DEVELOPMENT OF THE KIARA PV 7 FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR LICHTENBURG, NORTH WEST PROVINCE

Avifauna Scoping Report

May 2022

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EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Voltalia South Africa (Pty) Ltd to compile an avifauna scoping report for three proposed Kiara PV 7 facility and associated infrastructure with a contracted capacity of up to 130MW located on a site approximately 16km north east of the town of Lichtenburg in the North West Province.

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Four avifaunal habitat types were identified on the study site and immediate surroundings, ranging from open mixed grassland with bush clump mosaics, short potentially moist grassland, artificial livestock watering points and transformed areas. A total of 174 bird species have been recorded within the study area, including nine Red listed species (threatened and near threatened species).

The main potential impacts associated with the proposed PV solar facility are expected to be the following:

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction.
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies).
- Collision with associated infrastructure (mainly overhead powerlines and reticulation).

The endangered Cape Vulture (*Gyps coprotheres*), critically endangered White-backed Vulture (*Gyps africanus*) and Lappet-faced Vulture (*Torgos tracheliotos*) could occur as regular foraging visitors on the study site (according to reporting rates obtained from the atlas project - SABAP2). These species are highly prone to powerline collisions, whereby the proposed grid connection could pose a collision risk to vultures. The risk of collision is considered high when vultures feed on a carcass in close proximity to a powerline. The risk may be mitigated by locating the proposed powerline parallel to the existing Eskom powerline servitudes.

In addition, a total of 39 collision-prone bird species have been recorded from the study area (*sensu* atlas data), of which 20 species were birds of prey. The study site was not located near any prominent wetland system or impoundment, and therefore the risk of waterbird collisions with the proposed infrastructure is considered to be low.

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DECLARATION OF INDEPENDENCE

I, Lukas Niemand (Pachnoda Consulting CC) declare that:

- I act as the independent specialist in this application to Savannah Environmental (Pty) Ltd and Voltalia South Africa (Pty) Ltd;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have no vested financial, personal or any other interest in the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; and
- All the particulars furnished by me in this form are true and correct.

Lukas Niemand (Pr.Sci.Nat)
09 May 2022

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 20 years of experience in ecological-related assessments and more than 15 years in the field of bird interactions with electrical and renewable energy infrastructure. He has conducted numerous ecological and avifaunal impact assessments including Eskom Transmission projects, hydro-electric schemes, solar farms and other activities in South Africa and other African countries.

1. INTRODUCTION

1.1 Project Description

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Voltalia South Africa (Pty) Ltd to compile an avifauna scoping report for the proposed Kiara PV 7 solar facility and associated infrastructure with a contracted capacity of up to 130MW. The Kiara PV 7 solar facility will be located on a site approximately 16km north east of the town of Lichtenburg in the North West Province. The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality. The site is accessible via an existing gravel road which provides access to the development area.

The infrastructure of the Kiara PV 7 facility will consists of the following components:

- PV modules and mounting structures;
- Inverters and transformers;
- Battery Energy Storage System (BESS);
- Site and internal access roads (up to 8m wide);
- Site offices and maintenance buildings, including workshop areas for maintenance and storage;
- Temporary and permanent laydown area; and
- Grid connection solution will include:
    - Facility Substation;
    - Eskom Switching Station; and
    - A 275kV powerline (16.6km in length) (either single or double circuit), to connect the PV facility to the Watershed MTS.

The development area for the Kiara PV 7 facility and associated infrastructure will be located on Remaining Extent of the Farm Hollaagte No. 8. A facility development area (approximately 210ha) as well as grid connection solution will be considered in the Scoping phase.

Six additional PV facilities (Kiara PV 1, Kiara PV 2, Kiara PV 3, Kiara PV 4, Kiara PV 5, Kiara PV 6) are concurrently being considered on the project site (within Portion 2 of the Farm Hollaagte 8 and the Remaining Extent of the Farm Hollaagte No. 8) and are assessed through separate Environmental Impact Assessment (EIA) processes (see Figure 1 and Figure 2).

To avoid areas of potential sensitivity and to ensure that potential detrimental environmental impacts are minimised as far as possible, the developer will identify a suitable development footprint within which the infrastructure of Kiara PV 7 facility and its associated infrastructure is proposed to be located and fully assessed during the EIA Phase.

1.2 Terms of Reference

The main aim of this scoping exercise was to investigate the avifaunal attributes of the proposed PV facility by means of a desktop analysis of GIS based information and third-party datasets and included a brief site visit which constituted the austral winter season sampling survey.

The terms of reference for this scoping report are to:

- conduct an assessment on a screening level based on available information pertinent to the ecological and avifaunal attributes on the study site and immediate surroundings;
- conduct an assessment of all information on a screening level in order to present the following results:
    - typify the regional vegetation and avifaunal macro-habitat parameters that will be affected by the proposed project;
    - provide an indication on the occurrence of threatened, near-threatened, endemic and conservation important bird species likely to be affected by the proposed project;
    - provide an indication of sensitive areas or bird habitat types corresponding to the study site and immediate surroundings;
    - highlight areas of concern or "hotspot" areas;
    - identify potential impacts that are considered pertinent to the proposed development;
    - highlight gaps of information in terms of the avifaunal environment; and
    - recommend further studies to be conducted as part of the Environmental Impact Assessment (EIA) phase.

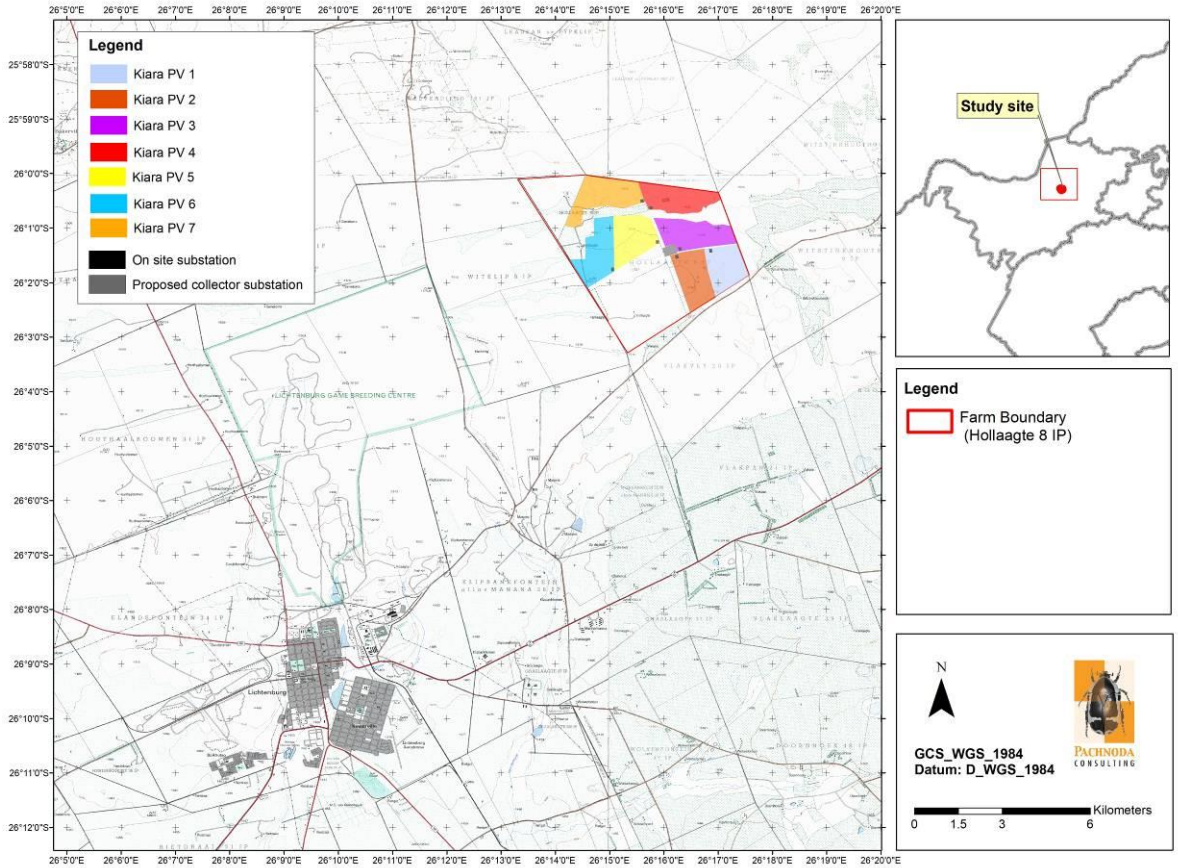

Figure 1: An ortho-cadastral map illustrating the geographic position of the proposed Kiara PV 7 facility in relation to six other planned PV facilities corresponding to the Farm Hollaagte No. 8.

