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Appendix D:
Preconstruction Avifauna Scoping Assessment

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Avifaunal Specialist Assessment:
Proposed De Rust PV1 and PV2
Solar Energy Facilities (SEFs)
Southwest of Pofadder
Northern Cape Province

November 2022

For

FE De Rust (Pty) Ltd

Enviro-Insight CC

Sam Laurence *(Pr. Sci. Nat.)*

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Professional Team

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

Team member	Qualification	Role on project
Samuel Laurence	*Pr. Sci. Nat.* No. 400450/13	Lead Avifaunal Specialist Field Observer Data analysis Report compilation
AE Van Wyk	*Cand. Sci. Nat.*	Field Observer

Specialist Declaration

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

Sam Laurence *Pr. Sci. Nat.*

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GLOSSARY AND ACRONYMS

AI	Artificial Intelligence
BA	Basic Assessment
BARESG	Bird and Renewable Energy Specialist Group
CITES	Convention on International Trade in Endangered Species
Cumulative impact	Impacts on a species, ecosystem or resource as a result of the sum of actions in the past, present and foreseeable future, from multiple SEFs or a SEFs 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
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 solar energy facility
Solar Energy related Priority species	Threatened or rare birds (in particular those unique to the region and especially those which are possibly susceptible to solar-energy impacts as defined by Ralston Paton *et al*. 2016), 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
SEFs	Solar energy facility. A power plant that uses solar to generate electricity, also colloquially known as a solar farm
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

1 INTRODUCTION AND PROJECT BACKGROUND

Enviro-Insight CC was commissioned by EnergyTeam (Pty) Ltd to conduct a pre-construction avifaunal survey for a proposed solar energy facility (SEF) and associated infrastructure which will be known as the De Rust PV 1 and PV 2 with the project description shown as Table 1-1.

Table 1-1: Project Description for the De Rust Solar PV 1 and PV 2

Component	Description / Dimensions
Project Name	De Rust Solar PV 1 and PV 2
Province	Northern Cape
Farm portion	Portion 1 of the Farm Samoep 147
Extent (ha)	PV1: 449 hectares PV2: 461 hectares
21-digit Surveyor General code	C03600000000014700001
Contracted capacity of the facility (MW)	240 MW (Maximum)
Cabling	Underground up to 1m deep
Capacity of onsite substation	33/132kV (100mX100M)
Grid connection	Korana Substation
Width of internal roads	up to 8 m
Proximity to grid connection	+-10km approximately
Laydown areas	Construction period laydown footprint (temporary): ± 6 ha Temporary hardstand area (boom erection, storage and assembly area): ± 12 ha O&M Area: 1.1ha

Additional infrastructure includes a network of roads between panel infrastructure footprints. 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 SEF.

1.1 SCOPE OF WORK

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

1.2 STUDY AREA

The proposed De Rust SEFs (boundary in **Error! Reference source not found.**) 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 **Error! Reference source not found.**). 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 proposed preferred layout is shown as **Error! Reference source not found.**.

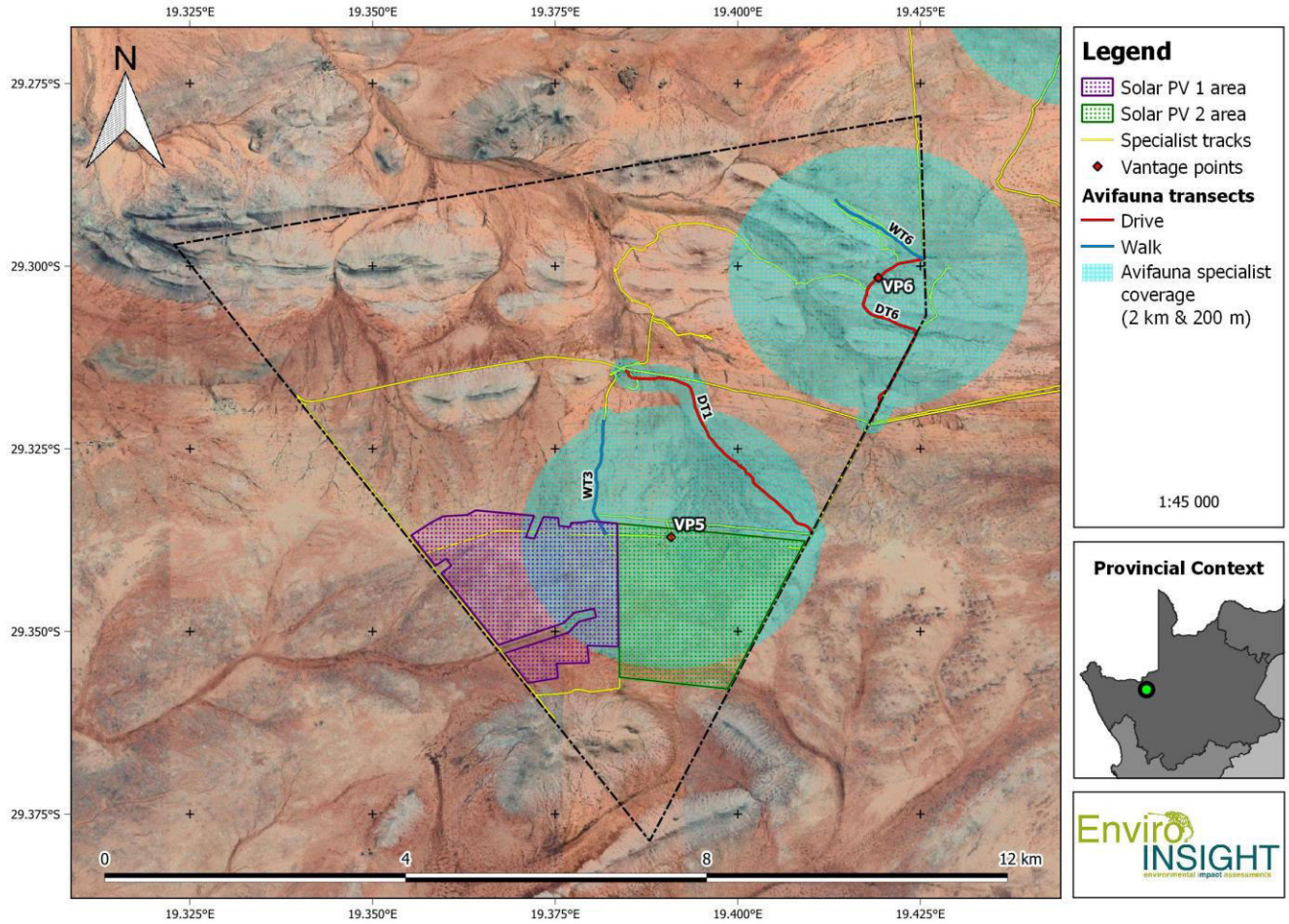

Figure 1-1: Locality map of the proposed Solar Energy Facilities (SEF).

1.3 STUDY LIMITATIONS

- It is assumed that all third-party information acquired is correct (e.g., GIS data, existing facility mortality data and the prescribed scope of work);
- There is still limited information available on the environmental effects of solar energy facilities in South Africa.
- While sampling effort was conducted as recommended in the guidelines, to achieve statistically powerful results it would need to be increased beyond practical possibilities. The data was therefore interpreted using a precautionary approach.
- Vantage point surveys are only conducted during daylight. Therefore, any bird movement occurring at night was recorded under *ad hoc* conditions. Some waterbirds and night migrants are known to make regular flights and migration movements at night.

2 LEGISLATIVE FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL SCREENING TOOL AND ENVIRONMENTAL THEME PROTOCOLS

2.1.1 Screening Report

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

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

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 solar energy developments.

Based on the screening report generated on 03/02/2021, (**Error! Reference source not found.**), 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*

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

- High Aves-*Neotis ludwigii*
- High Aves-*Falco biarmicus*
- High Aves-*Aquila verreauxii*
- Medium Aves-*Neotis ludwigii*
- Medium Aves-*Sagittarius serpentarius*
- Medium Aves-*Aquila verreauxii*

Due to the coarse scale of the tool and the presence of other Species of Conservation Concern (SCC), the overall theme is to be treated as High Sensitivity.

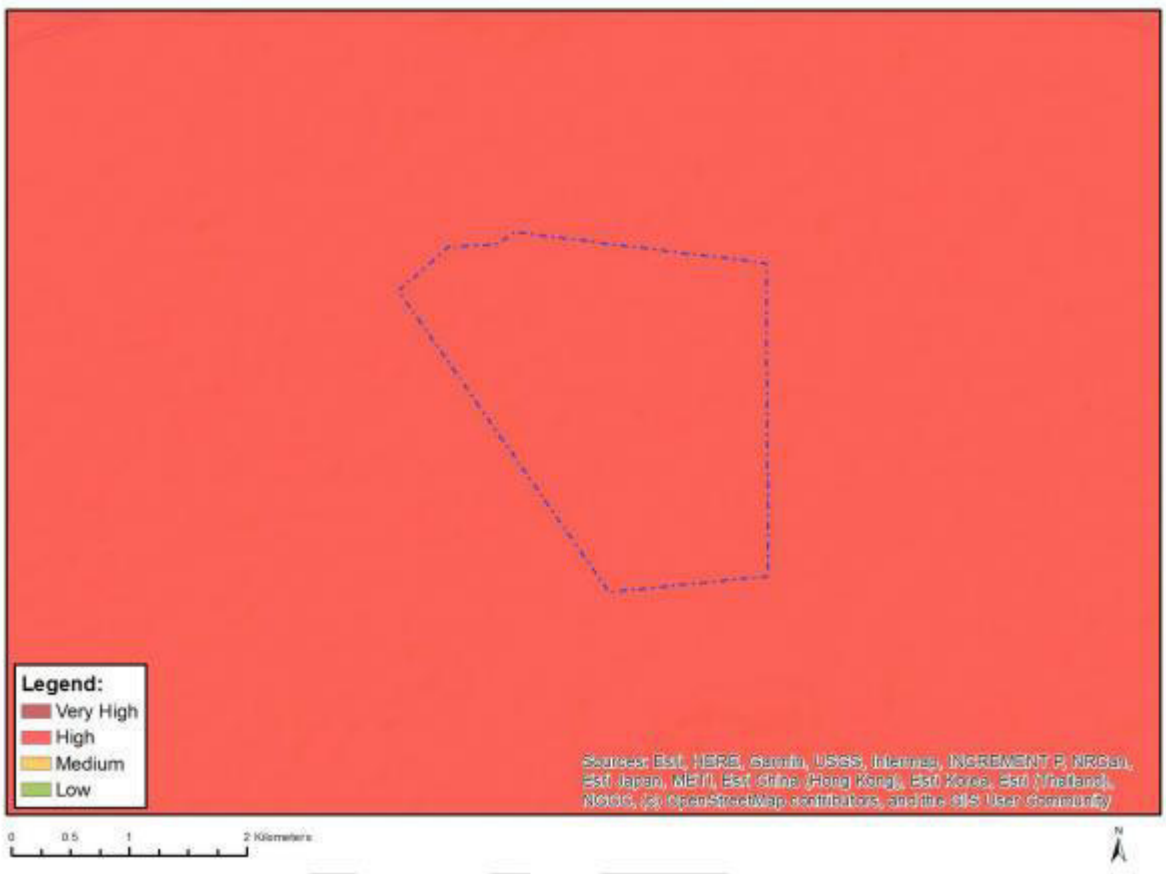

Figure 2-1: Environmental Screening Tool animal sensitivity theme map the proposed PV 1 De Rust SEF.

