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Enviro INSIGHT environmental impact assessments

Appendix D2:

Preconstruction Avifauna Assessment

Enviro INSIGHT environmental impact assessments

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Enviro INSIGHT
environmental impact assessments

Environmental Impact Assessment Report

Pre-construction Avifauna Monitoring Assessment for the Proposed De Rust Wind Energy Facility near Pofadder, Northern Cape

April 2023

Prepared For

EnergyTeam

Enviro-Insight CC

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Professional Team

The technical team responsible for the pre-construction monitoring surveys and impact assessment reporting:

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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). I have the necessary qualifications and expertise (*Pr. Sci. Nat. Zoological Science)* in developing 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
PA	Project Area (denotes infrastructure footprint)
PAOI	Project Area of Influence
Preconstruction Phase	The period prior to the construction of a wind energy facility
Wind Energy related	Threatened or rare birds (in particular those unique to the region and especially those which are

Priority species	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

Enviro-Insight CC was commissioned by EnergyTeam (Pty) Ltd to conduct a pre-construction avifaunal survey for a proposed wind energy facility (WEF) and associated infrastructure which is comprised of the De Rust WEF North and the De Rust WEF South, collectively referred to as the De Rust WEF. This WEF consists of two separate projects (individually submitted for environmental authorisation), FE De Rust North WEF and FE De Rust South WEF. Both projects are addressed in this report. The proposed WEFs will consist of up to 74 wind turbines in total, with a generation capacity of up to 7.5 MW per turbine. Each turbine will have a hub height of up to 150 m and a rotor diameter of up to 175 m. The final turbine model to be utilised will only be determined closer to the time of construction, depending on the technology available at the time. Additional ancillary infrastructure would include underground and above-ground cabling between project components, onsite substation/s, Battery Energy Storage System (BESS), foundations to support turbine towers, internal/ access roads (up to 10 m in width) linking the wind turbines and other infrastructure on the site, and permanent workshop area and office for control, maintenance and storage. As far as possible, existing roads will be utilised and upgraded (where needed) with the relevant stormwater infrastructure and gates constructed as required. The perimeter of the proposed WEF may be enclosed with suitable fencing. A formal laydown area for the construction period, containing a temporary maintenance and storage building along with a guard cabin will also be established. This report serves as a pre-construction assessment of the avifaunal activity and bird species present in the Project Area (PA) and Project Area of Influence (PAOI) of the proposed De Rust WEF.

1.1 SCOPE OF WORK

The main objective is to fully understand the avifaunal assemblage prevalent within the PAOI and successfully mitigate any possible negative impacts of wind energy production (and associated infrastructure) on the avifauna within the PAOI. This report will provide baseline information to assess avifauna habitat use in a pre-construction (pre-impact) scenario and evaluate the potential impact of the proposed De Rust WEF on avifauna (such as collision fatality, displacement due to disturbance, barrier effects and habitat loss).

1.2 STUDY AREA

The proposed De Rust WEF (boundary in Figure 1-1 is located 13 km south-south-east of Pofadder and 47 km east of Aggeneys in the Khâi-Ma Local Municipality in the Northern Cape Province of South Africa. It is accessed from the R358 from Pofadder, which bisects the PA (defined as the boundary shown in Figure 1-1). The minimum convex hull of the preferred turbine placement (B), with an 87.5 m buffer (to account for rotor sweep), covers an area of *ca.* 7,731 ha. The only land use in the area is sheep ranching due to the lack of rainfall and nearby permanent water sources, and several occupied farm smallholdings are present within or near to the Project Area (PA) known as the infrastructure footprint. The closest existing WEF is the Kangnas WEF, which is situated approximately 85 km west-south-west of the proposed De Rust WEF PA (the current project). It is vital to note that the pre-construction data acquisition for the proposed De Rust WEF was carried out in conjunction with that for the proposed De Rust Solar Energy Facility (SEF), which resulted in an overlap of datasets and geospatial data analysis, which is why Figure 1-2 shows the combined SEF and WEF Pas in relation to each other.

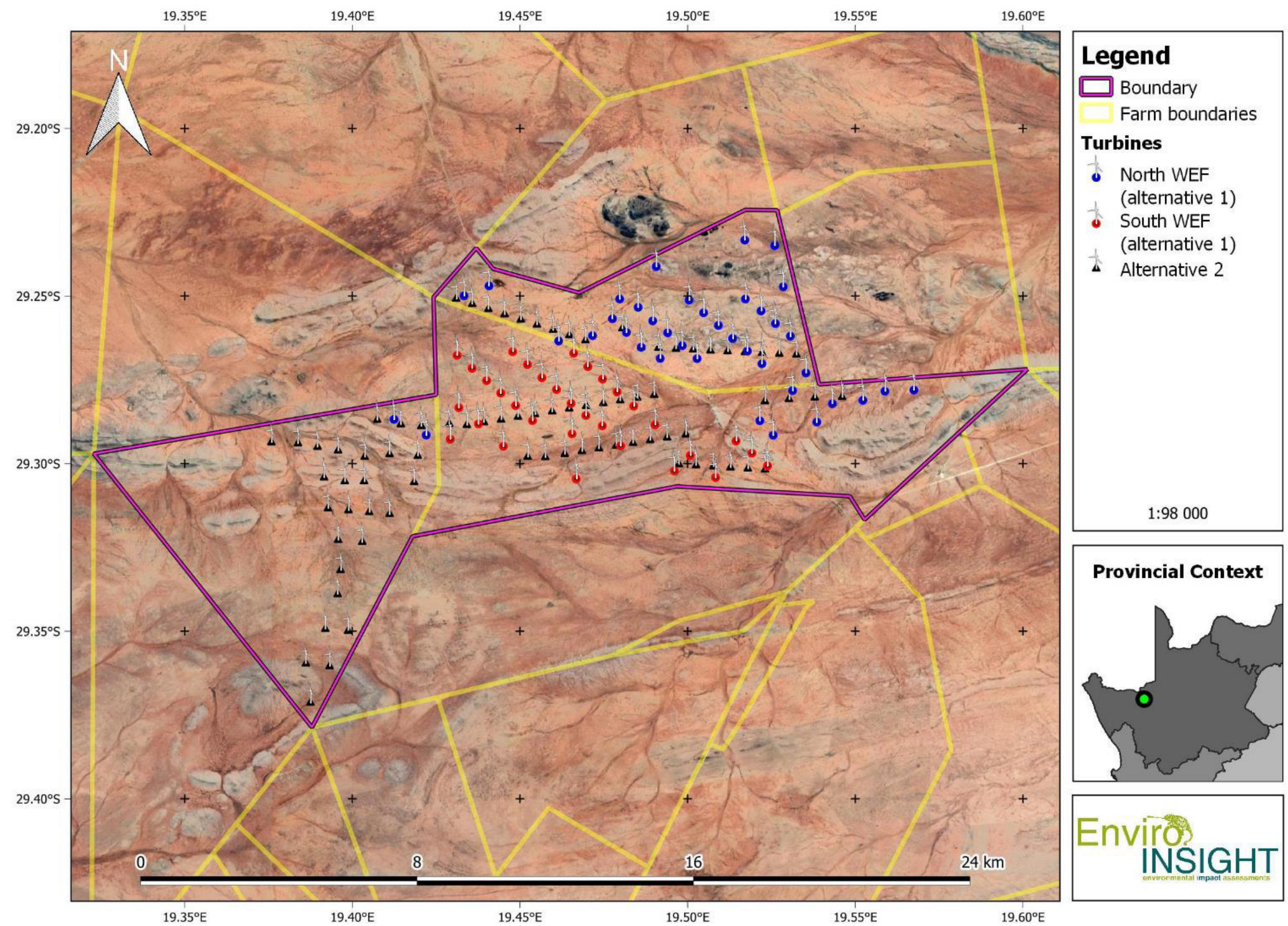

Figure 1-1: Location of the project area (WEF boundary) for the proposed De Rust WEF development, showing proposed turbine layout alternatives and associated infrastructure.

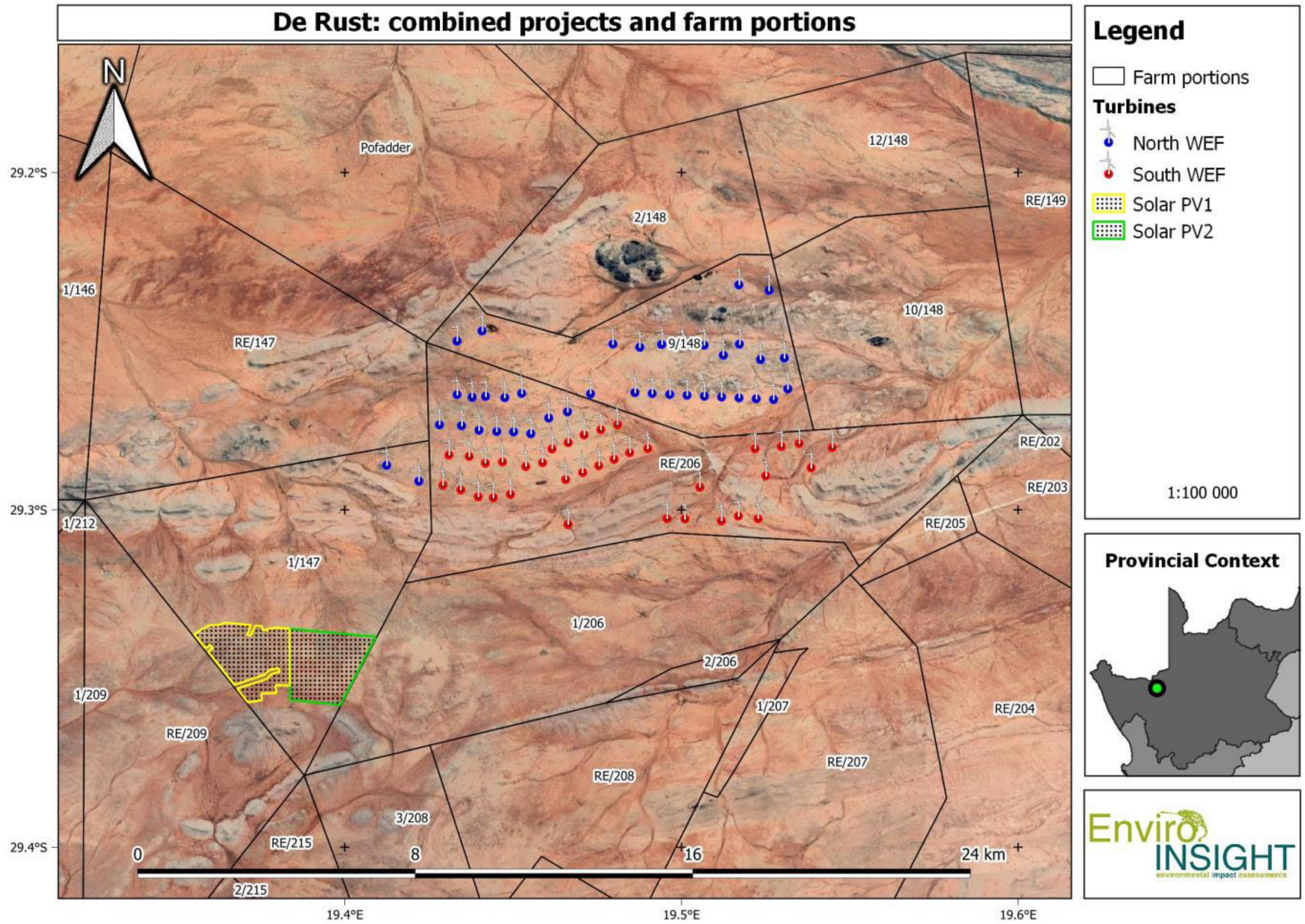

Figure 1-2: Location of the proposed De Rust WEF turbine layouts in relation to the proposed De Rust SEF .

1.3 STUDY LIMITATIONS & CONSIDERATIONS

- It is assumed that all third-party information acquired is correct (e.g., GIS data, existing facility fatality 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) as well as the specialists own experience with post-construction monitoring at WEFs. Estimates of impacts are therefore also based on knowledge gained internationally, which should be applied with caution to local species and conditions;
- 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.

- The period between the finalization of the Scoping Report Submission and the submission of the final EIA showed an unusual ecological pattern described below:
  - When the Scoping Report was written, it was taking into consideration that two living Martial Eagles (monogamous breeding pair) were occupying a distinct territory. From November 2022, and after the last scheduled field survey, one of the resident Martial Eagles had died and two different Martial Eagles moved into areas directly adjacent to the proposed De Rust WEF PA.
  - There is a possibility that the disused Martial Eagle nest evaluated for the sensitivity mapping may now become active due to the colonisation by a new pair of birds which have been frequently observed within the PA and PAOI.
  - The ecological situation thus remains fluid and requires intensive discussion as to adapted mitigation measures which may differ somewhat to the Scoping Report, especially in relation to the Cumulative Impact Assessment section of this final EIA report.

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.

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.

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

Based on the environmental screening tool reports generated on 03/02/2021, (Figure 2-1, Figure 2-1), the Animal Combined Sensitivity Theme is indicated as a combination of Medium and **High** sensitivity in areas that are said to contain the following Sensitivity Feature(s).

- High Aves-*Cursorius rufus* (Burchell's Courser)
- High Aves-*Neotis ludwigii* (Ludwig's Bustard)
- High Aves-*Falco biarmicus* (Lanner Falcon)
- High Aves-*Aquila verreauxii* (Verreaux's Eagle)
- Medium Aves-*Neotis ludwigii* (Ludwig's Bustard)
- Medium Aves-*Sagittarius serpentarius* (Secretary Bird)
- Medium Aves-*Aquila verreauxii* (Verreaux's Eagle)

Due to the coarse spatial scale of the tool and the presence of other Species of Conservation Concern (SCC), the overall theme was treated as High Sensitivity. The Screening Report clearly ignored the consistent and seemingly high (regional) density of Martial Eagles *Polemaetus bellicosus*.

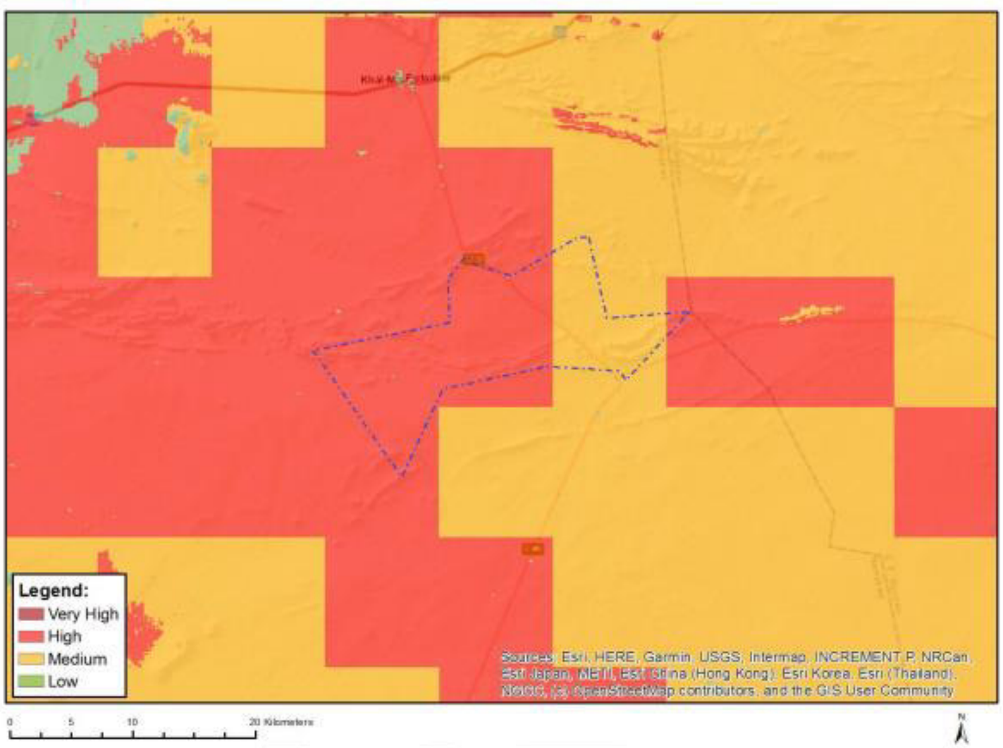

Figure 2-1: Environmental Screening Tool avifauna sensitivity theme map the proposed De Rust North WEF.

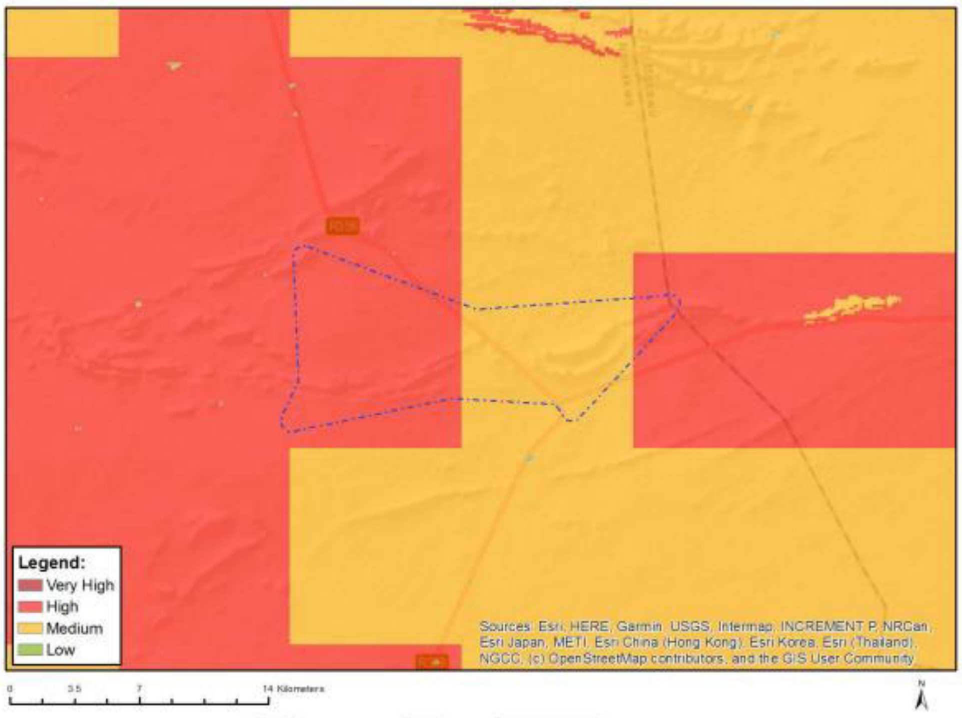

Figure 2-2: Environmental Screening Tool avifauna sensitivity theme map the proposed De Rust South WEF.

2.2 RENEWABLE ENERGY DEVELOPMENT ZONE

On 17 February 2016, Cabinet approved the Renewable Energy Development Zones (REDZs) for large scale wind 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. The project is not located within Renewable Energy Development Zones (REDZ) and accordingly, a full EIA process and not a Basic Assessment (BA) was followed.

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) were 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 of Jenkins *et al.* (2015) - *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. In-depth study – Could include structured and repeated data collection on which to base the impact assessment report and provide a baseline against which post-construction monitoring can be compared.
4. Impact assessment - Informed by the data collected during the preliminary assessment.

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 proposed WEF using data from the second South African Bird Atlas Project (SABAP 2[3]; [SABAP2, 2021]). 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 (2910_1915, 2910_1920, 2910_1925, 2910_1930, 2910_1935, 2915_1915, 2915_1920, 2915_1925, 2915_1930, 2915_1935,2920_1915, 2920_1920, 2920_1925, 2920_1930, 2920_1935, 2925_1915, 2925_1920, 2925_1925, 2925_1930, 2925_1935, (Figure 3-1). The expected species list (Appendix 1) is therefore based on an area 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 Project was evaluated using the Avian Wind Sensitivity Map (Retief *et al.,* 2012). Other

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

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 fatality monitoring reports for similar projects in the region the area and supplemented with sensitive species identified in the previous steps.

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

- 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, 2022);
- 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, 2019); 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).