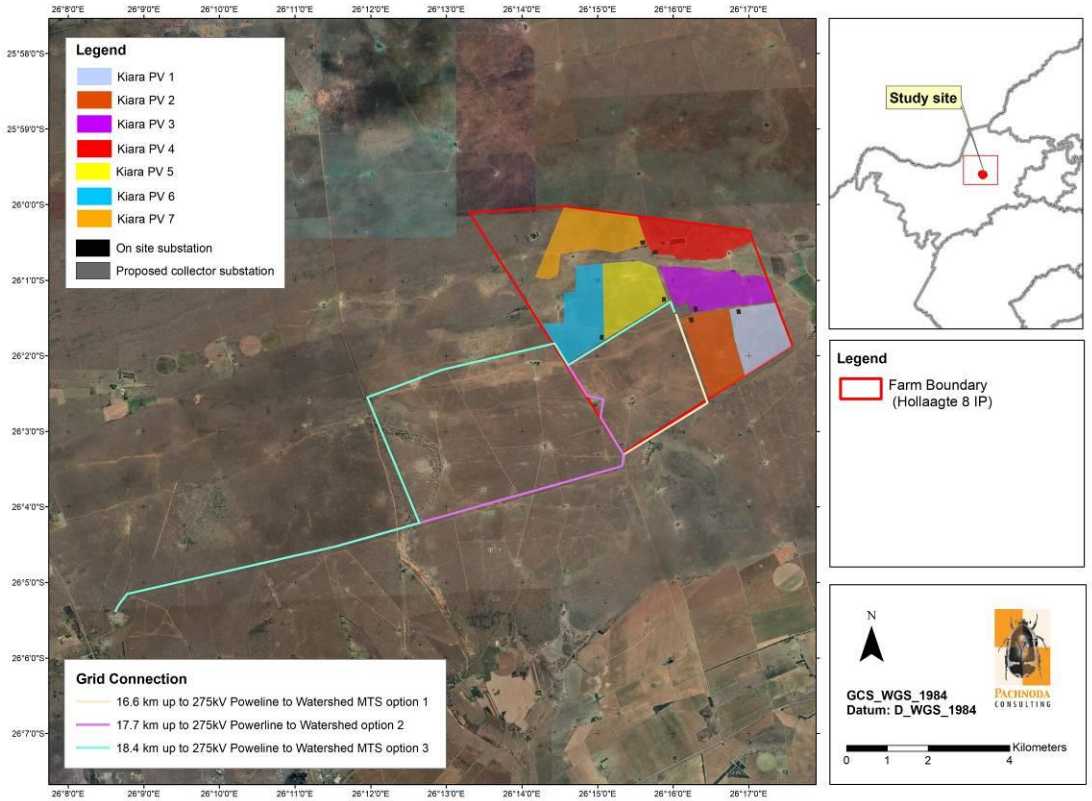

Figure 2: A satellite image illustrating the geographic position of the proposed Kiara PV 7 facility in relation to six other planned PV facilities corresponding and the proposed grid connection options.

2. METHODS & APPROACH

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Also take note that the current report put emphasis on the avifaunal community as a key indicator group on the proposed study site and immediate surroundings, thereby aiming to describe the preliminary conservation significance of the ecosystems in the area. Therefore, the occurrence of certain bird species and their relative abundances (to be determined during the EIA although herewith deduced from reporting rates) could determine the outcome of the ecological sensitivity of the area and the subsequent layout of the proposed solar facility infrastructure.

The information provided in this report was principally sourced from the following sources/observations:

- relevant literature – see section below;
- personal observations from similar habitat types in close proximity to the study area, with emphasis on assessments conducted by Pachnoda Consulting (2018 and 2021) of where an avifauna study was conducted by the author.

2.1 Literature survey and Database acquisition

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the detailed baseline survey. Literature consulted primarily makes use of small-scale datasets that were collected by citizen scientists and are located at various governmental and academic institutions (e.g. Animal Demography Unit & SANBI). These include (although are not limited to) the following:

- Hockey *et al*. (2005) for general information on bird identification and life history attributes.
- Marnewick *et al.* (2015) was consulted for information regarding the biogeographic affinities of selected bird species that could be present on the study area.
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2022) and the regional conservation assessment of Taylor *et al.* (2015).
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison et al. (1997) for species corresponding to four quarter-degree grid cells (QDGCs) 2526CC (Bakerville), 2526CD (Lead Mine), 2626AA (Lichtenburg) and 2626AB (Twee Buffels) (Figure 3). The information was then modified according to the prevalent habitat types present on the study area. The SABAP1 data

provides a “snapshot” of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which was the sampling unit chosen (corresponding to an area of approximately 15 min latitude x 15 min longitude). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;

- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.birdmap.africa). The information was then modified according to the prevalent habitat types present on the study area. Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min latitude x 5 min longitude, equating to 9 pentads within a QDGC). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection). The pentad grids relevant to the current project are 2600_2615 and 2600_2610 (although all ten pentad grids surrounding the site were also scrutinised; Figure 4).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 12.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2022). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion;
- The incidental occurrence records for large birds of prey and vulture tracking data were included (only for 2018).
- Data on power line derived bird mortalities were requested from the electrical infrastructure mortality incident register (the dataset was provided by EWT).
- The best practice guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa were also consulted (Jenkins *et al.,* 2017).
- Additional information regarding bird-power line interactions was provided by the author's own personal observations.

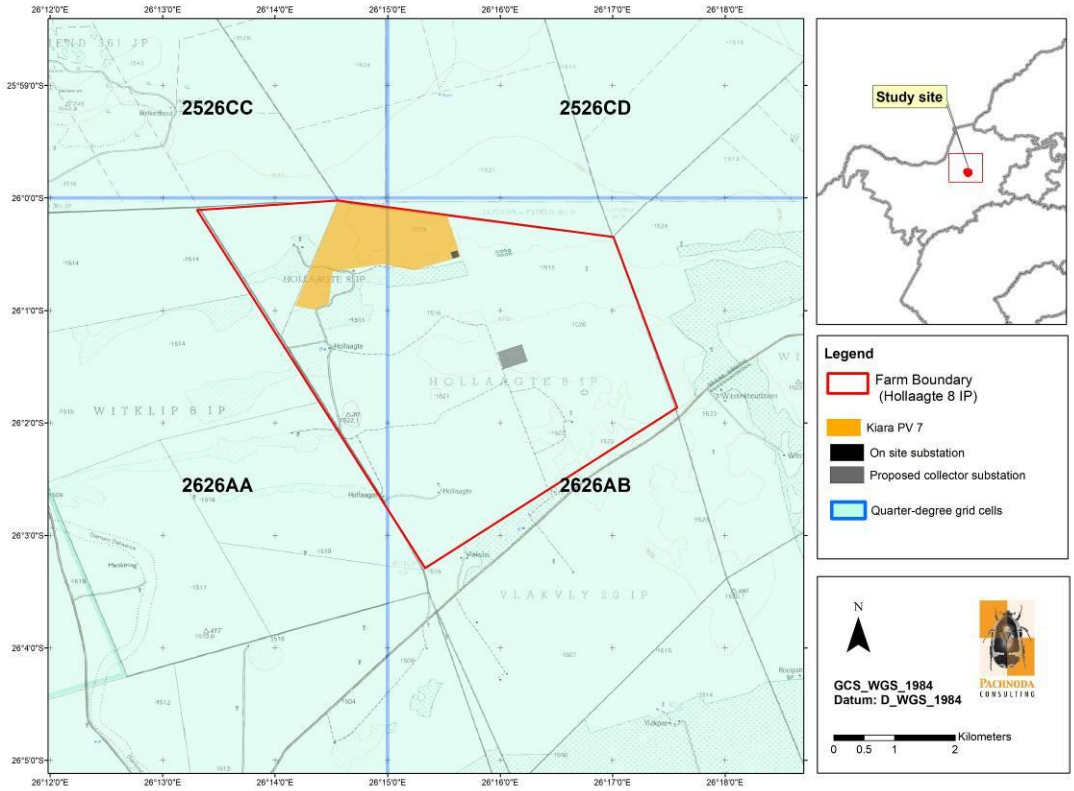

Figure 3: A map illustrating the quarter-degree grid cells that were investigated for this project.

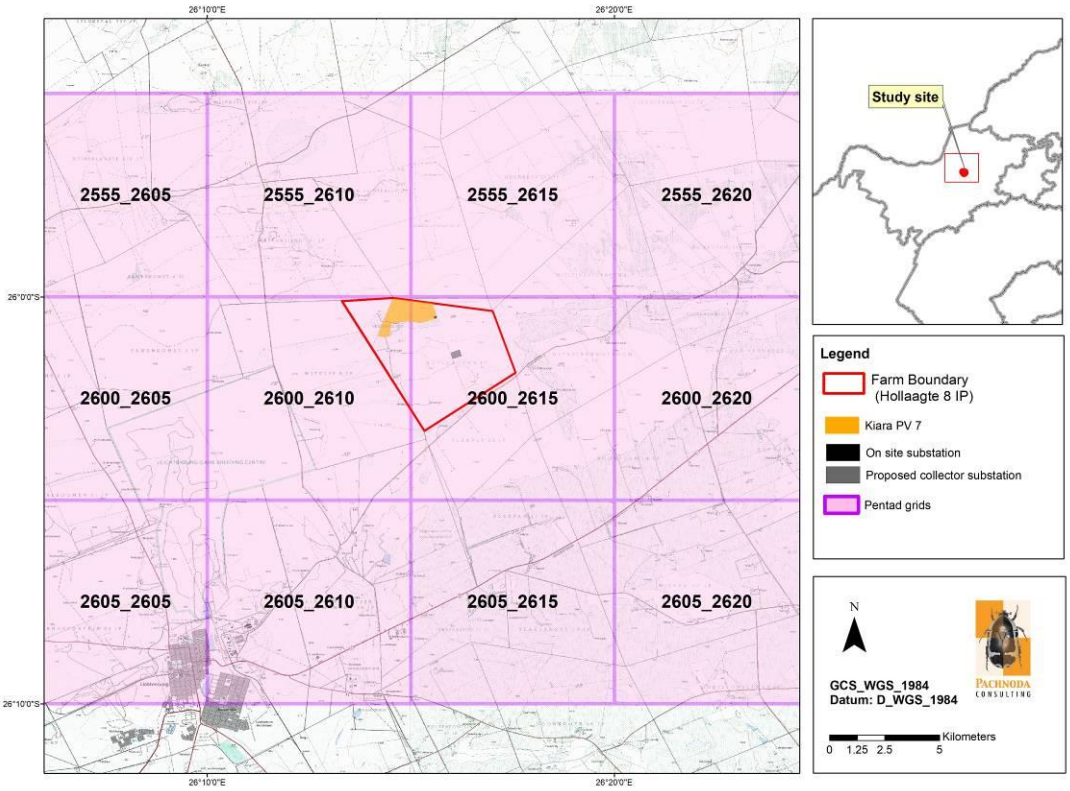

Figure 4: A map illustrating the pentad grids that were investigated for this project.