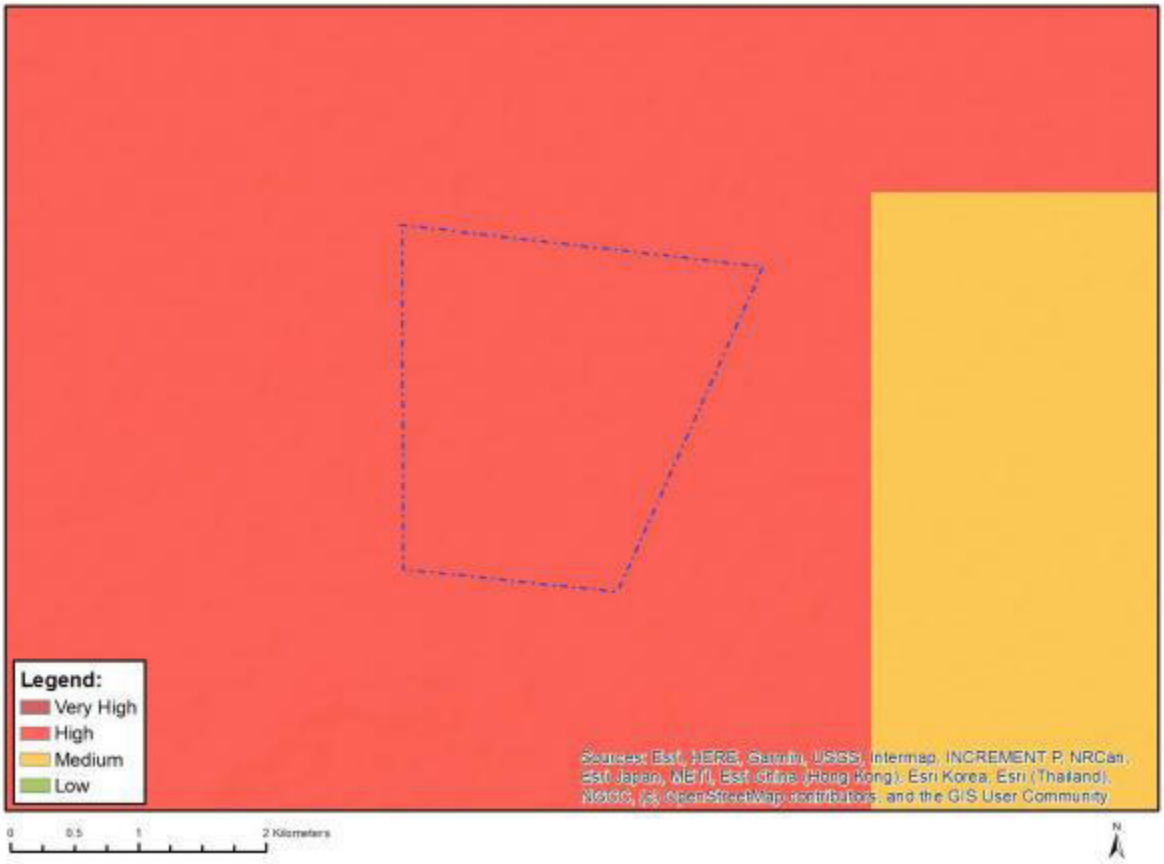

Figure 2-2: Environmental Screening Tool animal sensitivity theme map the proposed PV 2 De Rust SEF.

2.2 RENEWABLE ENERGY DEVELOPMENT ZONE

On 17 February 2016, Cabinet approved the Renewable Energy Development Zones (REDZs) for large scale solar 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. As previously stated, the project is not located within Renewable Energy Development Zones (REDZ) and accordingly, a full EIA process will be followed. Best Practice for both Birds and Solar Energy and Birds Guidelines were followed for the study.

2.3 BIRDS AND SOLAR ENERGY BEST-PRACTICE GUIDELINES (2017)

The "*Best-Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa*" (Jenkins *et al*., 2017) are followed in order to fulfil the outlined requirements.

As per Appendix 2 - *Minimum requirements for avifaunal impact assessment*, an avifaunal impact assessment for a SEF should follow a two-tier process (of which this report services the Tier 2 component):

Tier 1

1. **Scoping report**- process to identify issues that are likely to be important in the impact assessment process and to define the scope of work required in the assessment (e.g. timing, spatial extent and data collection methodologies). Largely based on desktop analysis of available data, but preferably also informed by a brief site visit.
2. **Preliminary assessment** – This is part of the planning for the EIA application, giving an overview on the biological context, likely impacts and potential red flags to the development, identifying alternatives and determining the appropriate assessment regime.

Tier 2

3. **In-depth Study** – Could including 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 SEFs 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 SEFs using data from the second South African Bird

[2] http://qgis.osgeo.org/en/site/

Atlas Project (SABAP 2[3]; [SABAP2, 2020]). SABAP 2 records were developed based on records per pentad (i.e., 5' X 5'). A list of species potentially occurring was developed from SABAP 2 data for the pentads within which the study area falls (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, (considered sensitive based on their abundance, flight characteristics, ecological role, population trend and conservation status.

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 was sourced from the Southern Africa Bird Atlas Project (SABAP 2, 2021), del Hoyo *et al.* (1992) and Sinclair & Ryan (2010);
- iNaturalist and Virtual Museum (ADU) was used to source the distribution bird data in the area; and
- Nomenclature and taxonomy followed the IOC World Bird Names unless otherwise specified (see www.worldbirdnames.org; Gill & Donsker, 2012).

[3] http://sabap2.birdmap.africa/

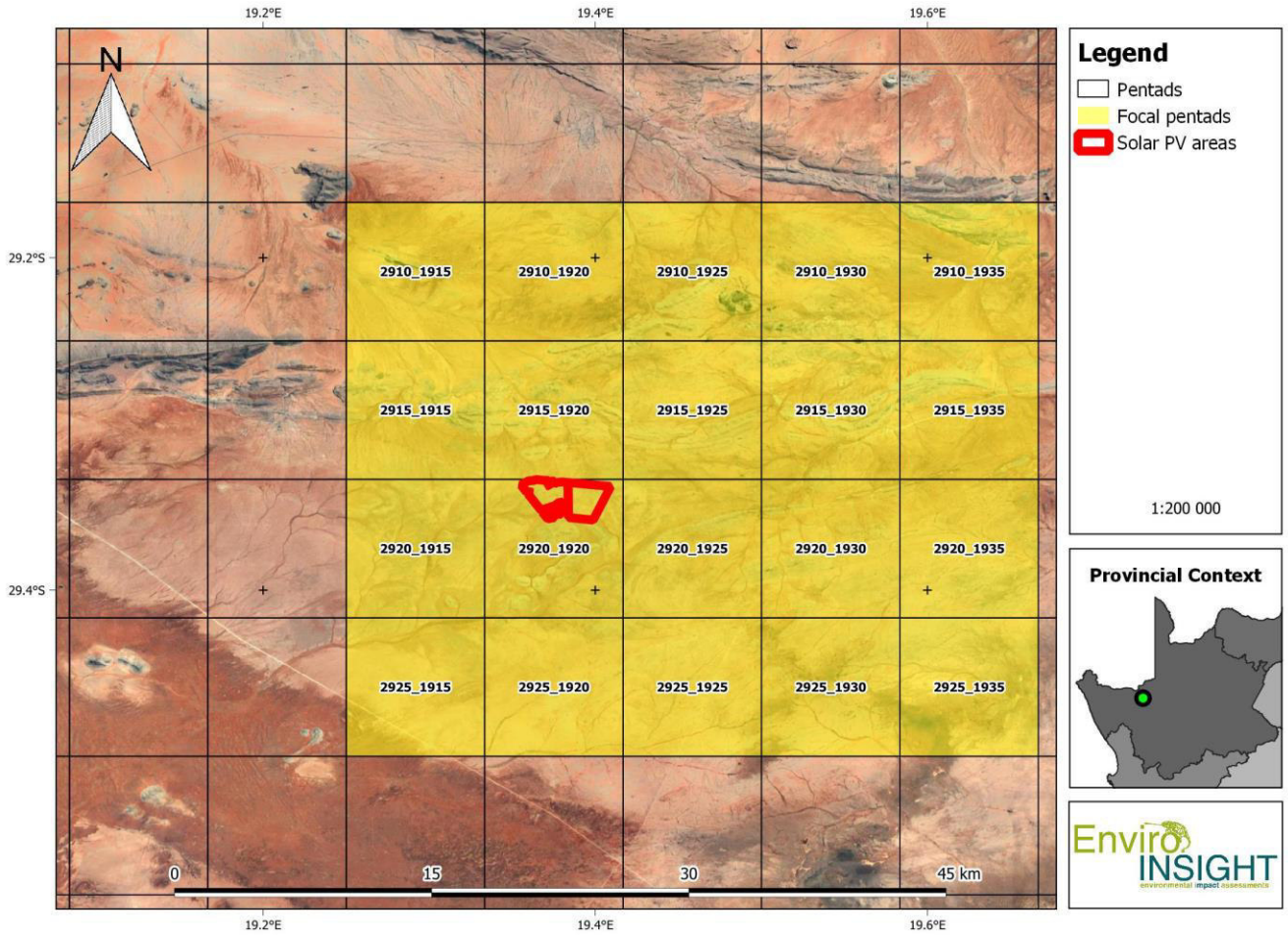

Figure 3-1). The expected species list (Appendix 1) is therefore based on an area larger than the actual study area and was therefore subsequently refined. This approach was adopted to ensure that all species potentially occurring within the study area, whether resident, nomadic, or migratory, are identified. From the generated expected species list, the sensitivity of avifauna species towards the potential impacts from the Project was evaluated using the Ralston-Paton *et al*. (2017) guidelines. Other species not listed in the referred document were also considered sensitive based on their abundance, flight characteristics, ecological role, population trend and conservation status.

