Final Environmental Impact Report:

Avifaunal Preconstruction Monitoring Assessment for the proposed Botterblom Wind Energy Facility located North of Loeriesfontein, Northern Cape

September 2022

APPLICANT

FE BOTTERBLOM (PTY) LTD

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Professional Team

The technical team responsible for the pre-construction monitoring surveys and Impact Assessment reporting is presented.

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Specialist Declaration

I, Sam Laurence *Pr. Sci. Nat.,* declare that the work presented in this report is our own and has not been influenced in any way by the developer or the EAP. At no point has the developer asked us as specialists to manipulate the results in order to make it more favourable for the proposed development. We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP) and the EIA Regulations (2014, as amended). We have the necessary qualifications and expertise (*Pr. Sci. Nat. Zoological Science)* in conducting this specialist report.

Sam Laurence *Pr. Sci. Nat.*

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GLOSSARY AND ACRONYMS

AI	Artificial Intelligence
BA	Basic Assessment
BARESG	Bird and Renewable Energy Specialist Group
CITES	Convention on International Trade in Endangered Species
Cumulative impact	Impacts on a species, ecosystem or resource as a result of the sum of actions in the past, present and foreseeable future, from multiple WEFs or a WEF in combination with other developments.
CWAC	Coordinated Waterbird Counts, a programme of bird censuses at a number of South African wetlands. See http://cwac.adu.org.za for more information.
ESKOM	Electricity Supply Commission (ESCOM), established in 1923.
Environmental Impact Assessment (EIA)	The process of identifying environmental impacts due to activities and assessing and reporting these impacts
GIS	Geographic Information Systems
GN	General Notice
IBA	Important Bird and Biodiversity Area. Part of a global network of sites that are critical for the long-term viability of bird populations. Now known as Important Bird and Biodiversity Areas.
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature.

Rotor swept area	The area where birds are at risk of colliding with turbine blades. The area of the circle or volume of the sphere swept by the turbine blades.
NEPA	National Freshwater Ecosystem Priority Areas
PAOI	Project Area of Influence
Preconstruction Phase	The period prior to the construction of a wind energy facility
Priority species	Threatened or rare birds (in particular those unique to the region and especially those which are possibly susceptible to wind-energy impacts as defined by Ralston Paton *et al*. 2017), which occur in the given development area at relatively high densities or have high levels of activity in the area. These species should be the primary (but not the sole) focus of all subsequent monitoring and assessment.
SABAP	The Southern African Bird Atlas Project. A project in which data on bird distribution and relative abundance are collected by volunteers. There have been two SABAP projects; i.e. SABAP1 (completed in 1991) and SABAP2 (started in 2007 and on-going). See http://sabap2.adu.org.za for more information.
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SEA	Strategic Environmental Assessment
STC	Strategic Transmission Corridors
TOPS	Threatened or Protected Species Regulations
REDZ	Renewable Energy Development Zones
VP	Vantage point
WEF	Wind energy facility. A power plant that uses wind to generate electricity, also colloquially known as a wind farm

1 INTRODUCTION AND PROJECT BACKGROUND

FE Botterblom WEF (Pty) Ltd ('the Applicant') is proposing to develop the Botterblom Wind Energy Facility (WEF) and associated infrastructure approximately 50 km NNE of Loeriesfontein in the Northern Cape Province. Enviro-Insight CC was appointed to undertake the requisite avifauna preconstruction monitoring and impact assessment associated with the proposed Botterblom WEF.

The proposed Botterblom WEF will cover approximately ~5 600 ha in extent located on the Remaining Extent of Farm Sous 226 where up to 35 wind turbines are proposed to be constructed as well as the associated infrastructure, which is required for such a facility including, but not limited to:

- The proposed series of turbines would be operated as a single facility with each turbine being up to 7.5 MW in capacity.
- Each wind turbine is expected to consist of a concrete foundation (20 m x 20 m x 4 m), a steel tower, a hub (up to 150 m above ground level, depending on the turbine size decided upon) and rotor diameter of 175 m.
- Internal/ access roads (up to 10 m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be utilised and upgraded.
- Security access gates and additional internal fencing.
- Workshop area / office for control, maintenance, and storage (approximately 100 m x 100 m).
- An on-site substation (200 m x 200 m) to facilitate grid connection.

Energy generated by the Botterblom WEF will be evacuated from the site via a proposed 132 kilovolt (kV) overhead transmission line of which alternative routes are currently being investigated. This would feed into the existing national electricity grid at the Helios Main Transmission Substation. The impacts of this overhead transmission line will be assessed separately in an Environmental Impact Assessment/ Basic Assessment process.

1.1 SCOPE OF WORK

The main objective is to fully understand and successfully mitigate the possible negative impacts of wind energy production (and associated infrastructure) on the region's avifauna. This report will provide baseline information to assess avifauna habitat use in a pre-construction (impact) scenario and evaluate the potential impact of the Botterblom WEF on avifauna (such as collision mortality, displacement due to disturbance, barrier effects and habitat loss).

1.2 STUDY AREA

The proposed Botterblom WEF (WEF boundary in Figure 1-1) is located 53 km north of Loeriesfontein on the remaining extent of Farm Sous 226 in the Hantam Local Municipality in the greater Namakwa District Municipality of the Northern Cape province, South Africa, and covers an area of 5 796 ha. This site has historically been used for sheep grazing and is nearly undisturbed by human presence. A regional road and railway run through the AOI. The Khobab and Loeriesfontein 2 WEF (Animalia, 2011) have been constructed to the north and north-east of the area proposed for the current WEF, and as such, existing infrastructure is present on and in the vicinity of the current AOI, including the Helios sub-station in the eastern section of the AOI (Figure 1-1).

The proposed turbine layout and project area of influence (AOI) is shown in Figure 1-2. The AOI was defined as the WEF boundary and additional habitat types to the south that appeared distinct from those present on the existing WEFs and which could be accessed.

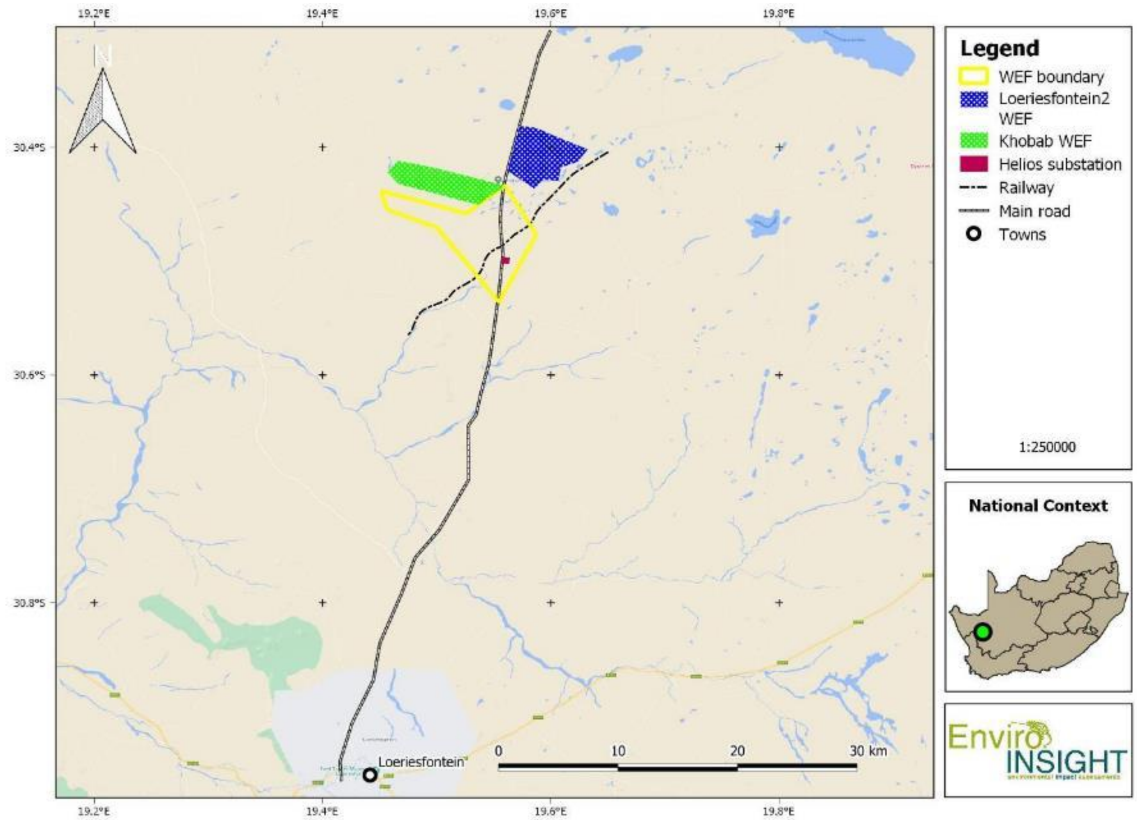

Figure 1-1: Locality map of the proposed Botterblom WEF.

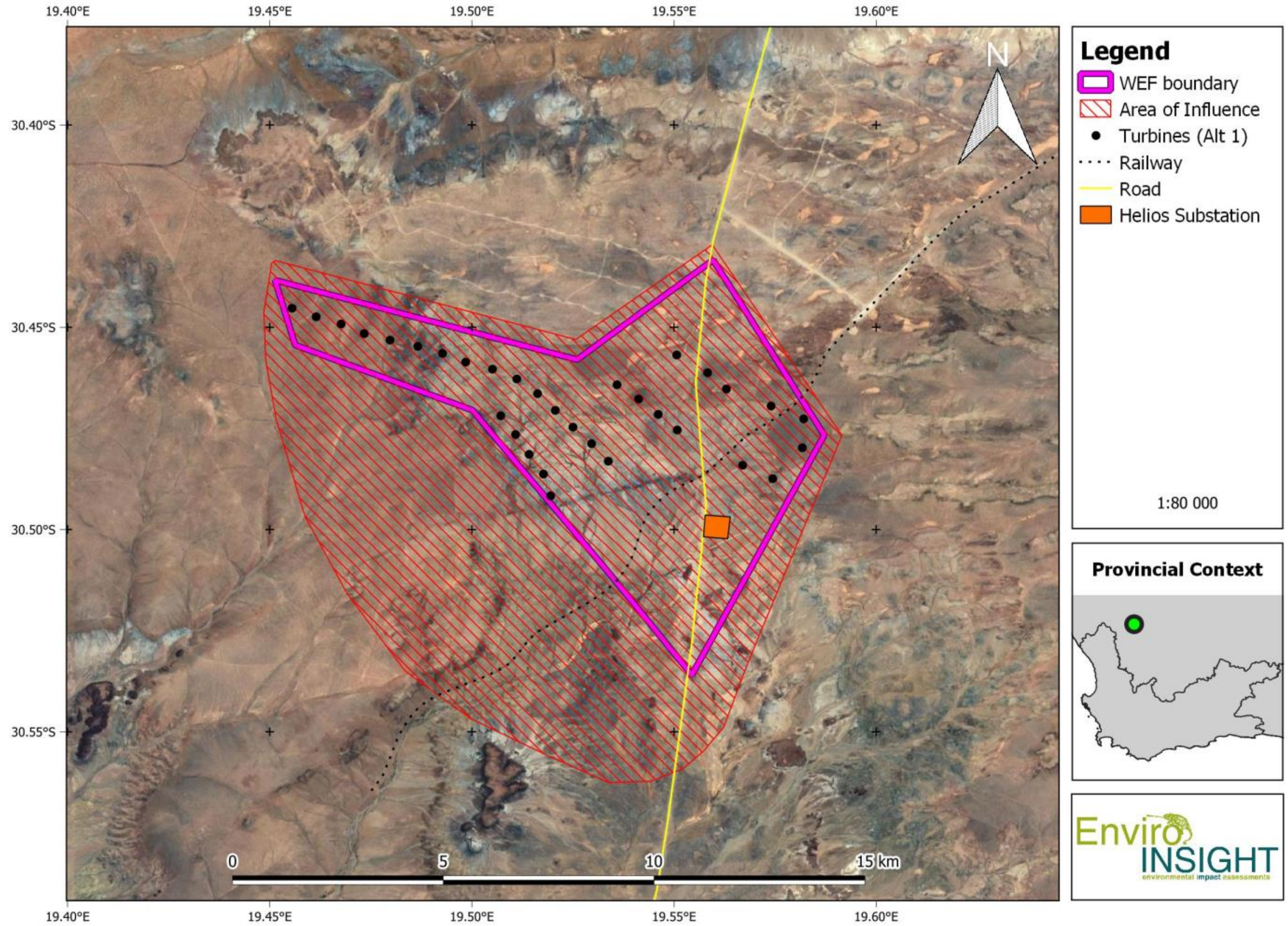

Figure 1-2: Proposed turbine layout and Project Area of Influence (PAOI) of the proposed Botterblom WEF.

1.3 DESCRIPTION OF THE LOCAL AND REGIONAL AFFECTED ENVIRONMENT

1.4 REGIONAL CONTEXT

The study area is located in the Bushmanland Basin Shrubland vegetation type (Figure 1-3;Table 1-1; Mucina & Rutherford, 2010). Bushmanland Basin Shrubland occurs on the extensive basin centered on Brandvlei and Van Wyksvlei, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt in the north to around Williston in the south. The area is characterised by slightly irregular plains dominated by a dwarf shrubland, with succulent shrubs or perennial grasses in places. The geology consists largely of mudstones and shales of the Ecca group and Dwyka tillites with occasional dolerite intrusions. Soils are largely shallow to non-existent, with calcrete present in most areas. The mean annual rainfall ranges from 100-200 mm and occurs mostly during the summer months as intermittent thunderstorms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Concern. None of the vegetation type is conserved in statutory conservation areas. According to Mucina & Rutherford (2006 as amended) no signs of serious transformation are present for the vegetation type, but scattered individuals of exotic and invasive *Prosopis* sp. occur in some areas (e.g. in the vicinity of the Sak River drainage system), and some localised dense infestations form closed 'woodlands' along the eastern border of the vegetation type with Northern Upper Karoo (east of Van Wyksvlei) (Mucina & Rutherford, 2006 as amended). There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum* subsp *oliverorum* are listed as being endemic to the vegetation type (Mucina & Rutherford, 2006 as amended). Other vegetation types which occur in the wider area include Hantam Karoo, some small pans in the area which fall within the Bushmanland Vloere and Namaqualand Riviere vegetation types. These are however outside of the study area and would not be affected directly by the proposed Botterblom WEF.

Table 1-1: Attributes of the Bushmanland Basin Shrubland vegetation type (Mucina & Rutherford, 2006 as amended)

Name of vegetation type	Bushmanland Basin Shrubland
Code as used in the Book	NKb6
Conservation Target (percent of area) from NSBA	21%
Protected (percent of area) from NSBA	%
Remaining (percent of area) from NSBA	99.5%
Description of conservation status from NSBA	Least threatened
Description of the Protection Status from NSBA	Not protected
Area (km^2) of the full extent of the Vegetation Type	34690.68
Name of the Biome	Nama-Karoo
Name of Bioregion	Bushmanland Bioregion

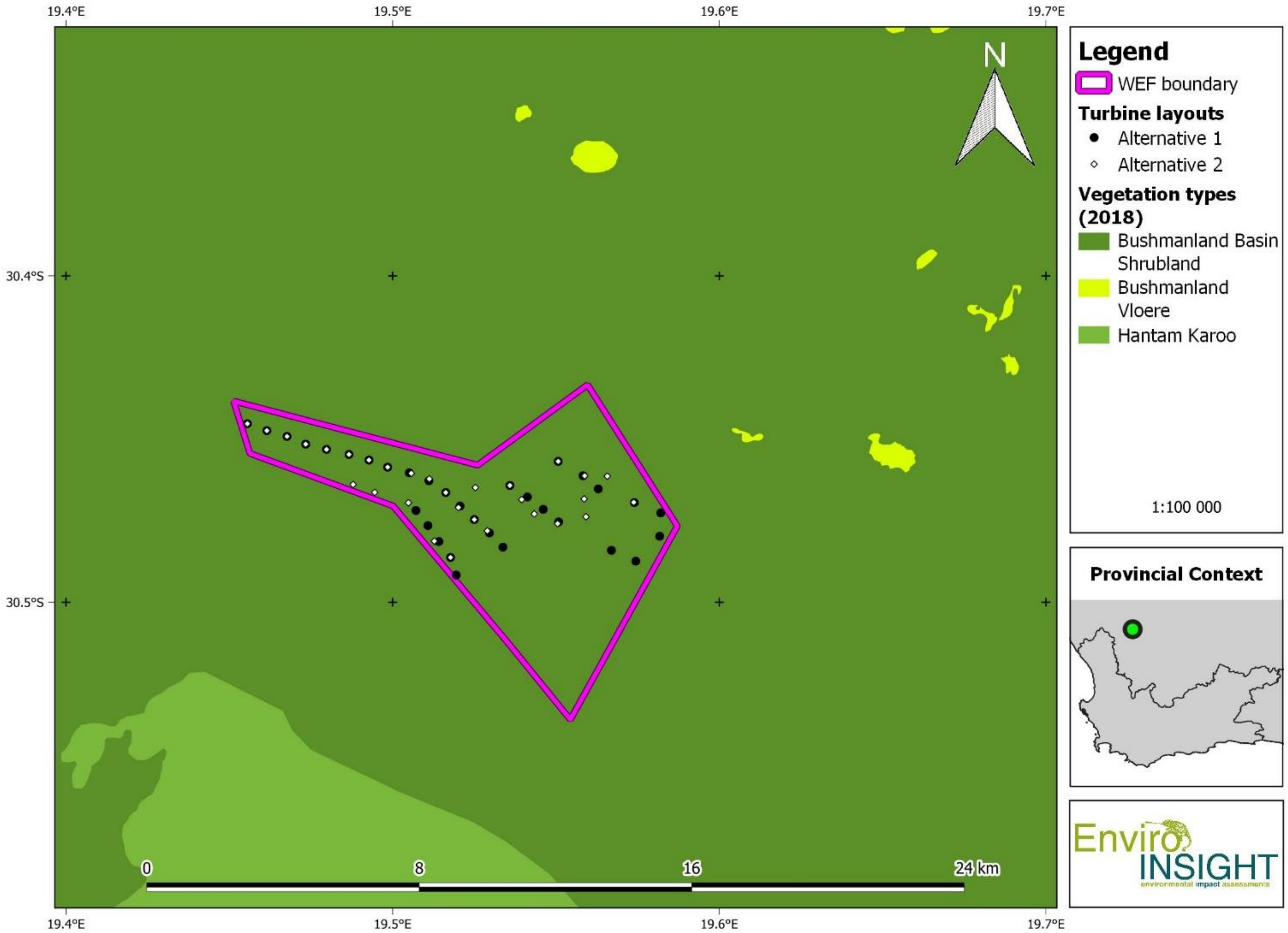

Figure 1-3: The proposed Botterblom WEF in relation to regional vegetation types.

1.5 STUDY LIMITATIONS

- It is assumed that all third-party information acquired is correct (e.g., GIS data, existing facility mortality data and the prescribed scope of work);
- There is still limited information available on the environmental effects of wind energy facilities in South Africa. Only a summary of the results of post-construction monitoring from eight wind farms in South Africa is available (Ralston Paton *et al*. 2017). Estimates of impacts are therefore also based on knowledge gained internationally, which should be applied with caution to local species and conditions;
- The Best Practice Guidelines for Martial Eagles are yet to be released onto the public sphere. Thus, a combination of case-study precedents, discussions with subject matter experts and the BARSEG panel as well as the specialist opinions were used to drive the species specific conclusions;
- While sampling effort was conducted as recommended in the guidelines, to achieve statistically powerful results it would need to be increased beyond practical possibilities. The data was therefore interpreted using a precautionary approach.
- Vantage point surveys are only conducted during daylight. Therefore, any bird movement occurring at night was recorded under *ad hoc* conditions. Some waterbirds and night migrants are known to make regular flights and migration movements at night.

2 LEGISLATIVE FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL SCREENING TOOL AND ENVIRONMENTAL THEME PROTOCOLS

2.1.1 Screening Report

The Minister of Environment, Forestry and Fisheries, gave notice that the submission of a report generated from the national web-based environmental screening tool[1], as contemplated in Regulation 16(1)(b)(v) of the Environmental Impact Assessment Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, will be compulsory from 4 October 2019 when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the Environmental Impact Assessment Regulations, 2014.

In addition, a set of protocols that an applicant needs to adhere to in the Environmental Authorisation (EA) process were developed and on 20 March 2020 the Minister of Forestry, Fisheries and the Environment gazetted the Protocols for national implementation purposes. The gazette '*Procedures to be followed for the Assessment and Minimum Criteria for Reporting of Identified Environmental Themes in terms of Section 24(5)(a) and (h) of the National Environmental Management Act (1998) when Applying for Environmental Authorisation*', has protocols that have been developed for environmental themes which include agriculture, avifauna, biodiversity (Terrestrial and Aquatic Biodiversity), noise, defence and civil aviation.

[1] https://screening.environment.gov.za/screeningtool/#/pages/welcome

The protocols set requirements for the assessment and reporting of environmental impacts of activities requiring EA. The higher the sensitivity rating of the features on the proposed site as identified by the screening tool report, the more rigorous the assessment and reporting requirements. bird species sensitive to wind energy developments. Accordingly, the sensitivity has been reclassified as High (Figure 2-1).

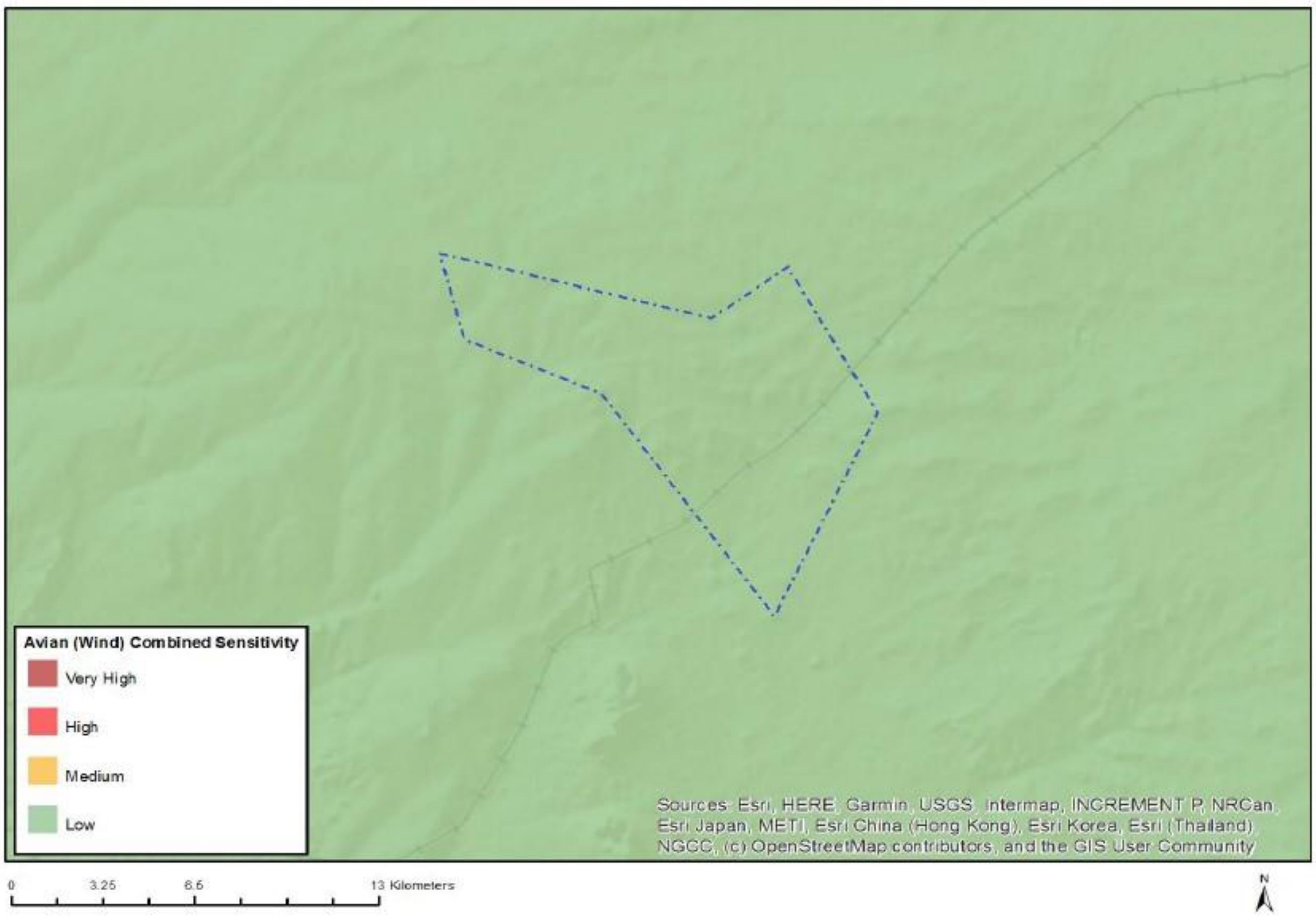

Figure 2-1: Environmental Screening Tool avifauna sensitivity theme map the proposed Botterblom WEF.