2.2 Preliminary Sensitivity Analysis

A preliminary sensitivity map was compiled based on the outcome of a desktop analysis.

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity.

2.3.1 Ecological Function

Ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or the overall preservation of biodiversity.

2.3.2 Avifaunal Importance

Avifaunal importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.3.3 Sensitivity Scale

- *High* – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should preferably be protected;
- *Medium* – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- *Low* – Degraded and highly disturbed/transformed systems with little ecological function and are generally very poor in species diversity (most species are usually exotic or weeds).

2.3 Limitations

To obtain a comprehensive understanding of the diversity and dynamics of avifaunal community on the study area, as well as the status of endemic, rare or threatened species in the area, detailed assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to the fact that the findings in this report were based on a scoping/screening assessment, long-term studies were not feasible and inferred interpretations were mostly based on ad hoc observations.

It should also be realised that bird distribution patterns fluctuate widely in response to environmental conditions (e.g. local rainfall patterns, nomadism, migration patterns, seasonality), meaning that a composition noted at a particular moment in time will differ during another time period at the same locality. For this reason two surveys will be conducted during the data collection.

Due to the scope of the work presented during a scoping assessment, a detailed investigation of the avifaunal community in the area were not possible and is not perceived as part of the Terms of Reference for a scoping/screening level exercise.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

The following assumptions are relevant to the literature survey and database acquisition phase:

- It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true;
- Some of the datasets are out of date and therefore extant distribution ranges may have shifted although these datasets could provide insight into historical distribution ranges of relevant species;
- The datasets are mainly small-scale and could not always consider azonal habitat types that may be present on the study area (e.g. small dams, pans and depressions). In addition, these datasets encompass surface areas larger than the study area that could include habitat types and species that is not present on the study area. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been overlooked in the past;
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were only recently initiated and therefore incomplete; and
- In addition, the study site is under private ownership and primarily inaccessible to the public. Since most of the species distribution ranges concerning the relevant datasets are subject to observations made by the public, it is likely that many bird species are overlooked or not formally catalogued for the area.

3. PRELIMINARY RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Locality

The proposed PV facility will be located on Remaining Extent of the Farm Hollaagte No. 8, located approximately 16km north east of the town of Lichtenburg in the North West Province (Figure 1).

3.2 Regional Vegetation Description

The proposed PV facility corresponds to the Grassland Biome and more particularly to the Dry Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as Carletonville Dolomite Grassland (Mucina & Rutherford, 2006) (Figure 5).

From an avifaunal perspective it is evident that bird diversity is positively correlated with vegetation structure, and floristic richness is not often regarded to be a significant contributor of patterns in bird abundance and their spatial distributions. Although grasslands are generally poor in woody plant species, and subsequently support lower bird richness values, it is often considered as an important habitat for many terrestrial bird species such as larks, pipits, korhaans, cisticolas, widowbirds including large terrestrial birds such as Secretarybirds, cranes and storks. Many of these species are also endemic to South Africa and display particularly narrow distribution ranges. Due to the restricted spatial occurrence of the Grassland Biome and severe habitat transformation, many of the bird species that are restricted to the grasslands are also threatened or experiencing declining population sizes.

Carletonville Dolomite Grassland is confined to the dolomite plains that stretch from Lichtenburg in the North West Province to sections of rocky grassland in Gauteng, especially between altitudes of 1 350 m and 1 450 m. It occurs on slightly undulating plains dissected by prominent chert ridges, thereby containing a grassland composition rich in floristic species forming a complex mosaic dominated by many plant species.

Currently, only 2 % of the remaining 76 % of untransformed Carletonville Dolomite Grassland is formally protected within the Cradle of Humankind World Heritage Site and various nature reserves such as Abe Baily and Krugersdorp Nature Reserves.

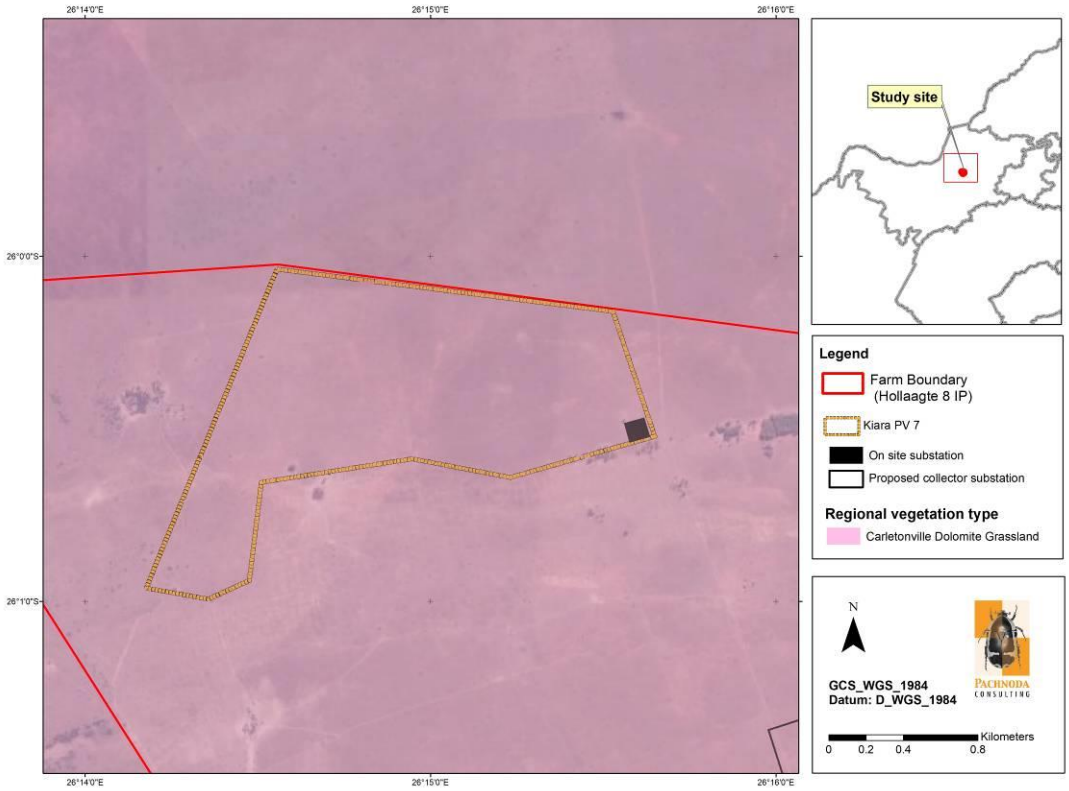

Figure 5: A satellite image illustrating the regional vegetation type corresponding to the study site and immediate surroundings. Vegetation type categories were defined by Mucina & Rutherford (2006; updated 2012).

3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study site comprehends the following land cover categories (Figure 7):

Natural areas:

- Grassland; and
- Low shrubland.

From the land cover dataset it is evident that most of the study site is covered by natural grassland and short mixed bush clumps (low shrubland). The study site is primarily used for livestock production and livestock grazing. Existing infrastructure includes cattle feedlots and livestock artificial watering holes.

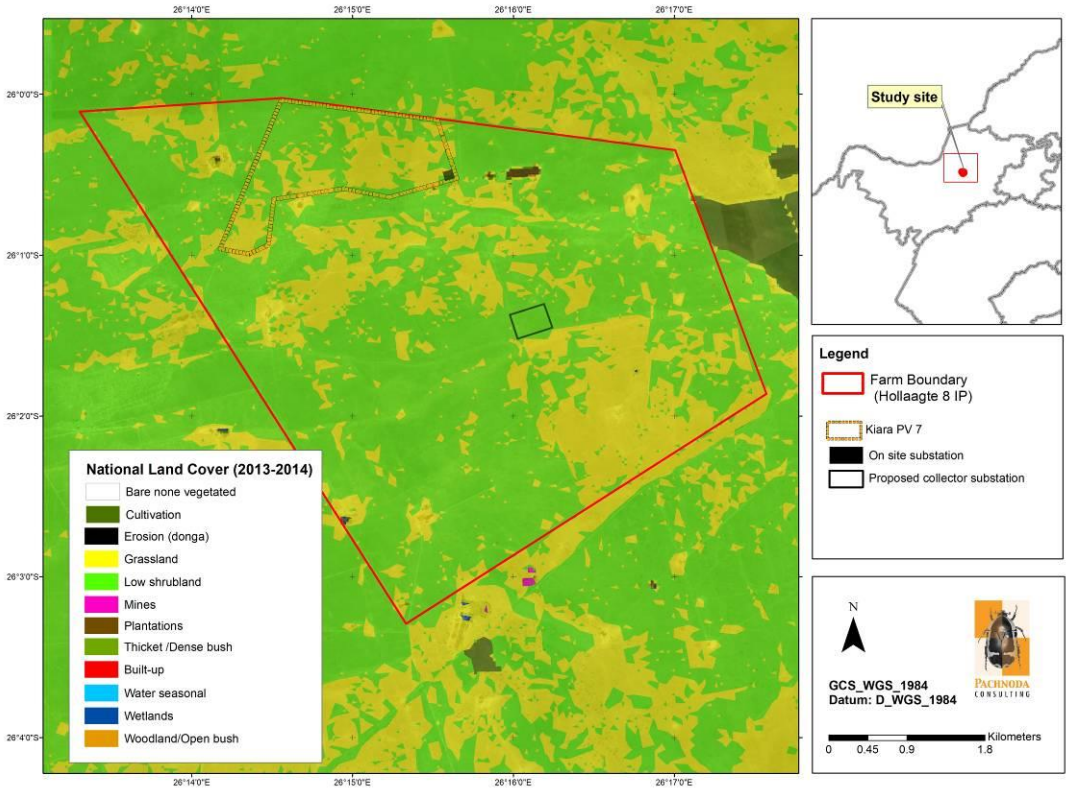

Figure 6: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed study site and immediate surroundings.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

The study site is located approximately 4.5km east of the Lichtenburg Game Breeding Centre (Figure 7). This conservation area contains a variety of game species, and the facility used to operate a vulture restaurant which attracts foraging vultures (c. three species) to the region. This area is currently under private management (by lease agreement with the municipality).