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);
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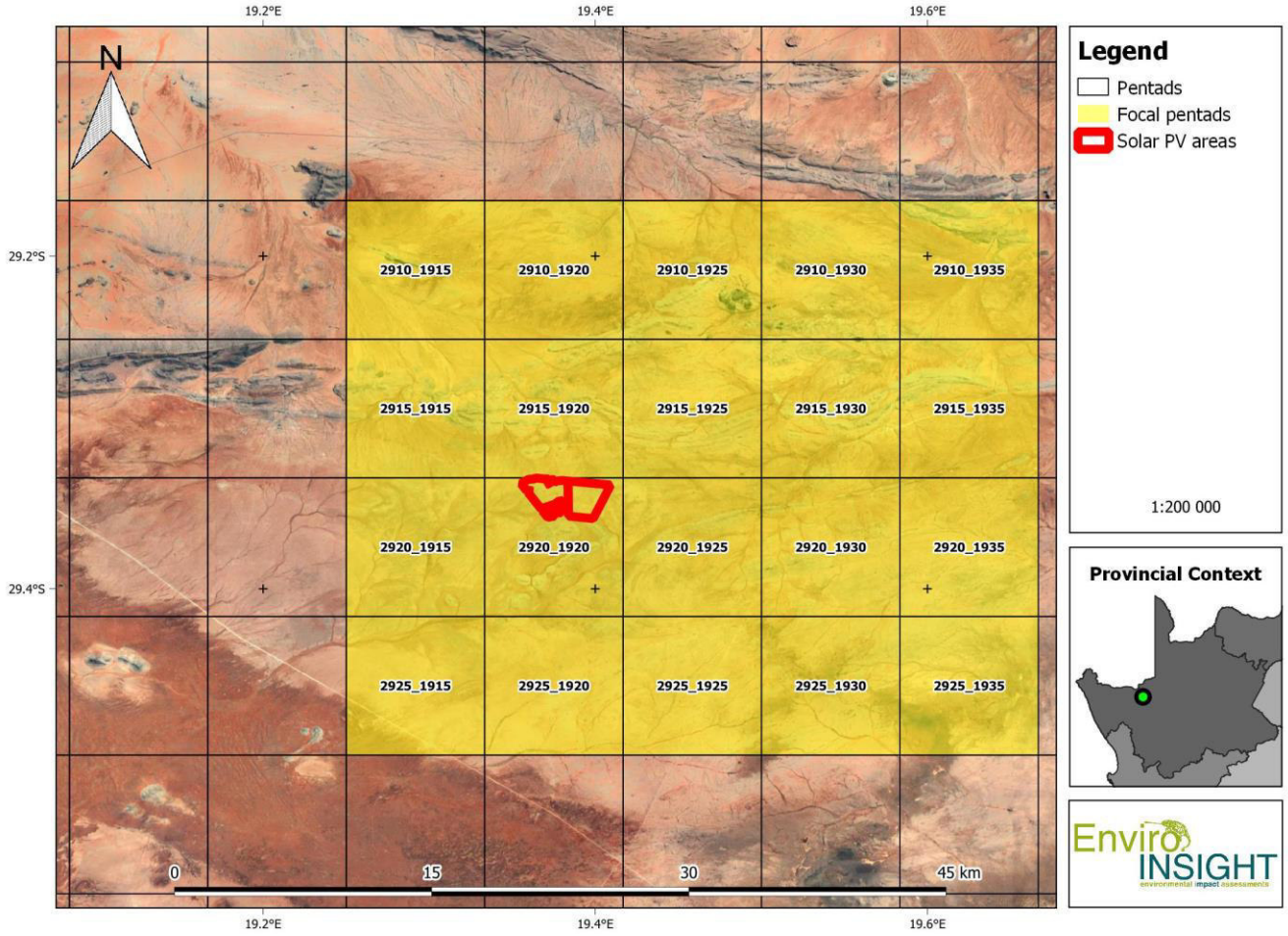

Figure 3-1: The De Rust SEFs in relation to the SABAP2 pentads.

3.3 PRECONSTRUCTION BIRD MONITORING SURVEY DESIGN

They proposed study area is classified as a Regime 2 based on the size of the study area (>150 ha), high avifaunal sensitivity and type of technology that will be used for the proposed project. The avifaunal sensitivity was determined based on the number of priority species occurring, or potentially present, within or around the study area, the regional or globally threat status of these species, avifaunal habitat found in the area, population of priority species, bird movement corridor and proximity to Important Bird and Critical Biodiversity Areas. The duration, in terms of data collection, for this study was 6 months consisting of 3 visits of 3-5 days each, covering both the peak wet and dry seasons of the year. This complies with the requirements of the Best

Practice Guidelines available at the time (Jenkins *et al*., 2017). The surveys conducted per season/ dates are summarised as Table 3-1 below. It is important to understand that although the methods do not require VPs (as per WEFs), the SEFs benefitted from concurrent data collection from the associated WEF development as shown in the combined development footprint map shown as Figure 3-3.

Table 3-1: Avifauna monitoring sampling period for De Rust SEFs and Control Site.

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

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

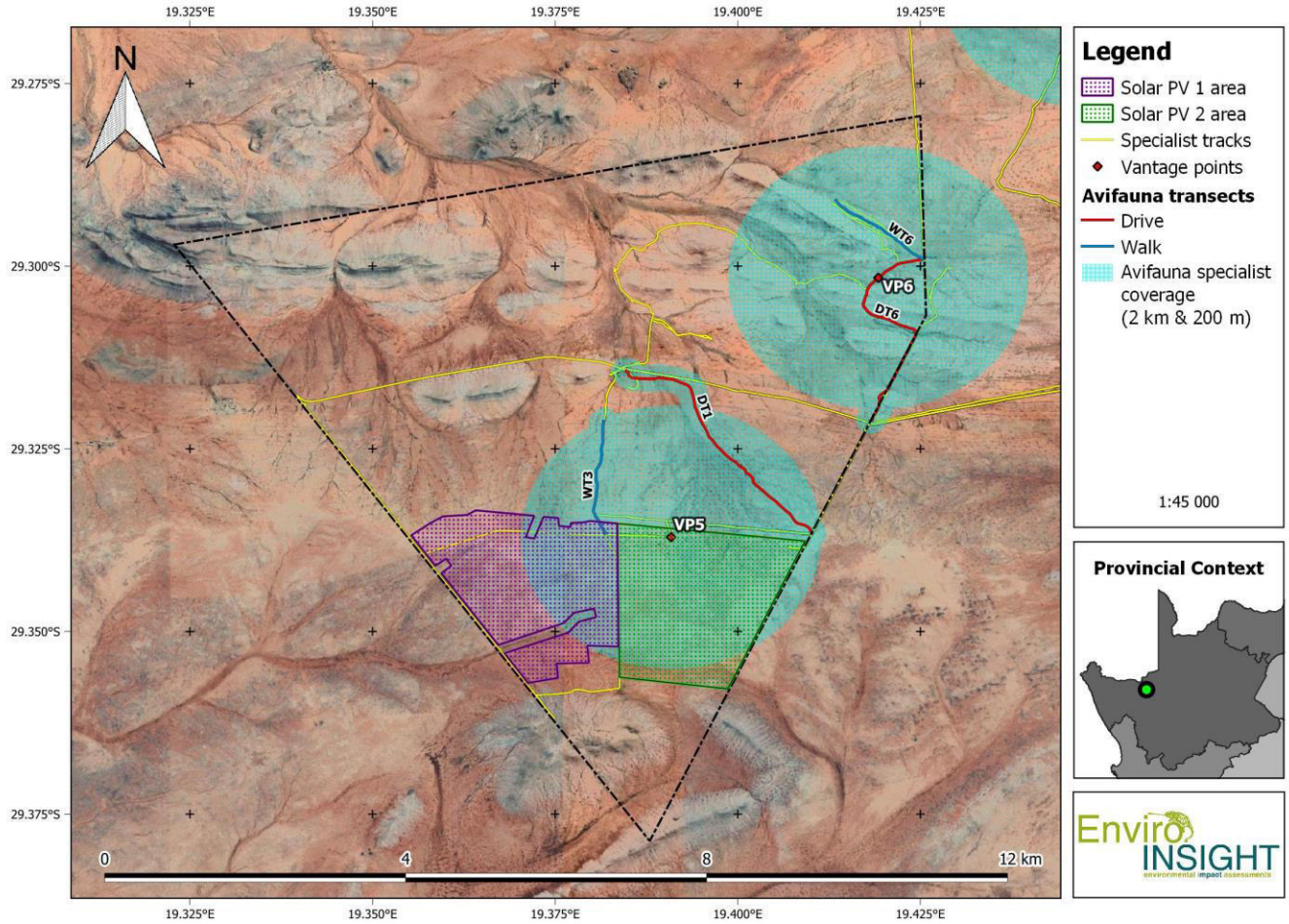

Figure 3-2: Avifauna survey sites and specialist coverage (GPS tracks) for the proposed De Rust SEFs.

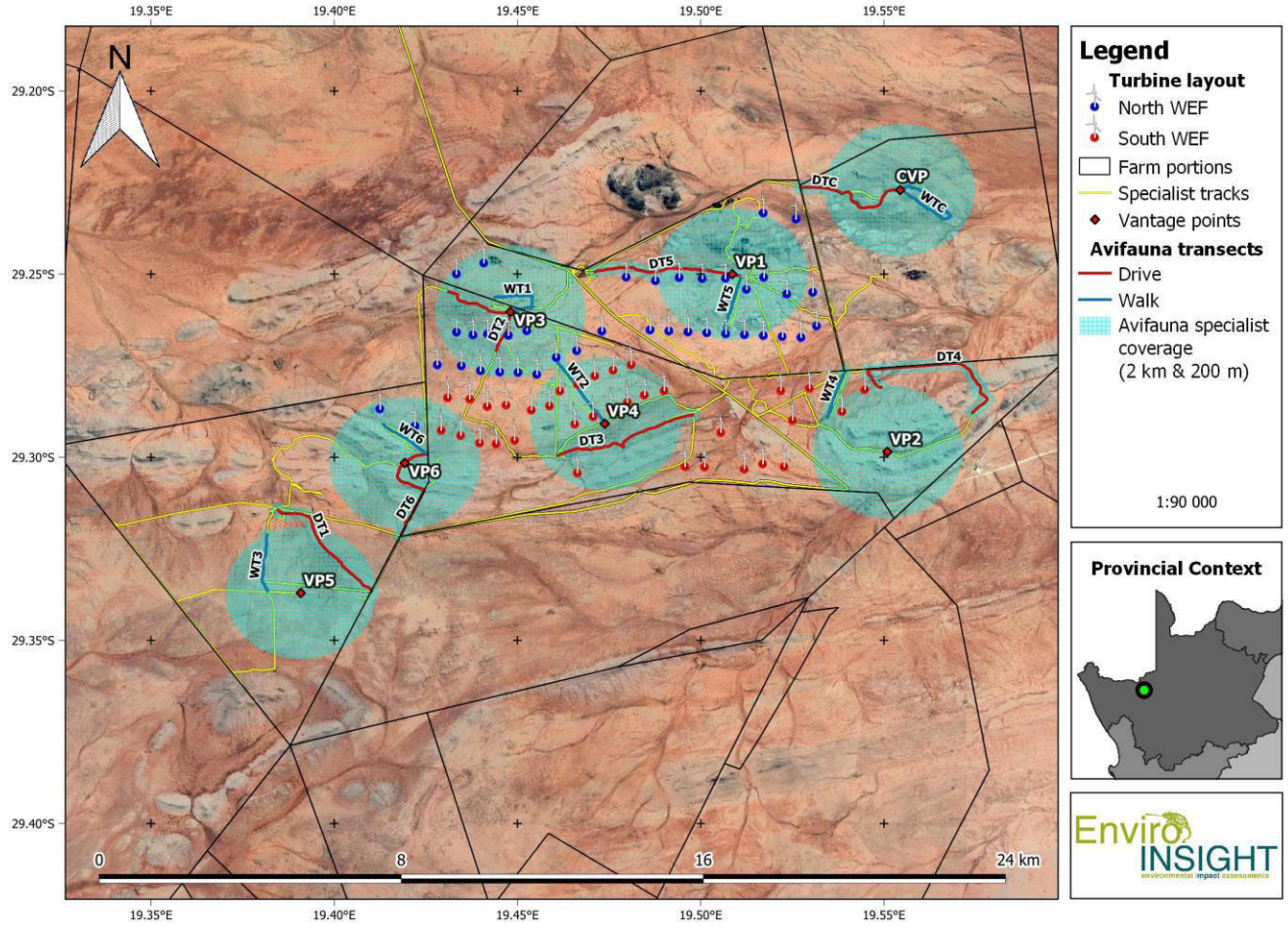

Figure 3-3: Avifauna survey sites and specialist coverage (GPS tracks) for the proposed De Rust WEF and SEF.