2.2 RENEWABLE ENERGY DEVELOPMENT ZONE

On 17 February 2016, Cabinet approved the Renewable Energy Development Zones (REDZs) for large scale wind and solar photovoltaic development and associated Strategic Transmission Corridors (STC) which support areas where long term electricity grid will be developed. The procedure to be followed in applying for EA for a large-scale project in a REDZ or in a Power Corridor was formally gazetted on 16 February 2018 in GN113 and GN114. On 17 July 2020, Minister Barbara Dallas Creecy, published Government Gazette 43528, Notice 786 for consultation with the intention to identify three additional Renewable Energy Development Zones to the eight Renewable Energy Development Zones published under Government Notice No. 114 in Government Gazette No. 41445 of 16 February 2018. REDZs are also aligned with the powerline corridors that were identified in the Electricity Grid Infrastructure SEA completed in 2016 and gazetted as powerline corridors in February 2018. In this way, the combination of the REDZs and power corridors provides strategic guidance to ESKOM on where to prioritise investment in grid infrastructure.

New renewable energy projects located within one of the 11 REDZ areas, and new electricity grid expansion within the 5 STCs are subject to a Basic Assessment (BA) and not a full EIA process, as well as a shortened timeframe of 147 days (90 day BA process and 57 decision-making process). The proposed Botterblom WEF is not located in a REDZ but is located in the Western Strategic Transmission Corridor.

2.3 BIRDS AND WIND-ENERGY BEST-PRACTICE GUIDELINES (2015)

The "*Best-Practice Guidelines for assessing and monitoring the impact of wind-energy facilities on birds in southern Africa*" (Jenkins et al., 2015) are followed in order to fulfil the outlined requirements. This document became a legal requirement due to the NEMA Protocols (March 2020).

As per Appendix 2 - *Minimum requirements for avifaunal impact assessment*, an avifaunal impact assessment for a WEF should follow a two-tier process:

1. Scoping - a review of the existing literature and data, as well as a site visit to inform the design of a site-specific survey and preconstruction monitoring plan.
2. Impact assessment – systematic and quantified monitoring over four seasons that will inform a full EIA detailing and analysing the significance of likely impacts and available mitigation options.

3 METHODS

3.1 GIS

Existing data layers were incorporated into a GIS to establish how the proposed WEF layout and associated activities interact with important terrestrial entities. Emphasis was placed on the following spatial datasets:

- Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018);
- NFEPA wetlands and rivers (CSIR 2011);
- Important Bird Areas (IBAs) (Marnewick *et al*., 2015); and
- GIS layers provided by the client.

All mapping was performed using open-source GIS software (QGIS[2]).

3.2 DESKTOP AND LITERATURE SURVEY

Prior to the initiation of field surveys, a desktop survey was conducted to consider the best information available, in order to provide a better evaluation of all conditions present within the study area. An initial literature review was undertaken to assess which bird species could potentially occur in the vicinity of the Botterblom WEF using data from the second South African Bird Atlas Project (SABAP 2[3]; [SABAP2, 2020]). SABAP 2 records were developed based on records per pentad (i.e., 5' X 5'). A list of species potentially occurring was developed from SABAP 2 data for the pentads within which the study area falls (3025_1930, 3025_1925, 3030_1930, 3025_1935) (

Figure 3-1). The expected species list (Appendix 1) is therefore based on an area much larger than the actual study area and was therefore subsequently refined. This approach was adopted to ensure that all species potentially occurring within the study area, whether resident, nomadic, or migratory, are identified.

From the generated expected species list, the sensitivity of avifauna species towards the potential impacts from the Botterblom WEF was evaluated using the Avian Wind Sensitivity Map (Retief *et al.,* 2012). Other species not listed in the referred document were also considered sensitive because of their abundance, flight characteristics, ecological role, population trend and conservation status. A preliminary list of focal species impacts for this study area was compiled based on existing Avifaunal Environmental Impact Assessment and post-construction mortality monitoring reports for the area (notably for the adjacent Khobab WEF) and supplemented with sensitive species identified in the previous steps.

The following main literature sources have been consulted for the avifauna study:

- The existing preconstruction avifaunal assessments for the Kokerboom 1, 2 and 3 WEFs, Dwarsrug WEF and Loeriesfontein WEF;

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[2] http://qgis.osgeo.org/en/site/
[3] http://sabap2.birdmap.africa/

- Information relating to avifauna species of conservation concern (SCC) was obtained from Taylor *et al.* (2015) and the IUCN Red List of threatened species (IUCN, 2021);
- del Hoyo *et al.* (1992) and Hockey *et al.* (2005) were consulted for general information on the life history attributes of relevant bird species;
- Distributional data (apart from those obtained during the surveys) was sourced from the Southern Africa Bird Atlas Project (SABAP 2, 2021), del Hoyo *et al.* (1992) and Sinclair & Ryan (2010);
- Nomenclature and taxonomy followed the IOC World Bird Names unless otherwise specified (see www.worldbirdnames.org; Gill & Donsker, 2012); and
- Priority species (including rankings) with regards to wind farms are based on Retief *et al.* (2012) which has been further applied in the region by Ralston-Paton *et al.* (2017).
- Mortality data (Chris van Rooyen Consulting, 2020) from the adjacent existing Khobab WEF were provided by BirdLife South Africa.

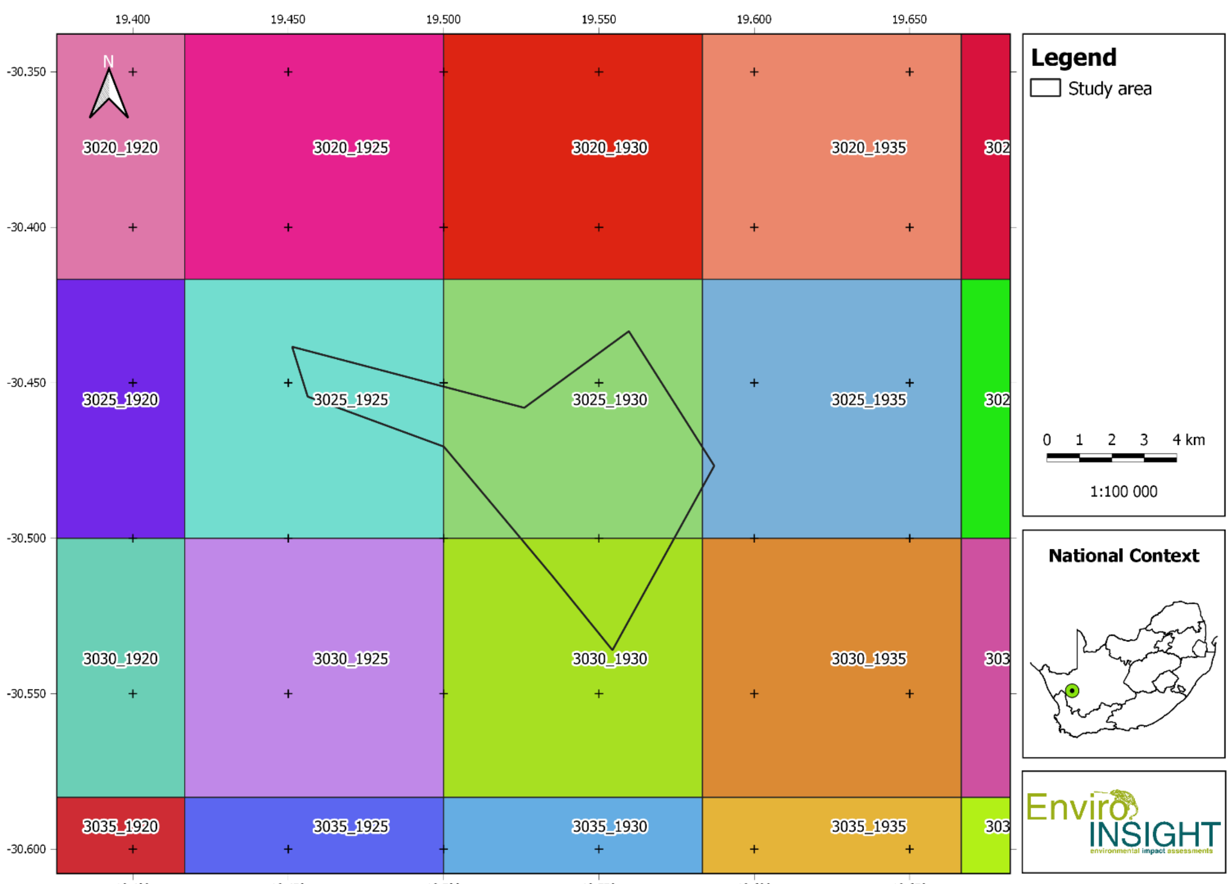

Figure 3-1: The Botterblom WEF in relation to the SABAP2 pentads.

3.3 PRECONSTRUCTION BIRD MONITORING SURVEY DESIGN

The field surveys were arranged so that the study area and control sites were surveyed for a total of 12 months and completed in September 2021. This complies with the requirements of the Best Practice Guidelines available at the time (Jenkins *et al.* 2015). The preconstruction monitoring programme has included a total of four visits to the site, covering the study area through a twelve-month period that included the spring, summer, autumn and winter seasons of the (non-calendar) year. The first survey conducted in September 2020 (Spring) was part of the scoping phase and limited methods were applied, i.e., only walk transect (WT) and drive transects (DT) were conducted to establish these sites, in addition to two vantage point (VP) were conducted for a limited time to capture initial data for planning purposes. All subsequent survey dates are summarised as Table 3-1 below.,

Table 3-1: Avifauna monitoring sampling period for Botterblom WEF and Control Site.

Date	Season	Methodology applied*
2-5 September 2020	Spring	VP, WT, DT – scoping phase
8-10 December 2020	Summer	VP, WT, DT
13 - 17 May 2021	Autumn	VP, WT, DT, NE, WB
9 - 14 July 2021	Winter	VP, WT, DT, NE, WB
31 August - 4 September 2021	Spring	VP, WT, DT, NE, WB

*** VP – Vantage points; WT – Walked transects; DT – Drive transects; NE – Nest searches, inspection and monitoring; WB – Water body inspections.**

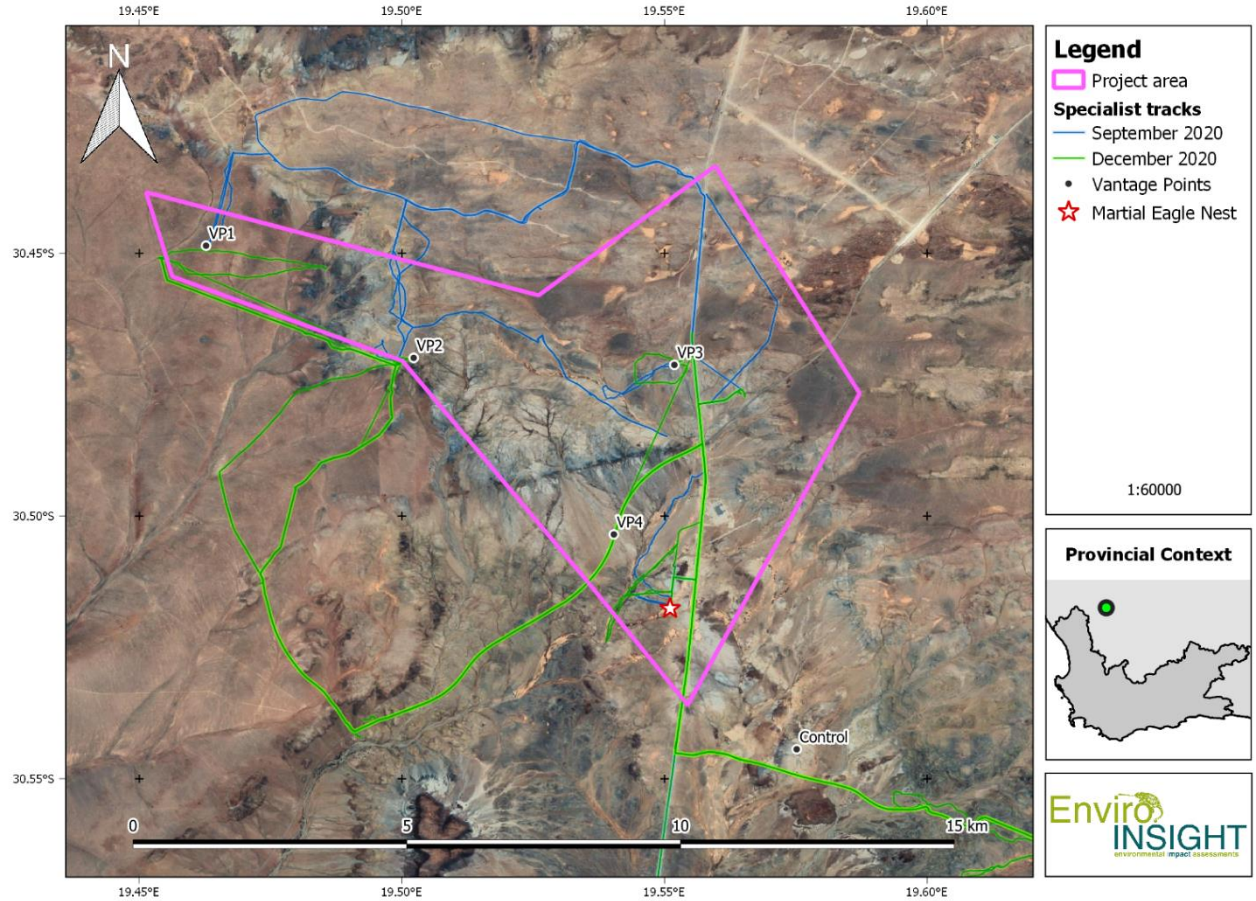

Figure 3-2: Avifauna survey sites and specialist coverage (GPS tracks) for the proposed Botterblom WEF.

3.3.1 Vantage Points

Four vantage points (VPs) within the project study area were identified based on the preliminary desktop and scoping survey in the Botterblom WEF, and one identified at the control area, to record the flight altitude and patterns of priority species (totaling five VPs). These sampling points were located at strategic locations within the Botterblom WEF and set up to allow the visual coverage of the wind farm (placing special emphasis on the proposed turbine locations) and its immediate surroundings. VP surveys were conducted accordingly to the most recent recommendation from the best practice guidelines at the time (Jenkins *et al.* 2015). Each location was surveyed for a minimum of 12 hours of observation per season divided through the early morning, midday and late afternoon times of day (Jenkins *et al.* 2015). For more information on each VP, refer to Table 3-2.

Table 3-2: Description of the five Vantage Points surveyed

Vantage Point	Location	Number of observers	Angle of survey	Line of site	Season
VP1	30°26'54.80"S, 19°27'45.70"E	One	180	>1000 m	Spring, Summer
VP2	30°28'11.67"S, 19°30'8.01"E	One	180	>1000 m	Spring, Summer
VP3	30°28'16.45"S, 19°33'6.65"E	Two	360	>1000 m	Summer
VP4	30°30'12.62"S, 19°32'25.19"E	Two	360	>1000 m	Summer
VP5 (control)	30°32'39.83"S, 19°34'30.50"E	One	180	>1000 m	Summer

3.3.2 Walked Transects

This method is utilised to monitor all birds, especially less obvious smaller bird species within the major habitat types within a study area. Transects were positioned at varying distances away from the proposed turbine arrays (see Figure 3-3) to maximise the comparative value of the data which will be compared with the surveys from the post-construction phase results.

Four linear transects ranging from 1.4 km to 3.3 km in length, three located in the Botterblom WEF and one within the control area, were walked in order to characterize the passerine and small bird communities (Table 3-3). These transects are representative of the biotopes present within the study area. These transects (excluding that in the control area) were located within the turbine area of influence available at the time (Drewitt & Langston, 2006). To avoid pseudo-replication, transects were located at a minimum distance of 400 m apart from one another (Sutherland, 2006). Each transect was conducted by one expert bird observers at a time (more than one observer for all transects were used), who recorded all bird contacts (both seen and heard) by walking slowly along the predetermined transect. Observations were made on both the left and right side of the predetermined transect. Birds were only recorded (seen or heard) within a fixed maximum width of between 150 to 200 m on either side if the transect line. The same transects were repeated in every season. Surveys started after sunrise and were performed throughout the day to account for temporal variation in bird activity.

As a general rule, transects were not walked in adverse conditions, such as heavy rain, strong winds or thick mist. During the surveys, no adverse conditions were recorded that precluded successful analysis.

Table 3-3: Walk transect lengths and total length.

Transect	Length (km)
Walk - Control	1.82
Walk - WT1	1.50
Walk - WT2	1.39
Walk - WT3	3.34
Total	**8.05**

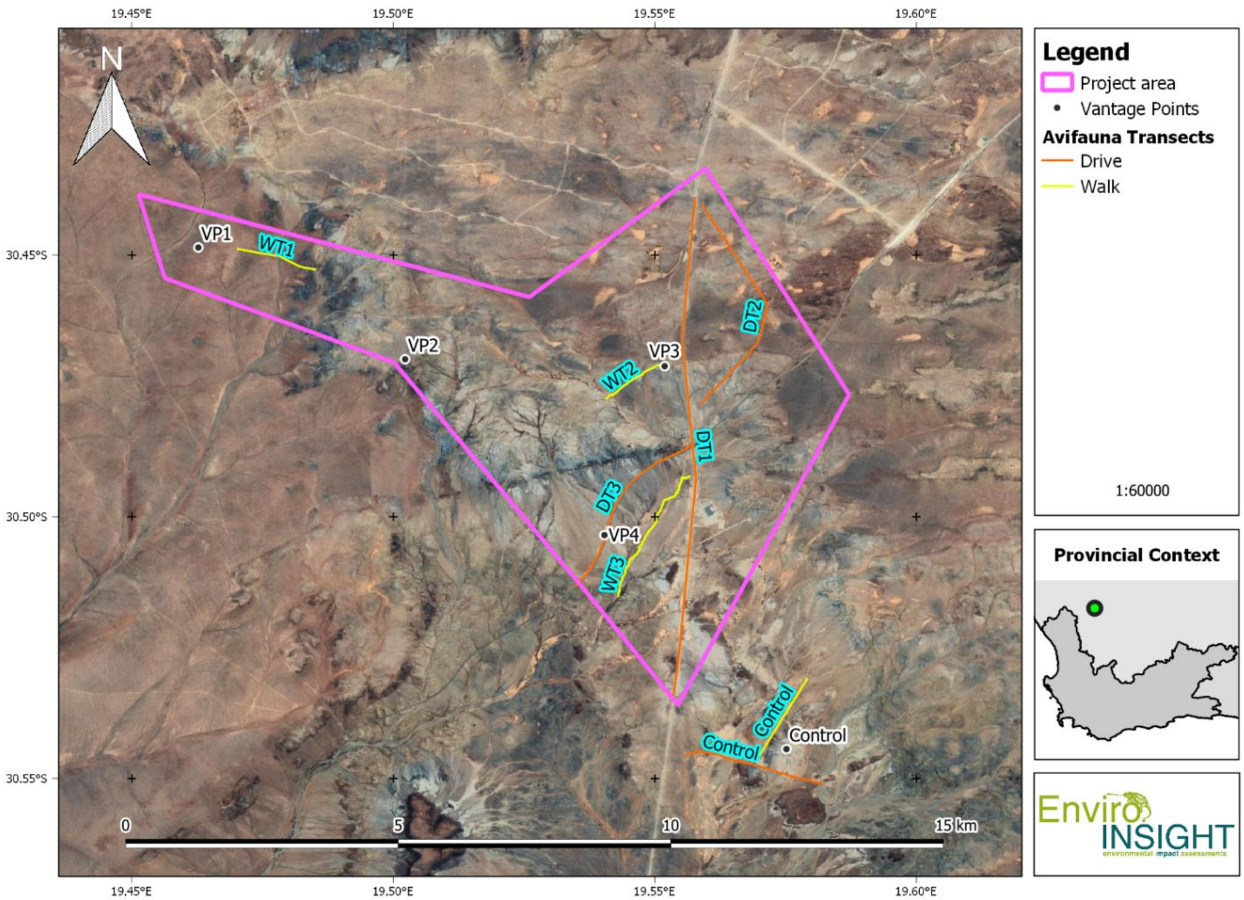

Figure 3-3: Avifauna walk transects (WT) and drive transects (DT) for the proposed Botterblom WEF.

3.3.3 Driven Transects

Large terrestrial birds (e.g., cranes, bustards, and most raptors) cannot be adequately surveyed using walked transects. Populations of such birds should be estimated on each visit to the project area by means of road counts (vehicle-based sampling; best applied for relatively large proposed WEFs, especially those with good networks of roads and tracks).

Road counts of large terrestrial birds and raptors require that one or a number of driven transects be executed (depending on site size, terrain and infrastructure), comprising one or a number of set routes, limited by the existing roadways but as far as possible directed to include a representative cross section of habitats within the project area of influence (PAOI).

These transects were driven at a constant and slow speed (± 15 km/h), and all sightings of large terrestrial birds and raptors were recorded in terms of the same data-capture protocols used for walked transects (above), and in general compliance with the road-count protocols described for large terrestrial species (Young et al., 2003) and raptors (Malan, 2009). Three drive transects were identified in the Botterblom WEF and one drive transect in the control area with a combined total length of 22 km (Figure 3-3; Table 3-4). One observer travelling slowly in a vehicle recorded all species on both sides of the drive transect. The observer stopped at regular intervals (every 100 to 300 m) to scan the environment with binoculars.