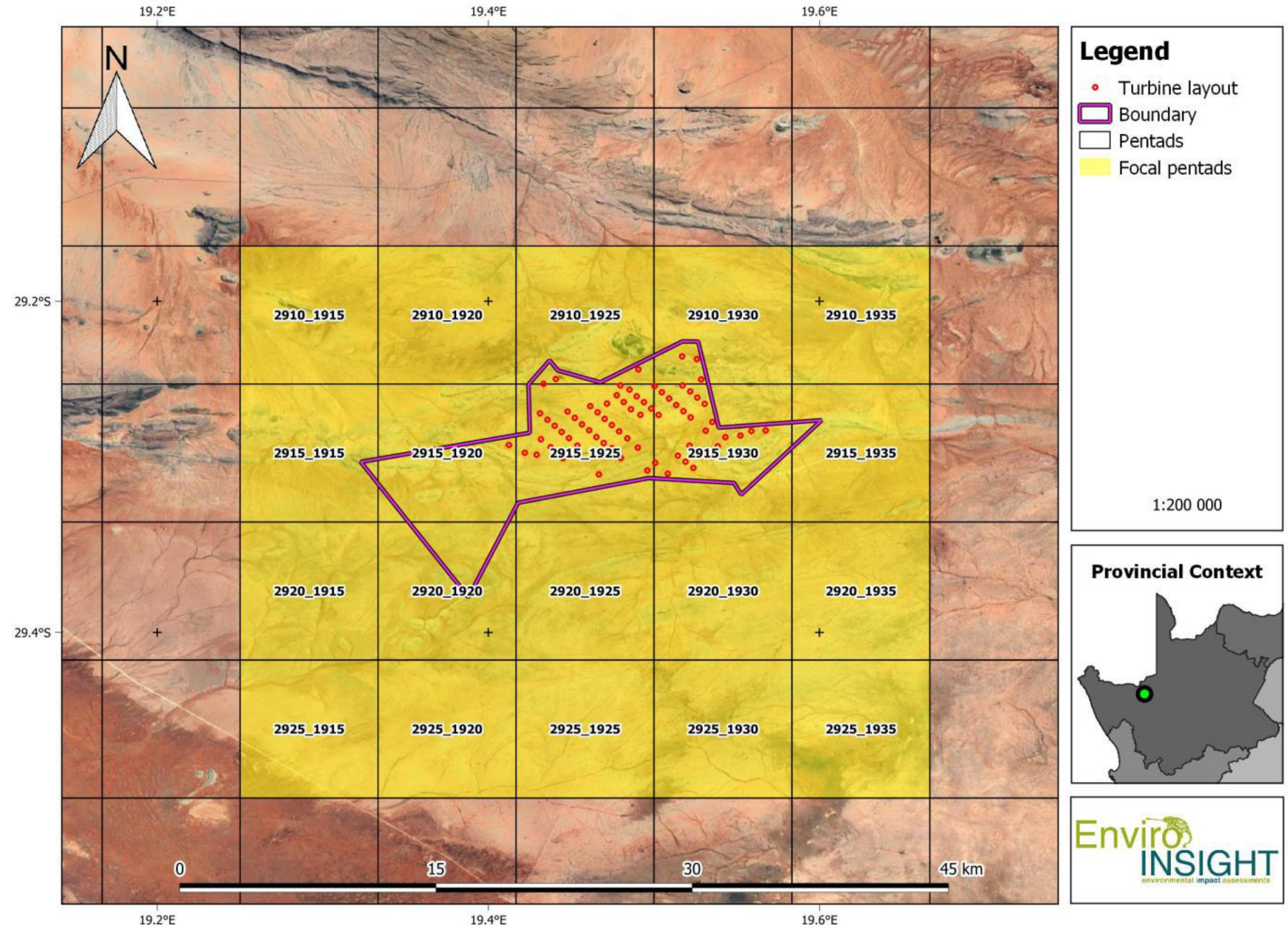

Figure 3-1: The proposed De Rust WEF in relation to the SABAP2 pentads.

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 (covering four seasons) and were completed in September 2022. However, further supplementary data collection took place in January 2023 which yielded more data regarding avifauna within the PA and PAOI. 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 five visits to the PA, with a further two surveys within an immediately adjoining survey area for another application, resulting in seven (7) surveys undertaken within the PAOI, covering the study area through a fourteen-month period that included the spring, summer, autumn and winter seasons of the (non-calendar) year. The surveys conducted per season/ dates are summarised in Table 3-1 below.

Table 3-1: Avifauna monitoring sampling period for the proposed De Rust WEF

Date	Season	Methodology applied
October 2021	Spring	VP, DT, WT, WB, NE
January 2022	Summer	VP, DT, WT, WB, NE
May 2022	Autumn	VP, DT, WT, WB, NE
August 2022	Winter	VP, DT, WT, WB, NE
January 2023	Summer	Supplementary data collection

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

3.3.1 Vantage Points

Six vantage points (VPs) within the PA were identified based on the preliminary desktop and scoping survey for the proposed De Rust WEF, and one identified as the control area outside of the PA, to record the flight altitude and patterns of priority species (totalling seven VPs). These sampling points were positioned at strategic locations within the PA and set up to allow the visual coverage of the PA (placing special emphasis on the proposed turbine locations) and its immediate surroundings (Figure 3-2). 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.

The Vantage Point data collection provided the richest observations of priority species during the surveys. To gain understanding of the risk to each priority species, observed flight heights were divided into three categories: Low 0-50 m, Medium 50-150 m and High >150 m.

Table 3-2: Geographic locations of the seven Vantage Points surveyed.

Vantage Point	Location	
	Latitude	Longitude
1	29°15'00.3"S	19°30'30.2"E
2	29°16'58.2"S	19°33'42.3"E
3	29°15'36.9"S	19°26'53.0"E
4	29°17'26.4"S	19°28'23.8"E
5	29°20'18.8"S	19°23'27.2"E
6	29°18'00.0"S	19°25'17.3"E

Control	29°13'36.0"S	19°33'18.6"E

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 3-2) to maximise the comparative value of the data which will be compared with the surveys from the post-construction phase results.

Seven linear transects ranging from 2 km to 3.4 km in length (14 km total), six located in the PA 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. 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 observer 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. The combined (across season) Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species observed.

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

Name	length (m)
WT1	2005
WT2	2227
WT3	1789
WT4	1698
WT5	1506
WT6	1512
WT Control	3356
Total	14093

3.3.3 Driven Transects

Large terrestrial birds (e.g., korhaans, bustards) and most raptors cannot be adequately surveyed using walked transects. Populations of such birds should be estimated on each visit to the PA 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 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). Seven drive transects were identified in the PA and one drive transect in the control area with a combined total length of 26.984 km (Figure 3-2; 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 surrounding environment with binoculars. The combined (across season) Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species observed.

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

Name	length (m)
DT1	3802
DT2	3137
DT3	4128
DT4	5147
DT5	3957
DT6	3497
DT Control	3316
Total	26984

3.3.4 Wetlands

Prior to the initiation of the preconstruction monitoring campaign, the main water bodies (including wetlands) present within the PA 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 PA. These identified and mapped water bodies were surveyed to determine their level of utilisation by water birds. Due to seasonality, the birds were only surveyed during periods with some prevailing inundation or rainfall. Some drainage lines within the greater PAOI were inundated during the 2021 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 PA, deemed likely to support nest sites of key raptor and other species of conservation concern (SCC), 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.

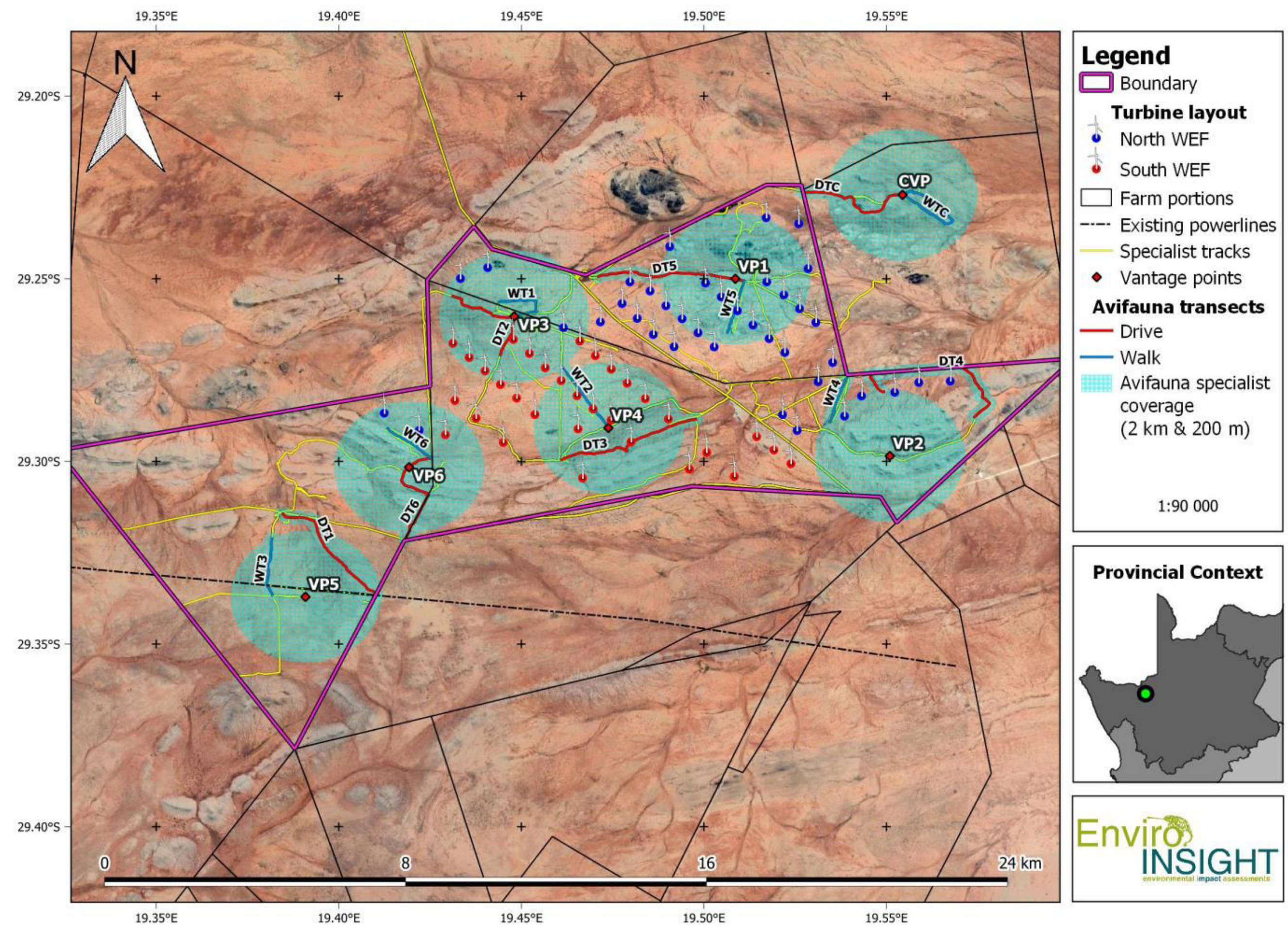

Figure 3-2: Avifauna survey sites and specialist coverage (GPS tracks as well as field of view) for the proposed De Rust WEF.

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) in the PA and control site as well as within the PAOI 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 PA, 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 (adapted by Smallie and Strugnell 2020 in order to account for undulations and terrain):

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

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. These calculations were used to inform this EIA.

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 report. The first three categories i.e., Critically Endangered, Endangered and Vulnerable, are collectively called 'threatened' species or Species of Conservation Concern (SCC).

The conservation status categories defined by the IUCN, which are considered here to represent 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).

3.4.1 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. The Red Lark 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 White-backed and Lappet-faced Vulture (incidental sightings).

3.5 SENSITIVE HABITAT DELINEATION & SEI

Habitat delineation will be cross pollinated to apply sensitivity ratings which are subsequently used to drive buffering and mitigation recommendations for the PA and PAOI. The SEI is also derived from the habitat delineation and follows the SEI specific methodology which provided layered richness of interpretation in order to both mitigate impacts from a habitat and species specific point of view.

3.6 IMPACT ASSESSMENT

Once a potential impact has been determined it is necessary to identify which project activity will cause the impact, the probability of occurrence of the impact, and its magnitude and extent (spatial and temporal). This information is important for evaluating the significance of the impact, and for defining mitigation and monitoring strategies. Direct and indirect implications of the impacts identified during the specialist investigations were assessed in terms of five standard rating scales to determine their significance.

The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on six criteria, namely:

- **Status** of impacts – determines whether the potential impact is positive (positive gain to the environment), negative (negative impact on the environment), or neutral (i.e. no perceived cost or benefit to the environment). Take note that a positive impact will have a low score value as the impact is considered favourable to the environment;
- **Spatial extent** of impacts – determines the spatial scale of the impact on a scale of localised to global effect. Many impacts are significant only within the immediate vicinity of the site or within the surrounding community, whilst others may be significant at a local or regional level. Potential impact is expressed numerically on a scale of 1 (site-specific) to 5 (global);
- **Duration** of impacts – refers to the length of time that the aspect may cause a change either positively or negatively on the environment. Potential impact is expressed numerically on a scale of 1 (project duration) to 5 (permanent);
- **Frequency of the activity** – The frequency of the activity refers to how regularly the activity takes place. The more frequent an activity, the more potential there is for a related impact to occur.
- **Severity** of impacts – quantifies the impact in terms of the magnitude of the effect on the baseline environment, and includes consideration of the following factors:
    - The reversibility of the impact;
    - The sensitivity of the receptor to the stressor;
    - The impact duration, its permanency and whether it increases or decreases with time;
    - Whether the aspect is controversial or would set a precedent;
    - The threat to environmental and health standards and objectives;
- **Probability** of impacts – quantifies the impact in terms of the likelihood of the impact occurring on a percentage scale of <5% (improbable) to >95% (definite).

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - Low;
  - Medium; or
  - High.

In addition, each impact needs to be assessed in terms of reversibility and irreplaceability as indicated below:

- **Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).
- **Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

Table 3-5: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment (positive impact)	+
Neutral	No determined cost or benefit to the receiving environment	N
Negative	At cost to the receiving environment (negative impact)	-

Determination of Impact Significance

The information presented above in terms of identifying and describing the aspects and impacts is summarised in below in Table 3-6 and significance is assigned with supporting rational.

Table 3-6: Consolidated Table of Aspects and Impacts Scoring

Spatial Scale	Rating	Duration	Rating	Severity	Rating
Activity specific	1	One day to one month	1	Insignificant/non-harmful	1
Area specific	2	One month to one year	2	Small/potentially harmful	2
Whole site/plant/mine	3	One year to ten years	3	Significant/slightly harmful	3
Regional/neighbouring areas	4	Life of operation	4	Great/harmful	4
National	5	Post closure	5	Disastrous/extremely harmful	5

Frequency of Activity	Rating	Probability of Impact	Rating
Annually / Once-off	1	Almost never/almost impossible	1
6 monthly	2	Very seldom/highly unlikely	2
Monthly	3	Infrequent/unlikely/seldom	3
Weekly	4	Often/regularly/likely/possible	4
Daily / Regularly	5	Daily/highly likely/definitely	5

Significance Rating of Impacts	Timing
Very Low (1-25)	
Low (26-50)	Pre-construction
Low – Medium (51-75)	Construction
Medium – High (76-100)	Operation
High (101-125)	Decommissioning
Very High (126-150)	
Adjusted Significance Rating	

Significance was classified according to the following:

- **Low**: it will not have an influence on the decision;
- **Medium**: it should have an influence on the decision unless it is appropriately mitigated;
- **High:** it will have an influence on the decision unless it is appropriately mitigated. Alternative options including rehabilitation and/or offset mitigation should be investigated if avoidance and minimisation mitigation measures are not considered feasible or effective enough.

- **Very High**: it would influence the decision regardless of any possible mitigation. Alternative options including rehabilitation and/or offset should be investigated.

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which is assessed by the relevant specialist. The description and assessment of the aspects and impacts is presented in a consolidated table with the significance of the impact assigned using the process and matrix detailed below.

The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the consequence of each impact. The sum of the last two criteria (frequency of activity and frequency of impact) determines the likelihood of the impact occurring. The product of consequence and likelihood leads to the assessment of the significance of the impact (Significance = Consequence X Likelihood), shown in the significance matrix below in Table 3-7.

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Table 3-7: Significance Assessment Matrix.

	Consequence (Severity + Spatial Scope + Duration)														
Likelihood (Frequency of Activity + Probability of Impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	08	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 3-8: Positive and Negative Impact Mitigation Ratings.

Colour Code	Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
	Very High	126-150	Avoidance – consider alternatives	Optimal contribution from Project
	High	101-125	Avoidance as far as possible; implement strict mitigation measures to account for residual impacts	Positive contribution from Project with scope to improve
	Medium-High	76-100	Where avoidance is not possible, consider strict mitigation measures	Moderate contribution from Project with scope to improve

	Low-Medium	51-75	Mitigation measures to lower impacts and manage the project impacts appropriately	Improve on mitigation measures
	Low	26-50	Appropriate mitigation measures to manage the project impacts	Improve on mitigation measures; consider alternatives to improve on
	Very Low	1-25	Ensure impacts remain very low	Consider alternatives to improve on

The model outcome is then assessed in terms of impact certainty and consideration of available information. Where a particular variable rationally requires weighting or an additional variable requires consideration the model outcome is adjusted accordingly.

4 RESULTS

4.1 REGIONAL VEGETATION

The project area (PA) consists various vegetation types, with Bushmanland Arid Grassland and Aggeneys Gravel Vygieveld, covering the most area in the low-lying parts of the PA, Bushmanland Inselberg Shrubland and Namaqualand Klipkloppe Shrubland on the quartzite ridges/hills, and Bushmanland Basin Shrubland to the northwest near the dolerite outcrops (SANBI 2018; Figure 4-1). However, structural differences of vegetation between the vegetation types was not always obvious during site visits, except for the vegetation associated with the quartzite ridges/hills. Watercourses are typically poorly defined but usually have denser and larger bushes than the surrounding landscapes. There are no large/perennial streams or rivers close to the PA, but there are numerous small ephemeral watercourses, some with extensive alluvial plains, that drain towards the west, north and east. The PA has varied terrain, consisting of a relatively flat plain with small quartzite ridges and koppies that form linear hilly regions across the PA, with especially large hills in the southeast, and dolerite outcrops forming small to large conical koppies in the northeast (Figure 4-2; Figure 4-3). There are some rocky areas on the flats that are not associated with higher terrain, located in the northern central portion of the PA. The PA is situated in an arid region between the summer and winter rainfall zone, with rainfall being highly variable in the region. The nearby town of Pofadder receives most of its rainfall between February and April (data from 1985[4]), and recent data (2009-2021) indicates that most rainfall occurs from October to March, with a mean annual rainfall of 135 mm[5]. The warmest months are October through to April with a mean daily maximum of 33 °C and minimum of 17°C (February) and winter maximum temperatures of 18 °C and minimum 2 °C (July[6]).

[4] https://www.meteoblue.com/
[5] https://wapor.apps.fao.org/
[6] https://www.meteoblue.com/

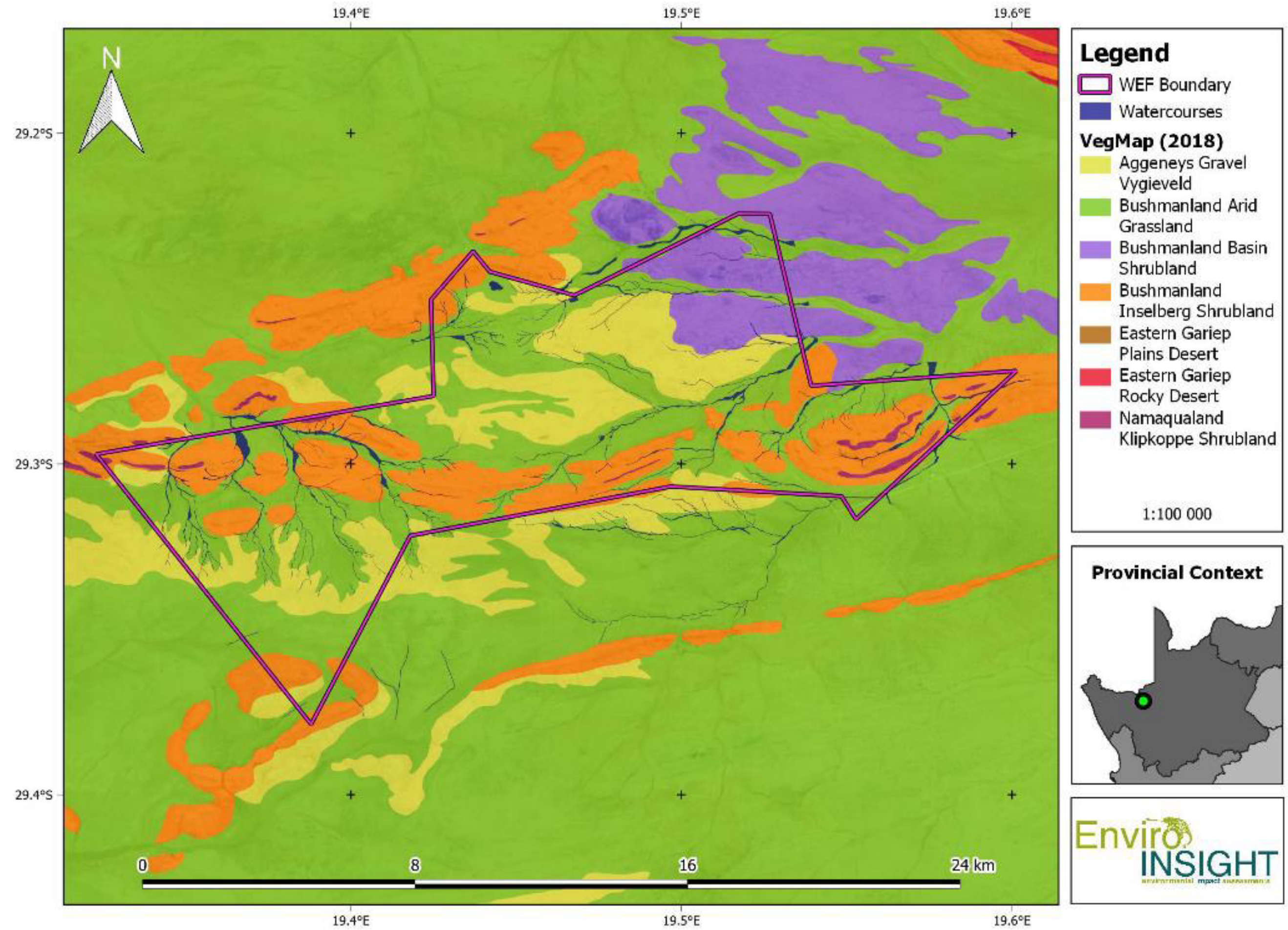

Figure 4-1: The proposed De Rust Wind Energy Facility (WEF boundary) in relation to major vegetation types (SANBI, 2018) and aquatic habitats .