3.3.1 Vantage Points

Only 2 vantage points (VPs) from the WEF survey within the project study area were applied to the De Rust SEFs, and one identified at the control area, to record the flight altitude and patterns of priority species (totaling three VPs). These sampling points were located at strategic locations within the Project Footprint and set up to allow the visual coverage of the SEFs and its immediate surroundings. Each location was surveyed for a minimum of 12 hours of observation per season divided through the early morning, midday and late afternoon times of day (Jenkins *et al.* 2015). For more information on each VP, refer to Table 3-2.

Table 3-2: Locations description of the five Vantage Points surveyed

Vantage Point	Location	
	Latitude	Longitude
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 solar panel arrays (see **Error! Reference source not found.**) to maximise the comparative value of the data which will be compared with the surveys from the post-construction phase results.

Three linear transects ranging from 1.5 km to 3.5 km in length (3.31 km total and 6657 inc. the control), two located in the proposed Project footprint and one within the control area, were walked in order to characterize the passerine and small bird communities (Table 3-3). To avoid pseudo-replication, transects were located at a minimum distance of 400 m apart from one another (Sutherland, 2006). Each transect was conducted by one expert bird observers at a time (more than one observer for all transects were used), who recorded all bird contacts (both seen and heard) by walking slowly along the predetermined transect. Observations were made on both the left and right side of the predetermined transect. Birds were only recorded (seen or heard) within a fixed maximum width of between 150 to 200 m on either side if the transect line. The same transects were repeated in every season. Surveys started after sunrise and were performed throughout the day to account for temporal variation in bird activity. As a general rule, transects were not walked in adverse conditions, such as heavy rain, strong winds or thick mist. During the surveys, no adverse conditions were recorded that precluded successful analysis.

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

Name	length (m)
WT3	1789
WT6	1512
WT Control	3356
Total	6.657

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 project area by means of road counts (vehicle-based sampling; best applied for relatively large proposed SEFs, especially those with good networks of roads and tracks).

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

These transects were driven at a constant and slow speed (± 15 km/h), and all sightings of large terrestrial birds and raptors were recorded in terms of the same data-capture protocols used for walked transects (above), and in general compliance with the road-count protocols described for large terrestrial species (Young et al., 2003) and raptors (Malan, 2009). Nine drive transects were identified in the project footprint and one drive transect in the control area with a combined total length of 10. 615 km (Table 3-4). One observer travelling slowly in a vehicle recorded all species on both sides of the drive transect. The observer stopped at regular intervals (every 100 to 300 m) to scan the environment with binoculars.

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

Name	length (m)
DT1	3802
DT6	3497
DT Control	3316
Total	10.615

3.3.4 Wetlands

Prior to the initiation of the preconstruction monitoring campaign, the main water bodies (including wetlands) present within the study area were identified on a Geographical Information System (GIS) by using 1:50 000 topographic maps and aerial photos. Several significant water bodies were identified on and surrounding the study area. These identified and mapped water bodies were surveyed to determine their level of utilisation by water birds. Due to seasonality, the birds were only be surveyed during periods with some prevailing inundation or rainfall. Some drainage lines within the greater PAOI were inundated during the 2021 spring surveys and were observed accordingly.

3.3.5 Specialist Nest Survey

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

3.3.6 Incidental Observations of Priority Species

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

3.4 SPECIES OF CONSERVATION CONCERN

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

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

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

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

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

3.5 IMPACT ASSESSMENT METHODOLOGY FOR FINAL EIA REPORT

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.

Direct, indirect and cumulative impacts associated with the project are assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M) P

S = Significance weighting
E = Extent
D = Duration

M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of Cumulative Impacts

As per DFFE's requirements, specialists are required to assess the cumulative impacts. In this regard, please refer to the methodology below that will need to be used for the assessment of Cumulative Impacts.

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[4].

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

» Unacceptable risk
» Unacceptable loss
» Complete or whole-scale changes to the environment or sense of place
» Unacceptable increase in impact

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

[4] Unless otherwise stated, all definitions are from the 2014 EIA Regulations, GNR 326.

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 in vegetation between the vegetation types was not 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 north east (shown within the Figure 4-2 Topography map). 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[5]), and recent data (2009-2021) indicates that most rainfall occurs from October to March, with a mean annual rainfall of 135 mm[6]. 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[7]).

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

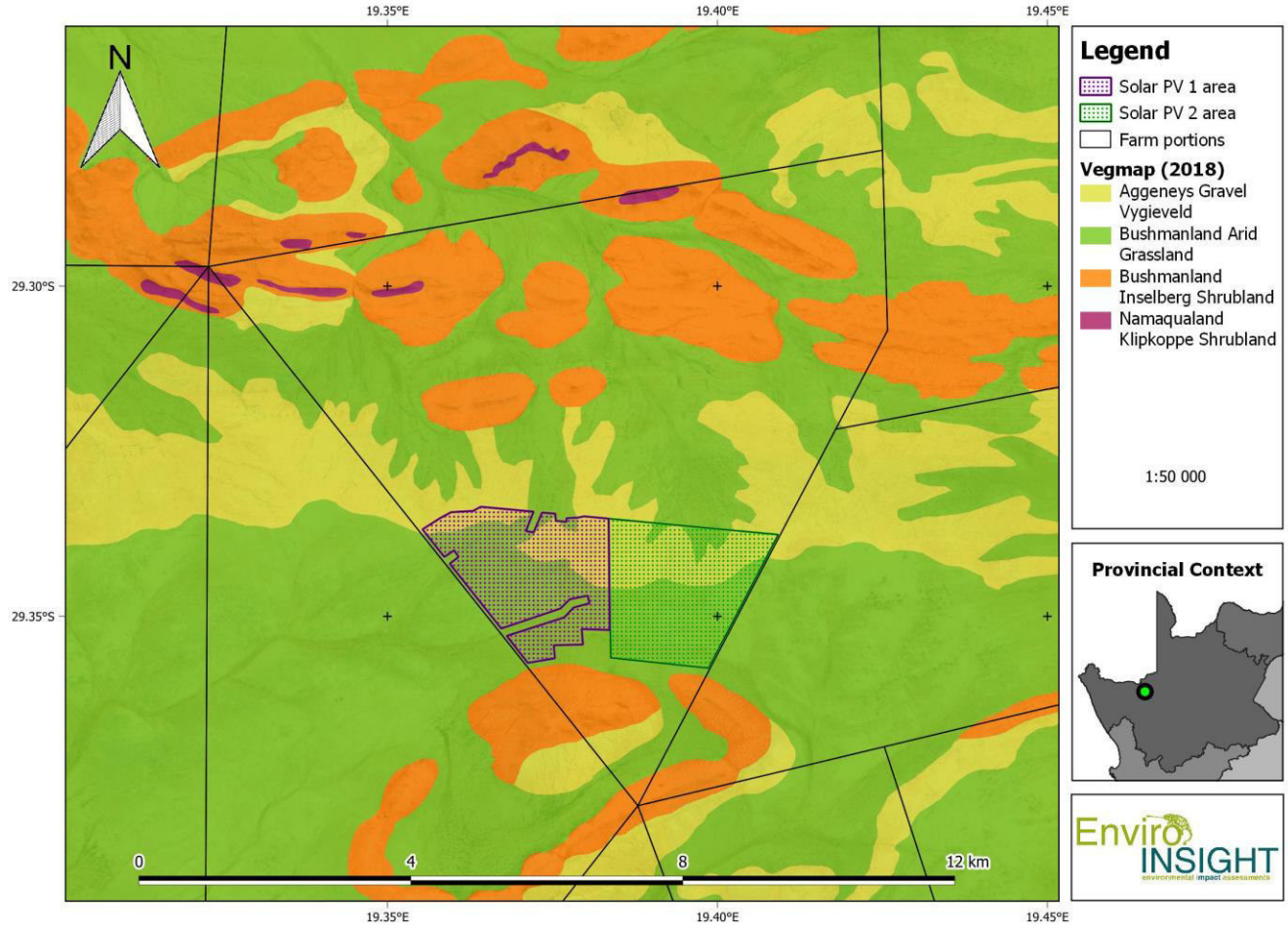

Figure 4-1: Regional vegetation types in relation to De Rust SEFs (SANBI, 2018).

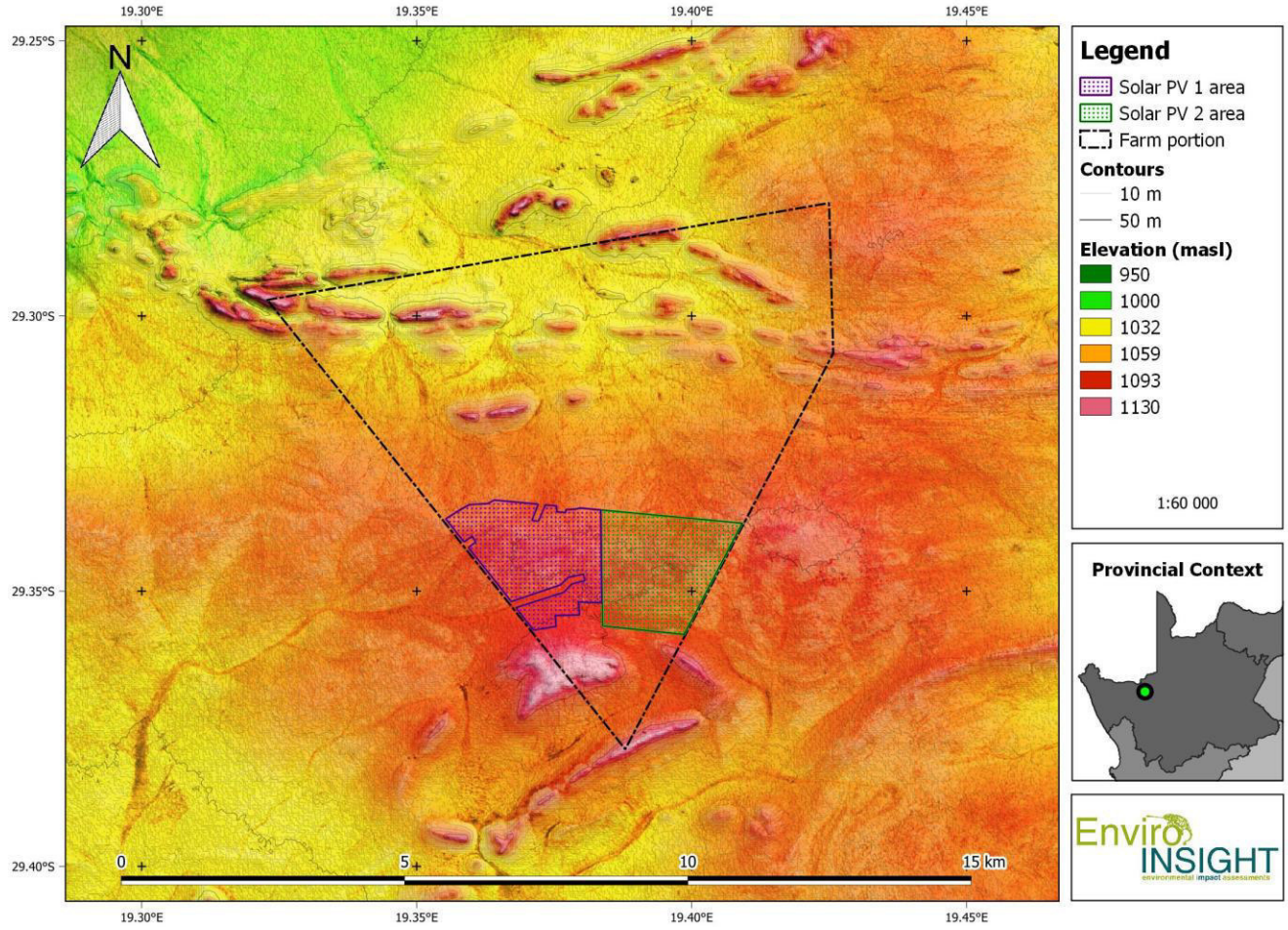

Figure 4-2: Topography in relation to De Rust SEFs (SANBI, 2018).