Table 3-4: Drive transects lengths and total length.

Transect	Length (km)
Drive - Control	2.62
Drive - DT1	10.63
Drive - DT2	4.91
Drive - DT3	3.81
Total	**21.97**

3.3.4 Wetlands

Prior to the initiation of the preconstruction monitoring campaign, the main water bodies (including wetlands) present within the study area were identified on a Geographical Information System (GIS) by using 1:50 000 topographic maps and aerial photos. Several significant water bodies were identified on and surrounding the study area. These identified and mapped water bodies were surveyed to determine their level of utilisation by water birds. Due to seasonality, the birds were only be surveyed during periods with some prevailing inundation or rainfall. Some drainage lines within the greater PAOI were inundated during the 2020 spring surveys and were observed accordingly.

3.3.5 Specialist Nest Survey

Any habitats within the PAOI of the proposed WEF, or equivalent habitats around the study area, deemed likely to support nest sites of key raptor and other species of conservation concern, including power lines, stands of large trees, marshes and drainage lines, were surveyed. All potential breeding sites, once identified fully, were mapped, and checked during each survey to confirm occupancy, and all evidence of breeding and the outcomes of such activity, where possible, recorded.

3.3.6 Incidental Observations of Priority Species

All other sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) on the WEF and control site as well as within the broader study area were recorded, along with additional relevant information such as habitat type, abundance, habits and weather data. These observations were used as complementary data to characterise the bird community and its utilisation of the site, as recommended by the Best Practice Guidelines (Jenkins *et al*., 2015).

3.3.7 Species Collision Risk and Bird Passage Rate

For pre-construction surveys of this nature, Collision Risks are usually calculated using the following equation:

Duration of medium and high-altitude flights x collision susceptibility calculated as the sum of morphology and behaviour ratings x number of planned turbines ÷100:

However, and for the survey area, this was not possible due to the extreme variations in undulations at the vantage points, not allowing for standardised measurements of duration. Therefore, collision risk was calculated based on a measurement of the three assumed variations of crude passage rates as described by Smallie and Strugnell (2020), primarily focusing on passage rate, flight height and total surface area of turbines.

3.4 SPECIES OF CONSERVATION CONCERN

The Red List of threatened species generated by the IUCN (http://www.iucnredlist.org/) provided the global conservation status of avifauna. However, Taylor *et al*. (2015) produced a regional conservation status assessment following the IUCN criteria which was used for this scoping report. The first three categories i.e., Critically Endangered, Endangered and Vulnerable, are collectively called 'threatened' species.

The conservation status categories defined by the IUCN, which are considered here to represent species of conservation concern (SCC), are defined as follows:

- **Critically Endangered (CR)** - Critically Endangered refers to species facing immediate threat of extinction in the wild.
- **Endangered (EN)** - Endangered species are those facing a very high risk of extinction in the wild within the foreseeable future.
- **Vulnerable (VU)** - Vulnerable species are those facing a high risk of extinction in the wild in the medium-term.
- **Near Threatened (NT)** - any indigenous species which does not qualify for Critically Endangered, Endangered or

Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. NEMBA also deals with endangered, threatened and otherwise controlled species, under the Threatened or Protected Species Regulations (ToPS). A ToPS permit is required for any activities involving the removal or destruction of any ToPS-listed species.

Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

4 RESULTS

4.1 PROTECTED AREAS AND IMPORTANT BIRD AREAS

The Botterblom WEF is not located in or directly adjacent to an Important Bird Area (IBA) or protected area. The closest IBA to the Botterblom WEF is Bitterputs Conservation Area which is approximately 72 km north-west of the study area.The Bitterputs Conservation Area (SA036) is an arid landscape which consists of extensive sandy and gravel plains covered with sparse, perennial desert grassland. A few large salt pans are a unique habitat type in this IBA. The conservation area falls within the Bushmanland Bioregion and the Nama Karoo Biome. Three vegetation types are present: the Bushmanland Vloere (salt pans), Bushmanland Arid Grassland and Bushmanland Sandy Grassland. The ecosystem status for the entire area is Least Concern.

The Bitterputs Conservation Area is one of a few sites protecting both the globally threatened Red Lark (*Calendulauda burra)*, which inhabits the red sand dunes and sandy plains where there is mixed cover of grasses and dwarf shrubs, and the near-threatened Sclater's Lark (*Spizocorys sclater)i*. This site also holds 16 of the 23 Namib-Karoo biome-restricted assemblage species and a host of other arid-zone birds. Other priority species, including globally threatened species, within this IBA include Ludwig's Bustard (*Neotis ludwigii),* Kori Bustard (*Ardeotis kor)i*, Karoo Korhaan (*Eupodotis vigorsii)*, Secretarybird (*Sagittarius serpentarius)* and Lanner Falcon (*Falco biarmicus)*. Restricted-range and biome-restricted species are Stark's Lark (*Spizocorys starki)*, Karoo Long-billed Lark (*Certhilauda subcoronata)*, Black-eared Sparrow-lark (*Eremopterix australis)*, Tractrac Chat (*Cercomela tractrac)*, Sickle-winged Chat (*C. sinuate)*, Karoo Chat *C. schlegelii*, Karoo Eremomela *Eremomela gregalis*, Cinnamon-breasted Warbler (*Euryptila subcinnamomea)* and Black-headed Canary (*Serinus alario)*.

The Bitterputs Conservation Area is one of three Bushmanland IBAs important for the conservation of endemic lark species. There has been a c. 75% loss of optimal habitat for the Red Lark over the past 100 years. The disappearance of this species from ranches where dune grassland has been replaced by ephemerals is probably linked to the reduction in grass awns for nesting, shelter and invertebrate and plant foods.

There is a serious threat from climate change and it is predicted that temperatures will increase and rainfall decrease sharply in arid areas such as Bushmanland. Locally resident endemic larks, in particular, are at risk. Increased CO_2 can lead to the increase of C3 plants (shrubs) at the expense of C4 plants (mainly grasses), causing a shift in vegetation diversity and structure and making the habitat unsuitable for some species. It is expected that the Red Lark will not meet the challenge of global warming (BirdLife International, 2021).

Currently no part of this IBA is formally conserved and no conservation actions have been implemented. Bitterputs falls within the Central Astronomy Advantage Area, which has restrictions on activities that can take place in it. This could result in some protection for the IBA.

4.1.1 Flagship species for the region

Flagship species are defined as species that may be highly conspicuous, readily identifiable, of high conservation value (SCC), of high tourism value or are endemic to the region. The Northern Cape is home to the South African (and Northern Cape Province) endemic Red Lark. It is a highly range restricted species that occurs on red dune (Nama Grassland as defined by the habitat delineation) habitat that provides a variety of sandy substrate and vegetation requirements, including annual grasses, perennial grasses and sparse woody vegetation. This species is currently poorly represented within existing protected areas across its range and is threatened by habitat loss and fragmentation primarily through intensive stock farming activities and most recently, renewable energy developments.

This province hosts significant populations of arid-adapted large terrestrial birds which have been recorded (and are expected) within the PAOI such as Kori Bustard, Ludwig's Bustard and Karoo Korhaan. Additional "flagship" bird species include Martial Eagle, Verreaux's Eagle, Secretary Bird, with occasional incursions within the PAOI such as Lappet-faced Vulture (incidental sightings) and indeed, other vulture species.

4.2 DESCRIPTION OF MAJOR BIRD HABITATS

A refined habitat map (Figure 4-1) was created in order to relate the delineation to avifaunal habitats in the study area. Some avifaunal habitats are merged from multiple vegetation types for the sake of ecological understanding. The primary avifaunal habitats are described in tabular formats below with accompanying representative photographs. The delineated sensitivity of the avifaunal habitats will not be fully understood until the completion of the 12-month monitoring period. Sensitivity will largely be based upon "Avifaunal value" which relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain certain avifaunal assemblages (with specific reference to SCC), their food supply and breeding habits. It is apparent throughout the study area that most of the habitats are generic in their ability to support general avifaunal species and Red-Listed / SCC with little differentiation. However, unique geological (such as red dunes) geographical or topographical features exist which may cause the areas these areas to be buffered from proposed development. Due to the high diversity and density of the above mentioned Red-Listed species recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the PAOI as a whole is considered to be an area of avifaunal importance and the EIA will be strongly associated with Guidelines at a policy level, prioritising avoidance mitigation and the monitoring of avifaunal SCC.

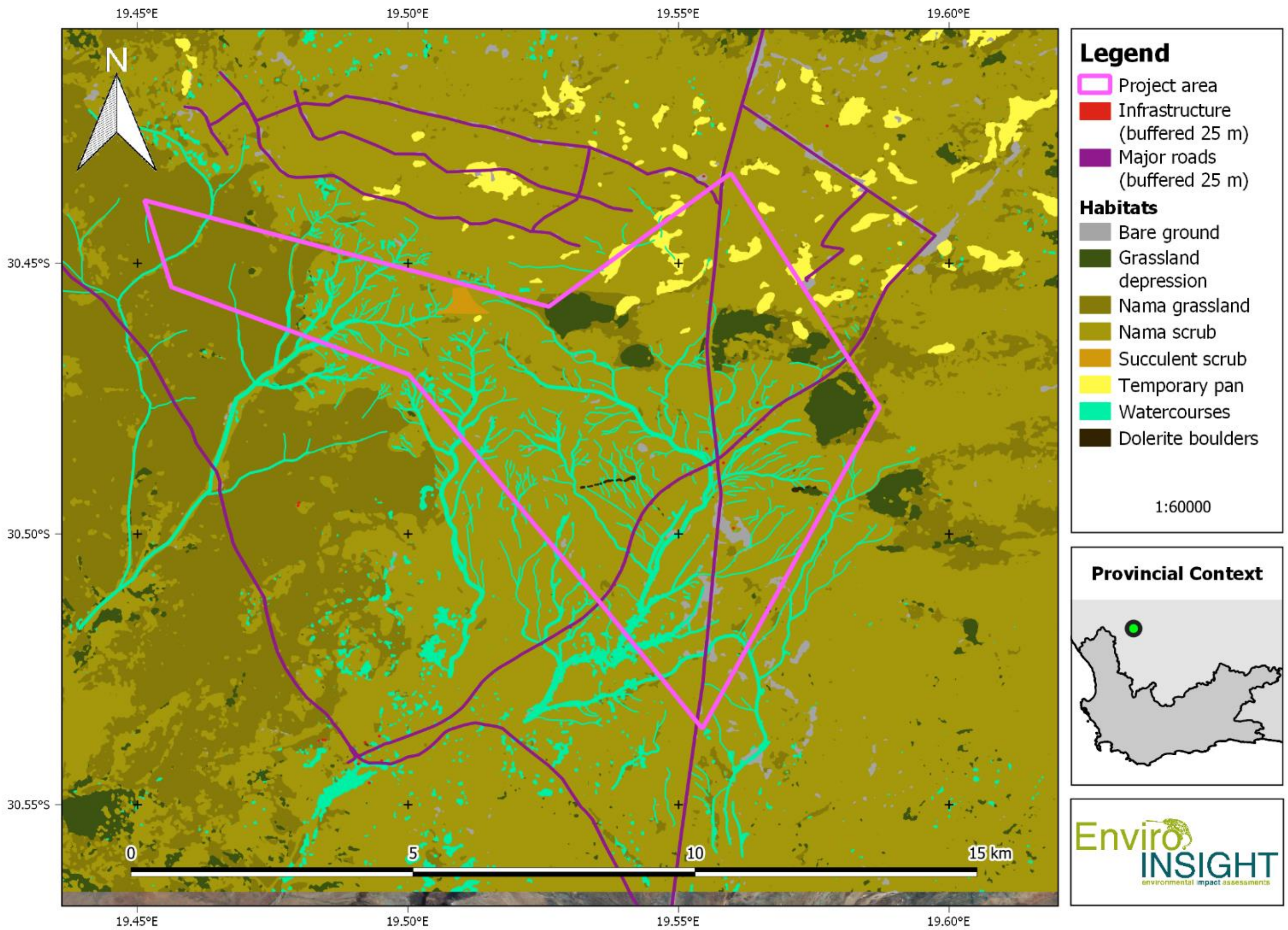

Figure 4-1: Avifauna habitat map for the proposed Botterblom WEF PAOI.

4.2.1 Watercourses and Drainage Lines

Photographs	Watercourses and Drainage Lines
 	**Classification:** Ephemeral and endorheic drainage lines **Hydrology:** No major hydrological impacts are expected from the development. **Geomorphology:** Channels varying in width and depth from large multi-channeled sandy gullies to shallow narrow channels. **Vegetation:** Vegetation varies depending on channel width and depth, where larger deep-rooted trees line larger channels with lower shrub layers characterising smaller drainage line systems. **Avifaunal Characteristics:** Avifaunal assemblages differed depending on the classification of the drainage line system as well as the season. Most of the drainage line systems are seasonally ephemeral or dry. Thus, most of the bird associations are linked to the prevailing vegetation and soil types within the delineated drainage line habitats. In summary, drainage lines with taller shrub and tree layers showed a much higher diversity of passerine species as well as sand-associates and ground-dwelling birds such as coursers and thick-knees. Species of conservation concern such as Red Lark and Sclater's lark were observed in varying densities. The seasonal drainage lines and accompanying riparian trees are linear dispersal corridors for terrestrial bird species. Much higher species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are classified to be of high avifaunal importance. The drainage lines act as important flight corridors for passerines and raptors between foraging and roosting sites.

4.2.2 Nama Grassland/ Grassland Depression

Photographs	Nama Grassland
	**Classification:** Nama Grassland/ Grassland Depressions **Hydrology:** No major hydrological impacts are expected from the development. **Geomorphology:** Undulating sandy karroid habitat with fewer flat areas and variable basal layer. **Vegetation:** Vegetation varies depending on slope and depth of topsoil and is characterized by grassland dominated and interspersed by succulent/ Nama/ scrub (in varying ratios) karroid vegetation **Avifaunal Characteristics:** The open grassed karoo habitats show a reduced structural complexity and vegetation which provides for a more generic species diversity albeit often higher densities of avifauna. The habitat contains features similar to the Nama Scrub, namely open karoo habitats (including old, cultivated lands and some grassland areas) that provide suitable foraging habitat for Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*). However, the habitat is characterised by a much-reduced rocky substrate and a higher prevalence of grassed red sand infusions which provides infused and highly localized portions of optimal habitat for Red Larks. .

4.2.3 Transformed areas

Photographs	Transformed areas
 	**Classification:** Roads, bridges, verges, powerlines, rail tracks, homesteads, existing infrastructure, kraals **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** Highly varied depending on location, especially for linear infrastructure. **Vegetation:** Vegetation varies depending on infrastructure type. **Avifaunal Characteristics:** Low density permanent structures, including bridges, railway tracks, gravel roads, homesteads consisting of houses, and kraals are present. These locations may be important for several bird species which use them for roosting and/or nesting, such as owls and swallows as well as valuable roosting and nesting habits for a wide spectrum of species ranging from the synanthropic (Pied Crows) to the Red-Listed (Martial Eagles). Observations confirmed that a high density of birds, mainly raptors, can frequently be found associated with road infrastructure, possibly due to the prevalence of perching locations, such as electric or telephone lines running alongside available roads, or due to road kills (attracting scavenging species). However, species such as Ludwig's bustard would fly directly above large linear structures such as train tracks, presumably for the purpose of navigation. Finally, homestead and livestock related transformed areas act as attractants for both synanthropic and some Red-Listed species that seek water or food.

4.2.4 Nama Scrub/ Succulent Scrub/ Dolerite Boulders

Photographs	Nama Scrub/ Succulent Scrub
	**Classification:** Nama Scrub/ Succulent Scrub/ Dolerite Boulders **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** Undulating scrub Nama and semi-succulent karroid habitat with large extents of flat terrain. **Vegetation:** Vegetation varies depending on slope and depth of topsoil and varies between Nama Scrub dominated and succulent dominated (in varying rations) karroid vegetation **Avifaunal Characteristics:** The stony and rocky ridges (ridges found more within the PAOI and not prevalent on the study area) act as prominent landmarks and foraging habitat for diurnal birds of prey. It also provides potential hunting habitat for the all SCC eagles which hunts rock hyrax (common in these habitats) and rock rabbits as a staple of their dietary requirements. The localised high population densities of small mammals such as rock rabbits within the PAOI as well as the regional linkage to the koppie habitats, elevates the importance of this habitat for avifauna. The rocky habitats provide structural complexity not available in the open karoo vegetation which provides for an increase in species diversity and often higher densities of avifauna due to the prey species that are found in this habitats;. Boulder and/ or rocky habitats intersperse much of the Nama Scrub and provide suitable foraging habitat for the Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*).

4.3 OBSERVED AND EXPECTED AVIFAUNA

4.3.1 Total species composition and abundance

The study area supports a relatively low diversity and abundance of avifauna, which is to be expected in an arid area like Loeriesfontein. A total of 92 species have been observed to date, as shown in Appendix 1. This low diversity is predominantly due to a number of factors including:

- High regional aridity which reduces the overall species diversity;
- Somewhat generic habitat types (albeit with some highly sensitive habitat such as red sands and temporary pans within the PAOI).
- Climate change which is characterised by lower rainfall and increased temperatures.
- A lack of standing water.
- Sub-optimal climate conditions experienced during the survey, especially at the end of a prolonged drought.

It must be noted that stochastic high rainfall events (especially after the prolonged drought periods) and other atypical prevailing influences (persistent cold) may have influenced the local avifaunal assemblages.

4.3.2 Priority species list

A list of expected and observed priority species (Retief *et al.* 2012) in the project area is provided in Table 4-1. A total of 24 priority species are expected to occur on and surrounding the study area, of which 14 have been recorded. Lappet-faced Vulture is included given the sighting of two individuals within the greater PAOI although the species is supposedly a highly uncommon vagrant within the region. However, evidence is growing that the species is undergoing a significant range expansion as a result of climate change

It is clear from Table 4-1 that numerous priority avifauna species occur within the PAOI and can be expected to interact with the proposed Botterblom WEF. The recorded mortality incidence due to priority species colliding with turbines from the adjacent Khobab WEF over 2 years is considered to be of low concern due to a very small number (four) of threatened and identified priority species being killed (Chris van Rooyen Consulting, 2020). The four priority species mortalities were one incidence each of the Near Threatened Karoo Korhaan and priority species Spotted Eagle Owl with two Greater Kestrel mortalities. This was deemed not to be ecologically significant. However, and as with all proposed WEF developments, it is vital to consider the context within which these species are observed in the current study, as congregatory behaviour, nesting behaviour and foraging behaviour may differ from that at the adjacent existing WEF facility. Indeed, Van Rooyen (2020) suggests that displacement effects of the WEF are more significant than direct mortality which can greatly affect habitat specific species such as Red Lark and Ludwig's Bustard. Consequently, all applicable data of priority species observed within the monitoring seasons of field surveys allowed for careful evaluation of potential impacts and application of suitable mitigation measures to reduce these impacts where possible.

Table 4-1: Priority avifauna species list (both expected and recorded as defined by Retief et al. 2012) for the study area.

Common name	Scientific name	Priority species rank	Global Status	Regional Status	South African Endemic	Khobab WEF obs.	Khobab WEF collision mortalities[4]	Current pre-construction monitoring
Bustard, Kori	*Ardeotis kori*	39	NT	NT				X
Bustard, Ludwig's	*Neotis ludwigii*	14	EN	EN		X		X
Buzzard, Jackal	*Buteo rufofuscus*	43	LC	LC	X			
Courser, Burchell's	*Cursorius rufus*	69	LC	VU	X			
Courser, Double-banded	*Rhinoptilus africanus*	72	LC	NT				X
Eagle, Booted	*Aquila pennatus*	59	LC	LC				
Eagle, Martial	*Polemaetus bellicosus*	4	EN	EN		X		X
Eagle, Verreaux's	*Aquila verreauxii*	2	LC	VU				
Eagle-owl, Cape	*Bubo capensis*	42	LC	LC				
Eagle-owl, Spotted	*Bubo africanus*	98	LC	LC			X	X
Falcon, Lanner	*Falco biarmicus*	24	LC	VU				X
Goshawk, Southern Pale Chanting	*Melierax canorus*	75	LC	LC	X	X		X
Kestrel, Greater	*Falco rupicoloides*	95	LC	LC		X	X	X
Kestrel, lesser	*Falco naumanni*	64	LC	LC				
Kite, Black-winged	*Elanus caeruleus*	94	LC	LC		X		X

[4] Confirmed collision mortalities for the SEN WEF as reported in Arcus (2020) for the 4 year post-construction monitoring period May 2016 - May 2020.

Common name	Scientific name	Priority species rank	Global Status	Regional Status	South African Endemic	Khobab WEF obs.	Khobab WEF collision mortalities[4]	Current pre-construction monitoring
Korhaan, Karoo	*Eupodotis vigorsii*	51	LC	NT	X	X	X	X
Korhaan, Southern Black	*Afrotis afa*	37	VU	VU				X
Korhaan, Northern Black	*Afrotis afraoides*	90	LC	LC				X
Lark, Red	*Calendulauda burra*	40	VU	VU		X		X
Lark, Sclater's	*Spizocorys sclateri*	50	NT	NT				X
Secretarybird	*Sagittarius serpentarius*	13	EN	VU				
Snake- Eagle, Black-chested	*Circaetus pectoralis*	60	LC	LC				
Stork, Black	*Circonia nigra*	10	LC	VU				
Vulture, Lappet-faced	*Torgos tracheliotus*	19	CR	CR				

According to the literature, 15 Red-Listed species are known to occur in the region with nine species confirmed during the completed surveys, representing a very high success rate given a single year study period. Of the expected species and according to Taylor *et al.* (2015), two of the species are Endangered, seven of the species are Vulnerable and four are Near-Threatened. For the current study, it was deemed unnecessary that all SCC should be discussed in intensive detail unless deemed highly relevant to the proposed development. However all SCC are described in brief (Table 4-2). Specifically excluded from initial discussions was Lappet-faced Vulture (rare vagrant). Three selected relevant species that are possibly susceptible to the proposed development were discussed below in greater detail, which include specific (Guideline-based) recommendations for monitoring and mitigation. Photographic evidence of SCC observed during the current study is provided in Figure 4-2.