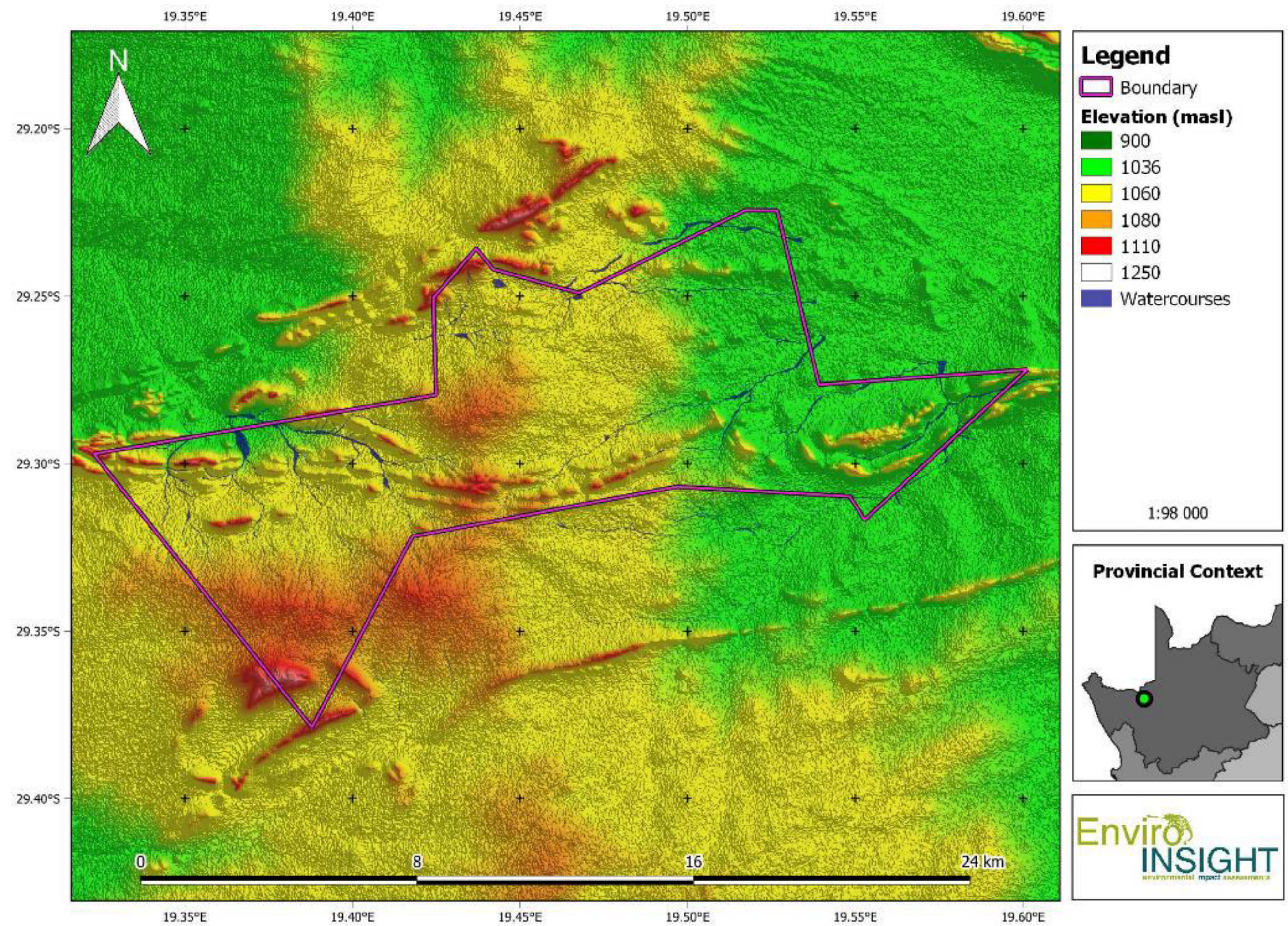

Figure 4-2: The proposed De Rust Wind Energy Facility (WEF boundary) in relation to the terrain elevation and aquatic habitats.

Figure 4-3: The proposed De Rust Wind Energy Facility (WEF boundary) in relation to the topographic position index and aquatic habitats .

4.2 PROTECTED AREAS AND IMPORTANT BIRD AREAS

The proposed De Rust WEF is not located in an Important Bird Area (IBA) or protected area but is situated in-between the Gamsberg and the Mattheus Cat Conservation Area. Also situated near to the PAOI are the Haramoep Black Mountain IBA, the Bitterputs Conservation Area and the Marietjie van Niekerk Nature Reserve all being situated within a 90 km radius.

- 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 Haramoep Black Mountain IBA is characterised by large sand dunes following the course of the Koa River although dominated by the sparsely vegetated gravel plains that are prevalent in the region. The IBA falls within the Bushmanland Bioregion and three biomes (Desert, Nama Karoo and Succulent Karoo) are represented. Seven vegetation types are present, of which one is Endangered. One Endangered and two Vulnerable habitat units within these are considered irreplaceable. Approximately 90% of the land is natural and utilised for ranching and disturbance and overgrazing is prevalent.
- All of the IBAs (Mattheus Gat and Haramoep Black Mountain IBA) and many of the other surrounding nature reserves (Gamsberg, Marietjie van Niekerk) provide habitat for 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 sclateri*). The sites also hold 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 these IBAs include Ludwig's Bustard (*Neotis ludwigii),* Kori Bustard (*Ardeotis kori*), 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*).

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 these IBAs are 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. The location of the IBAs in relation to the PA is shown in Figure 4-4.

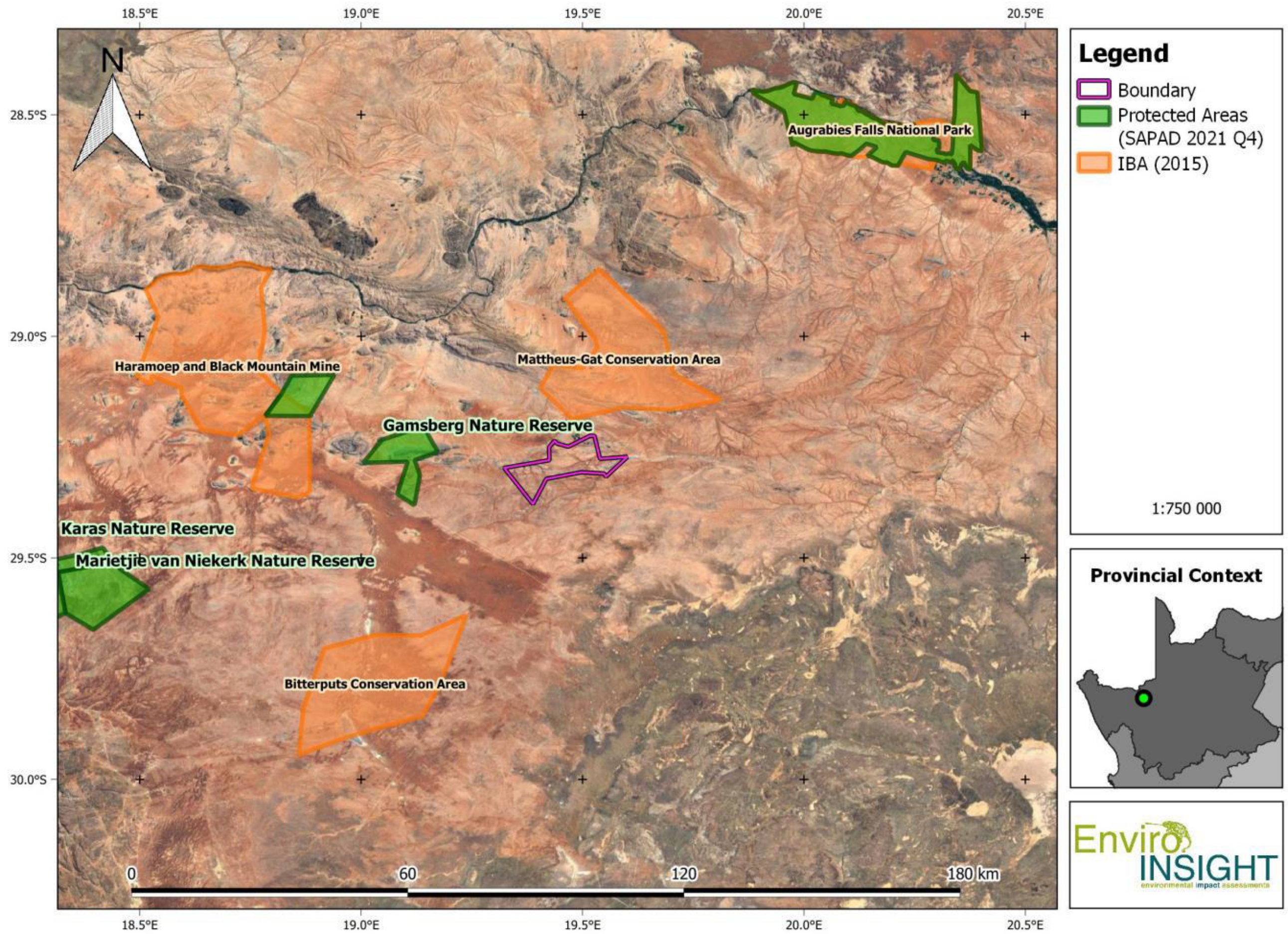

Figure 4-4: The proposed De Rust WEF in relation to the adjacent Protected Areas and Important Bird Areas (IBAs).

4.3 CRITICAL BIODIVERSITY AREAS (CBA)

The following CBA information has been extracted and mapped Verbatim from the Enviro-Insight Terrestrial Biodiversity survey conducted as part of the application process.

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. Biodiversity priority areas are described as follows:

- Critical biodiversity areas (CBA's) are areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses. For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g., loss of a populations or habitat). All FEPA prioritized wetlands and rivers have a minimum category of CBA1, while all FEPA prioritised wetland clusters have a minimum category of CBA2.
- Ecological support areas (ESA's) are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas. For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g., removing corridor result in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity). All natural non-FEPA wetlands and larger rivers have a minimum category of ESA.

According to the CBA Map, the PA is mainly located in the category "CBA 2 and ESA" (Figure 4-5; Figure 4-6). The CBA2 is listed due to recorded presence of SCC as well as potential habitat for listed unknown threatened species. The ESA is due to the large expanses of sandy habitat (suitable for Red Larks) and other natural non-FEPA Wetlands.

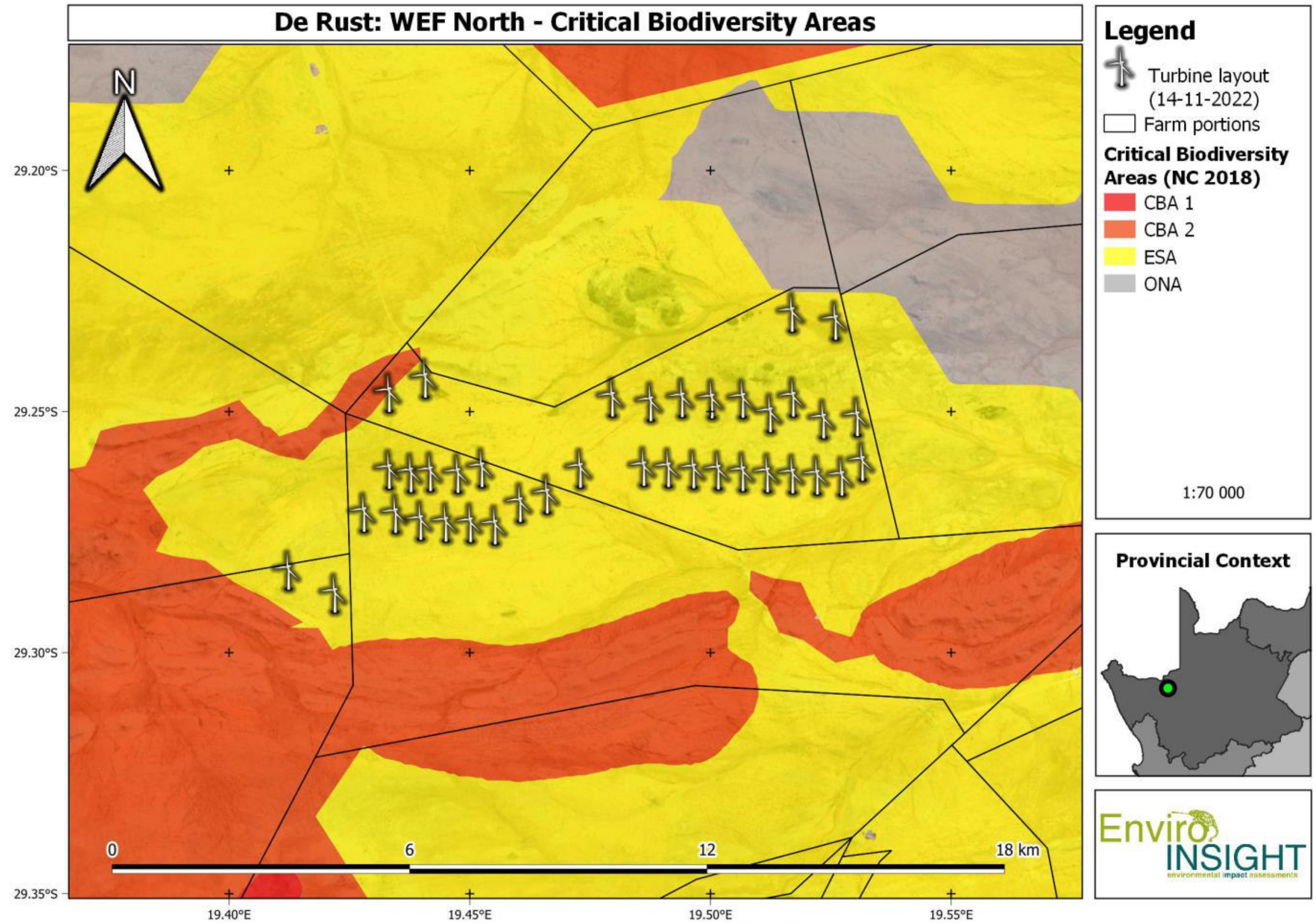

Figure 4-5: The proposed De Rust North WEF in relation to the Northern Cape Critical Biodiversity Areas (2016).

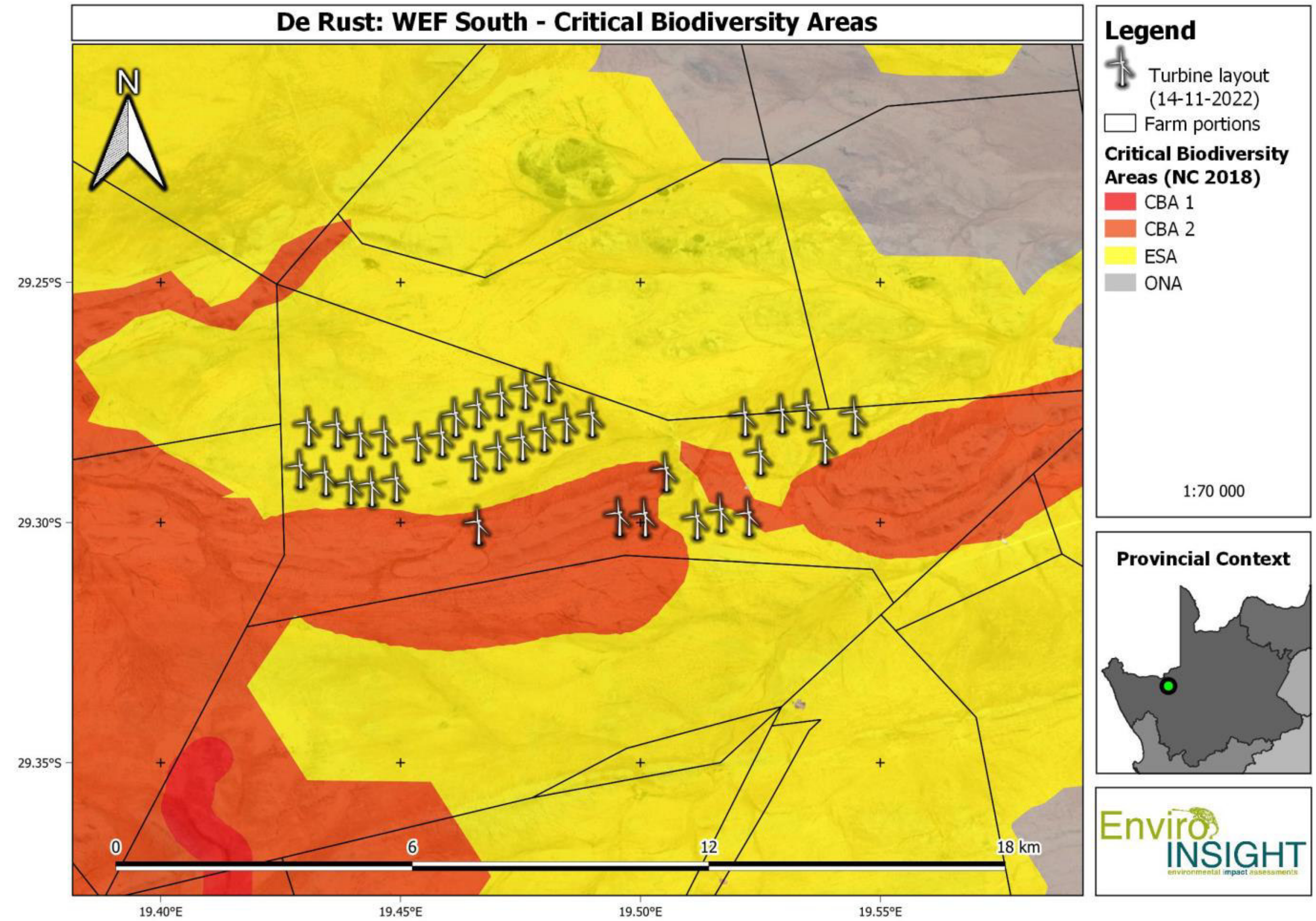

Figure 4-6: The proposed De Rust South WEF in relation to the Northern Cape Critical Biodiversity Areas (2016).

4.4 DESCRIPTION OF MAJOR BIRD HABITATS

The primary avifaunal habitats are described in tabular formats below with accompanying representative photographs. It must be noted that the habitats have been delineated (Figure 4-7) in accordance with the ecology of the prevailing avifaunal assemblages which may merge botanically divergent habitats and subsequently converted to sensitivity mapping. *In situ* habitat delineation can be viewed in the accompanying terrestrial ecology report while the designated avifaunal habitat sizes are shown as Table 4-1. The areas of the relevant habitats are shown in Table 4-1. The sensitivity of these habitat types was evaluated according to "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, with specific relation to wind energy infrastructure and activities. It is apparent throughout the PA that most of the habitats are capable of supporting a wide range of general avifaunal species and Red-Listed / SCC although some habitats are more generic in nature and therefore the presence/ absence of SCC is less easily predicted. Due to the high diversity and density of the below-mentioned SCC recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the PAOI as a whole is an area of avifaunal importance, and the impact assessment that follows prioritises avoidance mitigation and the monitoring of avifaunal SCC.

Table 4-1: Avifaunal Habitats and Area with in the proposed De Rust WEF PA.

Habitat	Area (ha)
Powerline Infrastructure (300 m buffer)	351.6
Aquatic features (Pans & drainage lines; 30 m buffer)	2155.7
Koppies and Ridges (including slopes)	3495.2
Overlay. Red Lark habitat (Sandy Grassland)	245. 5
Overlay. Ludwig's Bustard habitat	4140.0
Remaining habitat (Shrubland)	7998.3
Total	18386.3

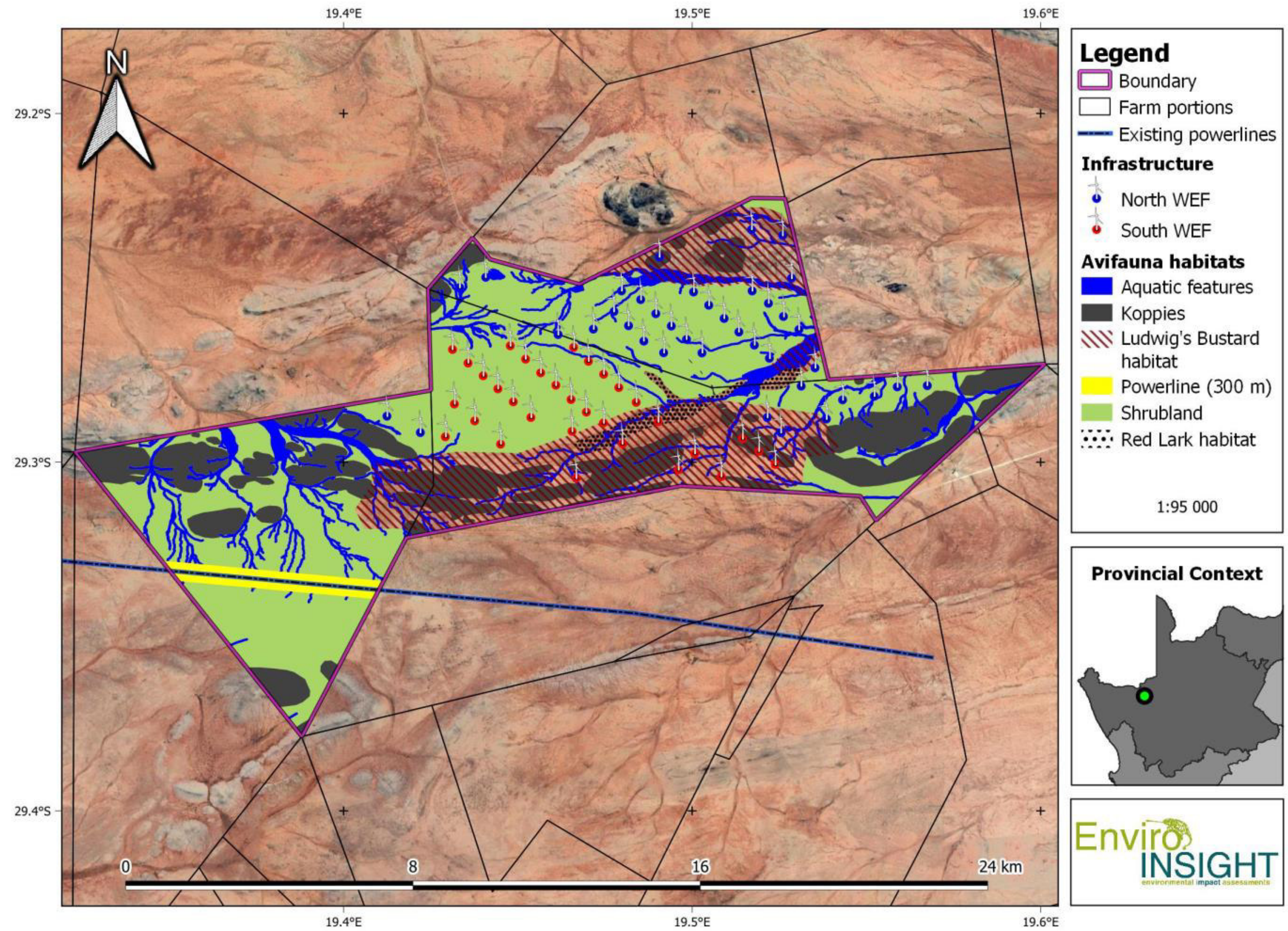

Figure 4-7: Avifaunal Habitats

4.4.1 Pans and Drainage Lines

Photographs	Description
	**Classification:** Ephemeral and endorheic drainage lines **Hydrology:** With avoidance, limited major hydrological impacts are expected from the development. **Geomorphology:** Channels varying in width and depth from large multi-channelled sandy gullies to shallow narrow channels with seasonally inundated pans with large surface areas. **Vegetation:** Vegetation varies depending on current levels of disturbance (especially biosphere effects around pans), 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 pan and drainage line systems as well as the season. Most of the drainage line systems are seasonally ephemeral or dry while the pans inundate seasonally. Thus, most of the bird associations are linked to the prevailing vegetation and soil types within the delineated drainage line habitats or standing water. 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. SCC such as Ludwig's Bustard (*Neotis ludwigii*) can occur in varying but potentially great densities depending on the prevailing ecological conditions. The seasonal drainage lines and accompanying riparian shrubs act as linear dispersal corridors for terrestrial bird species. Much greater 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, especially in association with ridges act as important flight corridors for bustards, passerines and raptors between foraging and roosting sites.