There are no other formal protected areas or any Important Bird and Biodiversity Areas in close proximity to the study site.

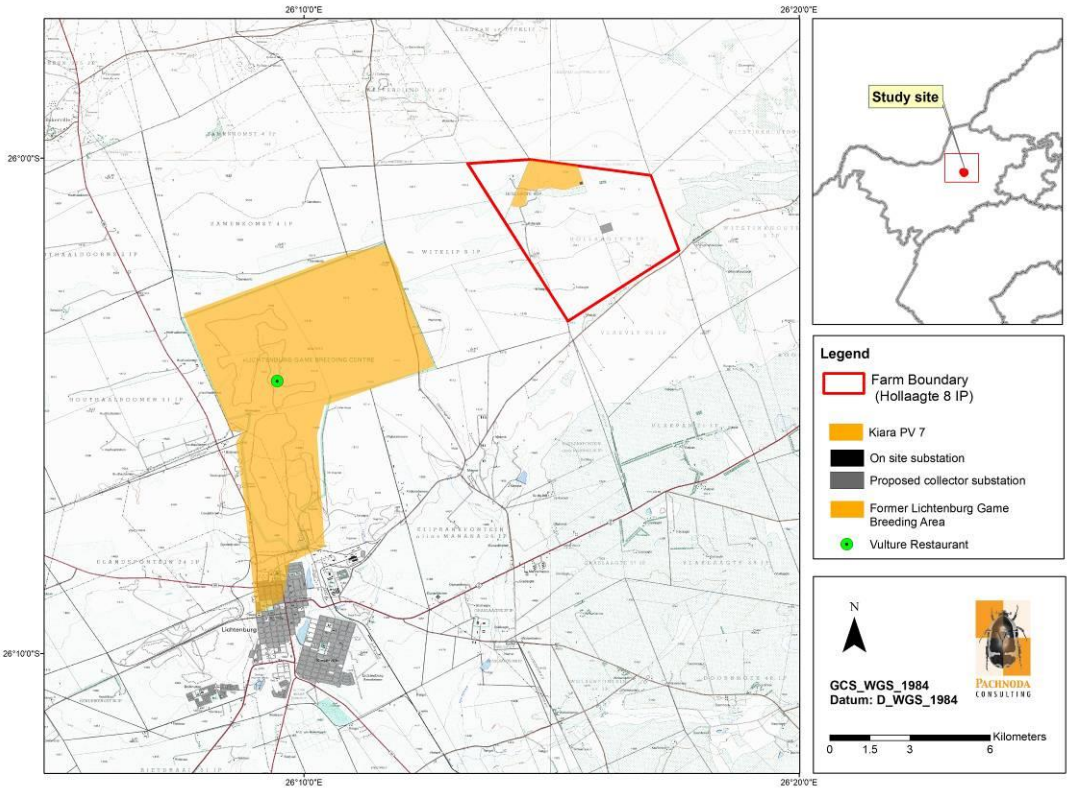

Figure 7: A map illustrating the locality of conservation areas in close proximity to the proposed study site.

3.5 Annotations on the National Web-Based Environmental Screening Tool

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 20145 (EIA Regulations) provides that an applicant for Environmental Authorisation is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Environmental Affairs, Forestry and Fisheries published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice.

The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the (preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols.

As the Screening Tool contains datasets that are mapped at a national scale, there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an

augmented and site-specific evaluation of the accuracy and 'infilling' of obvious and large-scale inaccuracies. Information extracted from the National Web-based Environmental Screening Tool (Department of Environmental Affairs, 2020), indicated that the study site and immediate surroundings (for Farm Hollaagte No. 8) hold a **low** sensitivity with respect to the relative animal species protocol (Figure 8) (report generated 09/05/2022):

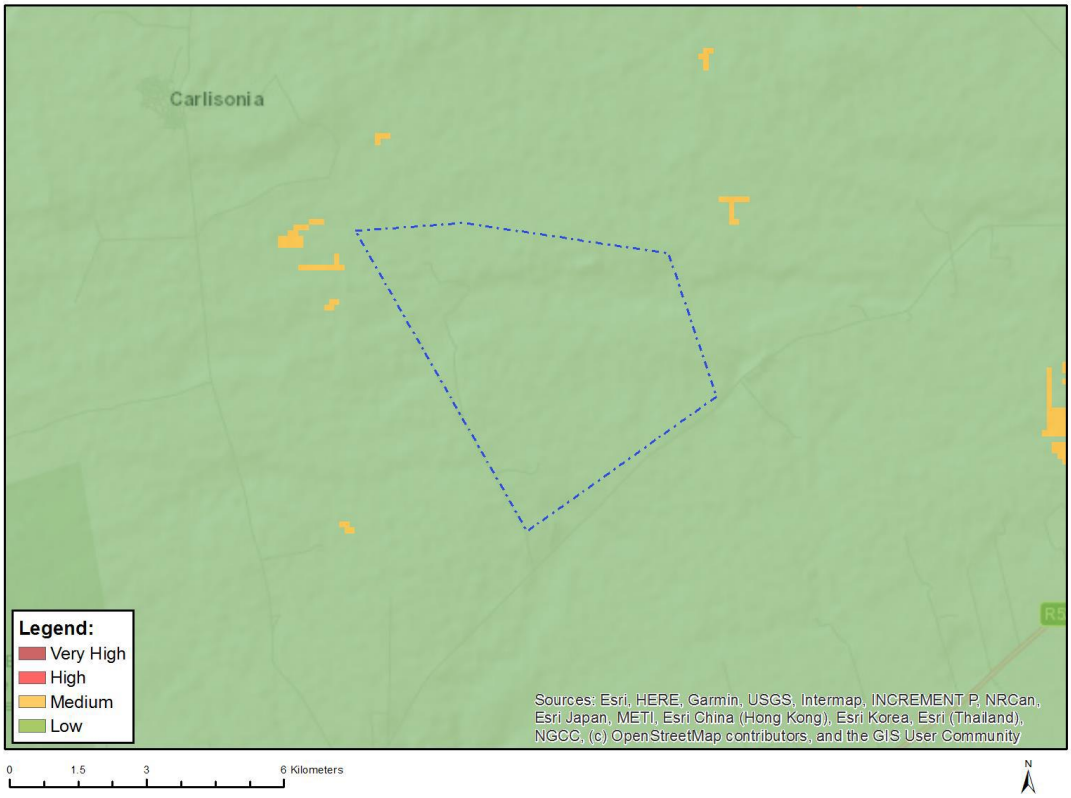

Figure 8: The animal species sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Low	Low sensitivity

It is evident that the study site and immediate surroundings (for Farm Hollaagte No. 8) correspond to a **high** avian theme since it is located within 20 km of known Cape Vulture (*Gyps coprotheres*) restaurants (see Figure 9). The endangered Cape Vulture is regarded as a regular foraging visitor to the study area with high reporting rates (c. 12 %) for the region. The presence of free-roaming livestock increases the probability for this species to forage over the study site (owing to the probability for carcasses to occur).