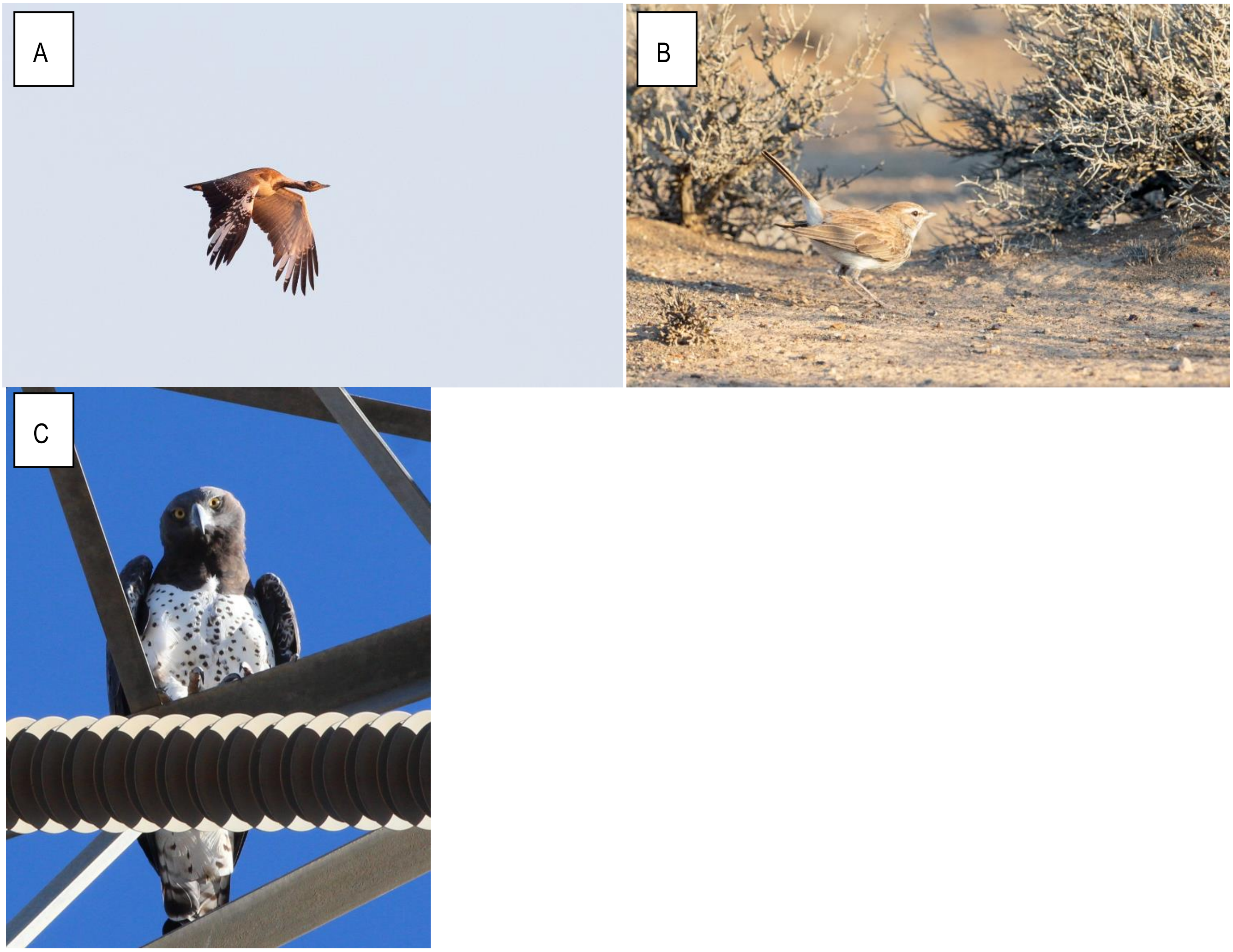

Figure 4-2: Avifauna SCC observed within the proposed Botterblom WEF PAOI[5].

[5] A = Ludwig's Bustard *Neotis ludwigii*; B = Red Lark *Calendulauda burra*; C = Martial Eagle *Polemaetus bellicosus*

Table 4-2: Summary of avifauna species of conservation concern of known distribution, previously recorded in or adjacent to the study area pentads.

Species	Global Conservation Status[6]	National Conservation Status[7]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk posed from the WEF
Ardeotis kori (Kori Bustard)	Near Threatened	Near Threatened	Primary upland grassland, desert savanna and karoo with foraging and roosting particularly on rocky/ hilly terrain.	**Confirmed**: Moderate densities throughout the region and PAOI but surprisingly low densities within the study area. The species is likely to be a breeding resident within or adjacent to the study area. A large bodied species, it is highly susceptible to WEF development activities.
Spizocorys sclateri (Sclater's lark)	Near Threatened	Near Threatened	Dry shrubland, karroid drainage lines and karoo shrubveld	**Confirmed**: High densities throughout the region but uncommon in the study area The species is likely to be a breeding resident within or adjacent to the study area. A localised low flying passerine, it is not highly susceptible to WEF development activities but is threatened by habitat loss
Calendulauda burra (Red lark)	Vulnerable	Vulnerable	Red dune open shrubland/ grassy duneveld	**Confirmed**: Low densities throughout the region but locally common in the study area The species is likely to be a breeding resident within or adjacent to the study area. A localised low flying passerine, it is susceptible to WEF development activities (high display flights) but is more threatened by habitat loss.
Aquila verreauxii (Verreaux's' Eagle)	-	Vulnerable	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax)	**Regionally confirmed, absent from study area**: Frequent foraging resident throughout the PAOI but far less frequent within the study areas due to the large distances to the mountainous preferred habitats and a general lack of localised abundant prey. Localised areas exhibiting high abundance of hyraxes and rock rabbits should be considered highly sensitive to the species. The species is susceptible to poisoning events and WEF facilities with a low risk from proposed activities.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	Open bushveld, desert savanna and karoo with adequate roosting and foraging potential.	**Confirmed:** A rare breeding resident and foraging visitor dependent on adequate food supply and roosts. At least one breeding pair nesting within the proposed WEF boundary (Figure 3-2), but limited sightings in terms of foraging activity

[6] IUCN 2021
[7] Taylor et al. 2015

Species	Global Conservation Status[6]	National Conservation Status[7]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk posed from the WEF
				on the development footprint area. Typically, the species would exhibit a Low to Moderate risk to the proposed development activities although the presence of a permanent nest site and foraging juveniles significantly increases the risk to local individuals.
Rhinoptilus africanus (Double-banded Courser)	Least Concern	Near Threatened	Flat, stony or gravelly, semi-desert terrains with firm, sandy soil and tufty grass or thorn scrub	**Confirmed**. A fairly common breeding resident recorded in the current study. Not highly vulnerable to the proposed activities due to ground dwelling habitats. .
Ciconia nigra (Black Stork)	-	Vulnerable	Breeds on steep cliffs within mountain ranges; forages on ephemeral wetlands, pastures and agricultural fields. .	Unlikely: A highly irregular to rare foraging visitor dependent on the wetland systems located throughout the study area and potentially vulnerable to the proposed development activities. The proposed WEF is not situated adjacent to large tracts of the preferred habitat of the species.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	**Confirmed:** A fairly common foraging migrant recorded in the current study and expected periodically to occur. Not highly vulnerable to the proposed activities.
Neotis ludwigii (Ludwig's Bustard)	Endangered	Endangered	Primary upland grassland, desert savanna and karoo with foraging and roosting particularly on rocky/ hilly terrain.	**Confirmed:** High densities throughout the study areas. The species is likely to be a breeding resident within or adjacent to the study area. A large bodied species, it is highly susceptible to WEF development activities as shown by direct interactions with the existing Khobab turbines (although no mortalities have been recorded).
Sagittarius serpentarius (Secretarybird)	Vulnerable	Vulnerable	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	Moderate to Highly Likely: Regular low-density resident which is most likely of lower risk to the proposed development activities given ground foraging habitats. In addition, persistent long term regional drought may have significantly decimated local prey sources (especially snakes) thus further reducing the likelihood of persisting local populations of significant densities.

Species	Global Conservation Status[6]	National Conservation Status[7]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk posed from the WEF
Eupodotis vigorsii (Karoo Korhaan)	Near threatened	Near threatened	Karroid habitats, large saline pans and shallow impoundments.	**Confirmed:** Common resident occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to WEF development activities but as a species is considered low risk.
Afrotis afra (Southern Black Korhaan	Vulnerable	Vulnerable	Prefers open grassland, succulent and nama karoo as well as cultivated fields and lightly wooded habitat although forages extensively in open karroid savannah associated with the study area.	**Confirmed:** Only two sightings within the PAOI as the study area overlaps with the far more common Northern Black Korhaan. Within the survey area regular breeding resident which is most likely of moderate risk to the proposed development activities given the species proclivity to fly at lower heights within the rotor sweep zone.
Falco naumanni (Lesser Kestrel)	Near Threatened	Near Threatened	Widespread species prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah. Roosts collectively in locations with tall trees.	Highly Likely: Regular migrant of fluctuating seasonal density which is most likely of lower risk to the proposed development activities due to most pressures occurring with breeding grounds and migration routes.

4.4 PRECONSTRUCTION MONITORING MAIN RESULTS

4.4.1 Walked and Driven Transects counts

During the walked transects, the total number of individual birds (per species) were recorded regardless of if they are listed as priority or not. Notable Priority Species recorded during walked transects included Ludwig's Bustards that were often flushed from foraging positions as well as Northern Black Korhaans and Karoo Korhaans. The main focus of drive transects were the recording of large birds and raptors. Raptors and korhaans and Red Lark were the most frequently recorded priority species. On some sample days, the observers returned at night and priority species were recorded (such as owls, coursers and thick knees). For walked transects, a total of 685 individual bird contacts were recorded (Appendix 3) of which 54 contacts and seven species are priority (Table 4-3). For driven transects, a total of 573 individual bird contacts were recorded (Appendix 3) of which 44 contacts and seven species are priority (Table 4-4). The combined Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species as an average of 3.26 with individual sampling results shown below. This is considered to be a low risk numeric value. The overall (priority and non-priority) IKA is 41,9 which is a significantly higher risk value. However, a wholly insignificant fraction of all observations occurred at rotor sweep height which thus shows a strong data set (based on s=density of observations) interpreted as a low risk of significant collision mortality.

Table 4-3: Per season priority species recorded during Walked Transects

Priority Species by Season	Walk Transects						
	1	2	3	Control	Leeuberg River	Waterbodies	Total
Autumn (2021-Apr)	**5**	**1**	**1**	**1**	**4**	**8**	**20**
Greater Kestrel				1			1
Karoo Korhaan						6	6
Ludwig's Bustard						1	1
Martial Eagle		1					1
Northern Black Korhaan	3				1	1	5
Pale Chanting Goshawk			1				1
Red Lark	2				3		5
Winter (2021-Jul)	**3**	**2**	**2**		**2**	**3**	**12**
Karoo Korhaan	1					1	2
Kori Bustard		1					1
Ludwig's Bustard						1	1
Martial Eagle		1					1
Northern Black Korhaan					2		2
Pale Chanting Goshawk			2				2

Red Lark	2					1	3
Spring (2021-Sep)	**6**	**5**	**2**	**1**	**3**	**5**	**22**
Greater Kestrel		2					2
Karoo Korhaan	1						1
Ludwig's Bustard			2			1	3
Martial Eagle		1					1
Northern Black Korhaan	2				1	1	4
Pale Chanting Goshawk				1			1
Red Lark	3	2			2	3	10
Totals	**14**	**8**	**5**	**2**	**9**	**16**	**54**

Table 4-4: Per season priority species recorded during Drive Transects

Priority Species by Season	**Drive Transects**							
	1	**2**	**3**	**4**	**5**	**6**	**Control**	**Total**
Autumn (2021-Apr)	**3**	**5**	**1**	**6**		**1**		**16**
Greater Kestrel		2						2
Jackal Buzzard	1					1		2
Lanner Falcon		2						2
Martial Eagle	1							1
Northern Black Korhaan				3				3
Pale Chanting Goshawk			1					1
Red Lark	1	1		3				5
Winter (2021-Jul)	**5**	**2**		**3**				**10**
Greater Kestrel	1							1
Ludwig's Bustard		2						2
Martial Eagle	1							1
Northern Black Korhaan				1				1
Pale Chanting Goshawk	3							3
Red Lark				2				2
Spring (2021-Sep)	**3**	**2**		**7**	**1**	**4**	**1**	**18**
Greater Kestrel	1	1		1	1			4
Karoo Korhaan				1		2		3
Ludwig's Bustard	1					1		2
Martial Eagle	1							1
Northern Black Korhaan				2				2

Pale Chanting Goshawk							1	1
Red Lark		1		3		1		5
Totals	**11**	**9**	**1**	**16**	**1**	**5**	**1**	**44**

4.4.2 Vantage Points

The Vantage Point data collection appeared to provide the richest avifaunal observations. Priority species recorded during VP surveys were divided into three flight height categories (Low 0 to 50 m, Medium 50 to 150 m and High with all observations of birds flying more than 150 m). The collated data capture is indicated in Appendix 2.

A total of 180 hours of bird flight observation were completed at the 5 Vantage Points on site during the year. Eleven (11) priority species were recorded during VP watches in the WEF (Table 4-5 and Table 4-6). The list of non-priority species observed is shown as Appendix 2.). In order to gain some understandings of which species are likely to be most at risk of collision, the collisions risk rating are discussed below.

Table 4-5: Per season priority species recorded at vantage points during the surveys.

Priority Species by Season	Vantage Points						Total
	1	2	3	4	5	Control	
Summer (2020-Dec)	**54**	**16**	**3**	**27**	**10**		**110**
Black-winged Kite	2			1			3
Greater Kestrel	3	1					4
Karoo Korhaan	7	6		8	7		28
Lanner Falcon		1					1
Ludwig's Bustard		3	2				5
Martial Eagle				1	1		2
Northern Black Korhaan	8	4		7			19
Pale Chanting Goshawk	1	1	1	2	2		7
Red Lark	33			8			41
Autumn (2021-Apr)	**40**	**13**	**4**	**10**		**5**	**72**
Black-chested Snake Eagle	1			3			4
Greater Kestrel	6	1					7
Jackal Buzzard						2	2
Karoo Korhaan	5	6	1	2			14
Ludwig's Bustard				3			3
Northern Black Korhaan	12	1					13
Pale Chanting Goshawk	1			1		3	5
Red Lark	15		3	1			19
Sclater's Lark		5					5
Winter (2021-Jul)	**19**	**6**	**1**	**8**		**2**	**36**
Greater Kestrel				1			1
Karoo Korhaan		3		2		2	7

Ludwig's Bustard		2					2
Martial Eagle				1			1
Northern Black Korhaan	12						12
Pale Chanting Goshawk				1			1
Pale Chanting Goshawk		1		3			4
Red Lark	7		1				8
Spring (2021-Sep)	**26**	**16**	**5**	**4**		**8**	**59**
Greater Kestrel	1	7	2	1			11
Karoo Korhaan	2					3	5
Ludwig's Bustard		9	3			5	17
Northern Black Korhaan	11						11
Pale Chanting Goshawk				3			3
Red Lark	12						12
Totals	**139**	**51**	**13**	**49**	**10**	**15**	**277**

Table 4-6: Priority species summary recorded at vantage points over the full year.

	Vantage Points						
Priority Species over full year	**1**	**2**	**3**	**4**	**5**	**Control**	**Total**
Black-chested Snake Eagle	1			3			4
Black-winged Kite	2			1			3
Greater Kestrel	10	9	2	2			23
Jackal Buzzard						2	2
Karoo Korhaan	14	15	1	12	7	5	54
Lanner Falcon		1					1
Ludwig's Bustard		14	5	3		5	27
Martial Eagle				2	1		3
Northern Black Korhaan	43	5		7			55
Pale Chanting Goshawk	1			5		3	9
Pale Chanting Goshawk	1	2	1	5	2		11
Red Lark	67		4	9			80
Sclater's Lark		5					5

Due to its abundance and conservation status, the Ludwig’s Bustard is a priority species of concern since it may be prone to collision at certain times (e.g., when commuting between roosting and feeding sites, following rainfall events, invertebrate outbreaks (locusts) or commuting after farming activities which increase food availability). The species has been observed flying at rotor height multiple times during the survey period. This included a (photographed) sighting of two individual bustards which were observed flying in a west to east directions directly between the existing turbines (Khobab WEF) within the rotor sweep area (Figure 4-3). In the remaining observations, Ludwig’s Bustards were mostly observed close to koppies, drainage lines, adjacent to roadsides, in adjacent livestock fields and flying above linear structures such as the large railway line that bisects the PAOI. On multiple occasions, the observers’ presence flushed some birds (presumably breeding pairs and/ or breeding pairs with a juvenile). Flights were most often generally very low (less than 50 m height) and short distanced although on numerous occasions, individuals would take flight and leave the vicinity (+/- 2 km). In order to gain some understanding of which species are likely to be most at risk of collision, the collisions risk rating for each priority species recorded during VP watches are discussed below.

Figure 4-3: A photo showing Ludwig's Bustards flying at rotor sweep height through the existing Khobab WEF.

4.4.3 Focal Sites

The drainage line system outside the western boundary of the project study area contained a relatively high density (and higher diversity) of passerines, including Sclater's Lark. However, this species was not directly associated with the project development footprint but was associated with the PAOI and a static bat recorder point. The existing power lines were also surveyed, and the only noticeable species of concern are the two recorded Martial Eagle pairs, chicks and nests (see section below).

4.4.4 Nest Survey

Nest sites were searched for during the surveys which included windmills, trees, pylons, bridges and masts, representing most potential roost and nesting sites for raptors. Water bodies were potential roost and nesting sites for multiple species but the high degree of seasonality and highly arid conditions was prohibitive to being representative of optimal breeding habitat for water associates. The most significant breeding habitat recorded during the survey were the two active Martial Eagle nests (Figure 4-4 and Figure 4-5), where breeding and foraging activity has been noted and strongly drive both the site development plan layout and the recommended mitigation measures. Ludwig's Bustard is considered a resident and to be breeding on site although no nests have been located.

Figure 4-4: Active Martial Eagle nest on the southern portion of the study area.

Figure 4-5: Bones and skulls of foraged species associated with the active Martial Eagle nest.

4.5 COLLISION RISK SUMMARY

1. All heights above ground for contacts were recorded for this analysis. For the pre-construction monitoring, three risk levels were defined considering the species characteristics and the risk behaviours, based upon Retief et al. (2012):
   - High probability movements of priority species at rotor swept height and presenting behaviours with potential to increase collision risk with rotating blades.
   - Medium probability- movements of priority species at rotor swept height or presenting collision risk behaviours;
   - Low probability- movements of sensitive species (regardless of the height or type of flight) and movements of non-priority species at rotor swept height or presenting collision risk behaviours.
2. The vast majority of all observations were recorded well below the anticipated rotor sweep height of 70 metres. However, the species observed frequently at moderate to high-risk altitudes (50 to 150 metres) included:
   - Pied Crow (most frequent)
   - Pale-chanting Goshawk
   - Karoo Korhaan (infrequent)
   - Northern Black Korhaan
   - Namaqua Sandgrouse
   - Greater Kestrel
   - Egyptian Goose

- South African Shellduck
- Eastern Clapper Lark
- Cape Crow
- Black-chested Snake Eagle
- Red Lark
- Rock Kestrel
- Sclater's Lark
- Ludwig's Bustard

Of these observations, most observations were recorded below rotor sweep height with the following species sighted over 80 metres;

- Ludwig's Bustard
- Pied Crow
- Greater Kestrel
- Pale Chanting Goshawk
- Black-chested Snake Eagle (single occasion)
- Red Lark (single occasion)
- Northern Black Korhaan
- Rock Kestrel
- Cape Crow
- Egyptian Goose (single occasion)

3. It was assumed that the 2km radius around vantage points was approximately equal to the maximum distance over which sightings were made, and that the coverage was approximately circular. This meant that at each vantage point an area of 12.57 km² was sampled ($A = \pi r2$).
4. It was assumed that the collision risk area is described by the area of each turbines rotor zone x # turbines. Using the measurement of a 160 m rotor diameter, and the current proposed layout of 35 turbines, this equals a wind farm collision risk area of 643 398.176 m² or 643.398 km² (32 x 20 106.193 m²).
5. Passage rates calculated from four seasons of sampling can be extrapolated to annual passage rates (by multiplying hourly passage rates by 12 x 365 in the case of resident species).
6. A 98% avoidance rate was assumed for passing birds as recommended by Scottish Natural Heritage guidance for species for which no established specific avoidance rate is available, www.project-gpwind.eu.

The individual risk ratings for the priority species are considered low, as very few high-altitude flights were recorded for the Priority Species and or Species of Conservation Concern. While this assumption is correct in theory, it should be noted that multiple published scientific studies indicate that a rotor sweep area do not automatically translate into an increased or decreased collision risk. Therefore, it can be surmised that turbine dimensions play an insignificant role in the magnitude of the collision risk in general, relative to other factors such as prevailing wind speed, topography, turbine location, bird species morphology and a species' inherent ability to avoid the turbines and may only be relevant in combination with other factors, specifically prevailing wind speed and direction.

The below calculations yielded an overall predicted facility collision fatality of 9.937 birds. It is important to repeat that this is a collision risk model replicated in other surveys, and its value is mostly in comparison with other sites and projects. The absolute numbers of predicted fatalities should be used in context. Despite some species such as Ludwig's Bustard being highly susceptible to powerline collisions, caution must be exercised when comparing the relative risks related to wind farms with risks associated with power lines. Indications are that Ludwig's Bustards are not prone to wind turbine collisions. The mortality monitoring data from Khobab Wind Farm has indicated no mortalities despite regular proximity of flying Bustards to the WEF.

Table 4-7: Selected bird species crude passage rates and crude predicted fatality at the Botterblom WEF.

Priority Species	Number of birds	Hourly passage rate at VP	Annual passage rate at VP	Annual passage rate through rotor zone	Annual fatality rate (98% avoidance)
Ludwig's Bustard	27	0,15	657.00	28,448	0,568
Pied Crow	176	0,977	4279,26	156,869	3,137
Greater Kestrel	21	0,166	727,08	5,348	0,107
Pale Chanting Goshawk	20	0,111	486,18	17,775	3,334
Black-chested Snake Eagle	40	0,222	972.36	35,555	0,355
Red Lark	80	0,333	1458,54	71.111	1,4222
Northern Black Korhaan	55	0,305	1335,90	50.678	1,0135

4.6 WEF SITE SENSITIVITY

Each demarcated sensitive feature was evaluated for the degree of sensitivity based on the complete 12-month data set and presented as Figure 4-6. There is an important presence of a number of SCC in the study area, recorded regularly and widespread through the proposed WEF area. In addition, there are several raptors utilising the PAOI, some of them priority species and/or of conservation concern, such as the Martial Eagle, Lanner Falcon, Pale-chanting Goshawk and Black-winged Kite. Areas of drainage lines and natural vegetation which are vital to maintaining populations of habitat obligate sensitive species (such as Sclaters' Lark and Red Lark) are deemed to have some probability of collision consistently throughout the year. Furthermore, natural drainage line vegetation represents an important habitat to maintain natural geohydrological processes of the PAOI. A 50 m buffer around these areas must be considered NO-GO where no turbines and associated infrastructure may be located. A 200 m buffer is also applied around seasonally inundated watercourses in the PAOI, as these features attract birds under certain conditions and could be the only locations were certain sensitive species such as the ducks, herons, storks and water birds are likely to occur. These areas must be avoided by the developer where no turbines and associated infrastructure may be located. Several of the proposed turbine positions and associated infrastructure coincide with areas currently demarcated as sensitive features within the prescribed buffers and consequently were subjected to the mitigation hierarchy, including mitigation measures and avoidance. The layout was carefully re-evaluated in order to mitigate against negative interaction with priority species such as Red Lark and Martial Eagle.