4.4.2 Sandy Grassland

Photographs	Description
	**Classification:** Sandy Grassland **Hydrology:** No major hydrological impacts are expected from the development. **Geomorphology:** Undulating sandy grassy 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 negligible succulent/ Nama scrub (in varying ratios) karroid vegetation **Avifaunal Characteristics:** The sandy grassland habitats show a reduced structural complexity and vegetation which provides for a more generic species diversity albeit often at high densities of individuals. The habitat contains features that provide suitable foraging habitat for Red Lark (*Calendulauda burra*), Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*). Secifically, the habitat is characterised by a much-reduced rocky substrate and a higher prevalence of grassed red sand infusions which provides highly localized portions of optimal habitat for Red Larks. .

4.4.3 Shrubland

Photographs	Description
	**Classification:** Shrubland **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** Undulating semi-succulent karroid habitat with large extents of flat terrain. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of karroid shrub interspersed with grassy patches **Avifaunal Characteristics:** There is a localised high population density of small mammals/ ground birds such as rodents, springhares, hares and korhaans within the PAOI as well as the regional linkage to the drainage line habitats. The absence of these animals in high densities reduces the ecological importance of this habitat for avifauna. The shrubland habitats do not provide structural complexity allowing for a higher species diversity and often showed lower densities of avifauna due to the lack of specific prey species that are found within. However, the habitat vegetation provides suitable foraging habitat for the Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*) and thus maintains a medium sensitivity. .

4.4.4 Koppies and Ridges

<table>
<tr><th>Photographs</th><th>Description</th></tr>
<tr><td>
</td><td>Classification: Koppies and Ridges
Hydrology: No major hydrological impacts are expected from the development although some ridges are associated with non-perennial watercourses and facultative wetlands.
Geomorphology: Undulating semi-succulent karroid habitat with large extents of connected and isolated ridges. The ridges are divided into quartz and dolerite based.
Vegetation: Vegetation varies depending on soil quality but is mostly comprised of karroid shrub interspersed with grassy patches

Avifaunal Characteristics:
The localised high population densities of small mammals such as rodents, springhares and hares within the PAOI as well as the local linkage to the drainage line habitats, elevates the overall ecological importance of this habitat for avifauna. The rocky habitats provide structural complexity which often showed higher diversity and densities of avifauna due to the abundance of prey species that are found in this habitat. The habitat vegetation provides suitable foraging, roosting and breeding habitat for the Ludwig's Bustard (Neotis ludwigii), Karoo Korhaan, Kori and Secretary bird (Sagittarius serpentarius).</td></tr>
</table>

4.4.5 Powerline Infrastructure

Photographs	Description
  	**Classification:** Powerline Infrastructure **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** The large powerline pylons have been placed on undulating vegetated habitat with large extents of flat terrain. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of sandy grassland and karroid shrub. **Avifaunal Characteristics:** The Powerlines have proven to be important habitat for large raptors, especially Martial Eagle, which nest frequently on the powerline pylon infrastructure and utilise the pylons to launch hunts from.

4.5 OBSERVED AND EXPECTED AVIFAUNA

4.5.1 Total species composition and abundance

The PA supports a medium to high diversity and abundance of avifauna, which is to be expected in an arid area with a high habitat diversity such as the Pofadder region. A total of 83 species were observed during the surveys, as shown in Appendix 1. This medium to high diversity is predominantly due to a number of factors including:

- High regional aridity which shows a high temporal variability (turnover) in species diversity between seasons;
- Diverse habitat types (with some highly sensitive habitat such as drainage lines and temporary pans within the PAOI);
- Climate change which is characterised by lower rainfall and increased temperatures but with stochastic high rainfall events (La Niña) as occurred during 2022;
- Powerline infrastructure bisecting the PA (raptor nesting habitat).

It must be noted that stochastic high rainfall events caused by the La Niña weather phenomenon (especially after the prolonged drought periods) and other atypical prevailing influences (persistent mild weather) may have influenced the local avifaunal assemblage densities which were often recorded as being very high.

4.5.2 Priority species

Table 4-2. A total of 19 priority species are expected to occur on and surrounding the PA, of which sixteen (16) were recorded during the surveys. It is clear from

Table 4-2 that numerous priority avifauna species occur within the PAOI and can be expected to interact with the proposed development. It is vital to consider the context within which these species were 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 a WEF can be more significant than direct fatality for certain species, especially for habitat specific species such as Red Lark and Ludwig's Bustard. Consequently, all applicable data of priority species observed across monitoring seasons allowed for careful evaluation of potential impacts and application of suitable mitigation measures to reduce these impacts where possible. According to the literature, 14 IUCN threatened, and near-threatened species are known to occur in the region with nine species highly likely and six species confirmed during the completed surveys (

Table 4-2), 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, four of the species are Vulnerable and three are Near-Threatened. All relevant SCC are described in brief (Table 4-3). 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 and Priority Species observed during the current study is provided in Figure 4-5,

Figure 4-6, Figure 4-7, Figure 4-8 and Figure 4-9.

Table 4-2: Priority avifauna species list (both expected and recorded as defined by Retief et al. 2012) for the Project Area of Influence.

Common name	Scientific name	Priority species rank	Global Status	Regional Status	South African Endemic	Current pre-construction monitoring
Bustard, Ludwig's	*Neotis ludwigii*	14	EN	EN		X
Buzzard, Jackal	*Buteo rufofuscus*	43	LC	LC	X	X
Courser, Burchell's	*Cursorius rufus*	69	LC	VU	X	X
Courser, Double-banded	*Rhinoptilus africanus*	72	LC	NT		X
Eagle, Booted	*Aquila pennatus*	59	LC	LC		X
Eagle, Martial	*Polemaetus bellicosus*	4	EN	EN		X
Eagle, Verreaux's	*Aquila verreauxii*	2	LC	VU		
Eagle-owl, Spotted	*Bubo africanus*	98	LC	LC		X
Falcon, Lanner	*Falco biarmicus*	24	LC	VU		X
Goshawk, Southern Pale Chanting	*Melierax canorus*	75	LC	LC	X	X
Kestrel,	*Falco*	95	LC	LC		X

Greater	*rupicoloides*					
Kite, Black-winged	*Elanus caeruleus*	94	LC	LC		X
Korhaan, Karoo	*Eupodotis vigorsii*	51	LC	NT	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
Lark, Sclater's	*Spizocorys sclateri*	50	NT	NT		
Secretarybird	*Sagittarius serpentarius*	13	EN	VU		
Snake- Eagle, Black-chested	*Circaetus pectoralis*	60	LC	LC		X
Vulture, White-backed	*Gyps africanus*	23	CR	CR		
23					4	16

Figure 4-8: Martial Eagle observed within the proposed De Rust WEF PA.

Figure 4-9: Double-banded Courser observed within the proposed De Rust WEF PA.

Figure 4-10: Karoo Korhaan observed within the proposed De Rust WEF PA.

Figure 4-11: Jackal Buzzard observed within the proposed De Rust WEF PA.

Figure 4-12: Booted Eagle observed within the proposed De Rust WEF PA.

Table 4-3: Summary of avifauna species of conservation concern of known distribution (SABAP2, 2021), previously recorded in or adjacent to the Project Area.

Species	Global Conservation Status[7]	National Conservation Status[8]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk from the proposed De Rust WEF
Spizocorys sclateri (Sclater's lark)	Near Threatened	Near Threatened	Dry shrubland, karroid drainage lines and karoo shrubveld	**Moderately Likely**: High densities throughout the region but uncommon in the PA. The species is likely to be a breeding resident within or adjacent to the PA. 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 PA The species is a breeding resident within or adjacent to the PA. A localised low flying passerine, it is susceptible to WEF development activities due to its high

[7] IUCN 2022
[8] Taylor et al. 2015

Species	Global Conservation Status[7]	National Conservation Status[8]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk from the proposed De Rust WEF
				display flights, but is more threatened by habitat loss and climate change.
Aquila verreauxii (Verreaux's' Eagle)	-	Vulnerable	Mountainous areas or areas with prominent outcrops with a high prey density (e.g. hyrax).	**Regionally confirmed, absent from PA**: Frequent foraging resident throughout the PAOI but far less frequent within the PAs due to the large distances to the preferred mountainous habitats and a general lack of localised abundant prey. However, localised areas exhibiting high abundance of hyraxes and rock rabbits, such as the Koppies and Ridges habitat in the PA, should be considered as potential foraging habitat for this species. The species is susceptible to poisoning events and WEF facilities, with a low risk from the proposed activities, if avoidance mitigation is applied to the Koppies and Ridges habitat where this species may occasionally forage.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	Open bushveld, desert savannah and karoo with adequate roosting and foraging potential.	**Confirmed:** A breeding resident adjacent to the PA and regular foraging visitor dependent on adequate food supply and roosts. No breeding pair nesting within the proposed WEF PA was recorded, but frequent sightings in terms of foraging activity on the PA, with breeding taking place within the PAOI. At the end of the survey period, one of the resident eagles was killed and a new pair of young eagles have moved into the greater PAOI and may colonise areas in association with the adjacent powerline infrastructure. Typically, the species is at a Moderate to High risk from WEF developments.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	**Confirmed:** A fairly common foraging and breeding resident recorded in the current study and expected periodically to breed in the PA. Not highly vulnerable to the proposed WEF activities.
Neotis ludwigii (Ludwig's Bustard)	Endangered	Endangered	Primary upland grassland, desert savannah and karoo with foraging and roosting particularly on rocky/ hilly terrain.	**Confirmed:** High densities throughout the PA. The species is likely to be a breeding resident within or adjacent to the PA. A large bodied species, it is highly susceptible to indirect WEF development activities as shown by collision fatalities with the existing powerlines in the region.
Sagittarius serpentarius	Endangered	Vulnerable	Prefers open grassland or lightly wooded habitat	**Moderate to Highly Likely:** Irregular low-density resident which is most likely at lower risk from the proposed

Species	Global Conservation Status[7]	National Conservation Status[8]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk from the proposed De Rust WEF
(Secretarybird)			although forages extensively in open karroid savannah.	development activities given its ground foraging habitats. Very limited nesting opportunities in the PA further reduces potential risk to this species from the proposed 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 at low risk.
Falco naumanni (Lesser Kestrel)	Near Threatened	Least Concern	Widespread species prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah. Roosts collectively in locations with tall trees.	**Confirmed:** Regular migrant of fluctuating seasonal density which is most likely at lower risk from the proposed development activities due to most pressures occurring within breeding grounds and migration routes, which are absent from the PA.

4.5.3 Nest Survey

Nest sites were searched for during the surveys on all suitable sites which included windmills, trees, pylons, bridges and masts, representing the most potential roost and nesting sites for raptors. Water bodies and drainage lines showed potential for roost and nesting sites for multiple species, but the high degree of seasonality in the area may not guarantee successful breeding every year. During the survey and above average rainfall conditions was representative of optimal breeding habitat for water associated species. Highly significant breeding habitat was recorded during the survey and Ludwig's Bustard is considered a resident and likely to be breeding on site. This has been confirmed by the local resident who state that in optimal seasons, Ludwig's Bustard temporarily colonise and breed within the PAOI/ PA. Power line pylons were examined for raptor nesting sites to be discussed below. However, it is vital to understand that the abandoned large raptor (Martial Eagle) nests driving the site sensitivity analysis still hold significance given the potential for recolonisation as well the use of the nests by other priority species such as Lanner Falcons Figure 4-13 and Figure 4-14.

Figure 4-13: Breeding Lanner Falcon utilising the abandoned Martial Eagle Nest observed adjacent to the proposed De Rust WEF PA.

Figure 4-14: Fledged Lanner Falcon chicks utilising the abandoned Martial Eagle Nest observed adjacent to the proposed De Rust WEF PA.

4.6 PRECONSTRUCTION MONITORING MAIN RESULTS

4.6.1 Walked and Driven Transect Counts

During the walked transects, the total number of individual birds (per species) were recorded regardless of their priority status. Notable Priority Species recorded during walked transects included Martial Eagle, Ludwig's Bustards that were often flushed from foraging positions as well as Namaqua Sandgrouse, Double-banded Coursers, Lesser Kestrel, Northern Black Korhaans and Karoo Korhaans. The main focus of drive transects were the recording of large birds and raptors. Ludwig's Bustards, large to medium-sized raptors, korhaans and Red Lark were the most frequently recorded priority species. On some sample days, the observers returned at night and nocturnal priority species were recorded (such as owls, coursers and thick knees). In addition, avifauna data was collected concurrently by specialists during bat surveys.

For walked transects, a total of 590 individual bird contacts were recorded of which nine contacts and three species are classified as priority. For driven transects, a total of 554 individual bird contacts were recorded of which 15 contacts and 6 species are classified as priority. The summary data for priority species observations made from these transects as well as the calculated Index of Kilometric Abundance (IKA = birds/km) ware provided in Table 4-4. Detailed data for priority species observations made from these transects are provided in Table 4-5.

The combined priority and non-priority (1170 contacts over 41.1 km) IKA is 28.5 birds/km which is a moderate risk value. and represents the sparse, ecologically sub optimal habitat of the PAOI which can be affected through seasonal ecological changes caused by events such as drought or high rainfall events.

Table 4-4: Priority species observation summary data and kilometric abundances for the Walk and Driven transects performed over four seasons.

		Individuals Observed		Index of Kilometric Abundance (IKA)		
Common Name	**Scientific Name**	**Drive 26.9 km**	**Walk 14.1 km**	**Drive**	**Walk**	**Drive & Walk Combined (41.1 km)**
Burchell's Courser	*Cursorius rufus*	2		0.074	0.000	0.002
Double-banded Courser	*Rhinoptilus africanus*		1	0.000	0.071	0.002
Greater Kestrel	*Falco rupicoloides*	3		0.111	0.000	0.003
Karoo Korhaan	*Eupodotis vigorsii*	4	12	0.148	0.851	0.024
Ludwig's Bustard	*Neotis ludwigii*	2	3	0.074	0.213	0.007
Northern Black Korhaan	*Afrotis afraoides*	3	7	0.111	0.497	0.015
Pale Chanting Goshawk	*Melierax canorus*	1	1	0.037	0.071	0.003
Red Lark	*Calendulauda burra*		1	0.000	0.071	0.002
Total		15	25	0.556	1.774	0.057

4.6.2 Vantage Points

The Vantage Point data collection provide the richest avifaunal observations with 5959 total contacts of which 149 were priority species (10 species in total).

A total of 189 hours of bird flight observation were completed at the seven Vantage Points in the PA during the year. Ten (10) priority species were recorded during VP watches in the WEF (Table 4-5). Non-priority species observations per VP are provided in Appendix 3. In order to gain some understandings of which species are likely to be most at risk of collision, the collisions risk ratings are discussed below.

4.6.3 Focal Sites

The pan, drainage line and sandy grassland systems scattered throughout much of the PA contained a relatively high density (and higher diversity) of passerines, Ludwig's Bustards and Red Larks. All pylon infrastructure warranted special attention regarding foraging and breeding of priority species. Due to the fact that focal sites yielded data related to SCC, they are discussed specifically under Species Specific Risk Analysis and Recommendations.

4.6.4 Combined Species Summary

Using the prescribed methodology, Ludwig's Bustards were recorded on 15 occasions with a total of 33 random contacts of which 0 sightings were above 40 metres, well below rotor height. In total, they were recorded on 48 occasions (55 individuals) Due to its relative abundance and Endangered extinction risk 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 (such as provision of fodder) which increase food availability). This species was not observed flying at rotor height during the survey period. For the majority of observations, Ludwig's Bustards were mostly observed close to drainage lines, adjacent to roadsides, and in adjacent livestock camps. On multiple occasions, the observers' presence flushed some birds (presumably breeding pairs). 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).

Red Larks were recorded 6 times (7 specimens although this is not an absolute count) of which only two display flights at 20 m height were recorded. The species is discussed in further detail below, but the presence of this species is potentially of significant concern with the implications to be discussed within the Impact Analysis below.

Martial Eagles were observed on nine occasions during the survey period with a further two times during supplementary data collection, totalling 11 observations. A maximum of four individuals were observed with one having perished. Observations were recorded at or above 50 metres, especially given the existing nests and propensity of the local eagles to roost on pylons. Given the absence of an active nest within the PA, this species is considered to be a low density (foraging flights only) and the species is of lesser concern than for other developments in close proximity to an active nest. In the PAOI, it is a resident (high risk).

Table 4-5: Per season priority species recorded during Walked Transects (WT), Vantage Points (VP) and Drive Transects (DT).

		Drive Transects								Vantage Points							Walk Transects									
Season	Common Name	DT1	DT2	DT3	DT4	DT5	DT6	DT7	CDT	VP1	VP2	VP3	VP4	VP5	VP6	CVP	WT1	WT2	WT3	WT4	WT5	WT6	WT7	CWT	Random	Total
Autumn	Burchell's Courser																								7	7
	Double-banded Courser												1													1
	Greater Kestrel		1	1	1									2	1											6
	Jackal Buzzard																								1	1
	Karoo Korhaan			3							1	1	3			4						1			28	41
	Lanner Falcon																								3	3
	Ludwig's Bustard			2						2							3								20	27
	Martial Eagle																								3	3
	Northern Black Korhaan									3		2	6			2		2								15
	Pale Chanting Goshawk															1	1								2	4
	Peregrine Falcon																								1	1
	Red Lark												3											1		4
	Spotted Eagle-Owl																								2	2
	Autumn		1	6	1					5	1	3	13	2	1	7	4	2				1		1	67	115
Winter	Double-banded Courser									1																1
	Greater Kestrel										1				1											2
	Karoo Korhaan									7		1	8	2	10	4	2			1				2	16	53
	Lanner Falcon																								3	3
	Ludwig's Bustard																								13	13
	Martial Eagle													2												2
	Northern Black Korhaan	1		1						2			10			3	1	2								20
	Pale Chanting Goshawk															4									1	5
	Red Lark												2												1	3
	Winter	1		1						10	1	1	20	4	11	11	3	2		1				2	34	102
Spring	Double-banded Courser											2			1		1									4
	Greater Kestrel																								2	2
	Karoo Korhaan		1							2	4	8			1	2		3		1			1		18	41
	Lanner Falcon																								1	1

	Martial Eagle					1															1
	Northern Black Korhaan							1												1	2
	Pale Chanting Goshawk																			2	2
	Spotted Eagle-Owl																			1	1
	Spring		1			3	4	11			2	2	1	3	1			1		25	54
Summer	Black-chested Snake Eagle							1													1
	Burchell's Courser				2			1												8	11
	Double-banded Courser										1										1
	Karoo Korhaan					2		2	2		2	2				1				12	23
	Ludwig's Bustard					5			2		1									7	15
	Martial Eagle																			3	3
	Northern Black Korhaan	1				1			7	3		1		1					1		15
	Pale Chanting Goshawk			1				1			1									2	5
	Red Lark								2												2
	Spotted Eagle-Owl																			2	2
	Summer	1		1	2	8		5	13	3	5	3		1		1			1	34	78
Total		2	2	8	3	26	6	20	46	9	19	23	8	8	2	1	1	1	4	160	349

4.7 COLLISION RISK SUMMARY

1. All heights above ground for contacts with priority species 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 majority of all flight observations were recorded well below the anticipated rotor sweep height of 62.5 metres with only 9 species (1 priority species) observed to have flown at heights greater than 62.5 m (Table 4-6). Only a single flight of height >150 m was observed (Black-chested Snake Eagle). Overall, the majority of species observed above rotor sweep height was considered to non-priority species. It was possible that a significant number of species are temporary foraging visitors (hence the frequent observations at lower heights) due to the highly unusual amount of rainfall that fell in 2022. However, the precautionary principle would suggest that all priority species be allocated a higher significance in regard to mitigation measures for the WEF.