4.2 PROTECTED AREAS AND IMPORTANT BIRD AREAS

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

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 IBAs in relation to the Project footprint is shown as Figure 4-3.

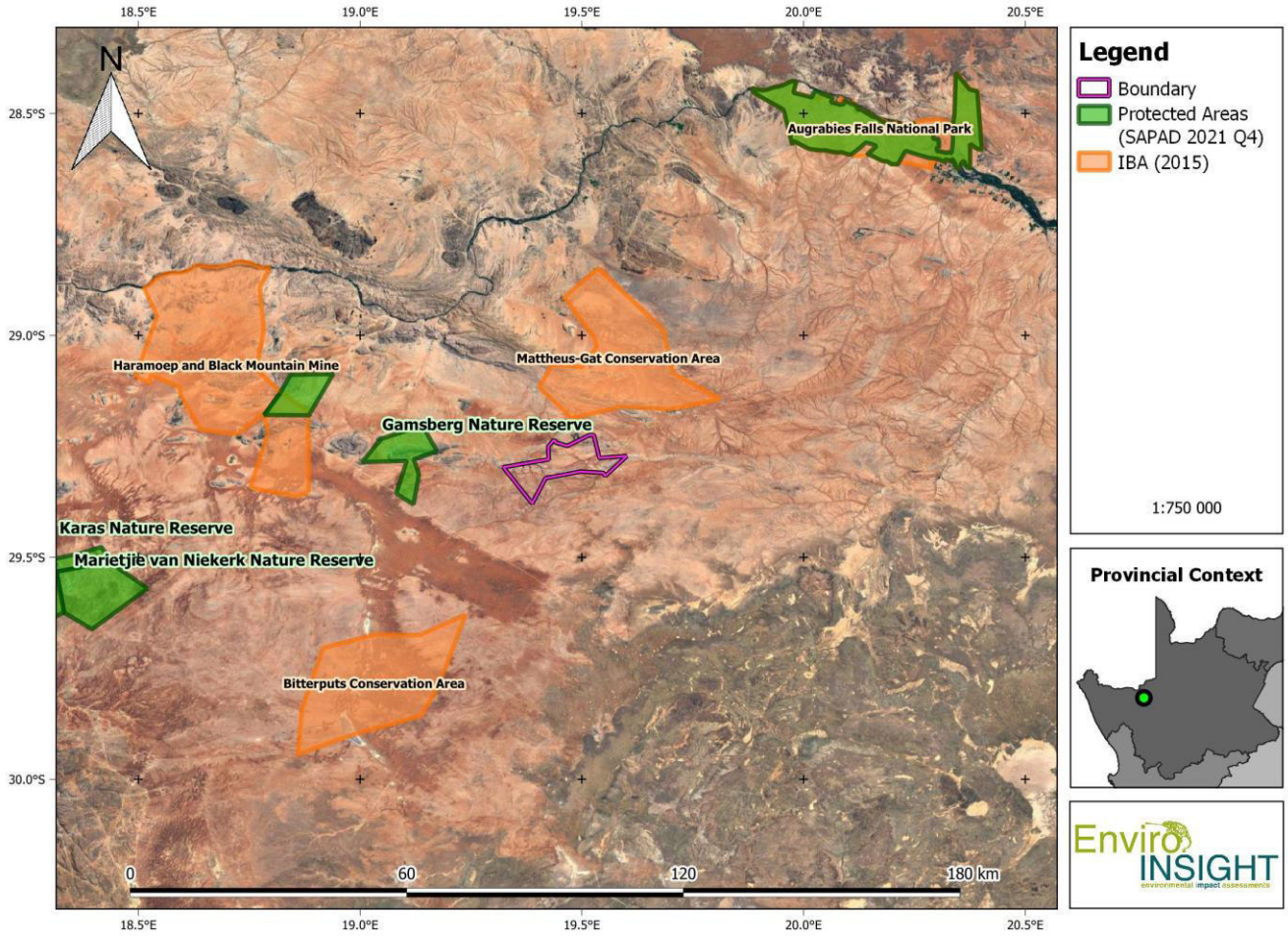

Figure 4-3: De Rust SEFs in relation to the adjacent Protected Areas and IBAs

4.3 CRITICAL BIODIVERSITY AREAS

The following CBA information has been extracted and mapped Verbatim from the Enviro-Insight Terrestrial Biodiversity survey conducted as part of the BA 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 in order 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 a corridor results 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 study area is mainly located in the category "CBA 2 and ESA" (Figure 4-4). The CBA2 is listed due to recorded presence of SCC as well as potential habitat for listed unknown threatened species. The ESA are due to the large expanses of sandy habitat (Red Larks) and other natural non-FEPA Wetlands.

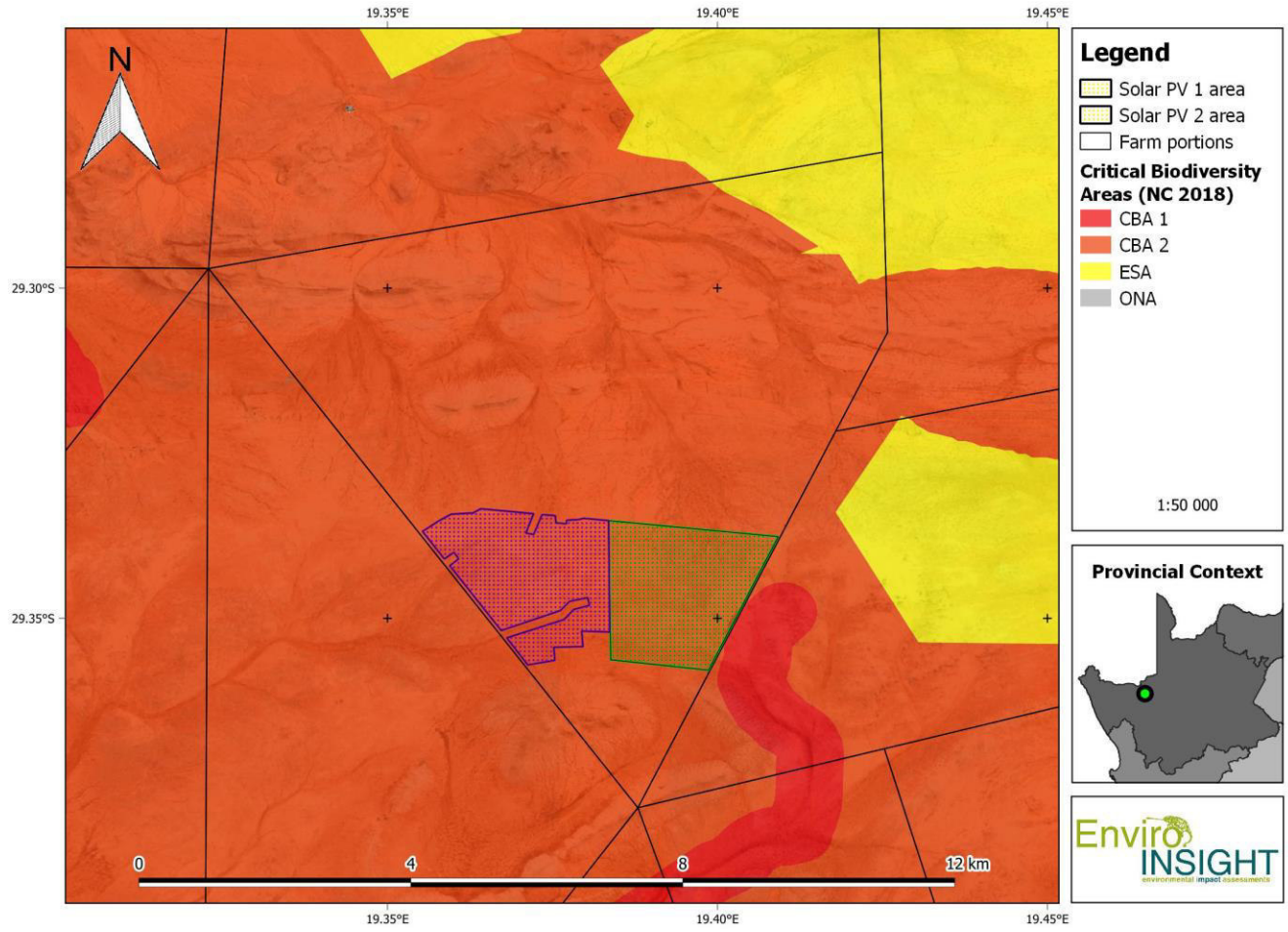

Figure 4-4: De Rust SEFs in relation to the Northern Cape Critical Biodiversity Areas (2016).

4.3.1 Flagship species for the region

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

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

4.4 DESCRIPTION OF MAJOR BIRD HABITATS

The primary avifaunal habitats are described in tabular formats below with accompanying representative photographs. Sensitivity of these habitat types will largely be based upon "Avifaunal value" which relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain certain avifaunal assemblages (with specific reference to SCC), their food supply and breeding habits. It is apparent throughout the PAOI that most of the habitats are ecologically specific in their ability to support general avifaunal species and Red-Listed / SCC with some significant differentiation. However, unique geological (such as red dunes) geographical or topographical features exist which may cause the areas these areas to be buffered from proposed development. Due to the high diversity and density of the above mentioned, Red-Listed species recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the PAOI as a whole is an area of avifaunal importance, and the EIA will be strongly associated with Guidelines at a policy level, prioritising avoidance mitigation and the monitoring of avifaunal SCC.

Despite a regionally (and within the PAOI) high diversity of habitats, only one natural and one artificial habitat type was described for the De Rust PV 1 and PV 2 PA.

4.4.1 Sandy Grassland

Photographs	Nama Grassland
 	**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 higher densities of avifauna. The habitat contains features that provide suitable foraging habitat for Red Lark, Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*). However, the habitat is characterised by a much-reduced dune like topography and a **lower** prevalence of grassed red sand infusions which provides infused supporting highly localized portions of optimal habitat for Red Larks. .

4.4.2 Powerline Infrastructure

Photographs	Shrubland
 	**Classification:** Powerline Infrastructure (adjacent to the Solar PV 1 and PV 2) **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** The large powerline structures 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 proved to be highly sensitive in regard to large raptors, especially Martial Eagle which nest frequently on the powerline infrastructure and who utilise the powerlines to launch hunts.