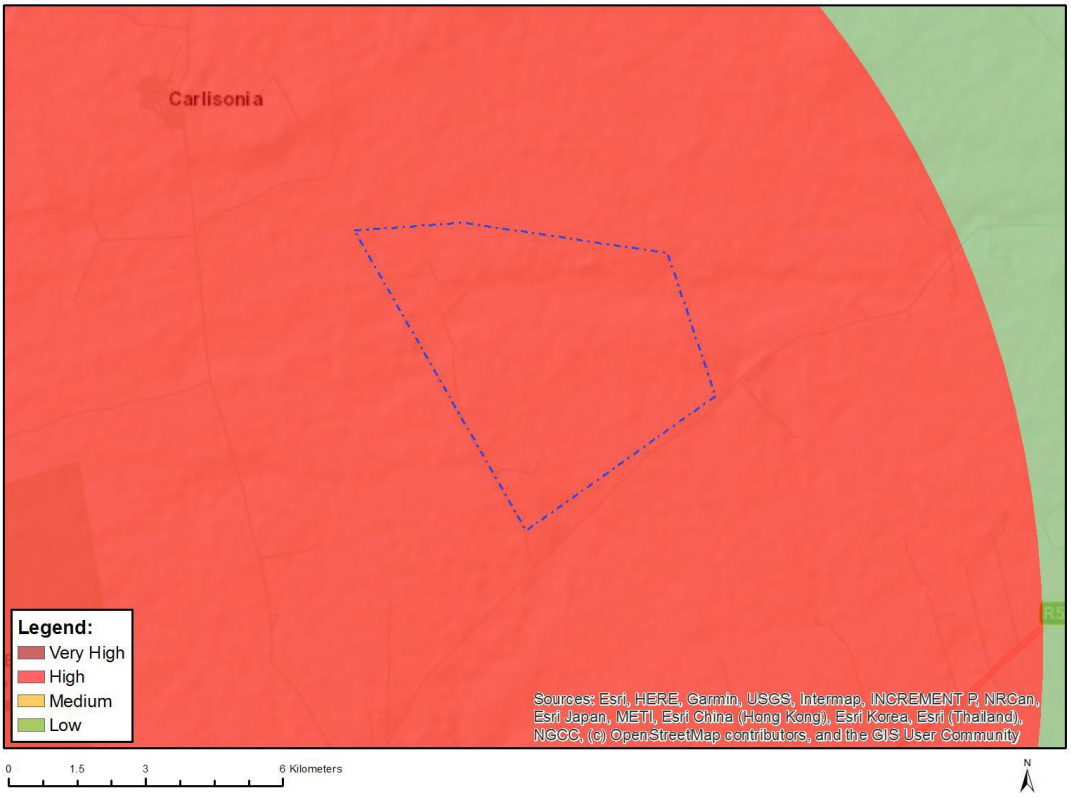

Figure 9: The relative avian sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
High	Within 20 km of known Cape Vulture restaurant sites

However, the study site and immediate surroundings (for Farm Hollaagte No. 8) hold a **very high** sensitivity with respect to the relative terrestrial biodiversity theme (Figure 10):

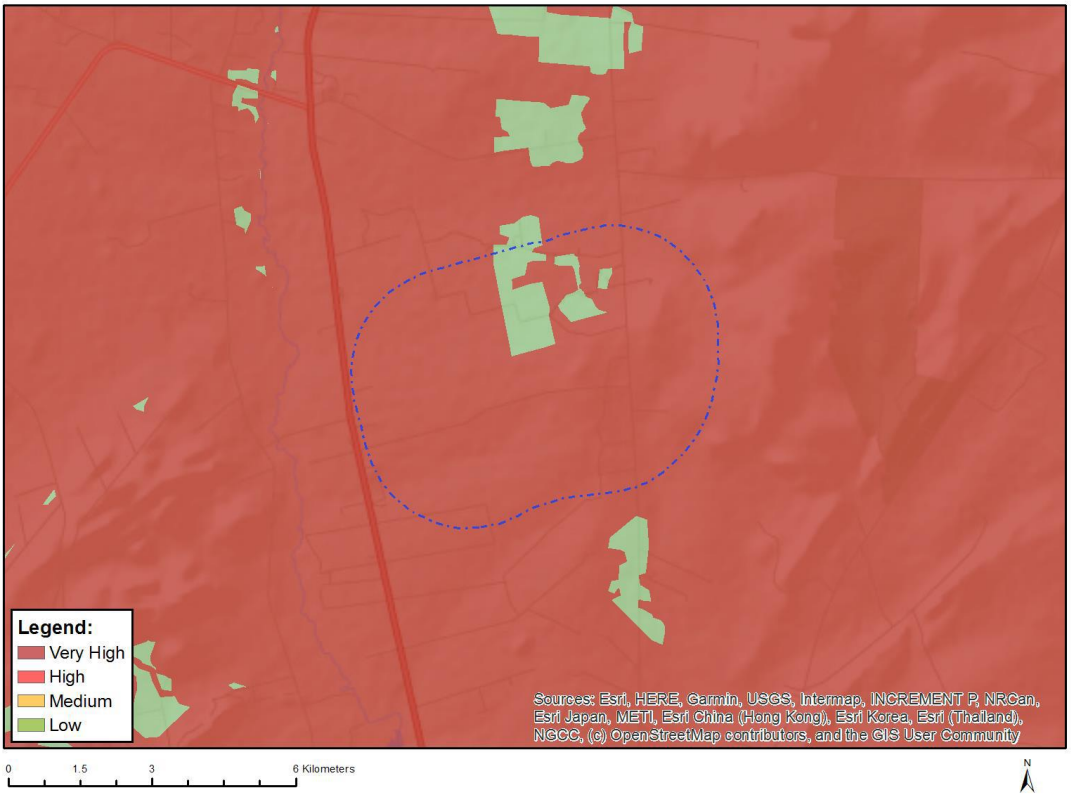

Figure 10: The relative terrestrial biodiversity sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Ecological support area 1

It is evident from the results of the Screening Tool report that part of the study area coincides with an Ecological Support Areas (ESA 1) as per the North West Biodiversity Sector Plan (Schaller and Desmet, 2015).

3.6 Preliminary avifaunal habitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the study site and immediate surroundings are a consequence of a combination of factors simulated by soil type, geology, moisture regimes, grazing intensity (presence of livestock) and past land use practice which have culminated in a number of habitat types that deserve further discussion[1] (Figure 11):

1. *Open mixed grassland with bush clump mosaics:* This unit is prominent on the study site and immediate surroundings and covers a significant extent in surface area of the proposed PV facility. It is represented by two discrete

[1] The habitat types are subject to change pending on the outcome of a detailed baseline surveys.

floristic variations which also provide habitat for two discrete avifaunal associations. The first floristic variation consists of open untransformed to semi-transformed mixed grassland. The grassland variation is represented by untransformed and grazed Carletonville Dolomite Grassland, depending on grazing intensity, and dominated by "late-successional" graminoids such a *Themeda triandra, Cymbopogon caesius, C. pospischilii, Trachypogon spicatus, Elionurus muticus* and *Andropogon schirensis*. It provides habitat for a typical grassland bird composition dominated by insectivorous and granivore passerine bird species such as Desert Cisticola, (*Cisticola aridulus*), Eastern Clapper Lark (*Mirafra fasciolata*), Spike-heeled Lark (*Chersomanes albofasciata*), Cape Longclaw (*Macronyx capense*), Ant-eating Chat (*Myrmecocichla formicivora*) and African Pipit (*Anthus cinnamomeus*). Prominent non-passerine species expected to be present are Orange River Francolin (*Scleroptila gutturalis*), Swainson's Spurfowl (*Pternistis swainsonii*), Northern Black Korhaan (*Afrotis afraoides*), Crowned Lapwing (*Vanellus coronatus*) and Black-winged Kite (*Elanus caeruleus*).

The bush clumps form a prominent mosaic characterised by the dominance of a woody layer of *Searsia lancea, S. pyroides, Ziziphus mucronata, Gymnosporia buxifolia* and *Asparagus laricinus*. *Celtis africana* and *Olea europaea subsp. africana*. The eminent increase in vertical heterogeneity provided by the woody layer which provides habitat for a "Bushveld" bird association consisting of insectivorous passerines such as Black-chested Prinia (*Prinia flavicans*), Chestnut-vented Warbler (*Curruca subcoerulea*), Kalahari Scrub Robin (*Cercotrichas paena*), Fiscal Flycatcher (*Melaenornis silens*), African Red-eyed Bulbul (*Pycnonotus nigricans*) as well as granivores such as Yellow Canary (*Crithagra flaviventris*) and Southern Masked Weaver (*Ploceus velatus*). Non-passerine bird taxa are expected to include Laughing Dove (*Spilopelia senegalensis*), Ring-necked Dove (*Streptopelia capicola*), Acacia Pied Barbet (*Tricholaema leucomelas*) and White-backed Mousebird (*Colius colius*).

2. *Short potentially moist grassland*: This habitat is expected to receive infiltration from run-off water during precipitation events which is colonised by palatable grass species. Due to the high palatability of the graminoid cover, the structure of this habitat remains short owing to persistent grazing. It provides ephemeral foraging habitat for granivores such as Long-tailed Widowbird (*Euplectes progne*), Southern Red Bishop (*E. orix*) but also insectivorous species such as Zitting Cisticola (*Cisticola juncidis*). It also provides potential foraging habitat for the endangered Secretarybird (*Sagittarius serpentarius*).

   Some parts of this unit was historically transformed due to agricultural activities and subsequently covered by secondary graminoid species.

3. *Artificial livestock watering points*: These are represented by artificial water troughs and reservoirs with the purpose to provide drinking water to livestock. However, they act as focal congregation areas for many granivore passerine and non-passerine species, including Cape Sparrow (*Passer melanurus*), Laughing Dove (*Spilopelia senegalensis*), Namaqua dove (*Oena capensis*), Scaly-feathered Weaver (*Sporopipes squamifrons*) and Wattled Starling (*Creatophora cinerea*). Due to the congregation of passerine species at these features, they could invariably attract small to medium sized bird of prey species (members of the genera Falco, Micronisus and Accipiter).

4. *Transformed areas*: These areas are represented by build-up land (houses) and exotic blue gum (*Eucalyptus* spp.) plantations. These features are an unimportant habitat for bird species, although the plantations often provide ephemeral roosting and nesting habitat for non-passerine species such as Pied Crow (*Corvus albus*), Black-headed Heron (*Ardea melanocephala*) and Hadeda Ibis (*Bostrychia hagedash*).