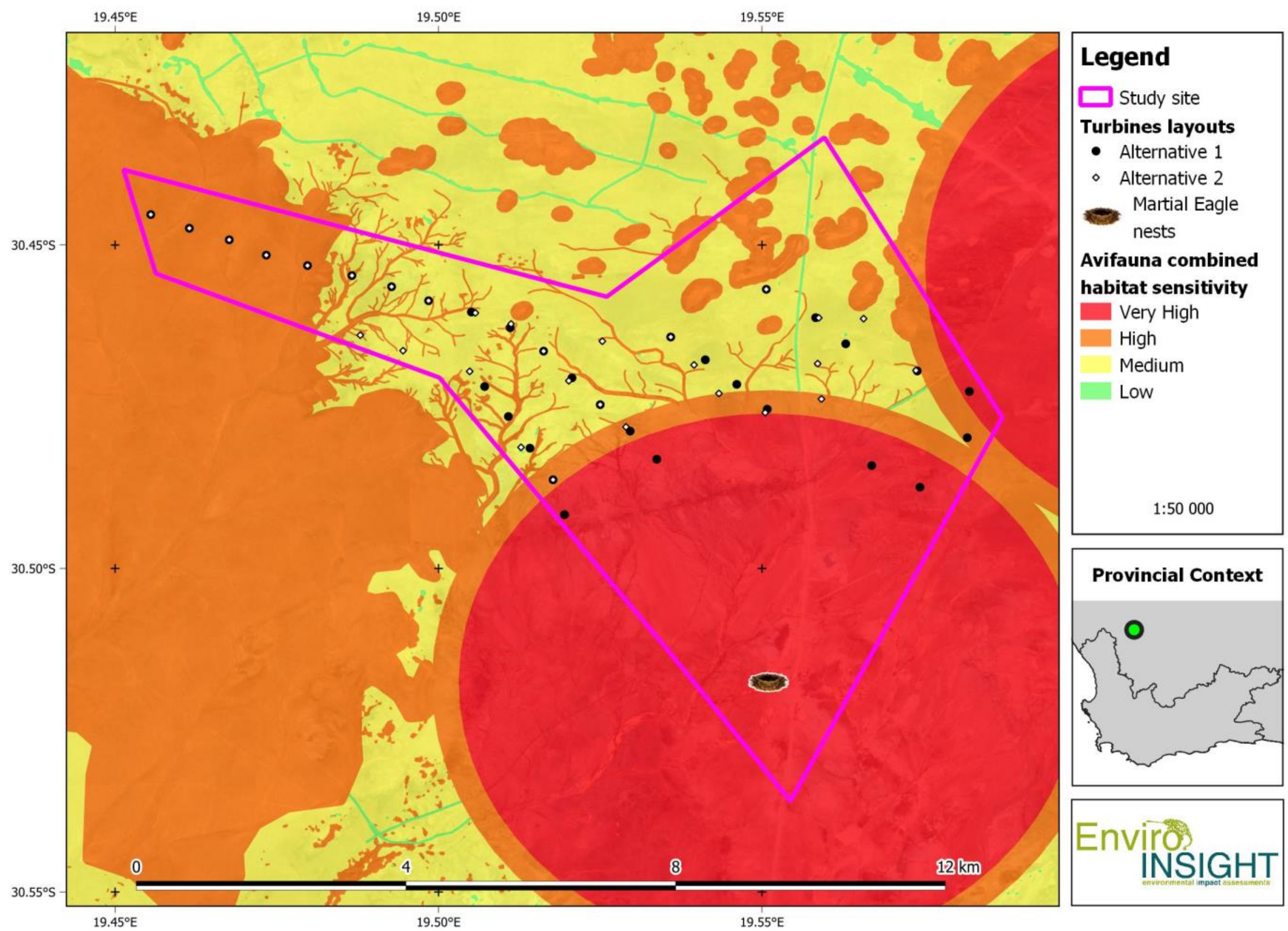

Figure 4-6: Overall Avifauna Sensitivity Buffers

4.6.1 Martial Eagle Nest Site

Utilising the interpretations stipulated above and in the absence of any mitigation measures, a preliminary buffer of 5 km is recommended as an exclusion area around the two active Martial Eagle nests, which were confirmed after the completion of the 12-month pre-construction monitoring. There is currently no species-specific guideline for the Martial Eagle, and buffer areas around nest sites remains a scientifically contentious topic of discussion in the industry without rigorous scientific studies providing necessary guidance (for example, Murgatroyd, Bouten & Amar 2021). The only published recommended buffer to implement around raptor nests in South Africa is for the Verreauxs' Eagle (Ralston-Paton, 2017), which dictates that a precautionary buffer of 3 km is recommended and may be reduced or increased based on the results of rigorous avifaunal surveys, but nest buffers should never be less than 1.5 km. This buffer is deemed inadequate for Martial Eagles.

A recent paper from Murgatroyd, Bouten & Amar (2021) indicated that by using predictive models to account for habitat use instead of simple buffers around a nest, a greater area of land can be made available for wind energy development without increased mortality risk to raptors. Accordingly, this tool can be used to provide robust guidance on wind turbine placement in a way which minimises the conflict between raptor species and the development of wind energy facilities in South Africa as well as provide the basis for rigorous monitoring programs to be applied. It must be noted that the study species for this research was Verreaux's Eagle which was tracked at only four locations (not including the current habitat or region), and accordingly the interpretation of the results needs to be considered as species- and site-specific, even though the same principle can be extrapolated to other raptor species in various regions. The study recommended that nest buffers should never be <3.7 km radius, but also indicated that additional site-specific specialist input or mitigation methods might allow a limited amount of development for high-risk developments. Based on the preliminary data collected during the pre-construction monitoring (see above), the two breeding pairs of martial eagles do not appear to be foraging regularly over the proposed Botterblom WEF development area, the ecological reasoning possibly related to territorial exclusion between the individuals. Thus, the current survey, in accordance with the accepted methods shows limited use of the proposed development footprint area by the four Martial Eagles. Only the southern pair was observed with any regularity and only one individual was recorded at any one time, and always from VP4 and DT1 which were close to the nest site, as well as VP5 (control) which is located approximately 3.8 km southeast of the nest site. Apart from the aforementioned territorial exclusion, this could be due to there being very low densities of livestock and limited preferred prey on or immediately adjacent to the proposed development footprint area, which forces the eagles to hunt further away from the study area. However, the specialists agree that sporadic monitoring information, as has been collected to date, is not a definitive substitute for robust telemetry-based home range data. Therefore, the absence of observations of these eagles flying over the proposed development footprint area may not provide conclusive evidence that they do not utilise this area for foraging purposes (see species specific mitigation measures below).

Considering that only four collision-caused fatalities for Martial Eagles have occurred at 20 WEFs across South Africa between 2014 and 2018 (Perold *et al*., 2020), coupled with the proposed development footprint not being within a core regional stronghold (Taylor *et al*. 2015), and the significance of the Martial Eagle nest being located in an unnatural situation (having nested on a pylon), the unmitigated impact of the proposed development for the species may be classified as moderate to high significance. The presence of the eagles is a direct result of the existing and planned WEFs and solar PV facilities because they are nesting on artificial structures (transmission line pylon) specifically built for the transmission of electricity generated from these renewable energy projects (via the Helios substation). Sterilizing large sections of the proposed renewable energy developments due to the unnatural presence of these eagles is therefore not advisable, especially since the eagles may at any moment willingly decide to abandon or relocate their nest for natural reasons (e.g. low prey availability). As a result, it is strongly recommended that mitigation measures below be coupled with a robust radar/ AI and/ or telemetry-based monitoring program directed by a recognised Martial Eagle specialist (we propose Dr. Gareth Tate of the EWT) be applied in order to investigate the movement patterns of the resident eagles. *In lieu* of a telemetry monitoring system, it is suggested that the Shutdown on Demand radar system combined with the AI be used in order to more accurately monitor not only Martial Eagle movements, but all species over 3 to 3.5 kg (including Ludwig's Bustard). The potential mitigation option of removing the Martial Eagle nest when no egg or fledgling is present so that the adults may disperse and rebuild a nest further away from the proposed Botterblom WEF and the other existing and planned WEFs in the immediate vicinity is not recommended. The 5km (with the 4.6 km sub buffer) is depicted as Figure 4-7.

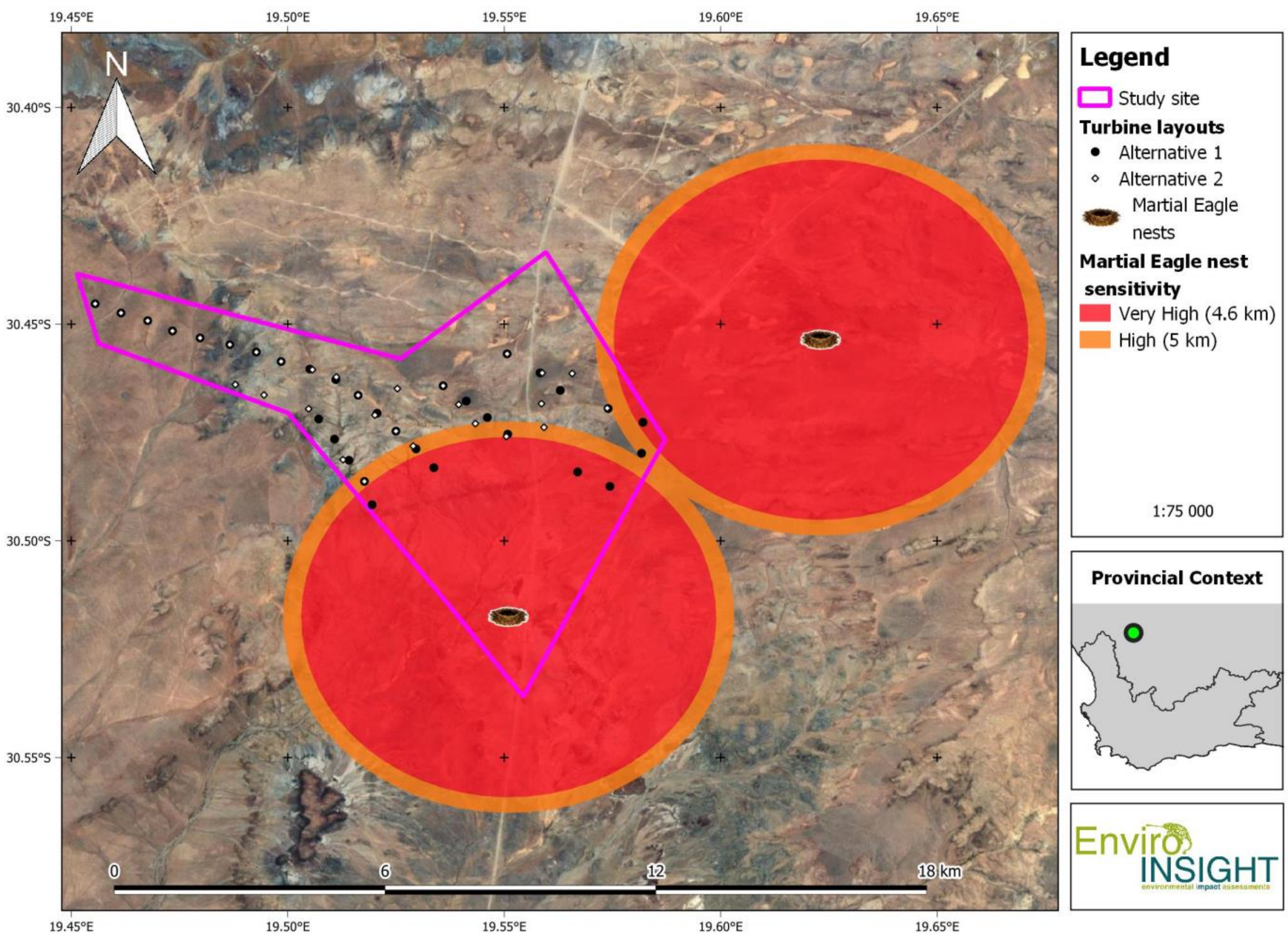

Figure 4-7: Martial Eagle Nest Buffers

5 POTENTIAL IMPACTS

5.1 BACKGROUND TO INTERACTIONS BETWEEN WIND ENERGY FACILITIES, POWER LINES AND BIRDS

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the design and specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present.

Typical potential impacts include (but are not necessarily limited to):

- Habitat loss (including foraging and breeding) and fragmentation due to displacement (avoidance of disturbance);
- Collision mortality with turbines;
- Collision and electrocution with above-ground power transmission lines (to be assessed in separate application);
- Disturbance of flight/migratory pathways; and
- Disturbance due to lights, noise, machinery movements and maintenance operations.

These potential impacts are assessed in the EIA phase of the project with specific reference to priority species and other non-priority species at high risk of negative impact from the proposed facility.

Table 5-1: Habitat loss and fragmentation impacts during the construction phase.

Impact: Habitat loss and fragmentation Access roads and turbine or infrastructure construction may necessitate the removal of foraging and roosting habitat, destruction or disturbance of bird breeding habitats, bird roosts and sensitive avifaunal habitats such as migratory routes. This will occur during the construction phase and sensitive areas include tall emergent trees, flight paths to the mountain ranges, the river and associated riparian vegetation, free standing water (impoundments) and drainage lines across the PAOI.			
Issue	Nature of impact	Extent	No-Go Areas
Habitat destruction due to construction of infrastructure.	Negative, especially species utilising watercourses for foraging and breeding, as well as migratory pathways.	Local	Watercourses, including the river, wetlands and all drainage lines.
Description of expected significance of impact: The relatively small operational footprint of the development may reduce the overall expected significance of the impact although the impact can potentially be high and long-lasting. However, if no-go areas are avoided and the necessary buffers against infrastructure applied, the impact should be medium to low. As far as possible all roads must utilise and upgrade existing farm roads to avoid further destruction of habitat.			
Gaps in knowledge and recommendations for further study			

Areas that might be important for avifaunal activity, especially migratory pathways may change over time in response to infrastructure establishment and subsequent monitoring.

Table 5-2: Collision mortality with turbines.

Impact: Avifauna mortalities due to collision with turbines This impact will occur during the operational phase due to avifauna collision with the blades of the turbines or due to barometric trauma suffered by avifauna caused by difference in air pressure created by the turning of wind turbine blades. This will be especially relevant during times of migration when avifauna move through the area between summer and winter breeding sites and there is a higher abundance of avifauna in the area.			
Issue	Nature of impact	Extent	No-Go Areas
Mortalities suffered due to collision with turbines.	Negative and highly relevant for migratory species that traverse through the area.	Local, but can be more extensive for species that migrate through the region.	Large emergent trees, water bodies including large rivers, and all drainage lines and areas with heavily vegetated wetlands. Based on observations, the Bergriver seems to act as a migratory pathway and this area must be subject to buffering. Areas shown to have high recorded densities of bird activity.
Description of expected significance of impact: The impact can potentially be highly significant and will persist during the life of project, but if no-go areas are avoided and the necessary buffers applied the impact may be reduced to medium/ low. This impact can be significantly reduced if mitigation measures are followed, which included no development in Very High and High bird sensitivity areas and implementing appropriate buffers in no-go areas.			
Gaps in knowledge and recommendations for further study: This has been well investigated, including from the neighbouring existing Khobab WEF, although the fatality risks of habitat types will be consistent with monitoring data.			

Table 5-3: Disturbance of flight/migratory pathways.

Impact: Disturbance of flight/migratory pathways Turbines placed along or close to flight pathways used for migration can cause a large number of collision-related mortalities on birds moving through the area during times of small-scale migration and seasonal migration between winter / summer roosts			
Issue	Nature of impact	Extent	No-Go Areas
Disturbance of bird migration pathways.	Negative, but should be low if pathways are avoided.	Regional.	The entire river section must have a 100m buffer around and anywhere in this buffer will be considered a No-Go Area.
Description of expected significance of impact: This impact could be extremely high, but easily reduced if the buffer around the river is strictly enforced.			
Gaps in knowledge and recommendations for further study: Migration in birds are poorly understood, and times of the year when these events occur can be unpredictable. It is also not established whether birds will follow the exact same pathway year after year.			

Table 5-4: Disturbance due to lights, noise, machinery movements and maintenance operations.

Impact: Disturbance due to lights, noise, machinery movements and maintenance operations Can have a negative effect on avifauna behaviour by affecting foraging activity and flight paths used. Artificial lights can attract insects which will entice nocturnal species (owls, nightjars etc) to feed in the area leading to a higher chance of mortalities due to collision or barotrauma. High noise levels could disturb breeding birds which could lead to abandonment of eggs or fledglings.			
Issue	Nature of impact	Extent	No-Go Areas
Increased noise, lighting and disturbance during operation	Negative, but can be reduced to acceptable levels	Local	All bodies of water including the river
Description of expected significance of impact: This impact could be high, but easily reduced if high intensity lights are not used and only the compulsory civil aviation lighting is employed, noise levels are within the accepted standards and machinery are fitted with dampers, where required.			

Gaps in knowledge and recommendations for further study:

In certain areas the use of artificial lights will be unavoidable, and these include areas where offices or operational and maintenance buildings will be constructed. Placement of these buildings is currently unknown, but it is recommended that these are constructed in areas away from watercourses.

5.2 IMPACT ASSESSMENT

5.2.1 Construction Phase

1. Impacts associated with the loss of bird foraging habitat due to construction activity (***Table 5-5***) can be mitigated by avoiding avifaunal specific sensitive areas and their associated buffers, such as the local drainage lines, impoundments, smaller watercourses, pans, koppies, sandy dunes and areas associated with infrastructure and/or large trees which will ultimately reduce the spatial extent of this impact and limit it to a once-off event. The overall severity of the impact can be reduced to being insignificant if avoidance mitigation is applied related to the positioning of the turbines and supporting infrastructure and minimisation mitigation is applied.

Table 5-5: Consolidation table of impacts due to habitat destruction during construction phase.

Nature: Habitat destruction during construction phase		
	Without mitigation	**With mitigation**
Extent	2	1
Duration	4	3
Magnitude	8	3
Probability	5	4
Significance	**High (70)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

2. Bird roosts varied from artificial structures such as windmills to the pan areas and impacts associated with the destruction or disturbance of such roosts (Table 5-6) can be mitigated by avoiding habitat features that could act as potential bird roosts as highlighted below. This impact can potentially be eliminated if mitigation measures are applied across the area.

Table 5-6: Consolidation table of impacts due to the destruction or disturbance of bird roosts during the construction phase.

Nature: The destruction or disturbance of bird roosts during the construction phase		
	Without mitigation	**With mitigation**
Extent	2	1
Duration	2	2
Magnitude	8	4
Probability	5	3
Significance	**(42)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	No	Yes
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

3. Impacts due to bird mortalities during the operational phase are practically unavoidable for any WEF, but with the appropriate mitigation measures these impacts can be minimised. Although the overall bird activity (especially average height flights) qualifies the proposed WEF boundary as a Low-Risk Area for bird/ turbine collisions, there are certain times of the year (and day) when it appears that large flocks of birds (such as bustards and large birds of prey) move through the area. If mitigation measures are followed and sensitive areas avoided the current WEF will have a Low-Medium directl mortality impact on the local bird populations (Table 5-7). If shutdown on demand technology is applied, then the magnitude of the impact will further reduce as larger species of conservation concern will be exposed to a near zero risk of collision.

Table 5-7: Consolidation table of impacts from bird mortalities during the operational phase.

Nature: Bird mortalities during the operational phase		
	Without mitigation	**With mitigation**
Extent	3	3
Duration	4	4
Magnitude	10	6
Probability	5	3
Significance	**High (85)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources?	Yes	Potentially
Can impacts be mitigated?	Partially	

4. Migratory pathways of birds cannot be changed and the resulting impacts are unavoidable. However, severity of the impacts can be reduced with appropriate mitigation measures. Very few discernible migratory flight pathways were able to be established which could be explained by the lack of distinguishing geographic features in the landscape, such as large rivers or a mountain range. However, the sandy western habitats represent a highly sensitive habitat feature which should allow for limited construction in this area (Table 5-8). If this is strictly applied there could be an adequate avoidance of any migratory pathways and minimal impact during migratory events and indeed, flight events that occur daily.

Table 5-8: Consolidation table of impacts due to disruption of bird migratory pathways during the operational phase.

Nature: Disruption of bird migratory pathways during the operational phase		
	Without mitigation	**With mitigation**
Extent	3	3
Duration	4	3
Magnitude	8	2
Probability	5	2
Significance	**High (75)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	No	Yes
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

5.3 CUMULATIVE IMPACTS

The existing Khobab WEF to the east of the current project area already has quantified negative impacts on the avifauna community in the region (Arcus, 2020;Table 5-9). Therefore, any impacts anticipated from the proposed WEF will add to these existing impacts. As such, the results obtained during this preconstruction survey and from the subsequent impact analysis should be considered in conjunction with the impacts created by the Khobab WEF and the other proposed WEF developments indicated in Figure 5-1. There is a large amount of WEF development within the region, which raises the possibility of significant cumulative impacts, especially concerning collision risk, habitat loss and fragmentation and loss of suitable habitat for threatened species.

The following current impacts will be exacerbated through increased WEF development regionally;

- Habitat loss: The destruction of highly sensitive habitat (for example sandy substrates for Red Lark) will potentially increase. The Red Lark exists within a narrow ecological and distributional belt and loss of its ecologically specific habitat may be highly significant.
- Road-kills: Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl.

- Regional saturation of turbines: This has implications for several priority species, both in terms of collision mortality for some species, especially Bustards and Raptors, and displacement due to transformation of habitats
- Powerlines: Numerous existing and new power lines are significant threats to large terrestrial priority species in the region as powerlines may kill significant numbers of all large terrestrial bird species.

Table 5-9: Cumulative impact of the project and other projects in the area.