4.5 OBSERVED AND EXPECTED AVIFAUNA

4.5.1 Total species composition and abundance

The study area supports a relatively high diversity and abundance of avifauna, which is to be expected in an arid area with a high habitat diversity like the Pofadder region. A total of 83 species have been observed, 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 in species diversity;
- 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 as with 2022.

- Powerline infrastructure bisecting the PA (raptor nesting habitat).

It must be noted that stochastic high rainfall events (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 list

Table 4-1represents a summary explanation of the Red-Listed species identified by SABAP 1 and SABAP 2 within the AOI and relates to the detailed discussion provided below. The table illustrates the long-term habitat suitability for the observed and high likelihood Red-Listed species. The remaining taxa are either (1) irregular to rare foraging visitors or (2) unlikely to be present on the study area due to the poor availability (surface cover) of suitable habitat on the study areas. The list of expected and observed priority species in the project area is provided in A total of 19 priority species are expected to occur on and surrounding the study area, of which fourteen (14) have been recorded.

It is clear from Table 4-1 that numerous priority avifauna species occur within the PAOI and can be expected to interact with the proposed development. With all proposed and approved SEFs developments, it is vital to consider the context within which these species are observed in the current study, as congregatory behaviour, nesting behaviour and foraging behaviour may differ from that at the adjacent existing SEFs facility. Indeed, Van Rooyen (2020) suggests that displacement effects of the SEFs are more significant than direct mortality which can greatly affect habitat specific species such as Red Lark and Ludwig's Bustard. Consequently, all applicable data of priority species observed within the monitoring seasons of field surveys allowed for careful evaluation of potential impacts and application of suitable mitigation measures to reduce these impacts where possible. According to the literature, 14 Red-Listed species are known to occur in the region with nine species highly likely and six species confirmed during the completed surveys, representing a very high success rate given a single year study period. Of the expected species and according to Taylor *et al.* (2015), two of the species are Endangered, four of the species are Vulnerable and three are Near-Threatened. For the current study, it was deemed unnecessary that all SCC should be discussed in intensive detail unless deemed highly relevant to the proposed development. However, all relevant SCC are described in brief (Table 4-2). 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 **within the PAOI** during the current study is provided in Figure 4-5, Figure 4-6,

Figure 4-5: Martial Eagle observed within the proposed De Rust SEF PAOI.

Figure 4-6: Double-banded Courser observed within the proposed De Rust SEFs PAOI

Figure 4-7: Karoo Korhaan observed within the proposed De Rust SEFs PAOI

Figure 4-8: Jackal Buzzard observed within the proposed De Rust SEF PAOI

Figure 4-9: Booted Eagle observed within the proposed De Rust SEF PAOI

, Figure 4-8 and Figure 4-9.

Table 4-1: Priority avifauna species list for the PAOI

Common name	Scientific name	Global Status	Regional Status	South African Endemic	Current pre-construction monitoring
Bustard, Ludwig's	*Neotis ludwigii*	EN	EN		X

Buzzard, Jackal	*Buteo rufofuscus*	LC	LC	X	X
Courser, Burchell's	*Cursorius rufus*	LC	VU	X	X
Courser, Double-banded	*Rhinoptilus africanus*	LC	NT		X
Eagle, Booted	*Aquila pennatus*	LC	LC		X
Eagle, Martial	*Polemaetus bellicosus*	EN	EN		X
Eagle, Verreaux's	*Aquila verreauxii*	LC	VU		
Eagle-owl, Spotted	*Bubo africanus*	LC	LC		X
Falcon, Lanner	*Falco biarmicus*	LC	VU		X
Goshawk, Southern Pale Chanting	*Melierax canorus*	LC	LC	X	X
Kestrel, Greater	*Falco rupicoloides*	LC	LC		X
Kite, Black-winged	*Elanus caeruleus*	LC	LC		X
Korhaan, Karoo	*Eupodotis vigorsii*	LC	NT	X	X
Korhaan, Southern Black	*Afrotis afa*	VU	VU		X
Korhaan, Northern Black	*Afrotis afraoides*	LC	LC		X
Lark, Red	*Calendulauda burra*	VU	VU		X

Lark, Sclater's	*Spizocorys sclateri*	NT	NT		
Secretarybird	*Sagittarius serpentarius*	EN	VU		
Snake- Eagle, Black-chested	*Circaetus pectoralis*	LC	LC		X
Vulture, White-backed	*Gyps africanus*	CR	CR		

Figure 4-5: Martial Eagle observed within the proposed De Rust SEF PAOI.

Figure 4-6: Double-banded Courser observed within the proposed De Rust SEFs PAOI

Figure 4-7: Karoo Korhaan observed within the proposed De Rust SEFs PAOI

Figure 4-8: Jackal Buzzard observed within the proposed De Rust SEF PAOI

Figure 4-9: Booted Eagle observed within the proposed De Rust SEF PAOI

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

Species	Global Conservation Status[8]	National Conservation Status[9]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk posed from the SEFs
Spizocorys sclateri (Sclater's lark)	Near Threatened	Near Threatened	Dry shrubland, karroid drainage lines and karoo shrubveld	**Highly Likely**: High densities throughout the region but uncommon in the study area. The species is likely to be a breeding resident within or adjacent to the study area. A localised low flying passerine, it is not highly susceptible to SEFs development activities but is threatened by habitat loss
Calendulauda burra (Red lark)	Vulnerable	Vulnerable	Red dune open shrubland/ grassy duneveld	**Confirmed**: Low densities throughout the region but locally common in the study area The species is likely to be a breeding resident within or adjacent to the study area. A localised low flying passerine, it is susceptible to SEFs development activities (high display flights) but is more threatened by habitat loss.
Aquila verreauxii (Verreaux's' Eagle)	-	Vulnerable	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax)	**Regionally confirmed, absent from study area**: Frequent foraging resident throughout the PAOI but far less frequent within the study areas due to the large distances to the mountainous preferred habitats and a general lack of localised abundant prey. Localised areas exhibiting high abundance of hyraxes and rock rabbits should be considered highly sensitive to the species. The species is susceptible to poisoning events and SEFs facilities with a low risk from proposed activities.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	Open bushveld, desert savanna and karoo with adequate roosting and foraging potential.	**Confirmed:** A breeding resident adjacent to the PA and regular foraging visitor dependent on adequate food supply and roosts. No breeding pair nesting within the proposed SEFs boundary were recorded but frequent sightings in terms of foraging activity on the development footprint area. Typically, the species would exhibit a Moderate risk.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	**Confirmed:** A fairly common foraging migrant recorded in the current study and expected periodically to occur. Not highly vulnerable to the proposed activities.

[8] IUCN 2021
[9] Taylor et al. 2015

Species	Global Conservation Status[8]	National Conservation Status[9]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk posed from the SEFs
Neotis ludwigii (Ludwig's Bustard)	Endangered	Endangered	Primary upland grassland, desert savanna and karoo with foraging and roosting particularly on rocky/ hilly terrain.	**Confirmed:** High densities throughout the study areas. The species is likely to be a breeding resident within or adjacent to the study area. A large bodied species, it is highly susceptible to SEFs development activities as shown by direct interactions with the existing powerlines in the region.
Sagittarius serpentarius (Secretarybird)	Endangered	Vulnerable	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	**Moderate to Highly Likely:** Irregular low-density resident which is most likely of lower risk to the proposed development activities given ground foraging habitats. In addition, persistent long term regional drought may have significantly decimated local prey sources (especially snakes) thus further reducing the likelihood of persisting local populations of significant densities.
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 SEFs development activities but as a species is considered 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 of lower risk to the proposed development activities due to most pressures occurring with breeding grounds and migration routes.

4.6 PRECONSTRUCTION MONITORING METHODS AND REQUIREMENTS

4.6.1 Walked and Driven Transects counts

During the walked transects, the total number of individual birds (per species) were recorded regardless of if they are listed as priority or not. Notable Priority Species recorded during walked transects included Ludwig's Bustards that were often flushed from foraging positions as well as 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, raptors and korhaans and Red Lark were the most frequently recorded priority species. For the final EIA, the data will be used to calculate the combined Index of Kilometric Abundance (IKA = birds/km) for each priority species.

4.6.2 Vantage Points

VP surveys data was only used to support the WT and DT data.

4.6.3 Nest Survey

Nest sites were searched for during the surveys which included windmills, trees, pylons, bridges and masts, representing most potential roost and nesting sites for raptors. Water bodies were potential roost and nesting sites for multiple species, but the high degree of seasonality and above average rainfall conditions was optimal to being representative of optimal breeding habitat for water associates. Highly significant breeding habitat was recorded during the survey and Ludwig's Bustard is considered a resident and to be breeding on site. Pylons were examined for raptor nesting sites to be discussed for Martial Eagles 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

Figure 4-10: Breeding Lanner Falcon utilising the abandoned Martial Eagle Nest observed adjacent to the proposed De Rust SEFs

Figure 4-11:Fledged Lanner Falcon chicks utilising the abandoned Martial Eagle Nest observed immediately (1500 m) adjacent to the proposed De Rust SEFs

4.7 PRELIMINARY SEF SITE SENSITIVITY

Each demarcated sensitive feature was evaluated for the degree of sensitivity based on the complete 12-month data set (minus passage rates) and presented as

. There is an important presence of a number of SCC in the study area, recorded regularly and widespread through the proposed SEF 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 Jackal Buzzard. Areas of drainage lines and natural vegetation which are vital to maintaining populations of habitat obligate sensitive species (such as Red Lark). Martial Eagle nests (occupied or abandoned) were buffered according to either best practice (1 km). These areas must be avoided by the developer where associated infrastructure may be located. Due to an interactive process within the client and the specialist team, very few of the proposed infrastructure coincide with areas currently demarcated as High sensitivity features as the layout was carefully re-evaluated in order to mitigate against negative interaction with priority species such as Martial Eagle, Red Lark and Ludwig's Bustard.