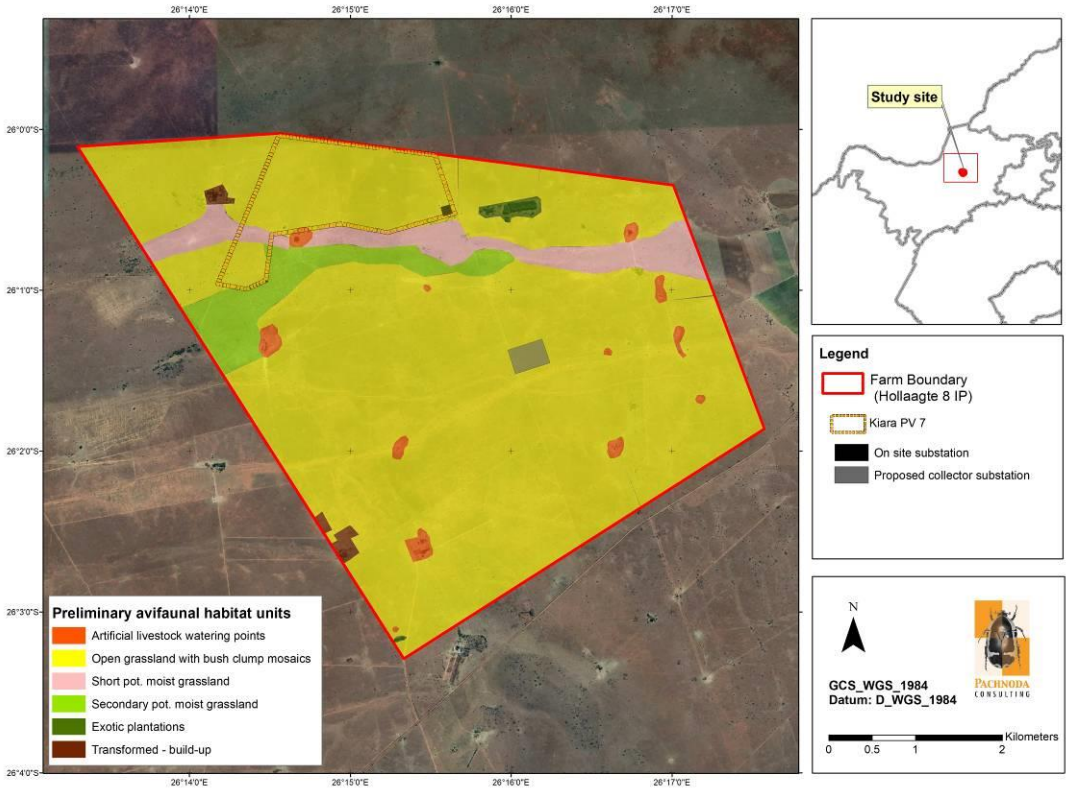

Figure 11: A preliminary habitat map illustrating the avifaunal habitat types on the study site and immediate surroundings (the habitat types are subject to change pending the outcome of a detailed baseline surveys).

3.7 Species Richness and Predicted summary statistics

Approximately ~174 bird species are expected to occur on the study site and immediate surroundings (refer to Appendix 1 & Table 1). The expected richness was inferred from the South African Bird Atlas Project (SABAP2)[2] (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat in the study area. This equates to 18 % of the approximate 987[3] species listed for the southern African subregion[4] (and approximately 20 % of the 871 species recorded within South Africa[5]). However, the species richness obtained from the pentad grids corresponding to the study area (c. 2600_2610 and 2600_2615) range between 32 and 40 species, with an average number of 36 species for each full protocol card submitted (for observation of two hours or more). The low number of observed species clearly illustrates that the study area has not been properly surveyed or atlased.

According to Table 1, the study area is poorly represented by biome-restricted[6] (see Table 2) and local endemic bird species. It does support *ca*. 31 % of the near - endemic species present in the subregion. Prominent wetland features and waterbodies are absent from the study site, thereby explaining the absence and low richness of waterfowl, wading birds and shorebird taxa.

Table 1: A summary table of the total number of species, Red listed species (according to Taylor et al., 2015 and the IUCN, 2022), endemics and biome-restricted species (Marnewick et al., 2015) expected (*sensu* SABAP2) to occur in the study site and immediate surroundings.

Description	Expected Richness Value***
Total number of species*	174 (20 %)
Number of Red Listed species*	9 (6 %)
Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes)*	3 (21 %)
Number of local endemics (BirdLife SA, 2022)*	2 (5 %)
Number of local near-endemics (BirdLife SA, 2022)*	5 (17 %)
Number of regional endemics (Hockey *et al.,* 2005)**	11 (10 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	19 (31 %)

* only species in the geographic boundaries of South Africa (including Lesotho and eSwatini) were considered.

** only species in the geographic boundaries of southern Africa (including Namibia, Botswana, Zimbabwe and Mozambique south of the Zambezi River) were considered

*** Percentage values in brackets refer to totals compared against the South African avifauna (*sensu* BirdLife SA, 2022).

[2] The expected richness statistic was derived from pentad grids 2600_2610 and 2600_2615 (including 10 adjacent grids) totalling 247 bird species (based on 76 full protocol cards).

3 *sensu* www.zestforbirds.co.za (Hardaker, 2020), including four recently confirmed bird species (vagrants.

4 A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, eSwatini and Lesotho).

5 With reference to South Africa (including Lesotho and eSwatini (BirdLife South Africa, 2022).

[6] A species with a breeding distribution confined to one biome. Many biome-restricted species are also endemic to southern Africa.

Table 2: Expected biome-restricted species (Marnewick *et al*, 2015) likely to occur on the study site and immediate surroundings.

Species	Kalahari-Highveld	Zambezian	Expected Frequency of occurrence
Kalahari Scrub-robin (*Cercotrichas paena)*	X		Common
White-throated Robin-chat (*Cossypha humeralis*)		X	Fairly common
White-bellied Sunbird (*Cinnyris talatala*)		X	Common

3.8 Bird species of conservation concern

Table 3 provides an overview of bird species of conservation concern that could occur on the study site based on their historical distribution ranges and the presence of suitable habitat. According to Table 3, a total of nine species could occur on the study site which includes six globally threatened species, one globally near threatened species, one regionally threatened species and one regionally near-threatened species.

It is evident from Table 3 that the highest reporting rates (>10%) were observed for the globally endangered Cape Vulture (*Gyps coprotheres*) and the globally critically endangered White-backed Vulture (*Gyps africanus*). These species have a high likelihood of occurrence pending the presence of suitable food (livestock carcasses).

The regionally vulnerable Lanner Falcon (*Falco biarmicus*), globally endangered Lappet-faced Vulture (*Torgos tracheliotos*), globally vulnerable Red-footed Falcon (*Falco vespertinus*) and globally near threatened Black-winged Pratincole (*Glareola nordmanni*) show reporting rates between 2% and 5.3 %. These species have a moderate probability of occurrence and are regarded as occasional foraging visitors to the area.

The remaining species have low reporting rates (<2%) and are regarded as irregular foraging visitors with low probabilities of occurrence. It is possible that the low reporting rates reflect the poor coverage of the study area by citizen scientists (e.g. birdwatchers), and some of these species could occur in higher numbers due to being overlooked. As an example, Red-footed Falcons (*F. vespertinus*) often occur in flocks of the similar-looking Amur Falcon (*F. amurensis*), which based on reporting rates appear to be a common summer visitor to the area. Therefore, it is highly possible that Red-footed Falcons were previously overlooked or misidentified.

Table 3: Bird species of conservation concern that could utilise the study site based on their historical distribution range and the presence of suitable habitat. Red list categories according to the IUCN (2022)* and Taylor et al. (2015)**.

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Falco vespertinus (Red-footed Falcon)	Vulnerable	Near threatened	2.67	Varied, prefers to hunt open arid grassland and savannoid woodland, often in company with Amur Falcons (*F. amurensis*).	An occasional summer foraging visitor to the area.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	4.00	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor to the study area.
Glareola nordmanni (Black-winged Pratincole)	Near threatened	Near threatened	2.67	Varied, but forages over open short grassland, pastures and agricultural lands (especially when being tilled)	A potential regular foraging visitor to the study area.
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	12.00	Mainly confined to mountain ranges, especially near breeding site. Ventures far afield in search of food.	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock carcasses).
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	13.33	Breed on tall, flat-topped trees. Mainly restricted to	A regular foraging/scavenging visitor to the study site pending the

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
				large rural or game farming areas.	presence of food (e.g. livestock carcasses).
Leptoptilos crumeniferus (Marabou Stork	-	Near threatened	1.33	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas	An irregular scavenging visitor to the area.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	1.33	Varied, from open karroid shrub to lowland savanna.	An irregular foraging visitor. It was last recorded from pentad 2605_2605 on 28 Jan 2012.
Sagittarius serpentarius (Secretarybird)	Endangered	Endangered	1.33	Prefers open grassland or lightly wooded habitat.	Regarded as an irregular foraging visitor to the study site despite the widespread presence of suitable foraging habitat.
Torgos tracheliotos (Lapped-faced Vulture)	Endangered	Endangered	5.33	Lowveld and Kalahari savanna; mainly on game farms and reserves	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock carcasses).

3.9 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 12):

Areas of high sensitivity

It includes the artificial livestock watering points and short potentially moist grassland habitat.

The artificial livestock watering points have the potential to attract large numbers of granivore passerine and non-passerine bird species, of which many need to drink water on a daily basis. The placement of electrical infrastructure in close proximity to these areas could increase potential avian collisions with the infrastructure. These features could also attract collision-prone bird species such as birds of prey. It is possible that the high number of birds at this habitat could attract birds of prey which could collide with the PV infrastructure during hunting bouts. These areas are therefore of artificial origin, but could be relocated to other areas.