Table 4-6: Summary of number of individuals per species observed having risky flights (higher than the rotor sweep height of 62.5 m).

		Flight height (m) categories	
Common Name	**Scientific Name**	**50-150**	**>62.5**
Black-chested Snake Eagle	*Circaetus pectoralis*	1	1
Booted Eagle	*Hieraaetus pennatus*	1	1
Cape Sparrow	*Passer melanurus*	2	2
Common Swift	*Apus apus*	24	24
Dusky Sunbird	*Cinnyris fuscus*	1	1
Eastern Clapper Lark	*Mirafra fasciolata*	2	2
Namaqua Sandgrouse	*Pterocles namaqua*	83	77
Pied Crow	*Corvus albus*	37	37
White-rumped Swift	*Apus caffer*	1	1
Total		152	146

3. It was assumed that the 2 km 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 175 m rotor diameter, and the current proposed layout of 74 turbines, this equals a wind farm collision risk area of 7,119,634.4 m² (7.12 km²).
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 mostly low although some species such as Karoo and Northern Black Korhaan sant out as moderate to high risk. The overall low risk is due to the fact that a low number of total 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 23 birds based on the actual observational data and 39 birds based on a 20% predicted fatality rate assumption. 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 Martial Eagle, Ludwig's Bustard being highly susceptible to powerline collisions, caution must be exercised when comparing the relative risks related to solar and/or wind farms with risks associated with power lines. However, and conversely, due to its resident status, one martial eagle fatality yearly (although low as an absolute number) is considered completely unacceptable (given the conservation status of the species and its ecology as a breeding resident) and thus the activation of strict mitigation measures is warranted. Therefore, and depending on the terrain and pylon placements, Martial Eagles may be highly susceptible to collision risk. Indications are that Ludwig's Bustards are not prone to wind turbine collisions and overall, given the very large size of the WEF and large numbers of turbines, these fatality numbers may fall within acceptable limits, especially when compared to the alarming number of fatalities recorded underneath the existing Homoud powerlines.

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

Common Name	Scientific Name	Annual individuals observed at Vantage Points (VP)	Hourly passage rate at VP	Annual passage rate at VP	Actual annual passage rate through rotor zone	Annual passage rate through rotor zone (10% assumption)	Actual annual fatality rate (98% avoidance)	Predicted (20% assumption) annual fatality rate
Black-chested Snake Eagle	*Circaetus pectoralis*	1	0.003	13.04	7.39	1.30	1 [0.15][9]	1 [0.26]
Burchell's Courser	*Cursorius rufus*	1	0.003	13.04	7.39	1.30	1 [0.15]	1 [0.26]
Double-banded Courser	*Rhinoptilus africanus*	6	0.018	78.21	44.31	7.82	1 [0.89]	2 [1.56]
Greater Kestrel	*Falco rupicoloides*	5	0.015	65.18	36.93	6.52	1 [0.74]	2 [1.3]
Karoo Korhaan	*Eupodotis vigorsii*	68	0.202	886.43	502.22	88.64	11 [10.04]	18 [17.73]
Ludwig's Bustard	*Neotis ludwigii*	10	0.030	130.36	73.86	13.04	2 [1.48]	3 [2.61]
Martial Eagle	*Polemaetus bellicosus*	3	0.009	39.11	22.16	3.91	1 [0.44]	1 [0.78]
Northern Black Korhaan	*Afrotis afraoides*	41	0.122	534.46	302.81	53.45	7 [6.06]	11 [10.69]
Pale Chanting Goshawk	*Melierax canorus*	7	0.021	91.25	51.70	9.13	2 [1.03]	2 [1.83]
Red Lark	*Calendulauda burra*	7	0.021	91.25	51.70	9.13	2 [1.03]	2 [1.83]
Total		149	0.443	1942.32	1100.45	194.23	23 [22.01]	39 [38.85]

4.8 AVIFAUNA SENSITIVITY

4.8.1 General

Delineated habitats and other important features for avifauna (e.g. eagle nests and powerline infrastructure) were evaluated in relation to the risk to priority species occurring in these habitats/features from the placement of wind turbines (Figure 4-15). There is an important presence of a number (mainly seven) SCC in the PA (namely Martial Eagle, Lanner Falcon, Ludwig's Bustard, Red Lark, Karoo Korhaan, Double-banded Courser and Burchell's Courser), recorded regularly and occurring relatively 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.

The placement of wind turbines on rocky ridges, in drainage lines and in patches of natural vegetation, which are vital to maintaining populations of habitat obligate sensitive species (such as Red Lark), would result in a high probability of collision fatalities for such SCC. Consequently, avoidance mitigation is required for such habitats when siting turbines. A 50 m buffer was applied around these habitat features and must be considered NO-GO where no turbines and associated infrastructure may be

[9] Rounded up to whole numbers with actual fraction provided in square brackets

located. A 200 m buffer was also applied around seasonally inundated watercourses in the PAOI, as these features function as flyways and attract birds under certain conditions and could be the only locations were certain sensitive species such as ducks, herons, storks and water birds are likely to occur. Buffered high sensitivity areas must be avoided by the developer where no turbines and associated infrastructure may be located (Figure 4-15).

Several of the proposed turbine positions and associated infrastructure coincide with areas currently demarcated as Medium sensitive features and consequently were subjected to the mitigation hierarchy. The layout was carefully re-evaluated in order to firstly avoid and secondly minimise negative interaction between wind turbines and priority species such as Red Lark and Ludwig's Bustard. Finally, the presence of the Houmoed Distribution line is a highly significant attractant for SCC and other priority species, with particular concern for the Martial Eagles which have been present and breeding within the PAOI for at least 30 years. The presence of this species warrants detailed discussion below.

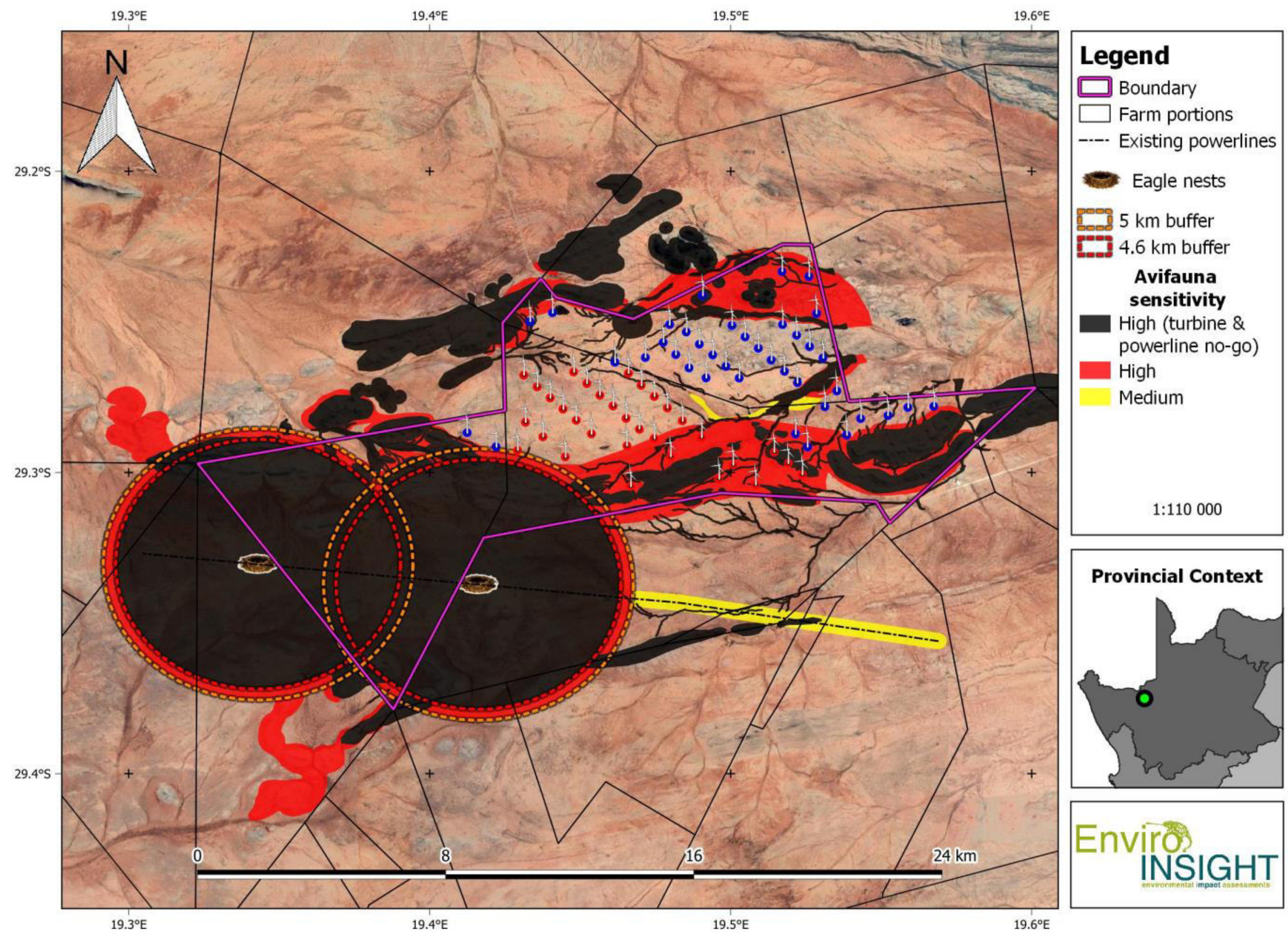

Figure 4-15: Avifauna Sensitivity Buffers with preferred turbine placements for the proposed De Rust WEF.

4.8.2 Martial Eagle Nest Sites

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 known Martial Eagle nests, which were confirmed to be present after the completion of the 12-month pre-construction monitoring (Figure 4-15). 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 *et al.*, 2021). The only published recommended buffer to implement around eagle 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. A buffer of 3 km is deemed inadequate for Martial Eagles within between 5 and 4.6 km (unmitigated) being recommended.

A recent paper from Murgatroyd *et al.* (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 fatality 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 data collected during the pre-construction monitoring (see above), the Martial Eagles (including the newly arrived pair) within the PAOI appeared to be foraging regularly over the proposed WEF development area (seen a total of 6 times, 3 times of which were of pairs). At the conclusion of the survey and with data acquired from supplementary surveying in January, one of the nesting resident Martial Eagles has subsequently perished (Figure 4-16). In addition and during this period, two Martial Eagles have (possibly) colonised the area, frequently roosting on the power line pylon infrastructure and foraging as far as VP 1. Although this will not affect turbine layout and the mitigation measures to be applied, the Cumulative Impact Assessment is significantly affected and there exists an ecological risk that this pair, or new pairs of eagles may come to occupy the territorial vacuum left as a result of this fatality, given the loss of territorial exclusion between the individuals.

Thus, the current survey, in accordance with the accepted methods shows widespread use of the proposed development footprint area by three different Martial Eagles. Although 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, a number of robust assumptions can be made.

1. The colonisation status of the new eagle pair is currently unknown;
2. It is highly likely given the prey base and habitat suitability that Martial Eagles will continue to forage within the PAOI and likely replace the territorial vacuum;
3. A near-certain predicted outcome of the death of the individual is that a new pair will likely forage within the previous pair's defended territory. In addition, other eagles may (or may not) occupy existing nests or build a new nest within the Houmoed Distribution line pylons;
4. The combination of the prescribed sensitive habitat buffering (Figure 4-15) and proposed Shutdown on Demand

Mitigation measure discussed below, are considered sufficient mitigation to prevent collision fatalities with turbines;

5. The loss of one of the eagles has increased the overall cumulative impact significance and stronger mitigation measures within the PAOI will be required.

As a result, it is strongly recommended that mitigation measures below be coupled with a robust radar/ AI based monitoring program directed by a recognised Martial Eagle specialist (we propose Dr. Gareth Tate of the EWT) in order to automate Shutdown on Demand (SoD) and to collect data on the movement patterns of the resident eagles. It is suggested that the Shutdown on Demand (SoD) 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 5 km nest buffers (with the 4.6 km sub buffer) and the proposed position of the radar system is shown in Figure 4-17.

Alternatively, the commercially available and cheaper BIOSECO system is recommended as it is capable of detecting large birds >500 m but not with 100% accuracy. Currently the system is very reliable within 300 m (Szurlej-Kielanska, 2022) although the manufacturing company is specifically looking to design systems with a range that exceeds beyond 500 m. In this case, because the main mitigation target is a Martial Eagle, which is a very large bird, a 400 m detection range is highly plausible for the current commercially available system meaning that placement of the unit on a specific turbine would cover detections for 2-3 adjacent turbines too, depending on the spatial configuration.

Figure 4-16: Martial Eagle fatality (November 2022)

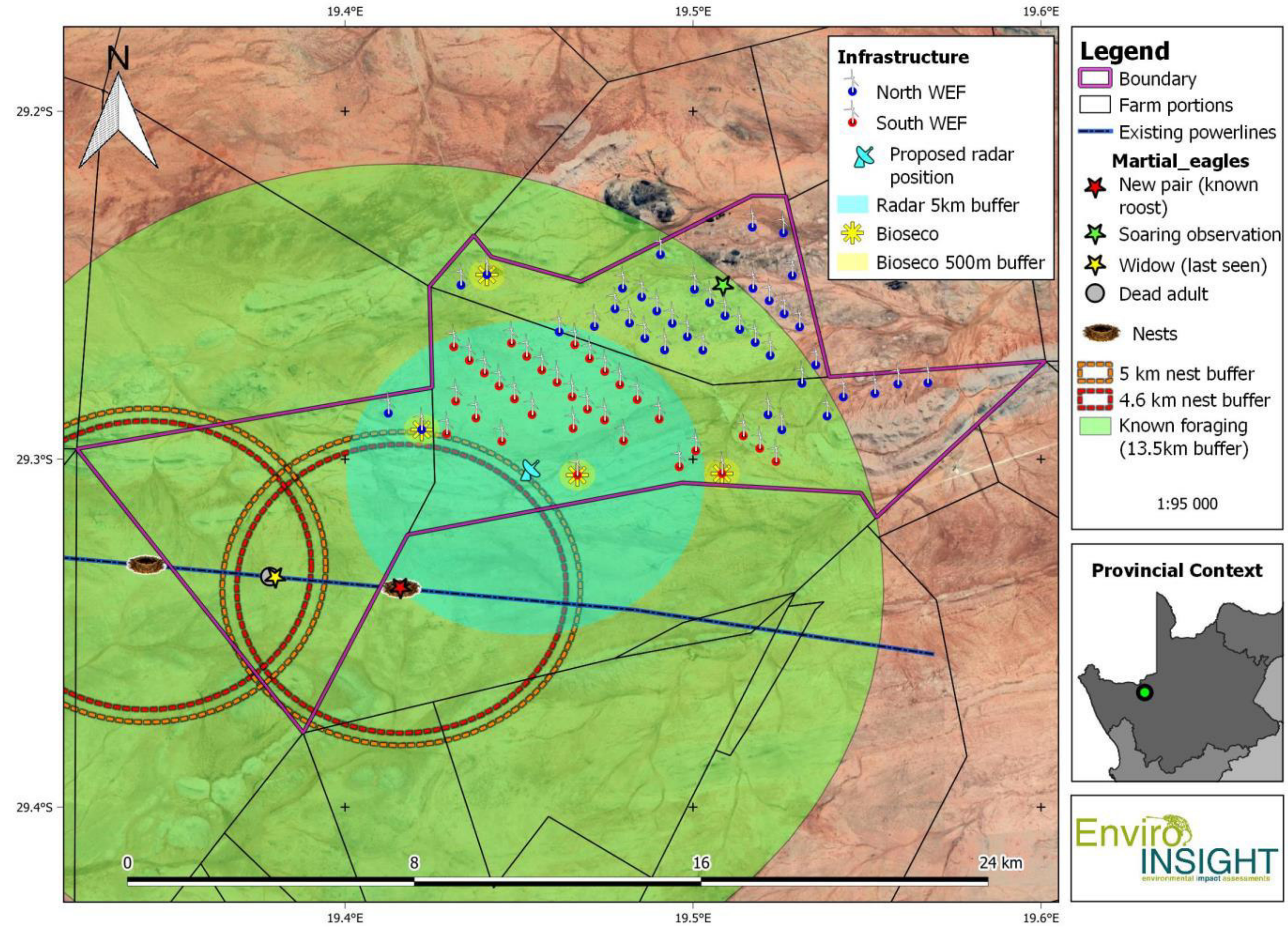

Figure 4-17: Martial Eagle Nest Buffers

4.9 SITE ECOLOGICAL IMPORTANCE (SEI)

As described in the species protocol guidelines (SANBI 2020), Site Ecological Importance (SEI) is a "standardised metric for identifying site-based ecological importance for species, in relation to a proposed project with a specific footprint and suite of anticipated activities". SEI allows for rapid spatial inspection and evaluation of impacts of a proposed development within the context of on-site habitats and SCC, and also facilitates integration of inputs from different specialist studies. SEI depends on the careful spatial delineation of habitat types and an understanding of their utilisation by SCC. The evaluation of SEI is presented in Table 4-8 with the guidelines for interpreting SEI shown in Figure 4-18

The final expression of the SEI delineation for the PA is shown in Figure 4-19.

Three habitats with High SEI are present in the PA where avoidance mitigation is recommended. Minimisation and restoration mitigation will be required for the Medium SEI habitats.

Table 4-8: Evaluation of Site Ecological Importance (SEI) of avifauna habitats in the project area. BI = Biodiversity Importance.

Habitat	Conservation Importance (CI)	Functional Integrity (FI)	Receptor Resilience (RR)	Site Ecological Importance (SEI)	WEF Site Sensitivity
Open Shrubland	**Low/ Medium** – Multiple confirmed or highly likely populations of SCC albeit relatively generic and where SCC of IUCN Vulnerable or Endangered are not necessarily dependent on the habitat.	**High** – Despite disturbance from livestock agriculture, this large habitat exhibits high ecological functionality.	**High** – Habitat that can recover relatively rapidly.	**MEDIUM (BI = Medium)**	**LOW**
Koppies and Ridges	**High** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Vulnerable or Endangered are relatively dependent on the habitat for foraging and breeding (e.g. breeding leks for Ludwig's bustard).	**High** – Cumulatively lower area for any conservation status of SCC and as a foraging and breeding habitat, the ecosystem type is crucial with currently only minimal current negative ecological impacts.	**Medium** – Associated vegetation will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality. Alteration to the physical rock structure cannot recover.	**HIGH (BI = High)**	**HIGH (No Go)**

Habitat	Conservation Importance (CI)	Functional Integrity (FI)	Receptor Resilience (RR)	Site Ecological Importance (SEI)	WEF Site Sensitivity
Pans and Drainage Lines	**High** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for migration. foraging and possibly breeding (Ludwig's Bustard Leks especially in association with Ridge Habitat).	**High** – Cumulatively medium (>100 ha) intact area for any conservation status of SCC. Currently only minimal negative ecological impacts.	**Medium** – Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality.	**HIGH (BI = High)**	**HIGH (No Go)**
Sandy Grassland	**Medium** – Confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for migration. foraging and possibly breeding. Habitat specific to Red Lark (IUCN VU).	**Medium** – Connected and classified as natural although not unmodified with relatively moderate level of current negative ecological impacts.	**Medium** – Will recover relatively rapidly, especially with "resting" and some minor ecological rehabilitation (~ more than 5 years) to restore > 75% of the original species composition and functionality.	**MEDIUM (BI = Medium)**	**MEDIUM**
Powerline Infrastructure (300 metre corridor either side)	**High** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for breeding.	**High** – The linear transect traverses multiple habitat types and assuming a "corridor" or 100 metres either side of the powerlines, can be considered of high functional integrity as a breeding site for raptors. Although the pylon structure itself is considered to be artificial, the breeding habitat is highly functional.	**Medium** – Does not apply to the actual powerline infrastructure. Assuming a neutral evaluation.	**HIGH (BI = High)**	**MEDIUM**

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

Figure 4-18: Guidelines for interpreting SEI in the context of the proposed development activities, reproduced from SANBI (2020).