Nature: Cumulative impact of the project and other projects in the area		
	Overall impact of the proposed project considered in isolation	***Cumulative impact of the project and other projects in the area***
Extent	1	4
Duration	4	4
Magnitude	4	8
Probability	4	5
Significance	**Medium (36)**	**High (80)**
Status (positive or negative)	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Possibly

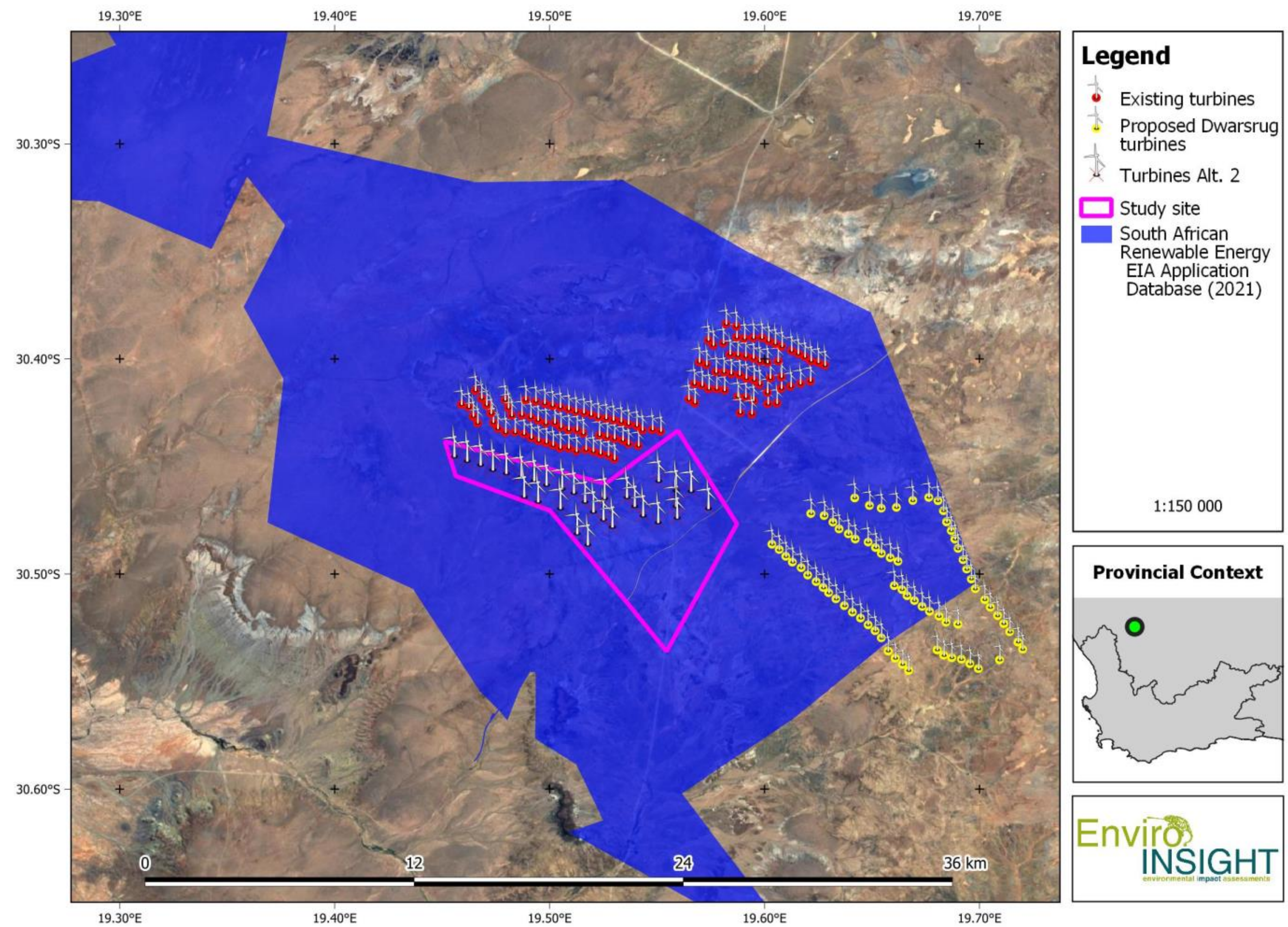

Figure 5-1. Current and proposed WEFs surrounding the proposed Botterblom WEF at a large scale.

5.4 MITIGATION OF IMPACTS

Due to the global demand for renewable energy, a strong research emphasis has been placed on describing and defining mitigation measures to negate or minimise the negative impacts associated with such facilities. In particular, much research is focused on bird-turbine collisions prevention/minimisation at wind energy facilities (see May *et al.*, 2015; Gartman *et al.*, 2016 a & b; May *et al.*, 2020; McClure *et al.*, 2021). New mitigation measures range from simple (e.g., painting one turbine blade black; May *et al.*, 2020) to complex (detecting approaching birds with cameras and artificial intelligence to slow turbines down; McClure *et al.*, 2021). However, by far the best mitigation option remains the first step of the mitigation hierarchy which is "avoidance". Consequently, all attempts will be made to avoid potential impacts arising from the proposed WEF through the application of necessary buffers for sensitive areas, where placement of turbines may not occur. Additional remaining impacts will be minimised through the application of known and previously tested mitigation measures (e.g., May *et al.*, 2015). Finally, there is strong support from the developer to apply experimental minimisation mitigation measures (e.g., painting of one blade) and to utilise the facility to generate important research data.

Alternative additional mitigation measures may include change of the current land use to minimise attraction for priority species.

Since development and construction go hand in hand with high ambient and stochastic noise levels (machinery) and habitat loss, it is possible for bird species and bird individuals to be displaced from the surrounding environment. It is essentially true for large species that require extensive home ranges, and those species that are inherently shy or unobtrusive by nature (e.g., raptors). Displacement will be the response of raptors to the disturbance activity, for example when a bird changes its behaviour or takes flight by aborting its activity prior to the disturbance or being unsuccessful in completing its current activity (Ruddock & Whitfield 2007). Reactions are likely to differ between species and between individuals of the same species (Rogers & Smith 1995; Rogers & Schwikert 2002). Reactions are also positively correlated to the magnitude and frequency of a particular disturbance event. For the proposed WEF as well as the cumulative impacts, it cannot be predicted to a 100% confidence to what degree these activities will affect the Priority Species, but it must be stated that many bird species will become accustomed, or have the ability to learn and adapt, to constant occurring disturbance events of low magnitude (e.g. vehicle noise) and turbine operation, unless they are directly affected (e.g. their physical habitat is affected). Collision with Turbines is the most significant impact for the species in the region.

Set-back areas or buffer zones are allocated to sensitive or important habitat features to alleviate the effect of foraging and roosting habitat in particular. The choice of an appropriate set-back distance is complex since different species and even different taxon groups demand different habitat types or home ranges to maintain a viable population in the long term. Other buffers of 650 metres or more have been recommended for large, bodied raptors. Given that the study area has been confirmed as a foraging site and breeding site for Martial Eagles and indeed most other raptor species, the following recommendations are proposed in order to preserve the ecological function of the raptor habitats, minimising collisions and to maintain foraging corridors for large SCC raptor species in the form of a set-back area of natural vegetation.

5.5 IMPACT SUMMARY

Construction phase:

- **Habitat destruction:** access roads and turbine or infrastructure construction may necessitate the removal of foraging habitat, breeding habitat, roosting habitat and sensitive avifauna features, such as migratory routes.

Operational Phase:

- **Avifaunal mortality**: physical bird collisions by spinning blades of the turbines during the operational phase.
- **Flight/migratory paths**: Turbines placed along flight pathways used for migration can cause a large number of mortalities on birds moving through the area during times of seasonal migration to winter / summer roosts as well as short-term daily migrations between preferred habitats.

5.6 SUMMARY OF PROPOSED MITIGATION MEASURES

It is deemed possible, through the application of appropriate mitigation measures, to restrict the impact of on priority species through collisions with the turbines to a low level of significance. The following mitigation measures are proposed:

Habitat destruction: Apply necessary buffers for roost sites and other sensitive bird habitat features, avoiding the construction of turbines and access roads in these areas. Roads must utilise or upgrade existing farm roads as far as possible.

Bird mortality: Avoid placement of turbines near sensitive bird breeding and roosting habitats. The application of adaptive mitigation measures (e.g., shutdown on demand retrofitting), according to post-construction monitoring results (counted strikes of threatened species) must be informed by environmental correlates of avifaunal activity and/or strikes.

Bird collisions with turbines: Increase turbine cut in speed as this has been shown to reduce collisions. The risk is not considered to be high, and the annual collision risk is estimated at less than 5 birds per year. This is confirmed by the post-construction monitoring at Khobab WEF. The fatality rates post-construction will provide additional data and the risk model can be adjusted accordingly. Advanced Radar-based shutdown on demand must be applied where turbines transcend recommended buffers for nesting Martial Eagles.

Avoidance: It is recommended that limited development (including the full rotor swept zone of wind turbines) takes place in High sensitivity areas. Minimise impacts to natural and artificial wetlands and water bodies by implementing the appropriate buffer areas where no development may take place. This includes a 200 m no-go buffer proposed around water points as they serve as focal points for bird activity.

General Mitigation Measures

- Formal post construction monitoring must be resumed once the turbines have been activated, as per the most recent edition of the best practice guidelines (Jenkins et al. 2015). The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of an establishment of available new technology and adaptive management. The purpose of this would be to establish if and to what extent displacement of priority species has occurred through the altering of flight patterns post-construction, and to search for and identify carcasses at turbines (mortality).
- High value target species such as Martial Eagle can be tracked using the Shutdown on Demand Radar Technology and/ or telemetry systems in order to more accurately monitor movement patterns, especially in conjunction with turbines. These programs should be implemented during and post construction.
- Post-construction monitoring should be undertaken as per the EMPr. The exact scope, nature and frequency of the post-construction monitoring will be informed on an ongoing basis by the results of the monitoring through a process of adaptive management.
- If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe lights should be used where possible (provided this complies with Civil Aviation Authority regulations).
- Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).

5.7 SPECIES SPECIFIC RISK ANALYSIS AND RECOMMENDED MITIGATIONS

Ultimately, it is suggested that the morphological and behavioural; characteristics of a given bird species traits of birds, especially those related to size, wing beat, manoeuvrability, flight pattern and hunting/ foraging behaviour, are known to influence the relative collision risk with structures such as power lines and wind turbines. Larger bird species often need to use thermal and updrafts to gain altitude, particularly for long distance flights. Thermal updrafts (thermals) and orographic lift (slope updraft) will affect the relative risk per species. The relatively flat nature of the survey area dictates that the overall topography related risks are low, However, some higher risk species have been identified and described below.

5.7.1 Martial Eagle and other Raptors

As a rule, all nesting raptors should be protected within the study area as they represent Priority Species. Many raptor species are under constant pressure from development due to modifications and alterations of their preferred foraging habitat and dispersal networks. Disturbance applies to direct mortality as well as to the disruption of a foraging, breeding or roosting bird caused by WEF activities. Collision-caused fatalities of birds at wind power facilities create a 'green versus green' conflict between wildlife conservation and renewable energy. These fatalities can be mitigated through several interventions, including informed curtailment whereby turbines are slowed or stopped when birds are considered at increased risk of collision (McClure *et al*., 2021). The use of human observers is deemed to be unsuitable due to the potential for human error as well as the impact of natural limiting factors such as poor weather conditions. Automated monitoring systems (radar detection systems) will greatly improve efficacy of informed curtailment, especially when considered in conjunction with other mitigation actions such as painting one turbine blade black (May *et al*., 2020). McClure *et al*., (2021) showed that automated curtailment of wind turbine operation substantially reduce (with the potential to fully eliminate) eagle fatalities. Thus, this technology therefore has the potential to significantly reduce the conflict between wind energy and raptor conservation.

5.7.1.1 Human Monitors

Due to the presence of Multiple Martial Eagle nests within the PAOI, the use of full time (shift work based) designated Martial Eagle observers cannot be considered for mitigation with a 99% confidence. However, general raptor monitors should be employed to monitor general movements and behaviours of target species, which may serve to both ensure local job creation as well as supplement the radar-based, shutdown on demand mitigation measures. Permanent observers can be assigned to both the nest sites as well as the affected WEF areas.

5.7.1.2 Nest Buffering and Potential Removal

As mentioned and after extensive expert consultation, the authors of this report therefore argue that the eagle nest is not removable. However, a standard precautionary 5 km buffer for this project, although sufficient for avoidance mitigation, will all but terminate the project. It must be reiterated that for the purposes on the following discussion, the 5 km buffer must be applied without compromise in the absence of mitigation measures.

5.7.1.3 Shutdown on Demand

The specialist conducted extensive research into radar and camera technology currently being applied in Europe. After careful evaluation of the technological capabilities of the automated monitoring systems and given the specific species of high risk, the prevailing topographical conditions and interactions with the client, it has been determined that the implementation of automated radar monitoring be implemented during the operation phase of the project. The following justification is deemed determinate.

- Avoidance measures in adherence to the 5 km recommended buffers is the most preferred option of mitigation. Given Alternative 2, the preferred layout, 5 turbines (16 %) of the turbines lie between 4.6 and 5 km away from one of the two martial eagle nests Figure 5-2. Without moving the turbine positions, this immediately triggers the requirement for the application of radar-based shutdown on demand technology.
- If the recommended radar technology is trained to monitor species of 2.8 kg or more (and given the topography), individual birds traveling towards a monitored turbine will be detected at 4000 metres. Topography (increasing effective range and accuracy) will be the most important factor determining radar placement and is illustrated in Figure 5-3.
- Once locked on to a target, Artificial Intelligence (AI) can track the direction, altitude and speed of the individual bird and utilising thresholds, can implement directed shutdown on demand actions.
- For example, if an individual bird is flying toward a turbine at a high speed without deviation, the AI based radar technology will implement a designated action at a greater distance than individuals approaching at a lower speed and/ or at a variable bearing (representative of migration vs foraging behaviour).
- The radar technology by design can detect bird weight (based upon water density) to a 95% accuracy. Therefore, the system must be calibrated to any species above 2.8 kg which will incorporate not only Martial and Verreaux's Eagles (3 to 6.5 kg), but all other SCC including Ludwig's/ Kori Bustard (3 to 18 kg), Secretary Bird (3.4 to 4.3 kg) and Lappet-faced/ Cape Vultures 6.5 to 12 kg). Thus, the application of radar technology will not only protect the nesting Martial Eagle population but other migratory, resident, vagrant and foraging species of concern.
- The threshold of 2.8 kg will prevent unnecessary shutdowns based upon incursions by species that may be classified as Priority but are not listed as a SCC of a status IUCN Vulnerable or above (Endangered, Critically Endangered).
- Careful consideration must be provided regarding the placement of the radar system in conjunction with the nesting Martial Eagles with the subsequent radar buffer options (in relation to radar placement) shown in Figure 5-4.Figure 5-4.
- Figure 5-5 specifically shows that multiple turbines will activate the radar-based shutdown on demand requirements by transcending the 5 km recommended buffer with Figure 5-2 depicting the final recommended radar placement based on the available data.
- Finally, it is suggested that shutdown on demand protocols not only be submitted as part of the EMP but updated every 3 years in regards to advancements in the hybridised approach to the technology. For example, diversionary trigger systems (such as sirens which trigger when larger target species breach 1000 metres) may be implemented not only to avoid unnecessary shutdowns but also to maximise the chances of a zero-collision record for the project operation. AI-based technology such as cameras may be implemented on higher risk turbines (determined through the monitoring programs and telemetry-based tracking of local eagles) as the preferred hybridised solution.

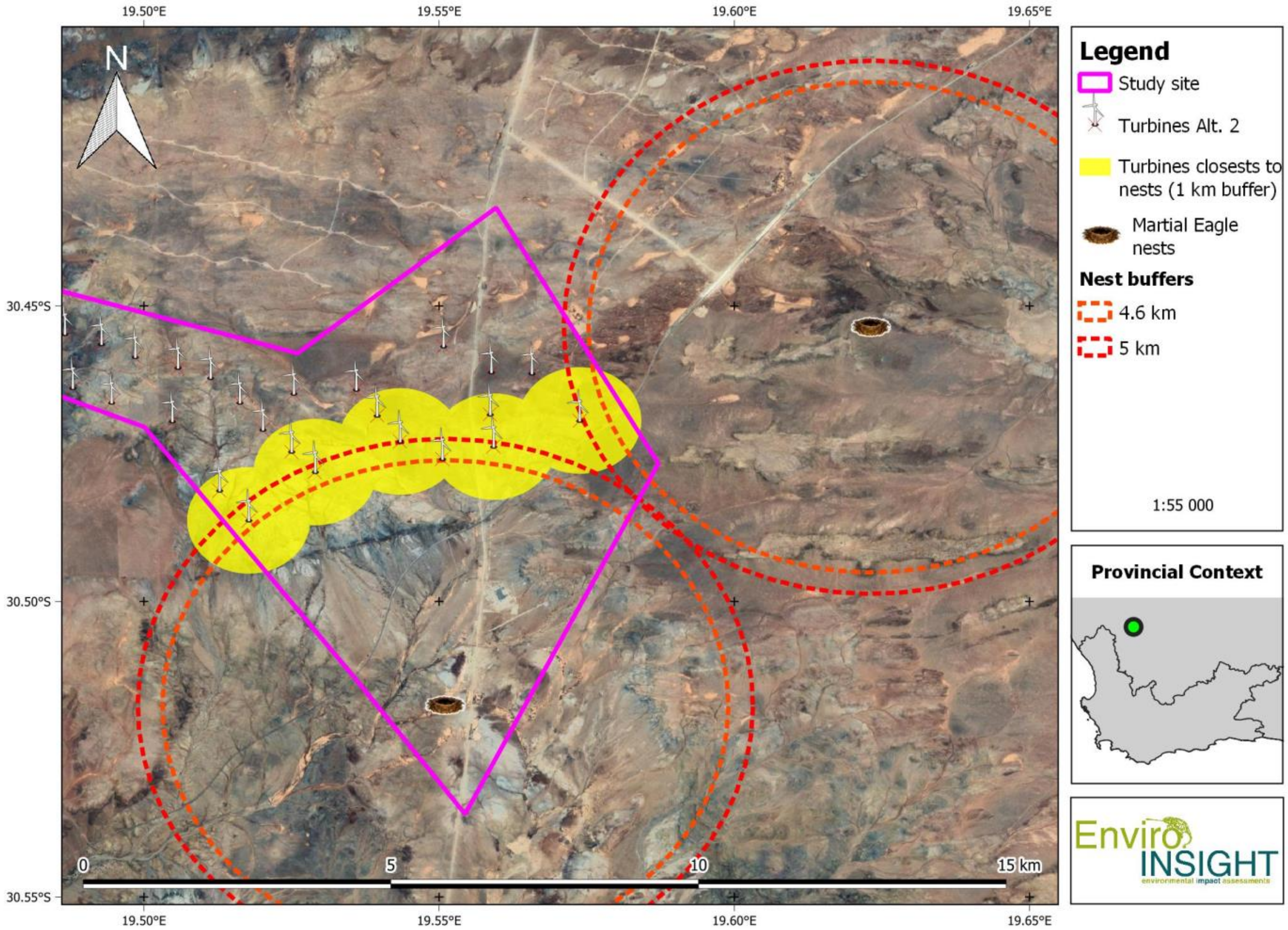

Figure 5-2: Turbine Specific Activation of Martial Eagle Nest Buffers

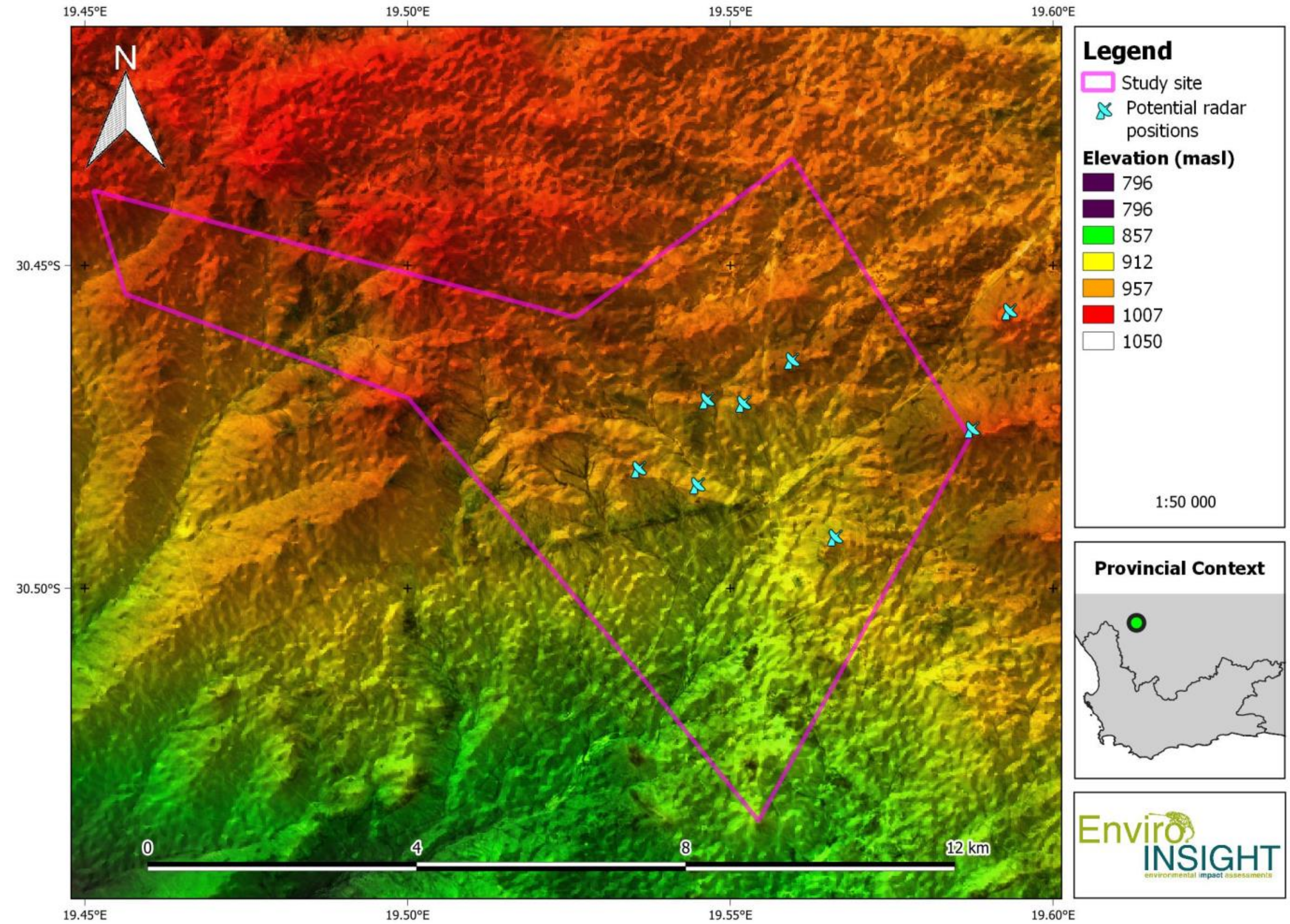

Figure 5-3: Preliminary radar placement in regards to site topography

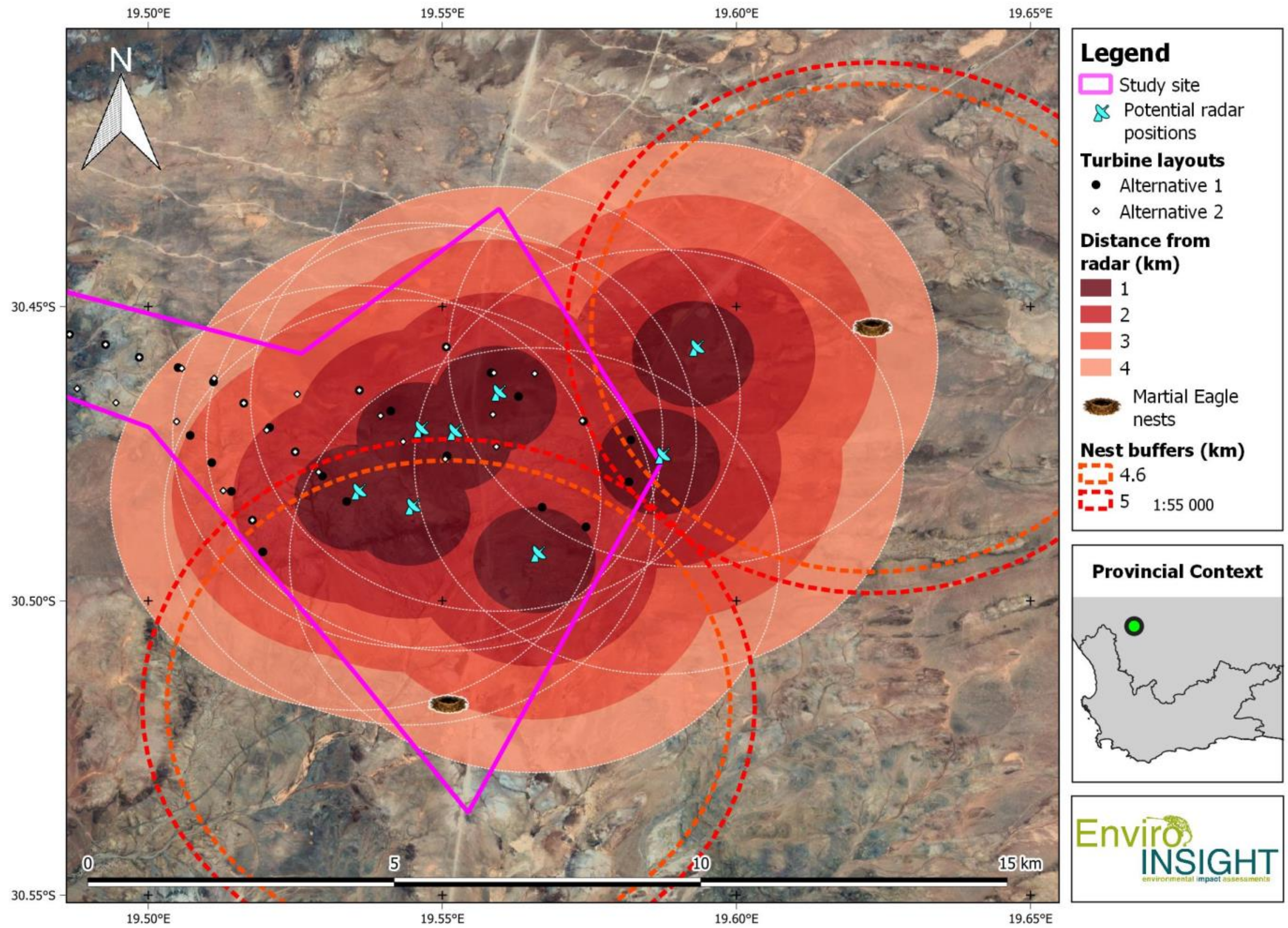

Figure 5-4: Preliminary radar positioning in conjunction with the location of martial eagle nest sites