The short potentially moist grassland provide ephemeral foraging habitat for large terrestrial bird species, which could include the endangered Secretarybird (*Sagittarius serpentarius*).

Areas of medium sensitivity

It includes the extensive open grassland and bush clump mosaics. The extensive open grassland and bush clump mosaics provide potential suitable foraging habitat for some collision-prone bird species, including the Northern Black Korhaan (*Afrotis afraoides*) with the potential to interact (e.g. collide) with the proposed electrical infrastructure. However, reporting rates for threatened and near threatened bird species are anticipated to be relatively low, thereby suggesting a medium sensitivity rating instead of a high sensitivity even though the majority of the habitat is natural. In addition, the open grassland and bush clump mosaics are widespread in the region.

Areas of low sensitivity

These habitat units are represented by transformed types and include a build-up land and exotic plantations.

The preliminary sensitivity map shows a large surface area that is earmarked with medium sensitivity. There is a probability that some of these units or part thereof could have higher (or lower) sensitivity ratings. It is therefore expected that some of the units or part thereof could represent different sensitivity ratings to those displayed in Figure 12 pending the outcome of a detailed austral summer season survey.

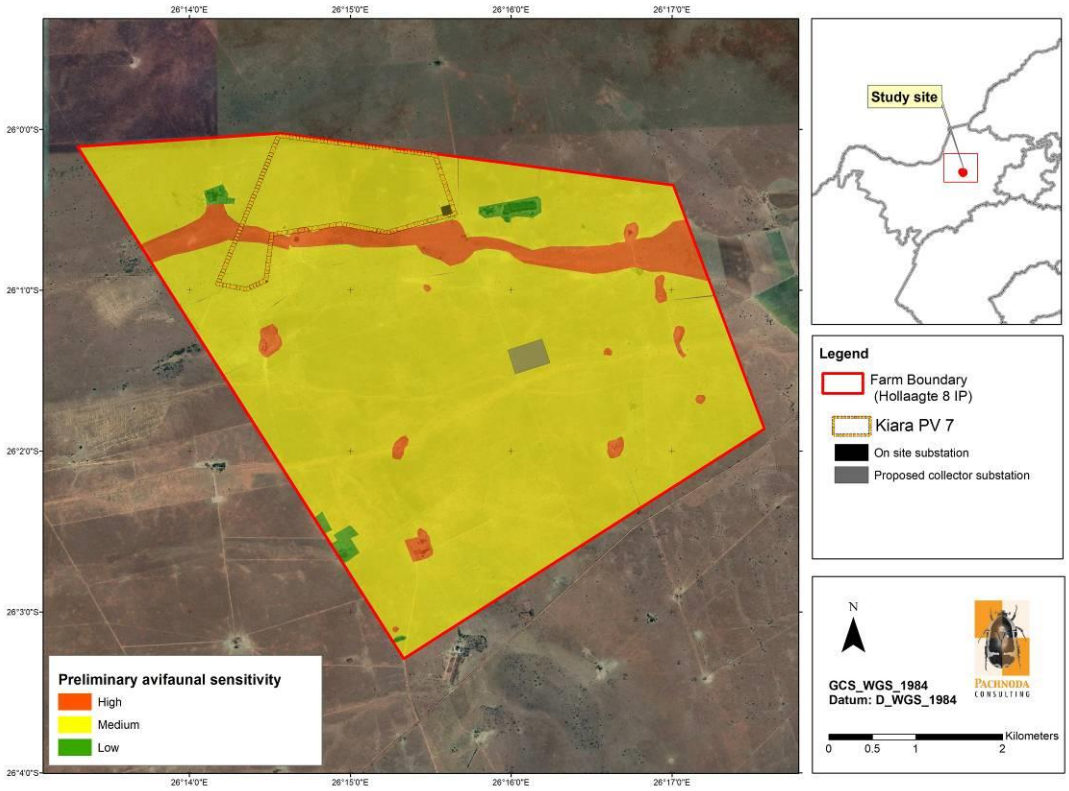

Figure 12: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

3.10 Overview of Avian Impacts at Solar Facilities

3.10.1 Background to solar facilities and their impact on birds

Birds are mobile, and are therefore also more readily affected by solar facilities than other taxonomic groups (e.g. mobile mammals that could move away from the facilities due to displacement). In fact, birds are also vulnerable to impacts caused by other types of energy facilities such as overhead power lines and wind farms. Little information is available on the impacts of solar energy facilities on birds although Gunerhan *et al.* (2009), McCrary *et al.* (1986), Tsoutsos *et al.* (2005) and the recent investigation reports on bird fatalities in the USA by Kagen *et al*. (2014) and Walston *et al*. (2016) provide discussions thereof. These studies have shown that avian fatalities vary greatly between the geographic positions of the solar facilities and also depend on the type of solar facility. In addition, very few of the large solar facilities in operation undertake systematic monitoring of avian fatalities, which explains the lack of detailed information of avian impacts. According to these studies conducted at both Concentrated Solar Power (CSP) and PV facilities, avian incidental fatalities range from 14 to over 180 birds which were summarised over a survey period conducted during one to three years. According to the Walston *et al.* (2016) assessment, the average annual mortality rate for known utility-scale solar facilities

(the annual number of estimated bird deaths per megawatt of electrical capacity) is 2.7, and 9.9 for known and unknown fatalities (which include carcasses found on the project site of which the death is not known). McCrary *et al.* (1986) found an average rate of mortality of 1.9-2.2 birds per week affecting 0.6-0.7 % of the local bird population. However, most of the avian fatalities at these solar facilities are also probably underestimated since 10-30 % of dead birds are removed by scavengers before being noted.. From these analyses and assessments it was evident that:

- Medium levels of bird fatalities occur at PV sites when compared to CSP sites (when taking powerline collisions into account).
- Approximately 81 % of all avian mortalities were caused by collisions, including collisions with electrical distribution lines.
- Most of the mortalities were small passerines (especially swallows).
- Fatalities at these solar facilities also include waterbirds (e.g. grebes, herons and gulls) which were probably attracted by the apparent "lake effect" caused by the reflective surface of the PV panels.
- Approximately 10-11 % of the fatalities consists of waterbirds, but could be as high as 49 % at certain facilities.
- It is unclear if the "lake effect" caused by the panels (at PV facilities) or mirrors (at CSP facilities) are the main cause of birds colliding or interacting with the infrastructure (since both waterbirds and other passerines are colliding with the infrastructure).
- Most of the fatalities are of resident birds as opposed to migratory species.

In a review report by Harrison *et al.* (2016), an attempt was made to provide evidence of the impacts caused by solar PV facilities alone (not combined with CSP facilities) on birds in the UK. These authors reviewed approximately 420 scientific documents, including 37 so-called "grey" literature from non-government and government organisations for any evidence relating to the ecological impacts of solar PV facilities. Their main findings were as follows:

- The majority of the documents were not relevant and peer-reviewed documents of experimental scientific evidence on avian fatalities were non-existent.
- Results based on carcass searches suggest that the bird collision risk at PV developments are low, although these studies did not take collision by overhead power lines into account.
- Many of the documents recommended that PV developments in close proximity to protected areas should be avoided.
- The PV panels reflect polarised light, which can attract polarotactic insects with potential impact to their reproductive biology. In addition, the polarising effect of the PV panels may also induce drinking behaviour in some birds, which may mistake the panels for water.

They conclude that impact assessment reports should consider taxon-specific requirements of birds and their guilds.

3.10.2 Potential impacts of PV solar facilities on birds

The magnitude and significance of impacts to birds caused by solar facilities will depend on the following factors:

- The geographic locality of the planned solar facility;
- The size or surface extent of the solar facility;
- The type of solar facility (according to the technologies applied, e.g. PV or Concentrated Solar Power (CSP)); and
- The occurrence of collision-prone bird species (which are often closely related to the locality of the solar facility).

Any planned solar facility corresponding to an area with many threatened, range-restricted or collision-prone species will have a higher impact on these birds. In addition, any planned solar facility located in close proximity to important flyways, wetland systems or roosting/nesting sites used by the aforementioned species will have a higher impact.

The main impacts associated with PV solar facilities include (Jenkins *et al*., 2017):

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction;
- Disturbances caused to birds during construction and operation;
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies);
- Collision with associated infrastructure (mainly overhead powerlines and reticulation);
- Attracting novel species to the area (owing to the artificial provision of new habitat such as perches and shade) which could compete with the residing bird population.

3.11 Potential Impacts associated with the proposed PV Solar Energy Facility

3.11.1 Loss of habitat and displacement of birds

Most of the study site will cleared of vegetation and habitat to accommodate the panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species. From the preliminary results it is evident that large-bodied species are more likely to become displaced as opposed to small passerine species. It is particularly biome-restricted, endemic and conservation important species that are likely to become displaced, as well as habitat specialists (e.g. grassland specialists) which will disappear from the area. These include mainly passerine and smaller non-passerine species inhabiting the untransformed dolomite grasslands and bush clump mosaics.

To quantify the impact it is necessary to calculate the number of birds (density) lost or displaced by the activity, including estimated density values of important species per unit area of habitat. This will be conducted during an austral summer season survey of the proposed PV facilities. From a preliminary analysis, the following bird species are most likely to be impacted by the loss of habitat due to their habitat requirements, fecundity and conservation status (although not limited to) due to the proposed development:

- Northern Black Korhaan (*Afrotis afraoides*);
- Kalahari Scrub Robin (*Cercotrichas paena*);
- White-browed Scrub-robin (*Cossypha humeralis*); and
- Orange River Francolin (*Scleroptila gutturalis*).