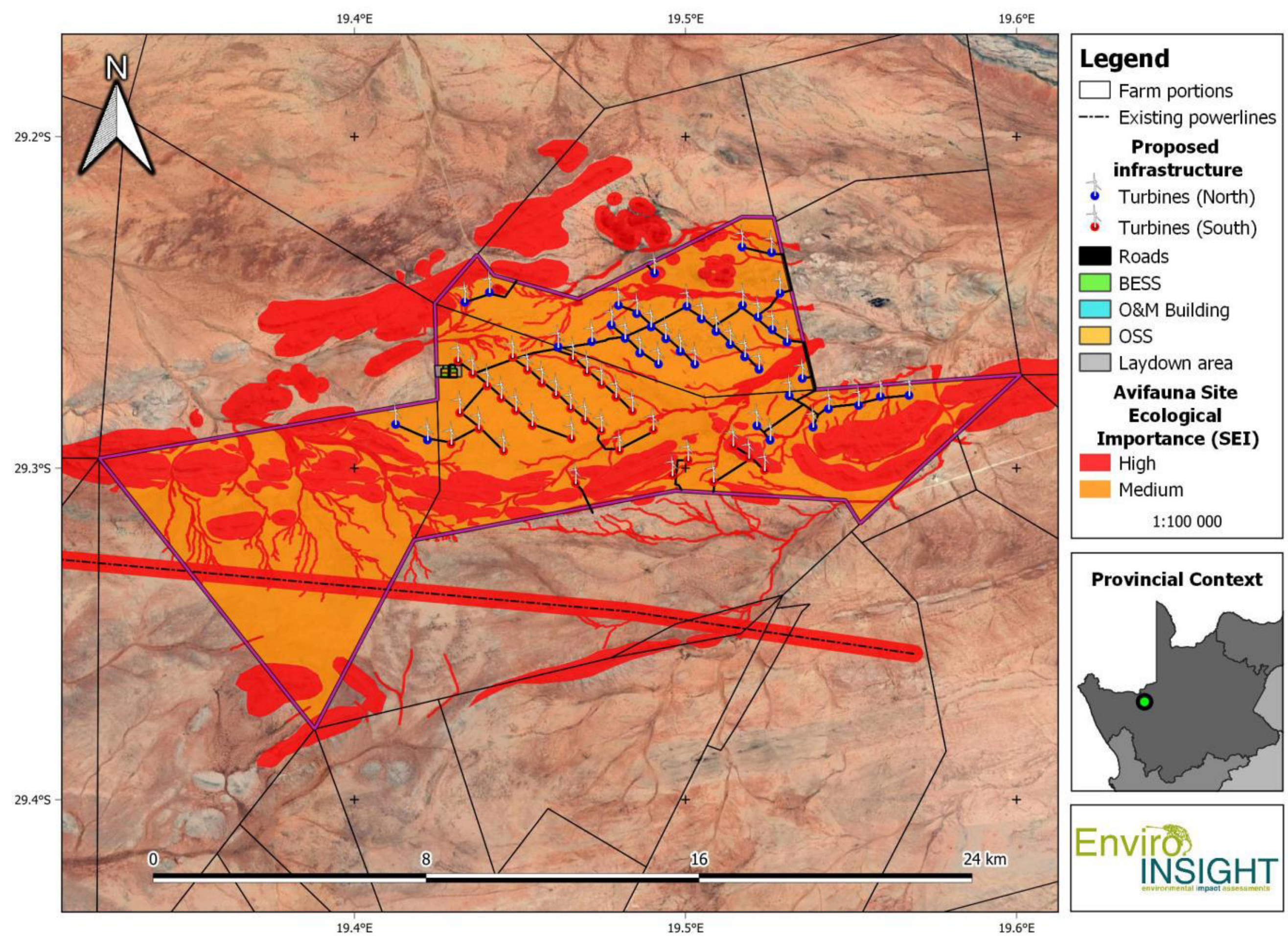

Figure 4-19: The De Rust Combined Project Area Site Ecological Importance (SEI).

4.9.1 SEI Discussion

Avifaunal importance relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain avifaunal assemblages, their food supply as well as the density and diversity of SCC. Throughout the PA, much of the habitat is generic in their ability to support a high diversity of general avifaunal species, Red-Listed species and SCC. However, unique geographical or topographical features exist in significant proportions which would cause the areas targeted for development to be classified as a "No Go" development in regard to avifauna. Due to the high diversity of the above mentioned, Red-Listed species recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the region as a whole is considered to be an area of high avifaunal importance and activities should be managed in a holistic manner, prioritising mitigation and monitoring of avifauna SCC.

4.9.2 High SEI

Habitats with high avifauna sensitivities include the seasonal drainage lines and water sources:

- The seasonal drainage lines and accompanying vegetation are linear dispersal corridors for terrestrial and wetland associated bird species. A significantly high species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are assigned high avifaunal importance. The drainage lines act as important flight corridors for passerines and raptors between foraging and roosting sites. Ludwig's Bustard utilise the habitat on the upslopes of drainage lines for foraging and lekking (breeding).
- The surface water habitats (artificial dams) are vital in the landscape, primarily due to the very arid conditions prevailing within the region. Avifaunal species depend on an interconnected system of water features (artificial or otherwise) and, based on seasonality and prevailing climatic conditions, it is anticipated that these systems experience a frequent turnover of species over time (seasonally and long term). They often provide essential breeding habitat, foraging habitat and water resources for avifaunal species including large, bodied SCC such as korhaans and bustards.
- The rocky ridges, specifically the steeper koppies, act as prominent landmarks and foraging habitat for diurnal birds of prey. It also provides potential hunting habitat for all SCC eagles (especially Martial) which hunt prey common in these habitats.

4.9.3 Medium SEI

Areas with medium avifaunal sensitivities include the Open Scrub Habitat and Sandy Grasslands:

- The open karoo habitats and Sandy grassland areas provide suitable foraging habitat for, Ludwig's Bustard *and* Red Larks but are very common in the landscape and are not a specific attractant for most SCC.
- The habitats are fairly resilient despite current disturbance and recovery is likely with adequate management and avoidance.

5 POTENTIAL IMPACTS

5.1 BACKGROUND TO ANTICIPATED IMPACTS

The effects of a wind energy facility 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 density of bird species 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) (Table 5-1);
- Collision fatality with turbines (
- Table 5-2);
- Flush related collision fatality with fencing or other infrastructure (such as anchor cables) (Table 5-3);
- Disturbance of flight/migratory pathways (Table 5-4);
- Disturbance due to lights, noise, machinery movements and maintenance operations (Table 5-5); and
- Attraction of birds to the WEF.

Table 5-1: Habitat loss and fragmentation impacts.

Impact: Habitat loss and fragmentation Access roads and turbine or infrastructure construction will necessitate the removal of foraging and roosting habitat, destruction or disturbance of bird breeding habitats, bird roosts and potentially sensitive avifaunal habitats such as migratory routes. The act of clearing vegetation will occur during the construction phase but the effects of habitat loss and fragmentation will persist for the lifespan of the facility.			
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	Koppies and Ridges, Pans and 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 required 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 fatality with turbines.

Impact: Avifauna fatalities due to collision with turbines This impact will occur during the operational phase due to avifauna collision with the blades of the turbines. 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
Fatalities suffered due to collision with turbines.	Negative and highly relevant for SCC such as Red Larks and Martial Eagles.	Local, but can be more extensive for species that migrate/disperse through the region.	See Figure 4-15
Description of expected significance of impact: The impact can potentially be highly significant as local populations of SCC (specifically Red Larks and Martial Eagles) can be affected to a highly unacceptable limits. Potential collision impacts will persist during the life of project, but if no-go areas are avoided and the necessary buffers applied along with application of automated SoD systems, the impact may be reduced to medium/ low. The very high hub and rotor sweep heights (150 m and 62.5 m respectively) limits the likelihood of potential collisions by Red Larks during their display flights.			
Gaps in knowledge and recommendations for further study: The residency status of the Martial Eagle pair and their utilisation of nesting and foraging habitat in the PA is currently unknown and difficult to predict for the near future.			

Table 5-3: Flush-related collision fatality with fences and other infrastructure.

Impact: Flush related fatalities due to collision with fences and other infrastructure This impact will occur during the construction and operational phase due to avifauna collision with fences or other infrastructure due to vehicles flushing birds. This will be especially relevant during times of migration or when there is an insect abundance (e.g. after heavy rains) when there is a higher abundance of avifauna in the area.			
Issue	Nature of impact	Extent	No-Go Areas
Fatalities suffered due to collision with	Negative and especially relevant	Local, but can be more extensive for species that	Does not apply. Design-related mitigation measures.

fence and other infrastructure.	for large-bodied birds.	migrate through the region and especially larger species based on the ground (bustards and korhaans).	
Description of expected significance of impact: The impact can potentially be highly significant and will persist during the life of project, but if design-mitigation is applied the significance can be minimised.			
Gaps in knowledge and recommendations for further study: Location of fences and other infrastructure in relation to planned roads as turbine layout may not yet be final			

Table 5-4: 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 fatalities for birds moving through the area during times of small-scale migration and seasonal migration.			
Issue	Nature of impact	Extent	No-Go Areas
Disturbance of bird migration pathways.	Negative, but should be low if pathways are avoided.	Regional.	All drainage lines must be buffered by 100m and this buffer will be considered a No-Go Area for the placement of infrastructure (including turbine blade reaches).
Description of expected significance of impact: This impact significance will be low if infrastructure is avoided in the drainage lines and their buffers.			
Gaps in knowledge and recommendations for further study: Spatial aspects of migration in birds can be unpredictable as well as times of the year when these events occur. It is also not established whether all birds will follow the exact same pathway year after year.			

Table 5-5: 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 or breeding activity and flight paths used. Artificial lights can attract insects which will entice nocturnal species (nightjars etc) to feed in the area leading to a higher chance of fatalities due to collision. 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 (movements) during operation	Negative, but can be reduced to acceptable levels	Local	See Figure 4-15
Description of expected significance of impact: This impact could be significant for breeding SCC, but easily reduced if noise and high intensity lights are not used, and only downward lighting is applied for all lights other than the compulsory civil aviation lighting. Noise levels must be kept within the accepted standards and machinery must be fitted with sound 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 and drainage lines, as per the No-Go mapping in Figure 4-15.			

Table 5-6: Attraction of some bird species due to the development of a WEF with associated infrastructure such as, perches, nest and shade opportunities.

Impact:			
Issue	**Nature of impact**	**Extent**	**No-Go Areas**
Description of expected significance of impact: This impact could be significant for breeding SCC a SCC and other species attracted to infrastructure (e.g., pylons for grids) can subsequently breed in the vicinity of impacts such as turbine-blade collisions.			
Gaps in knowledge and recommendations for further study: Spatial aspects of migration and levels of attraction to infrastructure in birds can be unpredictable as well as times of the year when these events occur (and for how long). It is also not established whether all birds will follow the exact same pathway year after year or permanently settle in infrastructure in order to breed as colonists. .			

The above-described potential impacts are assessed with specific reference to priority species and selected non-priority species at high risk during either the Construction or Operation Phases.

5.1.1 Construction Phase

Impacts associated with the loss of bird foraging habitat due to construction activity (Table 5-7) can be mitigated by avoiding avifaunal specific sensitive areas and their associated buffers (Figure 4-15). The overall severity of the impact can be further reduced to being insignificant if minimisation mitigation is applied though selective use of previously disturbed areas such as existing roads.

Table 5-7: Consolidation table of impacts due to habitat destruction during construction phase.

Nature: Habitat loss during construction phase		
	Without mitigation	**With mitigation**
Extent	4	3
Duration	3	2
Magnitude	5	4
Probability	5	4
Frequency	3	1
Significance	**Medium-High (96)**	**Low (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Bird roosts varied from artificial structures such as pylons, windmills to the pan areas and impacts associated with the destruction or disturbance of such roosts (Table 5-8) can be mitigated by avoiding habitat features that could act as potential bird roosts as highlighted below. This impact can potentially be minimised further if temporal avoidance mitigation measures are applied so that intensive construction activities near known nests of SCC occur only outside of the breeding season (laying between May and July).

Table 5-8: Consolidation table of impacts due to the destruction or disturbance of bird nests during the construction phase.

Nature: The destruction or disturbance of bird nests during the construction phase		
	Without mitigation	**With mitigation**
Extent	2	2
Duration	3	3
Magnitude	5	3
Frequency	5	2
Probability	5	3
Significance	**Low-Medium (100)**	**Low (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes

Irreplaceable loss of resources?	Potentially	No
Can impacts be mitigated?	Yes	

5.1.1 Operations Phase

Impacts due to bird fatalities 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 flight heights) qualifies the proposed WEF boundary as a Low-Risk Area for bird/ turbine collisions in terms of numbers of collisions (not importance of species), 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 fatality impact on the local bird populations (Table 5-9). If automated shutdown on demand technology is applied, then the probability and magnitude of the impact will be further reduced as larger SCC will be exposed to a near zero risk of collision.

Table 5-9: Consolidation table of impacts from bird fatalities (turbine collision) during the operational phase.

Nature: Bird fatalities during the operational phase		
	Without mitigation	**With mitigation**
Extent	4	4
Duration	4	4
Magnitude	5	4
Probability	5	4
Frequency	5	3
Significance	**Very High (130)**	**Medium-High (84)**
Status (positive or negative)	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources?	Yes	Potentially
Can impacts be mitigated?	Partially	

It is likely that most of the avifaunal populations will be largely displaced from some of the project infrastructure and/ or be attracted to road verges due to increased forage availability (moisture collection). Significant risks are associated with the likelihood of project vehicles flushing birds into fencing (or other) infrastructure as well as collisions of large bodied species with fences and wire/cable strands (e.g. mast support cables). In all areas where service road intersects with semi natural or natural habitat, all fences constructed must be set back at least (strictly) 75 metres from the edge of every service road in order to allow for vulnerable species such as bustards and korhaans to obtain adequate height after being flushed by vehicle traffic. Alternatively, and where a 75 m buffer is not possible, new fences must be set back no more than 2 metres (directly adjacent) from the edge of service roads to prevent congregations of susceptible birds on road verges. This will limit the probability of vulnerable species foraging on road verge vegetation and subsequent fence collisions. Furthermore, all other wire/cable spans must be clearly marked with visible bouys and/or coloured tape to increase visibility thereof.

Table 5-10: Consolidation table of impacts from bird fatalities (powerline and fence collision) during the operational phase.

Nature: Bird fatalities during the operational phase		
	Without mitigation	**With mitigation**
Extent	3	3
Duration	4	4
Magnitude	4	2
Probability	5	3
Frequency	5	3
Significance	**High (110)**	**Low-Medium (52)**
Status (positive or negative)	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources?	Yes	Potentially
Can impacts be mitigated?	Partially	

Migratory pathways of birds are unpredictable and cannot be changed (directed). 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 pylon habitats and southern koppie habitats represent a highly sensitive habitat features which could facilitate migration and therefore these areas have been buffered (see Figure 4-15 and Table 5-11). In addition, automated Shutdown on Demand technology must be placed in designated areas (see below). If these measures are 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 5-11: 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	4	3
Duration	4	4
Magnitude	4	3
Probability	4	3

Frequency	4	2
Significance	**Medium High (96)**	**Low-Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	No	Yes
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

The development of a WEF with associated infrastructure such as perches, nest and shade opportunities may attract birds which can cause both damage to the infrastructure through acidic defecation by certain species but also draw birds closer to infrastructure and increase the probability of the above-mentioned impacts. All potential habitat attractants should be eliminated so that avifaunal populations will not embed themselves within the infrastructure over time. This includes deterrents such bird diverters, perch deterrents.

Table 5-12: The attraction of some bird species due to the development of a WEF with associated infrastructure such as, perches, nest and shade opportunities.

Nature: The attraction of some bird species		
	Without mitigation	**With mitigation**
Extent	4	3
Duration	4	4
Magnitude	4	3
Probability	5	3
Frequency	5	3
Significance	**High (120)**	**Low-Medium (60)**
Status (positive or negative)	Negative	Negative
Reversibility	No	Yes
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

5.2 CUMULATIVE IMPACTS

There are a number of proposed, approved and implemented renewable energy facilities within the PAOI and any impacts anticipated from the proposed De Rust WEF will add to these existing impacts. As such, the results obtained during this pre-construction survey and from the subsequent impact analysis should be considered in conjunction with the impacts created by the regional developments. The large amount of renewable energy development within the region, raises the possibility of significant cumulative impacts concerning collision risk, habitat loss and fragmentation and loss of suitable habitat for threatened species.

REAA Q3 (2022[10]) was used to assess the potential cumulative impacts. The De Rust WEF developments are surrounded by four approved WEF projects within a 30 km radius, 'Paulputs' to the north, and 'Namies', 'Poortjies' and 'Korana' to the west. There are also two approved solar PV projects, 'Paulputs PV1&2' to the north and Khai-Mai to the west, in addition to the proposed Red Sands PV area. Only the latest versions of approved and unique technologies are thus considered in the calculations below.

The main cumulative impact anticipated from WEFs is the increased fatality of birds resulting from turbine (and powerline) strikes. Assuming that the total areas represented by the WEFs developments shown in **Error! Reference source not found.** will contain turbines, Table 5-13 shows that the maximum transformed area from the WEF development boundaries (REAA Q3, 2022) within a 30 km radius of the proposed development cluster is expected to amount to 9.2% (46 675 ha) of the total land area. The proposed De Rust WEF cluster itself only represents 2.1% of the 30 km radius area, indicating a small proportion of transformation in the regional context. The combined transformed area for WEF (including the proposed De Rust WEF cluster) is expected to represent 13.0% of the 30 km radius area.

It is important to state that the current De Rust project is a hybrid project which will incorporate both WEF and SEF Infrastructure, not to mention the combination of Renewable Energy Facility infrastructure (approved and in process) within the PAOI. Solar PV projects do not result in highly significant incidences of bird fatality but the removal of vegetation in the footprint of the panels, heliostat mirrors or infrastructure is likely to reduce the foraging suitability for birds as well as other forms of migratory disruption. It is difficult to assess the cumulative impact when regarding interactions between impacts, for example, the reduced prey availability may deter birds foraging in the region and result in a lower fatality of birds by the WEFs, but the overall reduction in competition from livestock (as the density of livestock will reduce) may increase the habitat quality within the PAOI, causing an inadvertent attractant and thus placing more birds (including SCC) in closer proximity to infrastructure such as turbines (causing direct fatality). This may or may not negatively affect regional bird populations, which, in combination with prolonged WEF (within the PA), fatality may result in near unacceptable losses, especially for SCC. Foraging areas are required to sustain bird populations in the region and the current proposed WEF footprints (REAA Q3, 2022) amounts to potentially 4.6% (23 697 ha) of the total land area (calculated using farm portion boundaries), and the remaining habitat should provide ample foraging area for birds in the region.

However, not all of these areas will be transformed by the proposed developments and mitigation recommendations made below will ensure that the most sensitive habitats will be avoided by turbine or WEF infrastructure placement. Furthermore, since the avifauna SCC are expected to occur in the proposed development area both regularly and stochastically (nomadic) with a high likelihood of occurrence, significant cumulative impacts to avifauna SCC are therefore anticipated from the proposed development.

5.2.1 Summary of Impacts

The following 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

[10] https://egis.environment.gov.za/data_egis/data_download/current

increase. The Red Lark exists within a narrow ecological and distributional belt and loss of its ecologically specific habitat may be significant;

- Road-kills: Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl. Increased traffic to WEFs are likely to exacerbate this impact;
- Regional saturation of turbines: This has implications for several priority species, both in terms of collision fatality for some species, especially Bustards and Raptors, and displacement due to transformation of habitats and flyways;
- 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, mostly through collision but also occasionally through electrocutions.

Overall, it is unlikely that any cumulative impact assessment will, under the current *status quo*, result in a fatal flaw for a proposed WEF. The best approach to address cumulative impacts is to consolidate available information and determine acceptable (predicted) fatalities for a given area and restrict the number of developments in that area, taking care to allow for unrestricted flyways between WEFs. In addition, a landscape scale approach should be taken, where large areas of bird sensitivity should be identified (perhaps by BLSA) and set aside (under the NEMPA Act) as foraging and migration areas so that WEFs may not be constructed in these zones.

Mitigation measures can help reduce fatalities, and if all neighbouring WEFs practise effective bird mitigation measures then the cumulative impacts will be reduced. It is important for nearby WEFs to communicate with one another regarding bird activity and fatality levels, as one WEF may detect warning signs of peak bird activity (especially in relation to large influxes of nomadic SCC migrants such as Ludwig's Bustard), enabling other WEFs to implement adaptive mitigation before excessive fatalities occur. It is therefore crucial that operating WEFs make the post-construction monitoring data more available, to enable this approach. Combining monitoring datasets and analysis may also increase our understanding of bird activity across the region and assist in applying more strategically appropriate mitigation measures, or even to decline future proposed WEFs in locations that become known as highly sensitive due to the ongoing data collection from post-construction monitoring.

Table 5-13: Spatial summary of approved renewable developments in the region.

Elements	Area (ha)	Proportion of total area
Total area of 30 km buffer surrounding (and including) the proposed De Rust WEF cluster.	507 807	100.0%
Total area of approved renewable energy projects within the 30 km buffer	65 960	13.0%
Solar CSP[11]	0	0.0%
Solar PV	23 697	4.6%
Wind	56 774	11.2%

[11] Combined solar PV and wind areas calculated separately per technology

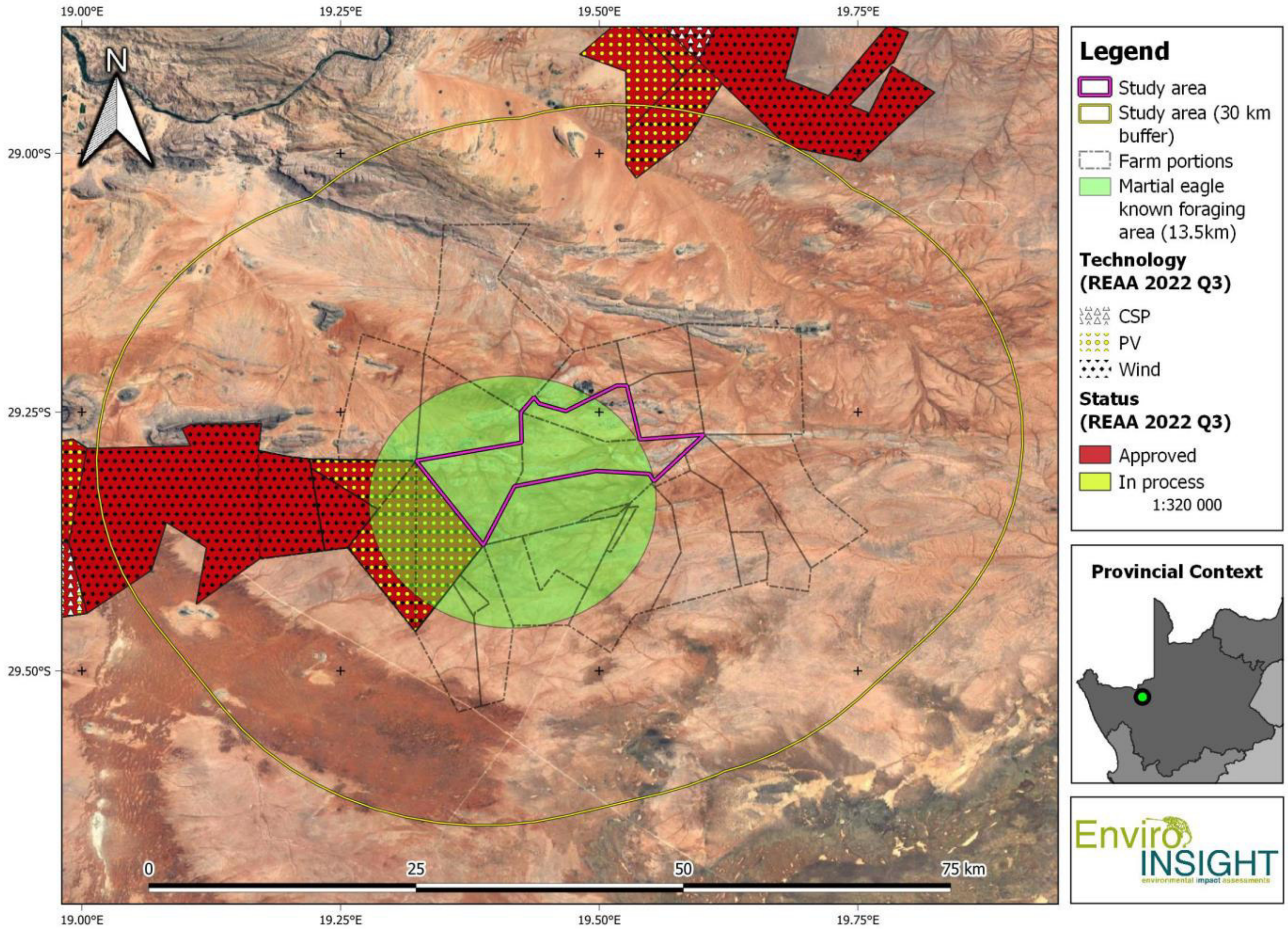

Figure 5-1. Renewable Energy EIA Applications surrounding the proposed De Rust WEF.