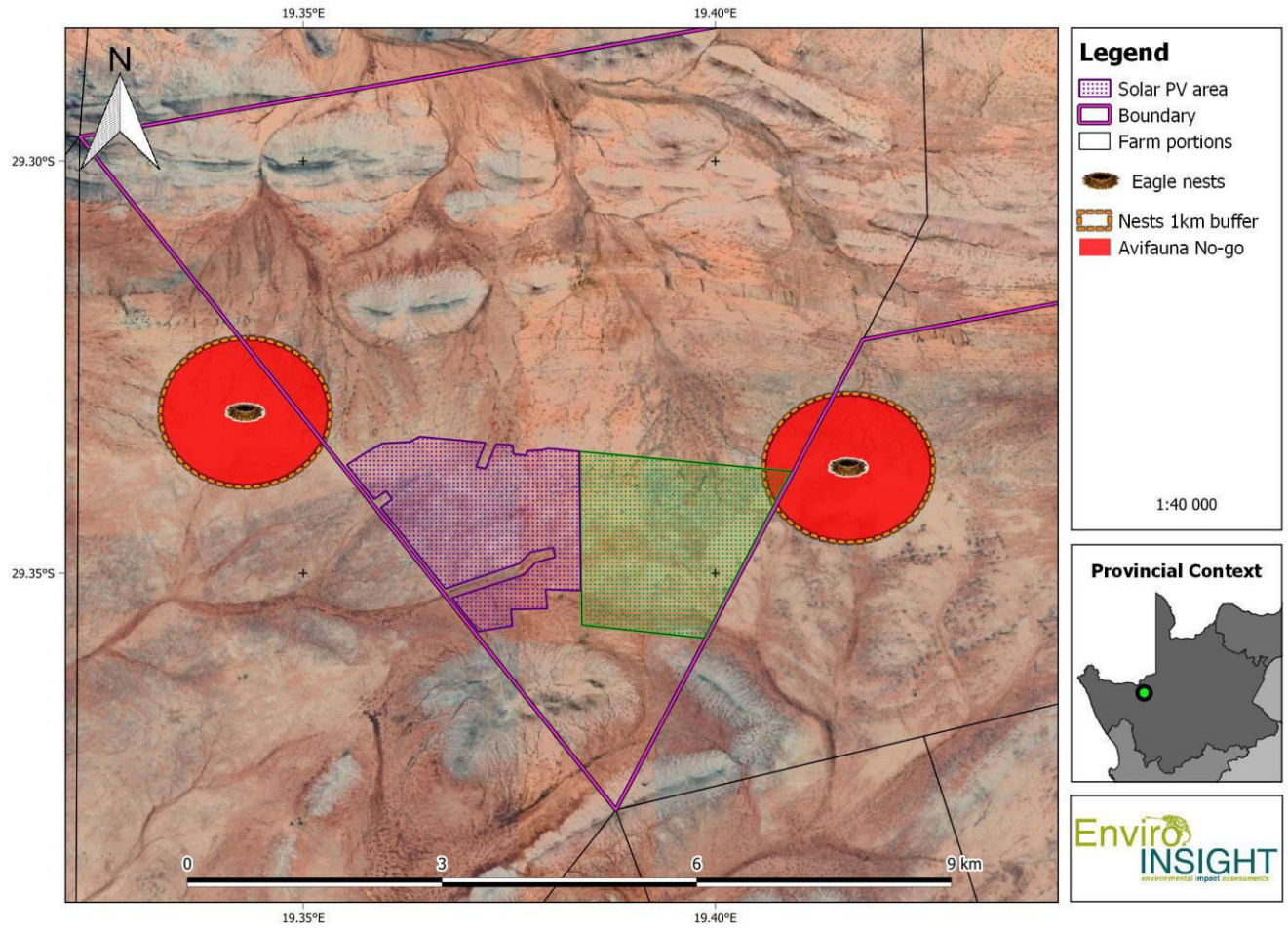

Figure 4-12: Overall Avifauna Sensitivity Buffers.

5 POTENTIAL IMPACTS

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

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

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

- Habitat loss (including foraging and breeding) and fragmentation due to displacement (avoidance of disturbance). Habitat loss has the tendency to not only destroy existing habitat but also displace bird species from large areas of natural habitat. This specifically has a greater impact on bird species restricted to a specific habitat and its requirements.

- Collision and electrocution with above-ground power transmission lines (to be assessed in separate application). In some cases, collision can be associated with combustion (streamers) from polarised light pollution and waterbird species mistaking large PV panels areas as wetlands or other waterbodies, a case known as the "lake effect" (as per Jenkins *et al*. 2017). The mitigation of these impacts will be addressed in the final EIA report with operational phase monitoring to be designed in the EMPr.
- Disturbance due to noise such as, machinery movements and maintenance operations during the construction and operational phase of the proposed PV solar farm.
- The attraction of some novel bird species due to the development of a solar farm with associated infrastructure such as perches, nest and shade opportunities
- Chemical pollution: Chemicals being used to keep the PV panels clean from dust (suppressants) etc.

5.2 CUMULATIVE IMPACTS

There are a number of proposed, approved and implemented renewable energy facilities within the PAOI as shown in Figure 5-1 and any impacts anticipated from the proposed De Rust SEFs will add to these existing and future cumulative impacts. As such, the results obtained during this preconstruction survey and from the subsequent impact analysis should be considered in conjunction with the impacts created by the regional developments. There is a 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.

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

- Habitat loss: The destruction of highly sensitive habitat (for example sandy substrates for Red Lark) will potentially increase.
- Road-kills: Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl and courser species.
- 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.

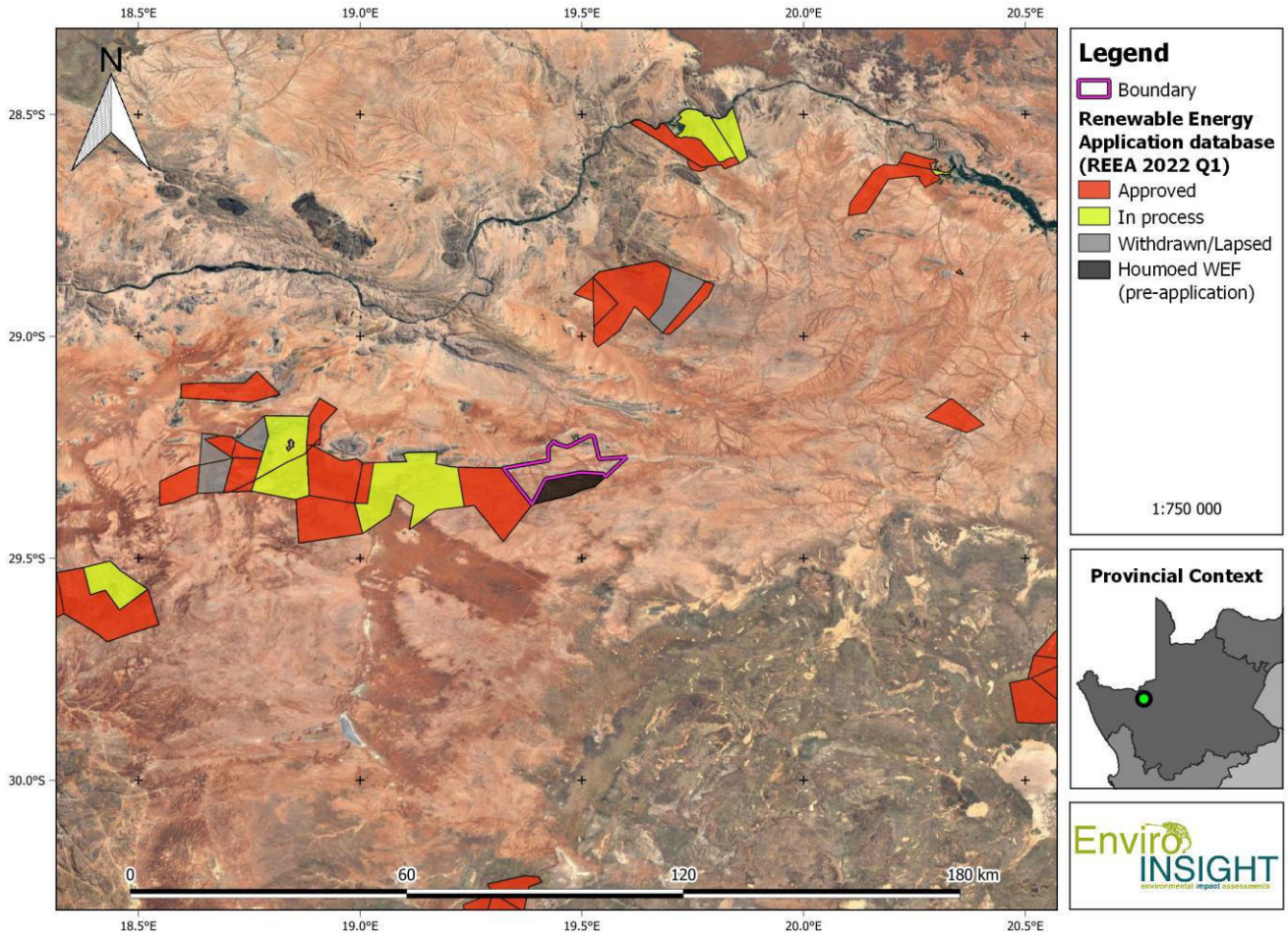

Figure 5-1: Local and regional renewable energy applications and operations

5.3 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 impacts prevention/minimisation at solar facilities (see TBC 2021). New mitigation measures range from simple (e.g., buffering of habitats) to complex (retrofitting of panels to avoid Lake Effect Impacts). 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 development through the application of necessary buffers for sensitive areas, where placement of panel infrastructure may not occur. Additional remaining impacts will be minimised through the application of known and previously tested mitigation measures.

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 solar facilities 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) unless they are directly affected (e.g. their physical habitat is affected). Collision with powerlines 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 nesting/ roosting habitat in particular. The choice of an appropriate set-back distance is complex since different species and even different taxon groups demand different habitat types or home ranges to maintain a viable population in the long term.. Given that the study area has been confirmed as a foraging site and breeding site for Ludwig’s Bustard, Martial Eagles and indeed many other raptor species, the mitigation recommendations that are proposed in order to preserve the ecological function of the raptor habitats, minimising collisions and to maintain foraging corridors for large SCC raptor species in the form of a set-back area of natural vegetation are considered non-negotiable.

5.3.2 Summary of Proposed Mitigation Measures

It is deemed possible, through the application of appropriate mitigation measures, to restrict the impact of on the local and regional avifaunal population to a low level of significance. The following mitigation summary is provided:

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

All underground cables bisecting sensitive habitats must be placed below the subsurface flow of the ephemeral wetlands with the linear construction pits subjected to full rehabilitation in order to maintain normal subsurface slow. All roads and crossings must be engineered not to impede surface or subsurface flow in any way.

Bird mortality: Avoid placement of panels near sensitive bird breeding and roosting habitats. The application of adaptive mitigation measures (e.g., retrofitting non-polarising white tape can be used around and/or across panels to minimise reflection), according to post-construction monitoring results (counted collisions of threatened species) must be informed by environmental correlates of avifaunal activity and/or collisions (EMPr).In addition, the addition of grazing sheep to the footprint may attract raptor SCC who may scavenge on dead lambs/ adult sheep or prey upon livestock. Strict carcass retrieval must be incorporated into the EMP where carcasses are removed and correctly disposed of within the same day of death. This will require constant monitoring of all sheep herds in the footprint.

Bird collisions with panels and powerlines: Use of parabolic (curved) mirrors is preferred instead of flat heliostats to reduce the likelihood of skyward reflection to minimise potential bird collisions. However the use of flat panels does not represent a fatal flaw. All powerlines must be flapped with appropriate diverters and no elevated powerlines are to cross drainage line habitats.

Avoidance: It is recommended that limited development takes place in High sensitivity areas. Minimise impacts to natural and artificial wetlands and water bodies by implementing the appropriate buffer areas where no development may take place. This includes a 50 m proposed no-go buffer proposed around small artificial water points as they serve as focal points for bird activity and 50 metres around drainage lines/ wetlands. All large impoundments require a 1000 metre buffer from any infrastructure activity although this may be reduced to approximately 800 metres if no new powerline infrastructure impacts the 1000 metre threshold. All Verreaux's and Tawny Eagle nests must be buffered by at least 1 km with a preferable "non-disturbance" exclusion of 1.5 km during breeding season (refer to **Error! Reference source not found.**). As some avoidance is not possible, the strict preconstruction prescriptive mitigation measures for infrastructure engineering described above must be applied.

General Mitigation Measures

All Mitigation measures are subject to the final EIA process.

