ELECTROCUTIONS ON THE 33KV NETWORK					
Bird electrocutions on the overhead sections of the internal 33kV cables	Prevention of electrocution and collision mortality on the overhead sections of the 33kV internal cable network.	1. Conduct regular inspections of the overhead sections of the internal reticulation network to look for carcasses.	1. Carcass searchers under the supervision of the Avifaunal Specialist. 2. Design and implement mitigation measures if mortality thresholds are exceeded. 3. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.	1. At least once every two months. 2. As and when required, within six months of threshold having been exceeded. 3. Quarterly and annually	1. Operations Manager/Avifaunal specialist 2. Wind farm operator/Avifaunal specialist 3. Wind farm operator/Avifaunal specialist

MANAGEMENT PLAN FOR THE DECOMMISSIONING PHASE

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE ASSOCIATED WITH THE DISMANTLING ACTIVITIES					
The noise and movement associated with the de-commissioning activities at the WEF 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 EMPr.	A site-specific EMPr must be implemented, which gives an appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction. The EMPr must specifically include the following:	**1.** Implementation of the EMPr. Oversee activities to ensure that the EMPr 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	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 6. Contractor and ECO

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<tr><th rowspan="2">Impact</th><th rowspan="2">Mitigation/Management Objectives and Outcomes</th><th rowspan="2">Mitigation/Management Actions</th><th colspan="3">Monitoring</th></tr>
<tr><th>Methodology</th><th>Frequency</th><th>Responsibility</th></tr>
<tr><td></td><td></td><td>1. No off-road driving.
2. Maximum use of existing roads as far as practically 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/vegetation specialist report pertaining to the limitation of the footprint.</td><td>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 footprint area is demarcated and that construction personnel are made aware of these demarcations.
6. Monitor via site inspections and report non-compliance.</td><td></td><td></td></tr>
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