Table 5-14: The 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	3	4
Duration	4	4
Magnitude	3	4
Probability	4	5
Frequency	4	5
Significance	**Low-Medium (80)**	**High (120)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	Possibly
Can impacts be mitigated?	Yes	Possibly

5.3 GENERAL MITIGATION OF IMPACTS

5.3.1 General

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 radar, 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 De Rust 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, application of Radar and Bioseco) 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 and associated infrastructure (including powerlines and fences situated near roads) 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 which fortunately is considered of low significance in the PAOI. 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.

5.3.2 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 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.
- 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 5-2.
- 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 5-2.
- Finally, all of the above information is subject to the final data analysis and submission of the EIA. However, it is suggested that shutdown on demand protocols not only be submitted as part of the EMP but updated every 3 years in regard 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.

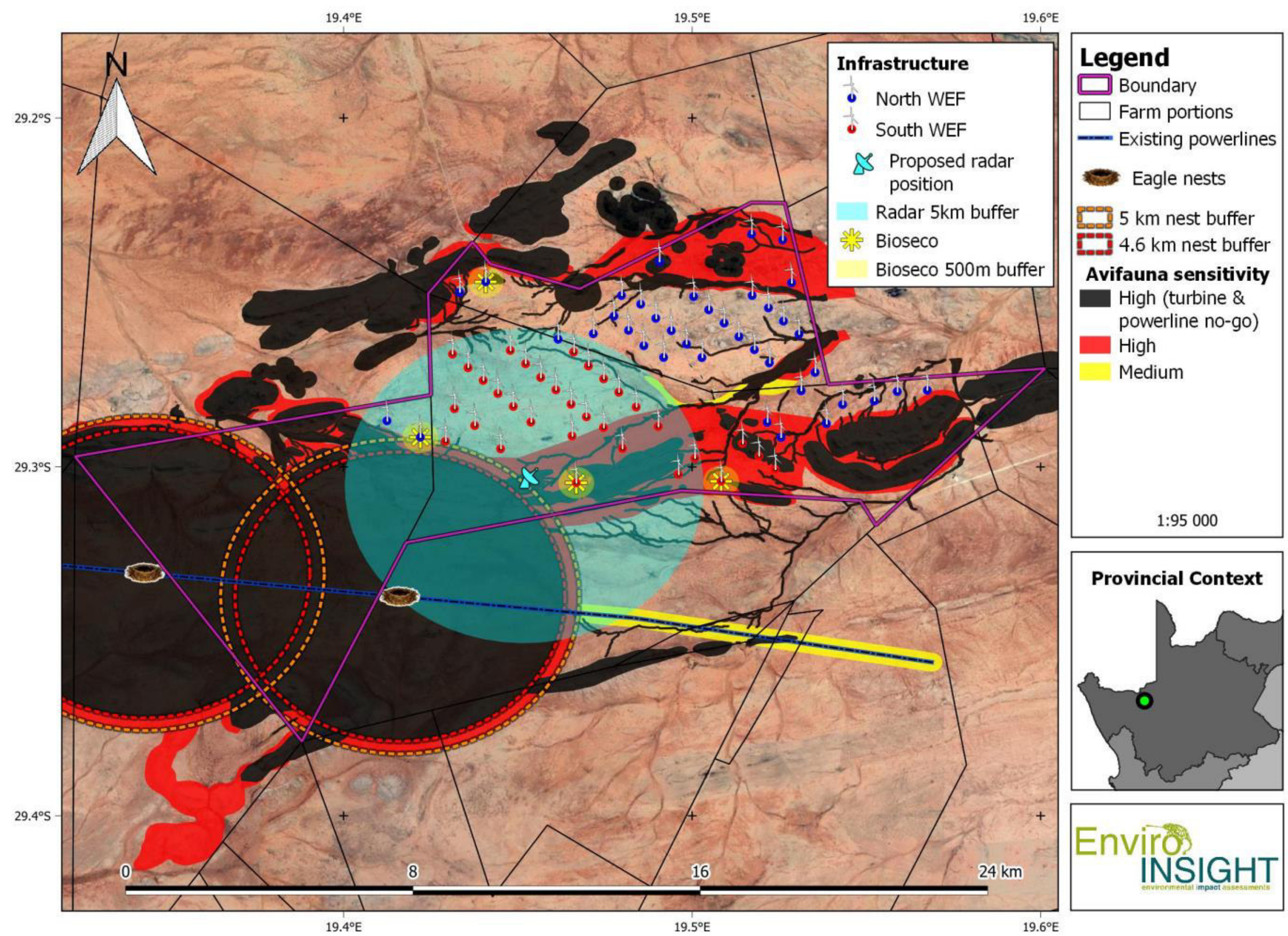

Figure 5-2: Preliminary radar positioning in conjunction with the location of martial eagle nest sites and high sensitivity areas

5.3.3 Summary of Proposed Mitigation Measures

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

Habitat destruction: Apply necessary buffers for roost and foraging 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 fatality: 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 39 birds per year (see Table 4-7). 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 in permanent populations of Martial Eagles in the PAOI.

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

General Mitigation Measures for Wind Energy

- 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 (fatalities).
- High value target species such as Martial Eagles and Ludwig's Bustards 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 Jenkins *et al.* (2015). 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).

5.4 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.

5.4.1 Ludwig's Bustard

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 carried out during the pre-construction monitoring process although and monitoring data suggest that a permanent (albeit seasonal changes in density) population including breeding pairs persist for prolonged periods within the PA. 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 are encountered in the PA provides strong anecdotal evidence of residential breeding behaviour which may have significance ramifications for the Impact Assessment and Cumulative Impact Assessment.

It must be stated that some local landowners stated that Ludwig's bustards have increased in density over the last ten years within the region (sometimes numbering up to 130 congregated individuals) and within the Project footprint. By all accounts, 2022 showed a high density (55 observations). A possible reason for this increase is that the species, as a nomad, may show localised and temporal increases as part of natural population dynamics due to climatic fluctuations. 2022 experienced a highly unusual amount of rainfall over an extended period of time. This caused an activation of the seed bank within the PAOI and subsequently, a large amount of fodder and insects were available for avifaunal species including Ludwig's Bustard.

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 and other vehicles 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, another prolonged drought may all but exclude local colonisation which will be immediately reversed with the onset of more unusual heavy rains. 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. Ludwig's Bustard Specific High Sensitivity Area based upon density of sightings and habitat suitability is shown in Figure 5-3.

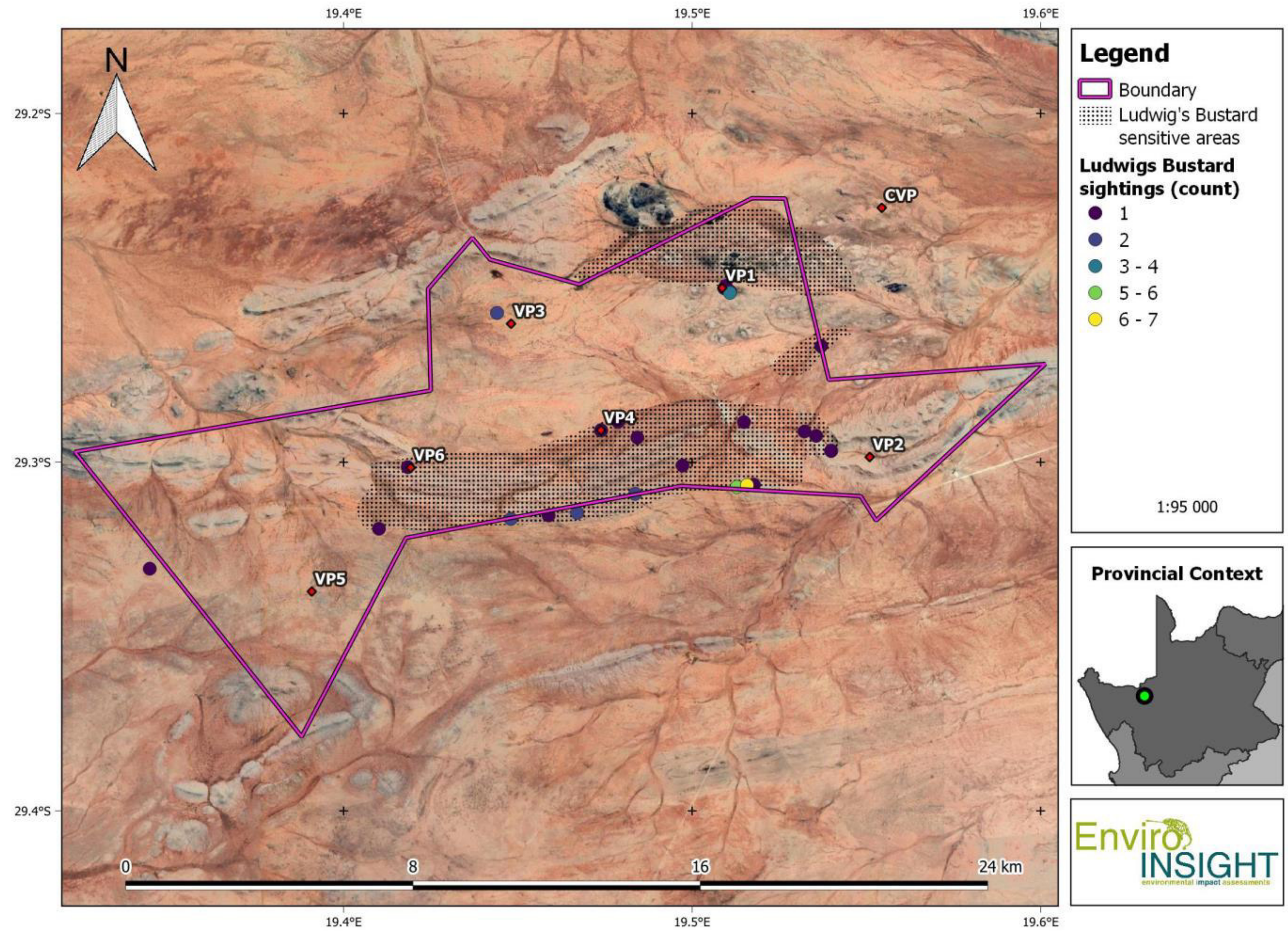

Figure 5-3: Ludwig's Bustard Specific High Sensitivity Area based upon density of sightings and habitat suitability.

5.4.1 Martial Eagles and 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 one active and one (recently dormant) Martial Eagle nests adjacent to the footprint, which were confirmed after the completion of the 12-month pre-construction monitoring. A detailed discussion of this species is provided in 4.8.2 Martial Eagle Nest Sites. In addition, photographic evidence of each nest is provided in Figure 5-4 and Figure 5-5.

Figure 5-4: Seemingly abandoned eastern Martial Eagle Nest

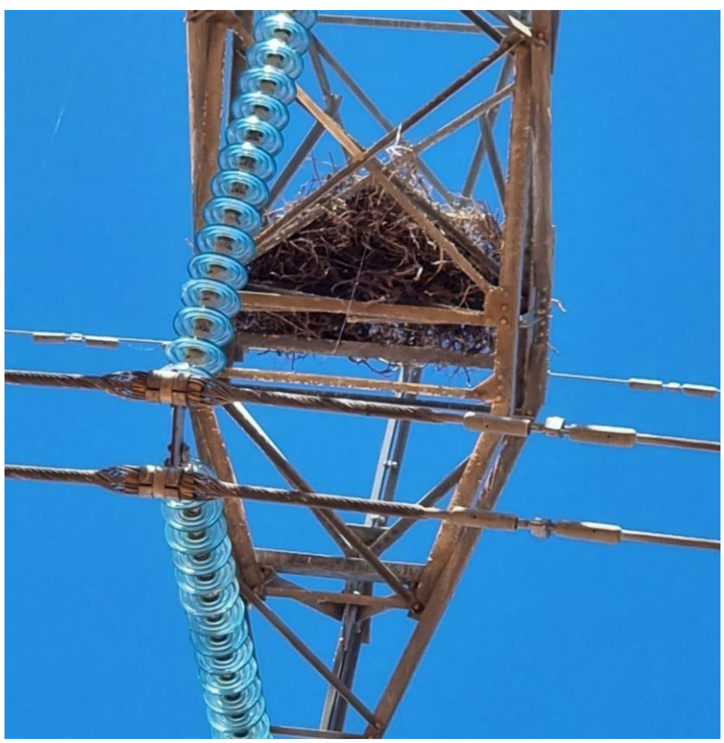

Figure 5-5: Western active Martial Eagle nest.

5.4.2 Large and Medium Raptors

This group includes falcons (including IUCN VU Lanner Falcon), Kestrels and Kites. As a rule, all nesting raptors should be protected within the PA as many species represent Priority Species and if not, their nests are often colonised by Priority Species. Many raptor species are under constant pressure from development due to modifications and alterations of their preferred foraging and breeding habitats. This includes direct fatality as well as to the disruption of a foraging, breeding or roosting bird caused by WEF activities. Collision-caused fatalities of birds at WEFs create a 'green versus green' conflict between wildlife conservation and renewable energy. This conflict 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 reduced (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.

5.4.3 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 if required.

5.4.4 Red Lark

This species is highly range range-restricted (Figure 5-6) and is listed as IUCN Vulnerable (Taylor *et al.*, 2015). The species was observed infrequently during the assessment period and within a restricted habitat preference. Even though the species exhibits a specific breeding behaviour (display flights of up to 20 metres as described in Hockey *et. al.* 2005), it has been deemed to have a relatively low risk of collision and thus is not considered a fatal flaw to the project. However, care must be taken as some individuals from other WEF developments near Aggeneys were observed displaying up to 60 metres (wind assisted). The species prefers the open sandy habitats, in particular open sandy karroid dunes and grassland, particularly on dune crests and dune side slopes. The species is considered as a regular, albeit low density breeding resident in the region. Avoidance-based mitigation is the primary mitigation measure and must be based upon the aforementioned delineated sensitivity. However as some turbines fall within the delineated high sensitivity area for Red Lark and large-scale avoidance may not be possible, additional small-scale micro sighting may be required.

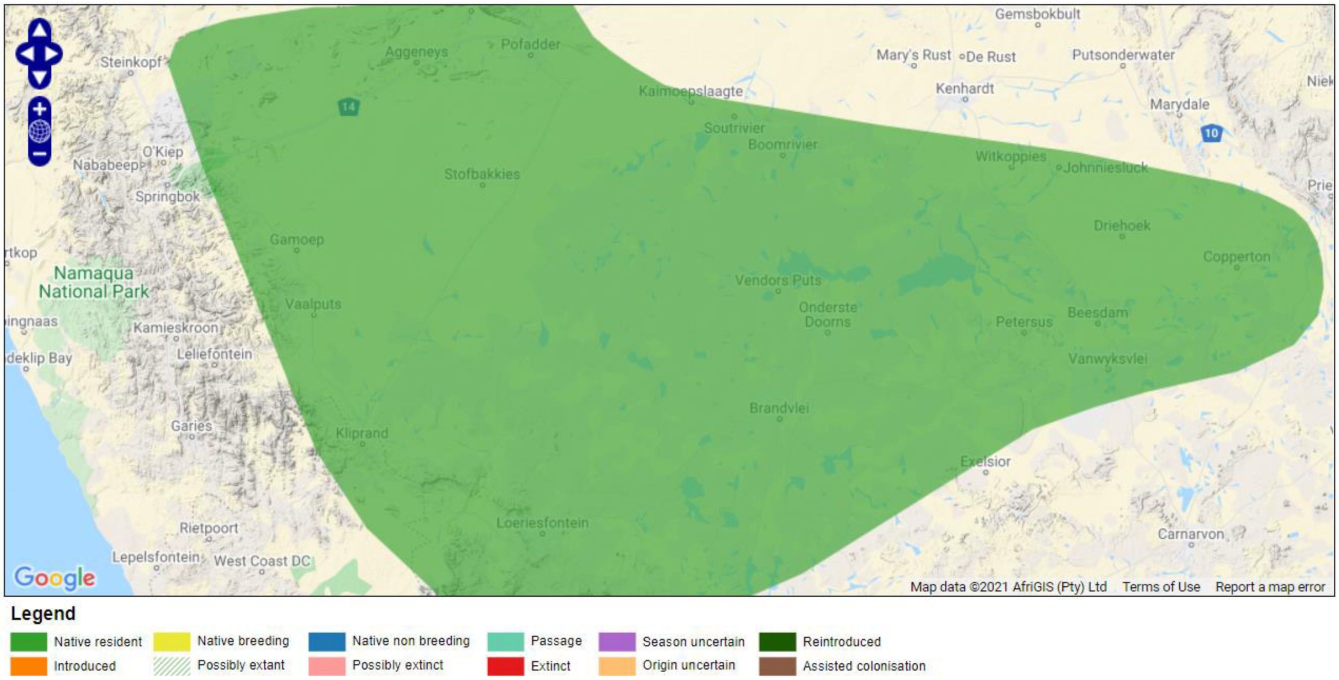

Figure 5-6: Red lark (Calendulauda burra) distribution map (BirdLife International, 2021[b]).

6 MONITORING REQUIREMENTS

Post-construction monitoring as per the relevant guidelines at the time must be implemented.

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

	Title: SCC community monitoring
Stressor	Project Activities, Micro 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	• 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 with focus on drainage lines, koppies, nesting sites and 500 m buffer around the project footprint.
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 Bustards, Large SCC Raptors and 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 and their cause. All reporting to be accompanied by GIS shapefiles and any original photographs.

	TITLE: Fatality monitoring
Stressor(s)	Avifauna-turbine and powerline collisions (incidents)
Receptor(s)	Avifauna community composition, density and distribution
Variables	Species, geographical location and date of every avifaunal fatality
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: weekly 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, weekly for panels
Sampling Site(s)	Along the entire powerline network on the PAOI. All operational panels.
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 retrofitting of mitigation measures).
Data Analysis	Geospatial analysis of density and dispersion of avifaunal fatalities highlighting the core areas of fatalities 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 fatalities associated with collision data highlighting locations where corrective measures are to be taken (if necessary).

	TITLE: Carcass monitoring
Stressor(s)	Avifauna- Livestock deaths (incidents)
Receptor(s)	Avifauna (large scavengers and raptors) community composition, density and distribution
Variables	Avifaunal species attracted, geographical location of every livestock fatality
Sampling Method	• Monitoring of livestock herds, especially during lambing/ birthing season • A thermal drone with a large radius must patrol target areas during the night in order to pick up the heat signature of large-bodied animals in a state of decomposition.
Sampling Frequency	Three-times weekly for herds, daily during birthing season
Sampling Site(s)	General PAOI and livestock locations
Collision Action Thresholds	General and unusually high presence of large scavenging and predatory species (vultures and raptors)
Data Analysis	Geospatial analysis of density and dispersion of livestock fatalities highlighting the core areas of fatalities so that corrective measures can be implemented. Monitoring of increased species of scavengers and raptors, numbers of carcasses removed and destroyed
Reporting requirements	• Annual reporting of faunal livestock fatalities and numbers of carcasses located (including locations) associated with presence of vultures and large raptors.

7 CONCLUSIONS

The PA is located in a region dominated by natural and diverse koppies/ ridge, drainage line, karroid and sandy grassland and shrubland karoo vegetation types. Several drainage lines and small farm dams as well as small to large natural pans can be found scattered across the PA with most being mostly dry with some seasonal flow/ inundation. The powerline infrastructure that traverses the PAOI is a significant habitat for Martial Eagles and other raptors.