- Formal post construction monitoring must be applied once the development have been activated, as per the most recent edition of the best practice guidelines (Jenkins et al. 2017). 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 breeding and foraging behaviour post-construction, and to search for and identify carcasses near panels and newly erected powerlines (mortality).
- High value target species such as Lanner Falcon, Ludwig's Bustards and Martial Eagles can be tracked using periodic ECO monitoring regimes to monitor movement patterns and breeding success. These programs should be implemented during and post construction.
- Post-construction monitoring should be undertaken as per the EMPr. The exact scope, nature and frequency of the post-construction monitoring will be informed on an ongoing basis by the results of the monitoring through a process of adaptive management.

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 solar panels.

5.4.1 Ludwig's Bustard (*Neotis ludwigii*)

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

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 particularly high density. There are a number of possible explanations for the observed increase in density in 2022:

- This 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 in 2022 over an extended period of time. This caused an activation of the seed bank within the PAOI and subsequently, a large amount of fodder was available for avifaunal species including Ludwig's Bustard.
- The lack of smaller (and less visible) powerlines within much of the study area allowing for localised lower mortality rates; and

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

On a final note, concerning monitoring of the species (and possible mitigations), it is vital to highlight that fact that as an Endangered species, Ludwig's bustard demands higher degrees of auditing and monitoring attention than other Red-Listed birds (a fact supported by multiple publications including Visser *et. al.* 2018 and Scott *et. al.* 2012). It is also vital to highlight that presence or absence over time for a nomadic species is difficult to predict and spatial/ temporal population reductions may or may not be development-induced. For example, 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.

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 1 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. There is currently no species-specific guideline for the Martial Eagle, and buffer areas around nest sites (especially nests that have been unused for long periods of time) remains a scientifically contentious topic of discussion in the industry without rigorous scientific studies providing necessary guidance (for example, Murgatroyd, Bouten & Amar 2021). The only published recommended buffer to implement around raptor nests in South Africa is for the Verreauxs' Eagle (Ralston-Paton, 2017), which dictates that a precautionary buffer of 3 km is recommended and may be reduced or increased based on the results of rigorous avifaunal surveys, but nest buffers should never be less than 1.5 km. This buffer is deemed more than adequate for Martial Eagles in relation to SEFs.

Figure 5-2: Seemingly abandoned Martial Eagle Nest

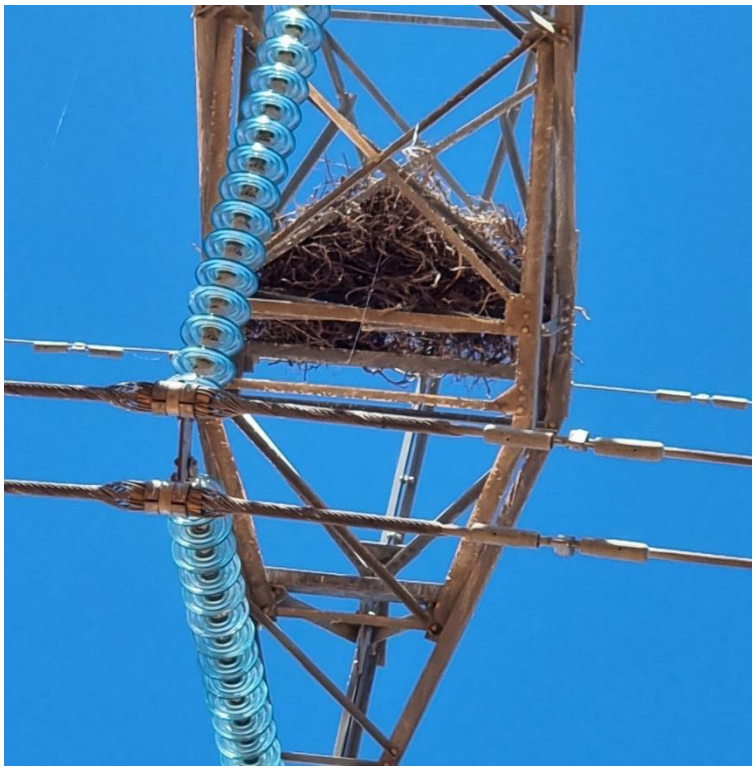

Figure 5-3: Western active Martial Eagle nest.

6 CONCLUSIONS

The study area is located in a region dominated by natural sandy grassland vegetation types. The powerline infrastructure that traverses the PAOI is a significant habitat for Martial Eagles.

Fourteen priority species were recorded during the initial surveys, including Martial Eagle, Karoo Korhaan, Ludwig's Bustard, Lanner Falcon, Red Lark and Black-winged Kite. Of these, the Martial Eagle and Ludwig's Bustard was the most concerning large bird species. At the commencement of the survey, the PAOI was characterised by extremely atypical high rainfall in areas normally associated with arid conditions. The onset of a stochastic extreme rainfall event (wet season) may have atypically transformed the PAOI where it is possible that diluted 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 concern regarding large nomadic species such as bustards, large wide foraging raptors such as Martial Eagle and vultures seeking water sources within the PAOI when typical arid conditions return over the next 12 months.

7 PROFESSIONAL OPINION

A final Professional Opinion will be submitted at the conclusion of the EIA submission. However, a preliminary opinion is provided below.

- The addition of the proposed De Rust SEFs does indicate potentially significant impacts to the receiving environment via the risk to Priority Species (such as Martial Eagle, Red Lark and Ludwig's Bustard) as well as the Cumulative Impacts need to be considered and provision made within the EMPr for this development.
- Overall, it is still the opinion of the consultants that the impacts associated with SEFs projects are far preferable (from an environmental impact perspective) to extractive and/ or non-renewable alternatives. It must be related that this report must be considered in context with the greater EIA process.
- In addition, while striving to maintain the highest standards of mitigation and monitoring as well as the commissioning of a highly detailed preconstruction assessment, developments such as the De Rust SEFs be encouraged within designated areas.
- The presence of nesting and breeding Ludwig's Bustard and Martial Eagles within the PAOI are of particular concern. Avoidance mitigation must be implemented in conjunction with the aforementioned avoidance mitigation. Thus, the author will look to support Environmental Authorisation (EA) based upon the following conditions;
- All recommended buffering be strictly adhered to.
- All recommended mitigation measures be applied preconstruction, post construction and operations.
- The EMPr be updated every three years in order to revaluate the potential distributional population changes of species such as Martial Eagles and Vultures. Thus, retrofitted mitigations such as AI, radar and camera technology may have to be applied.

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9 APPENDIX

9.1 APPENDIX 1: EXPECTED AVIFAUNA SPECIES LIST

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

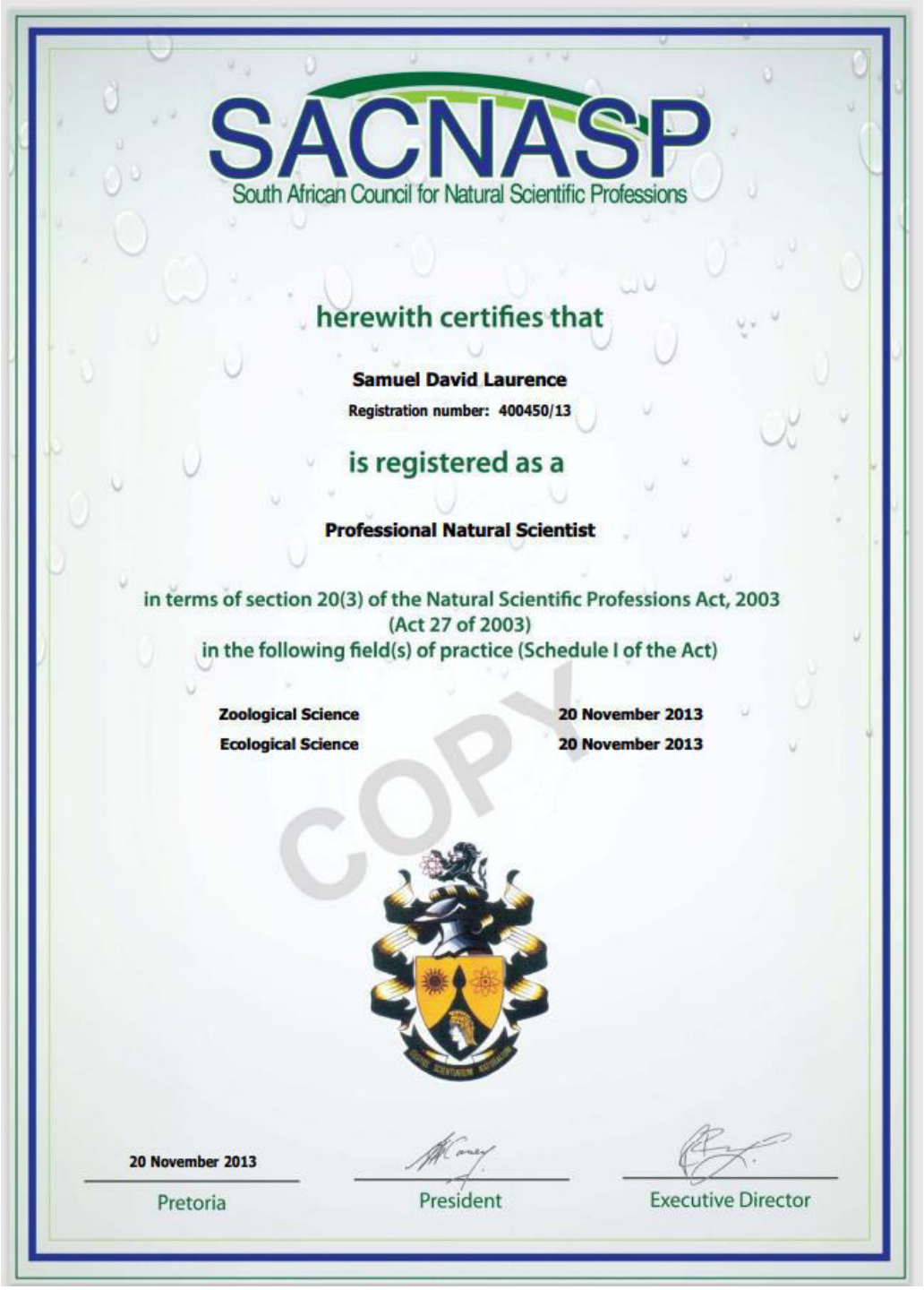
	Common Name	Scientific Name	SABAP2	Observed
1	Acacia Pied Barbet	*Tricholaema leucomelas*	YES	YES
2	African Hoopoe	*Upupa africana*	NO	YES
3	African Palm Swift	*Cypsiurus parvus*	NO	YES
4	African Pipit	*Anthus cinnamomeus*	YES	YES
5	African Red-eyed Bulbul	*Pycnonotus nigricans*	YES	YES
6	Alpine Swift	*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
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

	Common Name	Scientific Name	SABAP2	Observed
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
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

	Common Name	Scientific Name	SABAP2	Observed
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
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

	Common Name	Scientific Name	SABAP2	Observed
115	Yellow Canary	*Crithagra flaviventris*	YES	YES
116	Yellow-bellied Eremomela	*Eremomela icteropygialis*	YES	YES
Total				**83**

9.2 APPENDIX 2: SACNASP QUALIFICATION



SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Samuel David Laurence

Registration number: 400450/13

is registered as a

Professional Natural Scientist

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

Zoological Science	**20 November 2013**
Ecological Science	**20 November 2013**

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Executive Director