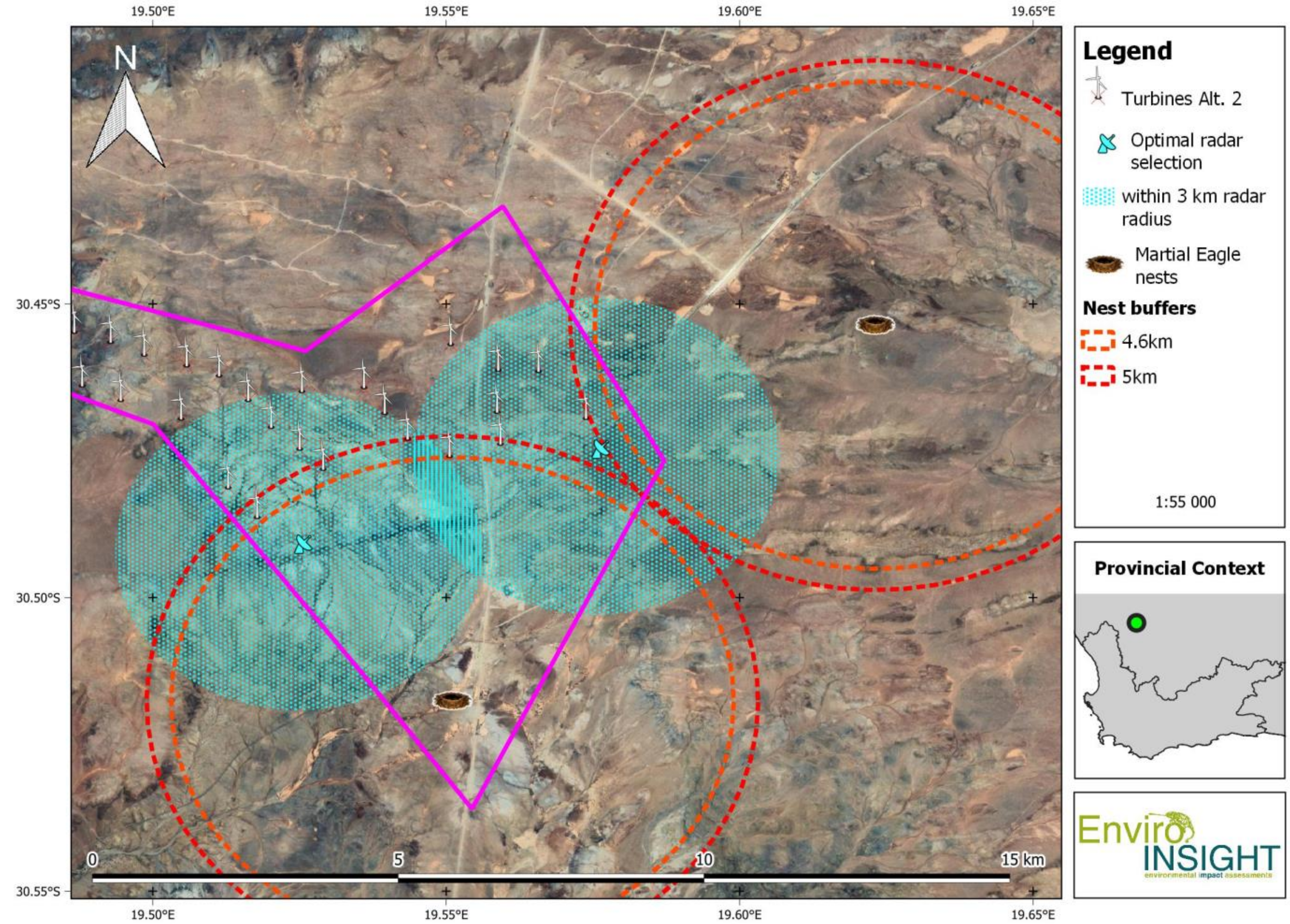

Figure 5-5: Final recommended placement of radar for shutdown on demand protocols

5.7.2 Ludwig's Bustard (*Neotis ludwigii*)

Ludwig's Bustards are globally and regionally listed as Endangered (BirdLife International 2012b and Taylor,*et. al.* 2015) which is cause for a significant evaluation of the species in relation to the proposed development. Actual counts were not carried out although monitoring data suggest that a permanent (albeit seasonal) population including breeding pairs persist for prolonged periods within the study area. Multiple and frequent sightings were recorded. The species is highly migratory and localised development may not represent a fatal flaw. However, the fact that sub-adults and juveniles are encountered in the study area provides strong anecdotal evidence of residential breeding behaviour which may have significance ramifications for the Cumulative Impact Assessment. Some local landowners stated that Ludwig's bustards have increased in density over the last five years. There are a number of possible explanations for the observed increase in density over time:

- It is possible that predator poisoning programs designed to eliminate jackals and black eagles (both of which prey on Ludwig's bustard and both of which are heavily targeted by sheep farmers) have allowed for a local population recovery/ increase;
- The lack of smaller (and less visible) powerlines within much of the study area allowing for localised lower mortality rates; and
- This species, as a nomad, may show localised and temporal increases as part of natural population dynamics due to climatic fluctuations.

This species is almost certainly resident and at risk to the creation of large, turbines in combination with non-marked powerlines may cause collision of birds which could significantly reduce local and regional populations. In addition, large-scale increases in fencing combined with a high volume of large maintenance trucks may cause drastic declines in bustard numbers due to flushing displacements, collisions and entanglements. The presence of this species must form a significant focal point of the mitigation measures.

On a final note concerning monitoring of the species (and possible mitigations), it is vital to highlight that fact that as an Endangered species, Ludwig's bustard demands higher degrees of auditing and monitoring attention than other Red-Listed birds (a fact supported by multiple publications including Visser *et. al.* 2018 and Scott *et. al.* 2012). It is also vital to highlight that presence or absence over time for a nomadic species is difficult to predict and spatial/ temporal population reductions may or may not be development-induced. For example, the cessation of predator poisoning activities within the study area may in fact cause a localised increase in jackal populations, thereby reducing the population of Bustards through good practice. Although it is highly feasible that the development may be directly responsible for local population reductions, comprehensive and continuous data collection is required to monitor the situation on site and apply appropriate mitigation measures and far more significant weighting and value should be applied to the Cumulative Impact Assessment.

Inclusive of appropriate buffering as per the avifaunal sensitivity delineation, the shutdown on demand technology applies to the Ludwig's Bustard species specific mitigation.

5.7.3 Red Lark (*Calendulauda burra*)

This species is highly range range-restricted (Figure 5-6) and is listed as IUCN Vulnerable (Taylor *et al.*, 2015). The species was observed frequently during the assessment period albeit within a highly restricted habitat preference. Significant populations (breeding and foraging) within he PAOI have been confirmed. Even though the species exhibits a specific breeding behaviour (display flights of up to 20 metres as described in Hockey *et. al.* 2005 and depicted in Figure 5-7), it has been deemed to have a relatively low risk of collision and thus is not considered a fatal flaw to the project. The species prefers the open sandy habitats (shown in Figure 5-8), in particular open sandy karroid dunes and grassland, particularly on dune crests and dune side slopes. The species is considered as a regular breeding resident in the region. Avoidance based mitigation is the primary mitigation measure and must be based upon the aforementioned delineated sensitivity. However as five turbines fall within the delineated high sensitivity area for Red Lark and large-scale avoidance is not possible. Therefore, additional small-scale micro sighting is required. Turbines should be placed away from dune crests and side slopes. In addition and for the five affected pylons, the dune habitat should be removed, fenced or artificially vegetated to a prescribed radius of 100 metres in order to ensure no breeding behaviour (and therefore, mating displays leading to potential collision) will not take place within range of the rotor sweep zone.

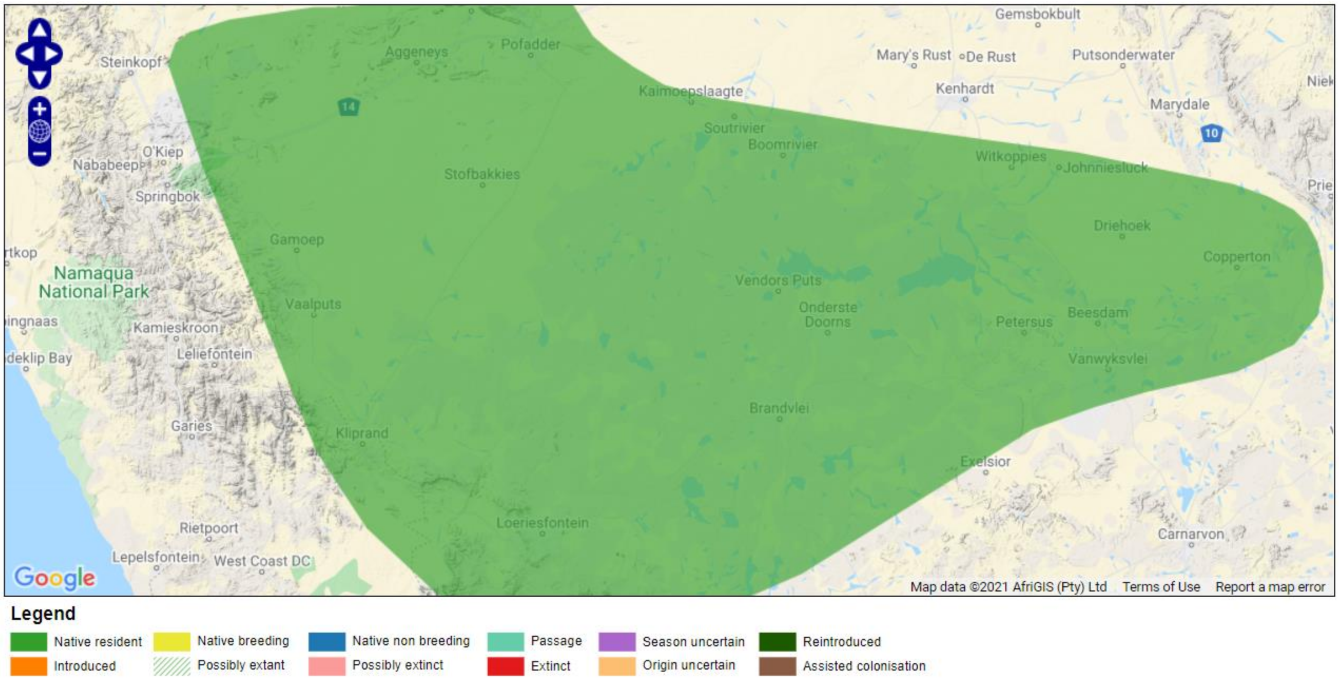

Figure 5-6: Red lark (Calendulauda burra) distribution map (BirdLife International, 2021b).

Figure 5-7: Red lark (Calendulauda burra) display flight not exceeding 20 metres

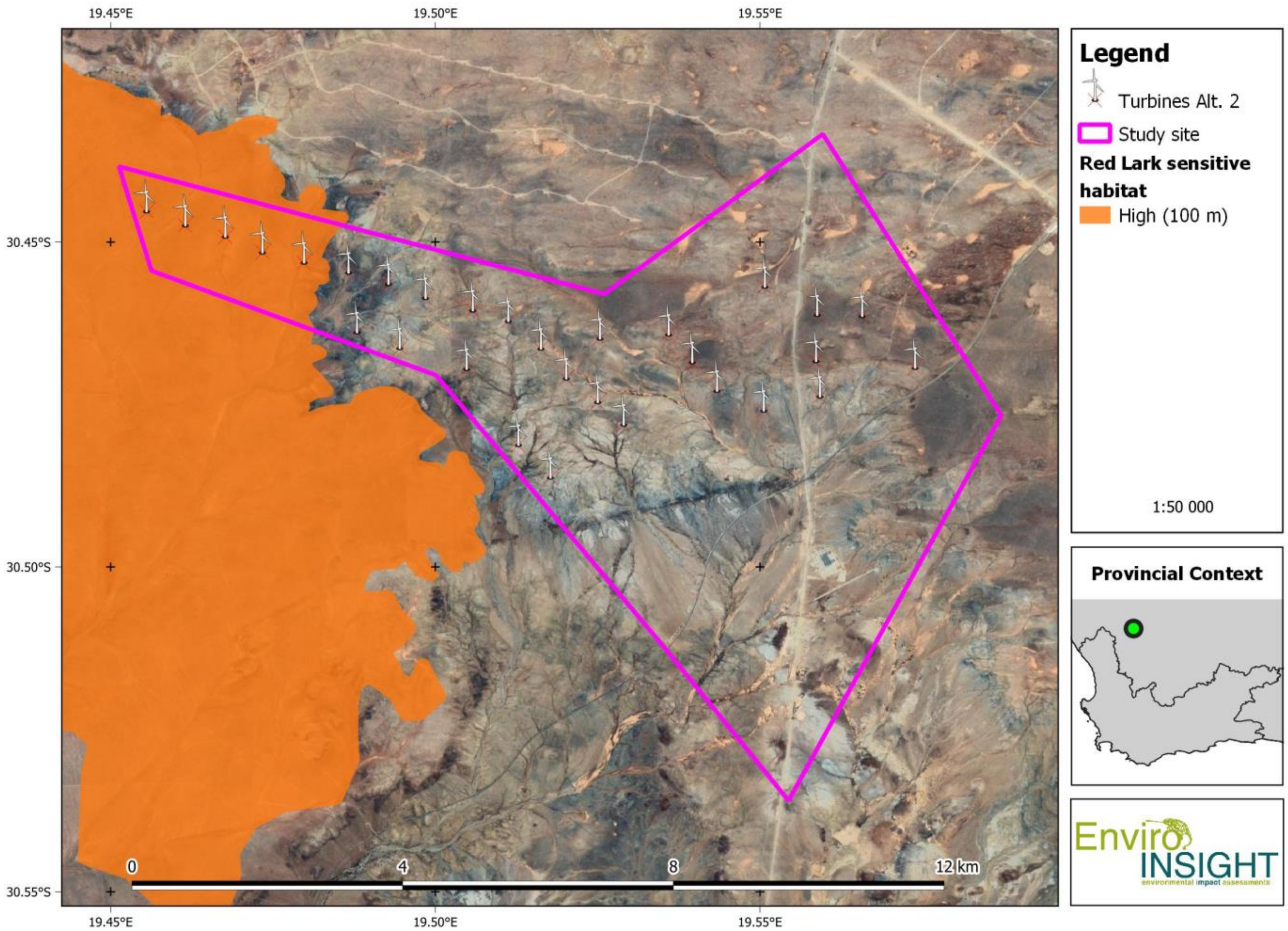

Figure 5-8: Red lark (Calendulauda burra) habitat within the concession

- **MONITORING REQUIREMENTS**

The following outlines a general monitoring plan (EMP) structure.

	Title: SCC community monitoring
Stressor	Project Activities, Climatic Changes
Receptor(s)	Avifauna SCC diversity and densities in each habitat type
Variables	Presence/absence of bird species of conservation concern, including observed breeding behaviour, proportion of SCC species present per sample site, species richness and densities.
Sampling Method	• Vantage Point counts – 2 x Three hour counts (morning and evening) to be conducted at each monitoring plot • Drive Transects (species lists) – all species seen to be recorded along set transects to be driven during dawn till pre 10 am; and • Walked Transects (species lists) – all species heard and seen to be recorded along set transects to be walked at dawn chorus
Sampling Frequency	• Annual wet and dry season surveys; and • Continuous observations by ECO.
Sampling Site(s)	As provided in EMPr.
Change and Action Thresholds	Loss/decrease in any SCC parameter, unnatural decline (cannot be explained by stochastic weather changes) in species densities and/or richness. Similarly, positive changes (e,g, unusual presence in high densities of nomadic species such as Ludwig's Bustard or establishment of SCC breeding population such as Secretary Bird) in species densities and/or richness that indicate disturbance. Rapid surveys of greater surrounding area should be conducted to attempt to determine cause of change detected.
Data Analysis	All variables acquired should be statistically and graphically compared to the available data and the original targeted baseline data. Photographs should be taken of as many SCC observed in the field.
Reporting requirements	Annual reporting presenting data analysis results and mapping indicating locations of change. Specific reporting on negative change detection not directly attributable to Project activities (Turbine Operation) and their cause. All reporting to be accompanied by GIS shapefiles and any original photographs.

	TITLE: Collision monitoring
Stressor(s)	Avifauna-Turbine collisions (incidents)
Receptor(s)	Avifauna community composition, density and distribution
Variables	Species, geographical location and date of every avifaunal mortality
Sampling Method	• For powerlines: Weekly surveys before dawn (prior to scavenger activity) by driving slowly along the servitudes and documenting each collision kill location and species (a georeferenced photograph as evidence is required). • For turbine location sites: daily inspection on foot of cleared areas for birds killed during the operation process. Location and species must be recorded (a georeferenced photograph as evidence is also required).
Sampling Frequency	Weekly for powerlines, daily for turbines

Sampling Site(s)	Along the entire powerline network on the PAOI. All operational turbines.
Collision Action Thresholds	Collision frequency and intensity (#kills per species per unit time) will need to be assessed per species by specialist. However, any non-specific collision concentrations (> 10 kills per month clustering in a stretch of powerline or a specific turbine) must initiate investigation and corrective measures (including temporary suspension of operations, additional mitigation infrastructure).
Data Analysis	Geospatial analysis of density and dispersion of avifaunal mortalities highlighting the core areas of mortalities so that corrective measures can be implemented. Time-series and trend analysis to accompany evaluation to inform on temporal fluctuations (e.g. seasonality) and steer adaptive management. Cumulative species-specific summary statistics to be calculated.
Reporting requirements	• Bi-annual reporting of faunal avifaunal mortalities associated with collision data highlighting locations where corrective measures are to be taken (if necessary).

6 CONCLUSIONS

The study area is located in a region dominated by natural karoo vegetation types with some transformed/ agricultural. Several drainage lines and small dams can be found scattered across the study area with most being mostly dry with some seasonal flow. Fourteen priority species were recorded during the initial surveys, including Martial Eagle, Ludwig's Bustard, Lanner Falcon, Red Lark and Black-winged Kite. Of these, the Ludwig's Bustard was the most concerning large bird species and was observed flying within the rotor sweep area. The high densities of other Bustard species (occasionally flying at rotor height) also represent a concern.

One current concern regarding the bird community observed is the presence of potential collision sensitive raptors species, of which one of them is considered a species of conservation concern, namely the Martial Eagle. Currently, this species has been observed at heights of >50 m, and therefore in the absence of additional data, the exact significance cannot be established with 100% certainty. In addition, it is perhaps noteworthy that in four years of monitoring no observed mortalities of this species was recorded at the adjacent Khobab WEF. However, the presence of two active nests within the PAI and proposed Botterblom WEF is of concern and requires intensive attention to mitigation measures and development footprint placement (avoidance).

The occurrence of several passerine species that might potentially be affected by collision was confirmed, namely endemic and/or range-restricted larks (Red Lark and Sclater's Lark representing the highest profile and frequently observed) which are widespread species in the area. These species are considered to have a "Vulnerable and Near threatened" conservation status respectively. As habitat obligates, the potential impact on these passerines may be mitigated via avoidance.

7 PROFESSIONAL OPINION

The addition of the proposed Botterblom WEF does indicate significant impacts to the receiving environment via the risk to Priority Species (such as Martial Eagle and Ludwig's Bustard) as well as the Cumulative Impacts need to be considered and provision made within the EMPr for this development.

Although previous impact assessments and monitoring programs for existing local WEFs indicated that not all impacts can be mitigated to acceptable levels, medium significance post-mitigation should be interpreted that more can be done to avoid critically important species-specific (especially Martial Eagle impacts as is the case for the impacts discussed within this statement). This is mainly because impact assessments regarding wind developments have been poorly understood since their inception and the impacts (especially cumulative impacts) of wind developments may have highly significant consequences if mitigation and monitoring is not implemented correctly. It is still the opinion of the consultants that the impacts associated with WEF projects are far preferable (from an environmental impact perspective) to extractive and/ or non-renewable alternatives. It must be related that this report must be considered in context with the greater EIA process. In addition, while striving to maintain the highest standards of mitigation and monitoring as well as the commissioning of a highly detailed regional strategic Cumulative Impact Assessment, developments such as the Botterblom WEF be encouraged within designated areas.

The presence of nesting Martial Eagles within the PAOI is of particular concern. The EMPr must be implemented in a manner that will be adaptable using ever improving technology. The author has evaluated the two (2) alternatives proposed for the site and is of the opinion that Alternative 2 the preferred alternative, be considered for development as it has the least impact of the two proposed alternatives. Thus, the author sees no reason why an Environmental Authorisation (EA) should not be granted on the following conditions;

- All recommended buffering be strictly adhered to.
- Shutdown on demand must be implemented if 5 km nest buffers are to be breached.
- No turbines should breach 4.6 km to any active Martial Eagle Nest.
- All recommended mitigation measures be applied preconstruction, post construction and operations.
- The EMPr be updated every three years in order to revaluate the advances in AI, radar and camera technology.
- Currently available Deterrent and Shutdown on demand technology is to be immediately applied to the identified turbines in the form of Artificial Intelligence Camera systems.

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9 APPENDIX

9.1 APPENDIX 1: EXPECTED AVIFAUNA SPECIES LIST

Avifauna predicted to potentially occur within the study area according to SABAP1 and SABAP2.