Sixteen (16) priority species were recorded during the initial surveys, including Pale-chanted Goshawk, Martial Eagle, Karoo Korhaan, Ludwig's Bustard, Lanner Falcon and Red Lark. Of these, the Martial Eagle and Ludwig's Bustard were the most concerning large bird species. At the commencement of the survey, the PAOI was characterised by extremely atypical high rainfall in areas not normally associated with arid conditions. The onset of an extreme rainfall event (wet season) may have atypically transformed the PAOI where it is possible that increased densities (and perhaps diversity) of avifaunal assemblages may have been recorded due to an abundance of high forage value habitat that became temporarily available in the region. This increases the perceived concern regarding large nomadic species such as bustards, large wide-foraging raptors such as Martial Eagle and possibly Vultures seeking water sources within the PAOI, when typical arid conditions return over the next 12 months.

8 PROFESSIONAL OPINION

A final Professional Opinion is provided below.

8.1.1 Project Footprint Summary

- The addition of the proposed De Rust WEF does indicate potentially significant impacts (without mitigation) to the receiving environment via the risk to Priority Species (such as Martial Eagle, Red Lark and Ludwig's Bustard) and need to be considered with 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 and Ludwig's Bustard impacts as is the case for the impacts discussed within this statement). This is mainly because impact assessments regarding wind energy 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.
- Overall, 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 which factors in economic desirability etc.
- In addition, while striving to maintain the highest standards of mitigation and monitoring as well as the commissioning of a highly detailed pre-construction micro siting assessment, developments such as the De Rust WEF should be encouraged within designated areas.
- The presence of nesting and breeding Ludwig's Bustard, Martial Eagles and Red Lark within the PAOI are of particular concern. Avoidance mitigation must be implemented in conjunction with the aforementioned micro siting as well as technological applications such as Shutdown on Demand. Thus, the author will look to support Environmental Authorisation (EA) based upon the following conditions:
    - Shutdown on Demand (both automated and human-mediated) will be required to mitigate negative impacts on Ludwig's Bustard and Martial Eagle;
    - All recommended No-Go buffering must be strictly adhered to;
    - Micro siting of turbine placement must occur prior to construction and should be supervised by a specialist zoologist in order to mitigate habitat loss and collision risks for Red Lark;
    - All recommended mitigation measures described above must be applied;.
    - The EMPr must be updated every three years in order to revaluate the potential distributional population changes of species such as Martial Eagles and Vultures. Thus, technological mitigations such as AI, radar and camera technology may have to be re-positioned, re-calibrated and updated.

8.1.2 Cumulative Impact Summary

Since the immediate area comprising approved or pending WEFs are expected to cumulatively result in a High impact significance to avifauna after the application of the recommended mitigation measures, and since the combined area will likely contribute significantly to the total land area in the region transformed by renewable energy projects, it is recommended that the development may proceed on condition that:

- All mitigation measures stipulated above are adhered to and captured in an Environmental Management Plan (EMP);
- The EMP must include the necessity for post-construction avifauna monitoring as stipulated in Jenkins *et al*., (2015);
- All updated mitigation recommendations issued post-construction (informed by monitoring) must be adhered to.

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10 APPENDIX

10.1 APPENDIX 1: EXPECTED AVIFAUNA SPECIES LIST

Avifauna recorded and predicted to potentially occur within the PA according to SABAP2.

	Common Name	Scientific Name	SABAP2	Observed
1	Acacia Pied Barbet	*Tricholaema leucomelas*	YES	YES
2	African Hoopoe	*Upupa africana*	NO	YES
3	African Palm Swift	*Cypsiurus parvus*	NO	YES
4	African Pipit	*Anthus cinnamomeus*	YES	YES
5	African Red-eyed Bulbul	*Pycnonotus nigricans*	YES	YES
6	Alpine Swift	*Tachymarptis melba*	YES	NO
7	Ant-eating Chat	*Myrmecocichla formicivora*	YES	YES
8	Ashy Tit	*Melaniparus cinerascens*	YES	NO
9	Barn Swallow	*Hirundo rustica*	YES	NO
10	Black Stork	*Ciconia nigra*	YES	NO
11	Black-chested Prinia	*Prinia flavicans*	YES	YES
12	Black-chested Snake Eagle	*Circaetus pectoralis*	YES	YES
13	Black-eared Sparrow-Lark	*Eremopterix australis*	YES	YES
14	Black-headed Canary	*Serinus alario*	YES	NO
15	Blacksmith Lapwing	*Vanellus armatus*	YES	YES
16	Black-throated Canary	*Crithagra atrogularis*	YES	YES
17	Black-winged Stilt	*Himantopus himantopus*	YES	YES
18	Bokmakierie	*Telophorus zeylonus*	YES	YES
19	Booted Eagle	*Hieraaetus pennatus*	NO	YES
20	Bradfield's Swift	*Apus bradfieldi*	YES	NO
21	Brown-throated Martin	*Riparia paludicola*	YES	NO
22	Burchell's Courser	*Cursorius rufus*	YES	YES
23	Cape Bunting	*Emberiza capensis*	YES	NO
24	Cape Penduline Tit	*Anthoscopus minutus*	YES	YES
25	Cape Robin-Chat	*Cossypha caffra*	YES	NO
26	Cape Sparrow	*Passer melanurus*	YES	YES
27	Cape Teal	*Anas capensis*	YES	YES
28	Cape Turtle Dove	*Streptopelia capicola*	YES	YES
29	Cape Wagtail	*Motacilla capensis*	YES	NO
30	Capped Wheatear	*Oenanthe pileata*	YES	YES

	Common Name	Scientific Name	SABAP2	Observed
31	Chat Flycatcher	*Melaenornis infuscatus*	YES	YES
32	Chestnut-vented Warbler	*Curruca subcoerulea*	YES	NO
33	Common Greenshank	*Tringa nebularia*	YES	NO
34	Common Ostrich	*Struthio camelus*	YES	NO
35	Common Quail	*Coturnix coturnix*	NO	YES
36	Common Swift	*Apus apus*	NO	YES
37	Desert Cisticola	*Cisticola aridulus*	YES	YES
38	Double-banded Courser	*Rhinoptilus africanus*	YES	YES
39	Dusky Sunbird	*Cinnyris fuscus*	YES	YES
40	Eastern Clapper Lark	*Mirafra fasciolata*	NO	YES
41	Egyptian Goose	*Alopochen aegyptiaca*	YES	YES
42	Fairy Flycatcher	*Stenostira scita*	YES	YES
43	Familiar Chat	*Oenanthe familiaris*	YES	YES
44	Fawn-colored Lark	*Calendulauda africanoides*	YES	NO
45	Greater Kestrel	*Falco rupicoloides*	YES	YES
46	Greater Striped Swallow	*Cecropis cucullata*	YES	NO
47	Grey Tit	*Melaniparus afer*	YES	NO
48	Grey-backed Cisticola	*Cisticola subruficapilla*	YES	YES
49	Grey-backed Sparrow-Lark	*Eremopterix verticalis*	YES	YES
50	House Sparrow	*Passer domesticus*	YES	YES
51	Jackal Buzzard	*Buteo rufofuscus*	NO	YES
52	Karoo Chat	*Emarginata schlegelii*	YES	YES
53	Karoo Eremomela	*Eremomela gregalis*	YES	YES
54	Karoo Korhaan	*Eupodotis vigorsii*	YES	YES
55	Karoo Long-billed Lark	*Certhilauda subcoronata*	YES	YES
56	Karoo Prinia	*Prinia maculosa*	YES	NO
57	Karoo Scrub Robin	*Cercotrichas coryphoeus*	YES	YES
58	Karoo Thrush	*Turdus smithi*	YES	NO
59	Kittlitz's Plover	*Charadrius pecuarius*	YES	NO
60	Lanner Falcon	*Falco biarmicus*	YES	YES
61	Large-billed Lark	*Galerida magnirostris*	YES	YES
62	Lark-like Bunting	*Emberiza impetuani*	YES	YES
63	Laughing Dove	*Spilopelia senegalensis*	YES	YES
64	Layard's Warbler	*Curruca layardi*	YES	YES
65	Little Grebe	*Tachybaptus ruficollis*	YES	NO
66	Little Swift	*Apus affinis*	YES	YES
67	Long-billed Crombec	*Sylvietta rufescens*	YES	NO
68	Ludwig's Bustard	*Neotis ludwigii*	YES	YES
69	Martial Eagle	*Polemaetus bellicosus*	YES	YES
70	Mountain Wheatear	*Myrmecocichla monticola*	YES	YES

	Common Name	Scientific Name	SABAP2	Observed
71	Namaqua Dove	*Oena capensis*	YES	YES
72	Namaqua Sandgrouse	*Pterocles namaqua*	YES	YES
73	Northern Black Korhaan	*Afrotis afraoides*	YES	YES
74	Pale Chanting Goshawk	*Melierax canorus*	YES	YES
75	Pale-winged Starling	*Onychognathus nabouroup*	YES	YES
76	Peregrine Falcon	*Falco peregrinus*	NO	YES
77	Pied Avocet	*Recurvirostra avosetta*	YES	YES
78	Pied Crow	*Corvus albus*	YES	YES
79	Pririt Batis	*Batis pririt*	YES	NO
80	Pygmy Falcon	*Polihierax semitorquatus*	YES	YES
81	Red Lark	*Calendulauda burra*	YES	YES
82	Red-billed Quelea	*Quelea quelea*	YES	YES
83	Red-billed Teal	*Anas erythrorhyncha*	NO	YES
84	Red-capped Lark	*Calandrella cinerea*	YES	YES
85	Red-faced Mousebird	*Urocolius indicus*	YES	NO
86	Red-headed Finch	*Amadina erythrocephala*	YES	NO
87	Rock Kestrel	*Falco rupicolus*	YES	NO
88	Rock Martin	*Ptyonoprogne fuligula*	YES	YES
89	Rufous-eared Warbler	*Malcorus pectoralis*	YES	YES
90	Sabota Lark	*Calendulauda sabota*	YES	YES
91	Scaly-feathered Weaver	*Sporopipes squamifrons*	YES	YES
92	Sclater's Lark	*Spizocorys sclateri*	YES	NO
93	Short-toed Rock Thrush	*Monticola brevipes*	NO	YES
94	Sickle-winged Chat	*Emarginata sinuata*	YES	YES
95	Sociable Weaver	*Philetairus socius*	YES	YES
96	South African Shelduck	*Tadorna cana*	YES	YES
97	Southern Fiscal	*Lanius collaris*	YES	YES
98	Southern Grey-headed Sparrow	*Passer diffusus*	YES	NO
99	Southern Masked Weaver	*Ploceus velatus*	YES	NO
100	Speckled Pigeon	*Columba guinea*	YES	YES
101	Spike-heeled Lark	*Chersomanes albofasciata*	YES	YES
102	Spotted Eagle-Owl	*Bubo africanus*	YES	YES
103	Spotted Thick-knee	*Burhinus capensis*	YES	YES
104	Stark's Lark	*Spizocorys starki*	YES	YES
105	Three-banded Plover	*Charadrius tricollaris*	YES	YES
106	Tractrac Chat	*Emarginata tractrac*	YES	YES
107	Verreaux's Eagle	*Aquila verreauxii*	YES	NO
108	Wattled Starling	*Creatophora cinerea*	NO	YES
109	Western Bar Owl	*Tyto alba*	NO	YES
110	White-backed Mousebird	*Colius colius*	YES	NO

	Common Name	Scientific Name	SABAP2	Observed
111	White-backed Vulture	*Gyps africanus*	YES	NO
112	White-browed Sparrow-Weaver	*Plocepasser mahali*	YES	NO
113	White-rumped Swift	*Apus caffer*	YES	YES
114	White-throated Canary	*Crithagra albogularis*	YES	NO
115	Yellow Canary	*Crithagra flaviventris*	YES	YES
116	Yellow-bellied Eremomela	*Eremomela icteropygialis*	YES	YES
Total				**83**

10.2 APPENDIX 2: NON-PRIORITY SPECIES CONTACT DATA PER SEASON (WALKED TRANSECT)

		Seasons				
Common Name	**Scientific Name**	**Autumn**	**Winter**	**Spring**	**Summer**	**Total**
Acacia Pied Barbet	*Tricholaema leucomelas*	7	6	7	6	26
African Hoopoe	*Upupa africana*			1		1
African Palm Swift	*Cypsiurus parvus*			1		1
African Pipit	*Anthus cinnamomeus*	15	5			20
African Red-eyed Bulbul	*Pycnonotus nigricans*	2	1			3
Ant-eating Chat	*Myrmecocichla formicivora*	12	16	2	1	31
Black-chested Prinia	*Prinia flavicans*	18	20		2	40
Black-eared Sparrow-Lark	*Eremopterix australis*	80	134	1	1	216
Blacksmith Lapwing	*Vanellus armatus*	1			1	2
Black-throated Canary	*Crithagra atrogularis*	1				1
Black-winged Stilt	*Himantopus himantopus*	2	6		4	12
Bokmakierie	*Telophorus zeylonus*	2	3		3	8
Booted Eagle	*Hieraaetus pennatus*		1		1	2
Cape Penduline Tit	*Anthoscopus minutus*	5	9	8	5	27
Cape Sparrow	*Passer melanurus*	15	24	16	12	67
Cape Teal	*Anas capensis*	5				5
Cape Turtle Dove	*Streptopelia capicola*				4	4
Capped Wheatear	*Oenanthe pileata*	4				4
Chat Flycatcher	*Melaenornis infuscatus*	13	24	20	11	68
Common Quail	*Coturnix coturnix*	8	16			24
Common Swift	*Apus apus*				1648	1648
Desert Cisticola	*Cisticola aridulus*	4	15			19
Dusky Sunbird	*Cinnyris fuscus*	31	19	1	8	59
Eastern Clapper Lark	*Mirafra fasciolata*		3		3	6
Egyptian Goose	*Alopochen aegyptiaca*	1			4	5
Fairy Flycatcher	*Stenostira scita*	2				2
Familiar Chat	*Oenanthe familiaris*			1		1
Grey-backed Cisticola	*Cisticola subruficapilla*	7	1	3		11
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	583	423	2	152	1160
House Sparrow	*Passer domesticus*		4			4
Karoo Chat	*Emarginata schlegelii*	9	6	13	13	41
Karoo Eremomela	*Eremomela gregalis*		4			4
Karoo Long-billed Lark	*Certhilauda subcoronata*	10	17	10	23	60
Karoo Scrub Robin	*Cercotrichas coryphoeus*	1				1
Large-billed Lark	*Galerida magnirostris*	1			7	8
Lark-like Bunting	*Emberiza impetuani*	299	307	46	125	777
Laughing Dove	*Spilopelia senegalensis*		2			2
Layard's Tit-Babbler	*Curruca layardi*	12				12
Layard's Warbler	*Curruca layardi*		1			1
Little Swift	*Apus affinis*				7	7

Mountain Wheatear	*Myrmecocichla monticola*	4	5	6	2	17
Namaqua Dove	*Oena capensis*	13	13	1	24	51
Namaqua Sandgrouse	*Pterocles namaqua*	549	650	105	105	1409
Pale-winged Starling	*Onychognathus nabouroup*	5			3	8
Pied Avocet	*Recurvirostra avosetta*		4			4
Pied Crow	*Corvus albus*	14	27	33	20	94
Pygmy Falcon	*Polihierax semitorquatus*	1				1
Red-billed Quelea	*Quelea quelea*	2			5	7
Red-billed Teal	*Anas erythrorhyncha*	2	1			3
Red-capped Lark	*Calandrella cinerea*				1	1
Rock Martin	*Ptyonoprogne fuligula*	1	1	1		3
Rufous-cheeked Nightjar	*Caprimulgus rufigena*				1	1
Rufous-eared Warbler	*Malcorus pectoralis*	26	28	12	19	85
Sabota Lark	*Calendulauda sabota*	13	14	2	7	36
Scaly-feathered Finch	*Sporopipes squamifrons*	2			2	4
Scaly-feathered Weaver	*Sporopipes squamifrons*		13			13
Short-toed Rock Thrush	*Monticola brevipes*	1				1
Sickle-winged Chat	*Emarginata sinuata*	5				5
Sociable Weaver	*Philetairus socius*		63	170	29	262
South African Shelduck	*Tadorna cana*	3	3			6
Southern Fiscal	*Lanius collaris*	5	1		2	8
Speckled Pigeon	*Columba guinea*	8	3	36		47
Spike-heeled Lark	*Chersomanes albofasciata*	57	79	106	49	291
Spotted Thick-knee	*Burhinus capensis*				1	1
Stark's Lark	*Spizocorys starki*	22	28	1	60	111
Three-banded Plover	*Charadrius tricollaris*				1	1
Tractrac Chat	*Emarginata tractrac*	8	5	14	4	31
Wattled Starling	*Creatophora cinerea*	2	29			31
Western Barn Owl	*Tyto alba*	1				1
White-rumped Swift	*Apus caffer*				50	50
Yellow Canary	*Crithagra flaviventris*	2		14	5	21
Yellow-bellied Eremomela	*Eremomela icteropygialis*	4	7	2	3	16
Total	72	1900	2041	635	2434	7010

10.3 APPENDIX 3: NON-PRIORITY SPECIES CONTACT DATA PER SEASON (VANTAGE POINT)

		Vantage Points							
Common Name	**Scientific Name**	**VP1**	**VP2**	**VP3**	**VP4**	**VP5**	**VP6**	**CVP**	**Total**
Acacia Pied Barbet	*Tricholaema leucomelas*	1	11	1	6	1	1	2	23
African Hoopoe	*Upupa africana*		1						1
African Palm Swift	*Cypsiurus parvus*						1		1
African Pipit	*Anthus cinnamomeus*	3		3	1			3	10
Ant-eating Chat	*Myrmecocichla formicivora*	4	2	2	9		1	3	21
Black-chested Prinia	*Prinia flavicans*	6	10		5		6	3	30
Black-eared Sparrow-Lark	*Eremopterix australis*	9				11	2	96	118
Black-throated Canary	*Crithagra atrogularis*		1						1
Bokmakierie	*Telophorus zeylonus*		1	1	2	2	1		7
Booted Eagle	*Hieraaetus pennatus*		1						1
Cape Penduline Tit	*Anthoscopus minutus*	2	1		21		1	2	27
Cape Sparrow	*Passer melanurus*	11	5	2	21	2	1	6	48
Cape Turtle Dove	*Streptopelia capicola*		3						3
Capped Wheatear	*Oenanthe pileata*			3					3
Chat Flycatcher	*Melaenornis infuscatus*	9	2		24		4	6	45
Common Quail	*Coturnix coturnix*	3						5	8
Common Swift	*Apus apus*	1090	118	52	256	16	106	6	1644
Desert Cisticola	*Cisticola aridulus*	1	1		6		3	6	17
Dusky Sunbird	*Cinnyris fuscus*	3	15	9	12	4	4	1	48
Eastern Clapper Lark	*Mirafra fasciolata*				5			1	6
Egyptian Goose	*Alopochen aegyptiaca*							2	2
Fairy Flycatcher	*Stenostira scita*		1						1
Grey-backed Cisticola	*Cisticola subruficapilla*		6						6
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	168	2	125	218	57	19	324	913
House Sparrow	*Passer domesticus*				4				4
Karoo Chat	*Emarginata schlegelii*	1	9	2	1	2	5		20
Karoo Eremomela	*Eremomela gregalis*				2				2
Karoo Long-billed Lark	*Certhilauda subcoronata*	3	15	10		5	15	4	52
Karoo Scrub Robin	*Cercotrichas coryphoeus*		1						1
Large-billed Lark	*Galerida magnirostris*		1	1					2
Lark-like Bunting	*Emberiza impetuani*	39	87	36	68	34	135	118	517
Layard's Tit-Babbler	*Curruca layardi*		3	2	4		1		10
Layard's Warbler	*Curruca layardi*						1		1
Mountain Wheatear	*Myrmecocichla monticola*	3	1				2	6	12
Namaqua Dove	*Oena capensis*	3	6	6	2	6	1	4	28
Namaqua Sandgrouse	*Pterocles namaqua*	326	27	178	153	69	135	450	1338
Pale-winged Starling	*Onychognathus nabouroup*			5					5
Pied Crow	*Corvus albus*	8	16	7	17	13	16	9	86
Red-billed Quelea	*Quelea quelea*		2		5				7
Red-capped Lark	*Calandrella cinerea*				1				1
Rock Martin	*Ptyonoprogne fuligula*				1	1	1		3
Rufous-eared Warbler	*Malcorus pectoralis*	19	10	1	12		10	10	62

Sabota Lark	*Calendulauda sabota*	3	8	2	5	3		1	22
Scaly-feathered Finch	*Sporopipes squamifrons*			2					2
Scaly-feathered Weaver	*Sporopipes squamifrons*				9				9
Sickle-winged Chat	*Emarginata sinuata*			3	2				5
Sociable Weaver	*Philetairus socius*	45	1		20			160	226
South African Shelduck	*Tadorna cana*							2	2
Southern Fiscal	*Lanius collaris*		1	3			3		7
Speckled Pigeon	*Columba guinea*	2						37	39
Spike-heeled Lark	*Chersomanes albofasciata*	46	10	35	27	15	29	21	183
Stark's Lark	*Spizocorys starki*	7	2	6	7	8	3	22	55
Tractrac Chat	*Emarginata tractrac*	2	6	8	3	4	3		26
Wattled Starling	*Creatophora cinerea*							24	24
White-rumped Swift	*Apus caffer*					50			50
Yellow Canary	*Crithagra flaviventris*	2	1	4		4	4		15
Yellow-bellied Eremomela	*Eremomela icteropygialis*	3	4		2		1	2	12
Total	57	1822	392	509	931	307	515	1336	5812

10.4 APPENDIX 4: SACNASP QUALIFICATION

SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Samuel David Laurence

Registration Number: 400450/13

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Ecological Science (Professional Natural Scientist)
Zoological Science (Professional Natural Scientist)

Effective **20 November 2013** Expires **31 March 2023**

Chairperson

Chief Executive Officer

To verify this certificate scan this code