#	Scientific Name	Common Name	# pentads
1	*Afrotis afraoides*	Northern Black Korhaan	2
2	*Alopochen aegyptiaca*	Egyptian Goose	2
3	*Amadina erythrocephala*	Red-headed Finch	1
4	*Anas capensis*	Cape Teal	1
5	*Anthoscopus minutus*	Cape Penduline Tit	4
6	*Anthus cinnamomeus*	African Pipit	3
7	*Anthus nicholsoni*	Nicholson's Pipit	3
8	*Apus affinis*	Little Swift	3
9	*Apus apus*	Common Swift	2
10	*Apus caffer*	White-rumped Swift	2
11	*Ardea melanocephala*	Black-headed Heron	1
12	*Ardeotis kori*	Kori Bustard	1
13	*Bubo africanus*	Spotted Eagle-Owl	4
14	*Burhinus capensis*	Spotted Thick-knee	3
15	*Buteo rufofuscus*	Jackal Buzzard	3
16	*Calandrella cinerea*	Red-capped Lark	4
17	*Calendulauda burra*	Red Lark	3
18	*Caprimulgus rufigena*	Rufous-cheeked Nightjar	1
19	*Cecropis cucullata*	Greater Striped Swallow	1
20	*Cercotrichas coryphoeus*	Karoo Scrub Robin	4
21	*Certhilauda subcoronata*	Karoo Long-billed Lark	4
22	*Charadrius pecuarius*	Kittlitz's Plover	1
23	*Charadrius tricollaris*	Three-banded Plover	2
24	*Chersomanes albofasciata*	Spike-heeled Lark	4
25	*Cinnyris chalybeus*	Southern Double-collared Sunbird	1
26	*Cinnyris fuscus*	Dusky Sunbird	3
27	*Circaetus pectoralis*	Black-chested Snake Eagle	3

28	*Cisticola subruficapilla*	Grey-backed Cisticola	4
29	*Colius colius*	White-backed Mousebird	2
30	*Columba guinea*	Speckled Pigeon	4
31	*Corvus albus*	Pied Crow	4
32	*Corvus capensis*	Cape Crow	4
33	*Coturnix coturnix*	Common Quail	1
34	*Crithagra albogularis*	White-throated Canary	4
35	*Crithagra flaviventris*	Yellow Canary	4
36	*Curruca layardi*	Layard's Warbler	3
37	*Curruca subcoerulea*	Chestnut-vented Warbler	1
38	*Cursorius rufus*	Burchell's Courser	2
39	*Emarginata schlegelii*	Karoo Chat	4
40	*Emarginata sinuata*	Sickle-winged Chat	3
41	*Emarginata tractrac*	Tractrac Chat	4
42	*Emberiza capensis*	Cape Bunting	3
43	*Emberiza impetuani*	Lark-like Bunting	4
44	*Eremomela gregalis*	Karoo Eremomela	4
45	*Eremomela icteropygialis*	Yellow-bellied Eremomela	4
46	*Eremopterix australis*	Black-eared Sparrow-Lark	4
47	*Eremopterix verticalis*	Grey-backed Sparrow-Lark	4
48	*Eupodotis vigorsii*	Karoo Korhaan	4
49	*Falco biarmicus*	Lanner Falcon	3
50	*Falco rupicoloides*	Greater Kestrel	4
51	*Falco rupicolus*	Rock Kestrel	4
52	*Galerida magnirostris*	Large-billed Lark	4
53	*Hieraaetus pennatus*	Booted Eagle	2
54	*Himantopus himantopus*	Black-winged Stilt	1
55	*Hirundo rustica*	Barn Swallow	4
56	*Lamprotornis bicolor*	Pied Starling	1
57	*Lanius collaris*	Southern Fiscal	4
58	*Malcorus pectoralis*	Rufous-eared Warbler	4
59	*Melaenornis infuscatus*	Chat Flycatcher	4
60	*Melaniparus afer*	Grey Tit	4
61	*Melierax canorus*	Pale Chanting Goshawk	4

62	*Merops apiaster*	European Bee-eater	2
63	*Motacilla capensis*	Cape Wagtail	3
64	*Muscicapa striata*	Spotted Flycatcher	1
65	*Myrmecocichla formicivora*	Ant-eating Chat	4
66	*Myrmecocichla monticola*	Mountain Wheatear	2
67	*Nectarinia famosa*	Malachite Sunbird	1
68	*Neotis ludwigii*	Ludwig's Bustard	4
69	*Oena capensis*	Namaqua Dove	4
70	*Oenanthe familiaris*	Familiar Chat	4
71	*Oenanthe pileata*	Capped Wheatear	4
72	*Passer domesticus*	House Sparrow	3
73	*Passer melanurus*	Cape Sparrow	4
74	*Plectropterus gambensis*	Spur-winged Goose	1
75	*Ploceus velatus*	Southern Masked Weaver	4
76	*Polemaetus bellicosus*	Martial Eagle	3
77	*Prinia maculosa*	Karoo Prinia	4
78	*Pterocles namaqua*	Namaqua Sandgrouse	4
79	*Ptyonoprogne fuligula*	Rock Martin	4
80	*Pycnonotus nigricans*	African Red-eyed Bulbul	1
81	*Rhinoptilus africanus*	Double-banded Courser	4
82	*Serinus alario*	Black-headed Canary	4
83	*Spilopelia senegalensis*	Laughing Dove	4
84	*Spizocorys sclateri*	Sclater's Lark	4
85	*Spizocorys starki*	Stark's Lark	3
86	*Stenostira scita*	Fairy Flycatcher	1
87	*Streptopelia capicola*	Cape Turtle Dove	4
88	*Tadorna cana*	South African Shelduck	3
89	*Telophorus zeylonus*	Bokmakierie	4
90	*Torgos tracheliotos*	Lappet-faced Vulture	1
91	*Tricholaema leucomelas*	Acacia Pied Barbet	3
92	*Vanellus armatus*	Blacksmith Lapwing	1
93	*Vanellus coronatus*	Crowned Lapwing	2

9.2 APPENDIX 2: ALL SPECIES CONTACT DATA PER SEASON

	Season					
All species	2020Dec	2020Sep	2021Apr	2021July	2021Sep	Total
African Pipit			5	2		7
African Stonechat				2		2
Ant-eating Chat			3	3	4	10
Black Sparrowhawk					22	22
Black-chested Snake Eagle			6			6
Black-eared Sparrow-Lark	27	47	7		64	145
Black-headed Canary			1	21		22
Blacksmith Lapwing			3	1		4
Black-winged Kite	3					3
Black-winged Stilt			3			3
Bokmakierie		2	6	1	1	10
Burchell's Courser					2	2
Cape Bunting		4	7	6	2	19
Cape Clapper Lark					2	2
Cape Crow		2	6	5	3	16
Cape Penduline Tit		1	1	3		5
Cape Sparrow		10	142	15	86	253
Cape Sparrow				18		18
Cape Teal			2			2
Cape Turtle Dove				3		3
Cape Wagtail			5	1		6
Cape Weaver					3	3
Capped Wheatear			21	4	3	28
Chat Flycatcher		3	9	1	8	21
Common Ostrich				2		2
Common Ostrich				10		10
Double-banded Courser		4		1	2	7
Dusky Sunbird		1			17	18
Eastern Clapper Lark				1	7	8

Egyptian Goose			5	4		9
European Bee-eater					5	5
Fairy Flycatcher				1		1
Familiar Chat			10	17	3	30
Greater Kestrel	4	1	11	2	17	35
Grey Tit			13	5	7	25
Grey-backed Cisticola		2	10	13	6	31
Grey-backed Sparrow-Lark	66	2	30		43	141
House sparrow			5			5
Jackal Buzzard			4			4
Karoo Chat		4	36	19	13	72
Karoo Eremomela		2	10	18	6	36
Karoo Korhaan	28	9	25	11	10	83
Karoo Long-billed Lark		7	12	5	12	36
Karoo Prinia		2	7	3	15	27
Karoo Scrub Robin		3	12	10	14	39
Karoo Thrush				1		1
Kittlitz's Plover			4	1		5
Kori Bustard				1		1
Lanner Falcon	1		2			3
Large-billed Lark		8	48	28	41	125
Lark-like Bunting		12	1		21	34
Laughing Dove				1		1
Layard's Warbler			3			3
Little Grebe			2			2
Long-billed Crombec				1	2	3
Ludwig's Bustard	5	9	4	15	23	56
Malachite Sunbird		1		4	2	7
Martial Eagle	2	3	2	3	3	13
Mountain Wheatear			2	2		4
Namaqua Dove				1	3	4
Namaqua Sandgrouse	84	2	20	47	120	273

Nicholson's Pipit		1				1
Northern Black Korhaan	19	4	22	16	17	78
Pale Chanting Goshawk		4	7	5	5	21
Pale Chanting Goshawk	7			7		14
Pied Avocet				1		1
Pied Crow	66	7	54	70	55	252
Pririt Batis			2		2	4
Red Lark	41	9	30	20	28	128
Red-capped Lark		3	13	3	9	28
Ring-necked Dove		1				1
Rock Dove					4	4
Rock Kestrel			12	5		17
Rock Kestrel				14		14
Rock Martin		1	2	4	3	10
Rufous-eared Warbler		2	25	11	22	60
Rufous-eared Warbler				8		8
Sclater's Lark			5		1	6
Sickle-winged Chat			2	1	1	4
South African Shelduck			17	3		20
Southern Fiscal			8	5		13
Southern masked weaver			19	3	6	28
Speckled Pigeon		11	30	2	43	86
Speckled Pigeons				5		5
Spike-heeled Lark		6	2	7	28	43
Steenbok				1		1
Three-banded Plover			3	2		5
Tractrac Chat		6	25	13	16	60
Tractrac Chat			1	5		6
Wattled Starling			1			1
Western Barn Owl		1				1
White-backed Mousebird				4		4
White-throated Canary		3	3	4	1	11

Yellow Canary		5	181	36	75	297
Yellow Canary				26		26
Yellow-bellied Eremomela		1	2	1	2	6
Yellow-fronted Canary				3		3
(blank)						
Totals	**353**	**206**	**971**	**598**	**910**	**3038**

9.3 APPENDIX 3: NON PRIORITY SPECIES CONTACT DATA PER SEASON (WALKED TRANSECT)

Non-Priority Species by Season	Walk Transects								Total
	1	2	3	Additional	Control	Dam	Leeuberg River	Waterbodies	
Autumn (2021-Apr)	**7**		**67**	**16**	**70**	**59**	**4**	**88**	**311**
African Pipit								2	2
Black-eared Sparrow-Lark	4								4
Blacksmith Lapwing						2			2
Black-winged Stilt						1			1
Bokmakierie			1		1				2
Cape Sparrow			21		10	10		13	54
Cape Teal						1			1
Cape Wagtail						4			4
Capped Wheatear				1		1		4	6
Chat Flycatcher			4						4
Egyptian Goose						4			4
Grey-backed Cisticola			2		1				3
Grey-backed Sparrow-Lark	2			10	1			7	20
Karoo Chat			2	1	1	2	2	4	12
Karoo Long-billed Lark				1					1
Karoo Prinia			2			1			3
Karoo Scrub Robin			2			2			4
Kittlitz's Plover						4			4
Large-billed Lark			4	1	6	1	1	8	21
Little Grebe						1			1
Namaqua Sandgrouse			1		1	2			4
Pied Crow					2	2		1	5
Red-capped Lark					1	1		4	6
Rufous-eared Warbler	1		1		2	2		2	8
South African Shelduck						10			10
Southern Fiscal			1					1	2
Southern masked weaver			2						2
Speckled Pigeon			20			5			25
Three-banded Plover						2			2
Tractrac Chat			1		1				2
White-throated Canary			1	1					2
Yellow Canary			2	1	43	1	1	42	90
Winter (2021-Jul)	**3**	**5**	**24**		**3**	**18**	**1**	**34**	**88**
African Pipit	1							1	2
Black-headed Canary								1	1
Blacksmith Lapwing						1			1
Cape Sparrow			3			1		2	6
Cape Turtle Dove						1			1
Cape Wagtail						1			1
Capped Wheatear						1		2	3
Common Ostrich						2			2
Egyptian Goose						2			2
Fairy Flycatcher			1						1
Familiar Chat			1						1
Grey-backed Cisticola	1		1					1	3
Karoo Chat		1							1
Karoo Eremomela								1	1
Karoo Prinia			2						2

Karoo Scrub Robin			3		1			4
Kittlitz's Plover					1			1
Large-billed Lark							6	6
Pied Avocet					1			1
Pied Crow		1	2	1	1			5
Red-capped Lark							1	1
Rock Martin					1			1
Rufous-eared Warbler		1				1	4	6
Sickle-winged Chat							1	1
South African Shelduck					1			1
Southern masked weaver			2					2
Speckled Pigeon					1		1	2
Three-banded Plover					2			2
Tractrac Chat		1	1	1			3	6
White-throated Canary			1					1
Yellow Canary	1	1	7	1			7	17
Yellow-bellied Eremomela							1	1
Yellow-fronted Canary							2	2
Spring (2021-Sep)	**24**	**9**	**138**	**7**	**8**	**10**	**90**	**286**
Black Sparrowhawk							22	22
Black-eared Sparrow-Lark	10						32	42
Cape Crow		1						1
Cape Sparrow		2	15	4	2		8	31
Capped Wheatear							1	1
Chat Flycatcher		1	2				2	5
Dusky Sunbird			7					7
Eastern Clapper Lark	2					2		4
European Bee-eater			5					5
Grey Tit			3					3
Grey-backed Cisticola			5					5
Grey-backed Sparrow-Lark	1					8		9
Karoo Chat	1		2	1				4
Karoo Eremomela							2	2
Karoo Long-billed Lark			1					1
Karoo Prinia		1	6				1	8
Karoo Scrub Robin		1	8					9
Large-billed Lark	1		1				2	4
Lark-like Bunting		1					2	3
Long-billed Crombec			2					2
Malachite Sunbird			2					2
Namaqua Dove			2					2
Namaqua Sandgrouse	5		24				10	39
Pied Crow	3		2		2		1	8
Pririt Batis			2					2
Red-capped Lark							5	5
Rufous-eared Warbler			4	2				6
Sickle-winged Chat			1					1
Southern masked weaver			4					4
Speckled Pigeon			10					10
Tractrac Chat		1					1	2
Yellow Canary	1	1	28		4		1	35

Yellow-bellied Eremomela			2						2
Totals	**34**	**14**	**229**	**16**	**80**	**85**	**15**	**212**	**685**

9.4 APPENDIX 4: NON PRIORITY SPECIES CONTACT DATA PER SEASON (DRIVETRANSECT)

Drive Transects

Non-Priority Species by Season	1	2	3	4	5	6	Control	Total
Autumn (2021-Apr)	**91**	**34**	**114**	**14**	**26**	**12**	**50**	**341**
African Pipit	1							1
Ant-eating Chat		3						3
Black-eared Sparrow-Lark				2				2
Black-winged Stilt							1	1
Bokmakierie				1			1	2
Cape Bunting		1	1				1	3
Cape Crow			1				1	2
Cape Sparrow	18	6	43		7		2	76
Capped Wheatear	2	1	3	5				11
Chat Flycatcher	1		2				1	4
Familiar Chat			1				3	4
Grey Tit	1							1
Grey-backed Cisticola	3		1			2		6
Grey-backed Sparrow-Lark		2		1	2	1		6
House sparrow	2							2
Karoo Chat	1	3	5	1	2	1	1	14
Karoo Eremomela			2					2
Karoo Long-billed Lark	1	1	2			3	2	9
Karoo Prinia							2	2
Karoo Scrub Robin	4							4
Large-billed Lark	6	2	6				2	16
Layard's Warbler	1						1	2
Pied Crow	8	4	2		5	1	3	23
Pririt Batis							2	2
Red-capped Lark	3	1					1	5
Rock Kestrel				1				1
Rock Martin	1							1
Rufous-eared Warbler	5	1	4		1	3		14
Sickle-winged Chat						1		1
South African Shelduck							1	1
Southern Fiscal	1		1		2			4
Southern masked weaver	1		13					14
Spike-heeled Lark		1						1
Tractrac Chat	8	1	2	3			4	18
Yellow Canary	21	7	25		7		21	81
Yellow-bellied Eremomela	2							2
Winter (2021-Jul)	**22**	**12**	**9**	**9**	**8**	**15**	**9**	**84**
Ant-eating Chat		1		1				2
Cape Crow	1							1
Cape Sparrow		1	1		3			5
Cape Sparrow	1							1
Capped Wheatear		1						1
Chat Flycatcher				1				1
Common Ostrich							2	2
Familiar Chat	4							4

Grey Tit			2					2
Grey-backed Cisticola	1		1					2
Karoo Chat			1	1		1	1	4
Karoo Scrub Robin						1		1
Large-billed Lark		1		1		2		4
Long-billed Crombec		1						1
Pied Crow	2	1		1		1	4	9
Red-capped Lark						2		2
Rock Kestrel					1	1		2
Rock Kestrel	3						1	4
Rock Martin		1						1
Rufous-eared Warbler		1		1		1		3
Speckled Pigeons	5							5
Spike-heeled Lark		1				2		3
Tractrac Chat				1	1	1		3
White-throated Canary			1					1
Yellow Canary		3	3	2	3	2		13
Yellow Canary	5						1	6
Yellow-fronted Canary						1		1
Spring (2021-Sep)	**9**	**19**	**25**	**42**	**14**	**28**	**11**	**148**
Ant-eating Chat		2						2
Black-eared Sparrow-Lark				10		1		11
Cape Sparrow	4	1	7	2	5	2	2	23
Capped Wheatear				1				1
Dusky Sunbird			1					1
Grey-backed Cisticola						1		1
Grey-backed Sparrow-Lark	1			17			4	22
Karoo Long-billed Lark						1	1	2
Karoo Prinia		1	1			1		3
Karoo Scrub Robin			2					2
Large-billed Lark				2		5		7
Lark-like Bunting				3		2		5
Namaqua Sandgrouse		2	12		8	6		28
Pied Crow		2		3	1	2	2	10
Rock Dove		3						3
Rufous-eared Warbler		1		1		2	2	6
Southern masked weaver			2					2
Spike-heeled Lark		7		2		3		12
Tractrac Chat				1		1		2
Yellow Canary	4					1		5
Totals	**122**	**65**	**148**	**65**	**48**	**55**	**70**	**573**

9.5 APPENDIX 5: ALL SPECIES CONTACT DATA PER SEASON

Non-Priority Species by Season	Vantage Points						Total
	1	2	3	4	5	Control	
Summer (2020-Dec)	**64**	**41**	**67**	**32**	**39**		**243**
Black-eared Sparrow-Lark			27				27
Grey-backed Sparrow-Lark	25	15	18		8		66
Namaqua Sandgrouse	23	9	8	21	23		84
Pied Crow	16	17	14	11	8		66
Autumn (2021-Apr)	**15**	**22**	**34**	**78**		**36**	**185**
African Pipit				2			2
Black-chested Snake Eagle			2				2
Black-headed Canary						1	1
Blacksmith Lapwing						1	1
Black-winged Stilt						1	1
Bokmakierie						2	2
Cape Bunting		2	2				4
Cape Crow		3		1			4
Cape Penduline Tit		1					1
Cape Sparrow			1	10			11
Cape Teal						1	1
Cape Wagtail						1	1
Capped Wheatear			1				1
Egyptian Goose						1	1
Familiar chat			1	5			6
Fiscal Shrike				1			1
Grey Tit			4	8			12
Grey-backed Cisticola		1					1
Grey-backed Sparrow-Lark	2	1	1				4
House sparrow				3			3
Karoo Chat	2		3	3		2	10
Karoo Eremomela		1	4	3			8
Karoo Long-billed Lark		1					1
Karoo Prinia			1	1			2
Karoo Scrub Robin			1	3			4
Large-billed Lark		4	3	2		1	10
Lark-like Bunting				1			1
Little Grebe						1	1
Mountain wheatear				2			2
Namaqua Sandgrouse	5		4	1		6	16
Pied Crow	1	2	4	6		7	20
Red-capped Lark		1					1
Rock Kestrel	1	2		7			10
Rock Martin				1			1
Rufous-eared Warbler	1	1				1	3
Sickle wing chat		1					1
South African Shelduck						6	6

Southern Fiscal				1		1
Southern Masked Weaver				3		3
Speckled Pigeon				5		5
Spike-heeled Lark	1					1
Three-banded Plover					1	1
Tractrac Chat	1		2		2	5
Tractrac Chat	1					1
Wattled Starling					1	1
White-throated Canary				1		1
Yellow Canary		1		8		9
Winter (2021-Jul)	**20**	**36**	**81**	**85**	**53**	**275**
African Stonechat				2		2
Bokmakierie				1		1
Cape Bunting		3	1			4
Cape Crow		2		1		3
Cape Sparrow			1	2		3
Cape Sparrow			6	5	6	17
Common Ostrich					8	8
Eastern Clapper Lark	1					1
Egyptian Goose				2		2
Familiar chat			3	8		11
Grey Tit			1	1		2
Grey-backed Cisticola		1		5		6
Karoo Chat		6	5	2		13
Karoo Eremomela		3	4	1	4	12
Karoo Long-billed Lark			1	3	1	5
Karoo Prinia				1		1
Karoo Scrub Robin				4		4
Large-billed Lark		4	6	5	1	16
Malachite Sunbird				3		3
Namaqua Dove				1		1
Namaqua Sandgrouse	1	2	37		4	44
Pied Crow	14	9	11	13	6	53
Rock Kestrel	1		1	1	6	9
Rufous-eared Warbler			1	1		2
Rufous-eared Warbler			2	6		8
South African Shelduck					2	2
Southern Fiscal		1		4		5
Southern Masked Weaver				1		1
Spike-heeled Lark				3	1	4
Tractrac Chat					1	1
Tractrac Chat	3	1	1			5
Yellow Canary		4		9	13	26
Spring (2021-Sep)	**84**	**48**	**40**	**124**	**65**	**361**
Ant-eating Chat	2					2
Black-eared Sparrow-Lark	6				2	8

Bokmakierie	1						1
Cape Bunting						2	2
Cape Clapper Lark	2						2
Cape Crow		1		1			2
Cape Sparrow			1	28		3	32
Cape Weaver				3			3
Capped Wheatear		1					1
Chat Flycatcher			3				3
Dusky Sunbird				9			9
Eastern Clapper Lark	3						3
Familiar chat				3			3
Grey Tit				4			4
Grey-backed Sparrow-Lark	11	1					12
Karoo Chat		4	3			2	9
Karoo Eremomela		3	1				4
Karoo Long-billed Lark		4	2			3	9
Karoo Prinia				3		1	4
Karoo Scrub Robin				3			3
Large-billed Lark	1	8	6	9		6	30
Lark-like Bunting	3	3		3			9
Namaqua Dove				1			1
Namaqua Sandgrouse	35	4	3			11	53
Pied Crow	5	12	5	11		4	37
Red-capped Lark	4						4
Rock Dove						1	1
Rock Martin		1		2			3
Rufous-eared Warbler	2		3	4		1	10
Speckled Pigeon				33			33
Spike-heeled Lark	4		5	2		5	16
Tractrac Chat	5			1		6	12
White-throated Canary				1			1
Yellow Canary		6	8	3		18	35
Grand Total	**183**	**147**	**222**	**319**	**39**	**154**	**1064**