3.11.2 Interaction with overhead powerlines and reticulation

An overhead powerline is proposed to the MTS is proposed. Birds are impacted in three ways by means of overhead powerlines (described below). It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with powerlines in general. These include the following:

- *Electrocution*

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a tower or attempts to fly-off a tower. Many of these species include vultures (of the genera *Gyps* and *Torgos*) as well as other large birds of prey such as the Martial Eagle (*Polemaetus bellicosus*) (Ledger & Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). These species will attempt to roost and even breed on the tower structures if available nesting platforms are a scarce commodity in the area. Other types of electrocutions happen by means of so-called “bird-streamers”. This happens when a bird, especially when taking off, excretes and thereby causes a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999).

Large transmission lines (from 220 kV to 765 kV) are seldom a risk of electrocution, although smaller distribution lines (88 – 132kV) pose a higher risk. However, for this project, the design of the pylon is an important consideration in preventing bird electrocutions. **The proposed pylon design must incorporate the following design parameters**:

- The clearances between the live components should exceed the wingspan of any bird species;

- The height of the tower should allow for unrestricted movement of terrestrial birds between successive pylons;
- The live components should be “bundled” to increase the visibility for approaching birds;
- “Bird streamers” should be eliminated by discouraging birds from perching above the conductors.

It is therefore recommended that the pylon design incorporates "features as illustrated by Figure 13[7].

From Figure 13 it is clear that perching of birds is discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird “streamers” are also eliminated by fitting the poles with bird guards/spikes above the conductors. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

Figure 13: Two bird-friendly tower designs to be used for the current project.

[7] Please note that these are examples of recommended pylon designs. These are taken from steel monopole pylons.

- *Collision*

Collisions with earth wires have probably accounted for most bird-powerline interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as bustards, korhaans and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. most species of storks) find it difficult to make a sudden change in direction while flying – resulting in the bird flying into the earth wires.

Areas where bird collisions are likely to be high could be ameliorated by marking the lines with appropriate bird deterrent devices such as “bird diverters” and “flappers” to increase the visibility of the lines. Although this is true for most other bird species that are prone towards power line collisions, the risk of Cape Vultures, Lapped-faced Vultures and White-backed Vultures colliding with the power line will persist due to the foraging behaviour and ecological requirements of these species. Cape Vultures feed communally and congregate in large numbers at a carcass; therefore any power line in close proximity to such a carcass/feeding area could result in this species colliding with the earth wires, often resulting in more than a single mortality.

- *Physical disturbances and habitat destruction caused during construction and maintenance*

It is anticipated that part of the power line servitude will be cleared of vegetation. In addition, construction activities go hand in hand with high ambient noise levels. Although construction is considered temporary, many species will vacate the area during the construction phase and will become temporarily displaced.

The artificial livestock watering points also deserve special consideration since these features are often overlooked or neglected during the construction of power lines as they often attract large numbers of small passerine birds and birds of prey (the latter often include falconiform taxa which hunt small passerines). Construction activities in close proximity to these features could possibly displace these individuals from the area or increase the risk of collision. Nevertheless, these features could easily be removed or relocated to other areas.

3.12 Collision-prone bird species

A total of 39 collision-prone bird species have been recorded from the study area, of which 20 species are birds of prey (Table 4), which include three vulture species (Cape Vulture *Gyps coprotheres*, White-backed Vulture *Gyps africanus* and Lappet-faced Vulture *Torgos tracheliotos*). Those species with mean reporting rates higher

than 10% are regarded to be regular on the area and includes the highly collision-prone White-backed Vulture (*Gyps africanus*) and Cape Vulture (*G. coprotheres*)

The study site does not coincide with any prominent wetland system or impoundment which will lower the risk of waterbird collisions with the proposed electrical infrastructure.

Table 4: Collision-prone bird species and Red listed species (in red) expected to be present on the study site and immediate surroundings inferred from the South African Atlas Project (SABAP2).

Common Name	Scientific Name	SABAP2 Reporting Rate			
		Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
African Harrier-Hawk	*Polyboroides typus*	2.67	2	0.00	0
African Sacred Ibis	*Threskiornis aethiopicus*	10.67	8	0.00	0
African Stonechat	*Saxicola torquatus*	44.00	33	0.00	0
Amur Falcon	*Falco amurensis*	17.33	13	7.69	1
Black Kite	*Milvus migrans*	1.33	1	0.00	0
Black Sparrowhawk	*Accipiter melanoleucus*	2.67	2	0.00	0
Black-chested Snake Eagle	*Circaetus pectoralis*	4.00	3	0.00	0
Black-headed Heron	*Ardea melanocephala*	22.67	17	7.69	1
Black-winged Kite	*Elanus caeruleus*	32.00	24	15.38	2
Black-winged Pratincole	*Glareola nordmanni*	2.67	2	0.00	0
Brown Snake Eagle	*Circaetus cinereus*	1.33	1	0.00	0
Cape Vulture	*Gyps coprotheres*	12.00	9	0.00	0
Common (=Steppe) Buzzard	*Buteo buteo vulpinus*	2.67	2	0.00	0
Coqui Francolin	*Peliperdix coqui*	10.67	8	0.00	0
Crested Francolin	*Dendroperdix sephaena*	2.67	2	0.00	0
Egyptian Goose	*Alopochen aegyptiaca*	21.33	16	7.69	1
Greater Kestrel	*Falco rupicoloides*	5.33	4	15.38	2
Hadada Ibis	*Bostrychia hagedash*	65.33	49	0.00	0
Hamerkop	*Scopus umbretta*	4.00	3	0.00	0
Helmeted Guineafowl	*Numida meleagris*	49.33	37	7.69	1
Lanner Falcon	*Falco biarmicus*	4.00	3	0.00	0
Lappet-faced Vulture	*Torgos tracheliotos*	5.33	4	7.69	1
Lesser Kestrel	*Falco naumanni*	16.00	12	0.00	0
Marabou Stork	*Leptoptilos crumenifer*	1.33	1	0.00	0
Martial Eagle	*Polemaetus bellicosus*	1.33	1	0.00	0
Natal Spurfowl	*Pternistis natalensis*	2.67	2	0.00	0
Northern Black Korhaan	*Afrotis afraoides*	42.67	32	7.69	1
Orange River Francolin	*Scleroptila gutturalis*	25.33	19	15.38	2
Pied Crow	*Corvus albus*	52.00	39	23.08	3
Red-footed Falcon	*Falco vespertinus*	2.67	2	0.00	0
Secretarybird	*Sagittarius serpentarius*	1.33	1	0.00	0
Speckled Pigeon	*Columba guinea*	69.33	52	23.08	3

Common Name	Scientific Name	SABAP2 Reporting Rate			
		Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
Spotted Eagle-Owl	*Bubo africanus*	2.67	2	0.00	0
Spur-winged Goose	*Plectropterus gambensis*	12.00	9	0.00	0
Swainson's Spurfowl	*Pternistis swainsonii*	49.33	37	0.00	0
Western Barn Owl	*Tyto alba*	4.00	3	0.00	0
Western Cattle Egret	*Bubulcus ibis*	49.33	37	0.00	0
White-backed Vulture	*Gyps africanus*	13.33	10	0.00	0
Yellow-billed Kite	*Milvus aegyptius*	12.00	9	0.00	0

The study site does not coincide with any prominent wetland system or impoundment which could increase the risk of waterbird collisions with the proposed electrical infrastructure.

3.12.1 Vultures

Three species of vulture occur in the study area, which are prone towards electrocution and collision with powerlines. These include the globally critically endangered White-backed Vulture (*Gyps africanus*), the globally endangered Cape Vulture (*G. coprotheres*) and the globally endangered Lapped-faced Vulture (*Torgos tracheliotos*). These species are of international significance and any mortality of adult individuals could have a negative effect on its species' population recruitment. Most of these suffer from a shortage of food supplies which is responsible for low reproductive rates, especially for Cape Vultures (Taylor *et al*., 2015). In addition, most of these species also tend to congregate at mammalian carcasses, where they feed in large groups, especially in terms of Cape Vultures. In addition, Cape Vultures also typically search for food in groups. It is such congregations which increase the risk of mortalities whenever these individuals forage or roost in close proximity to powerlines. For example, the proposed study area coincides with the foraging rangeland of Cape Vultures as evidenced by dispersal data obtained from vulture individuals fitted with satellite tracking devices (Figure 14).

The highest number of mortalities due to electrocution and collision recorded in the study region pertains to Cape Vultures (*Gyps coprotheres*) and White-backed Vultures (*Gyps africanus*) (according to the electrical infrastructure mortality incident register) (Figure 15). Most of the mortalities were caused during electrocution from smaller distribution lines in the area, although a significant number of Cape Vulture mortalities (*c*. 30 %) were also caused by collisions with transmission lines (Figure 16). There is a definite correlation between the size (in terms of voltage) of the powerline and the type of mortality, whereby electrocution incidents were prominent from distribution lines, while collisions were caused by transmission lines. Therefore, it is postulated that risk of collision mortalities in vulture species in the area will remain when considering the proposed powerline will be placed alongside existing powerlines. Most of the powerline interactions also occurred in the Ventersdorp and Lichtenburg area (Figure 17), with a single mass mortality involving 10 Cape Vultures

and eight White-backed Vultures on 09 March 2009 **It clearly shows that when these species congregate (for example when feeding from a carcass in close proximity to a powerline or when roosting on pylons or nearby structures in close proximity to powerlines), the risk of mortality due to both electrocution and collision is greatly increased**.

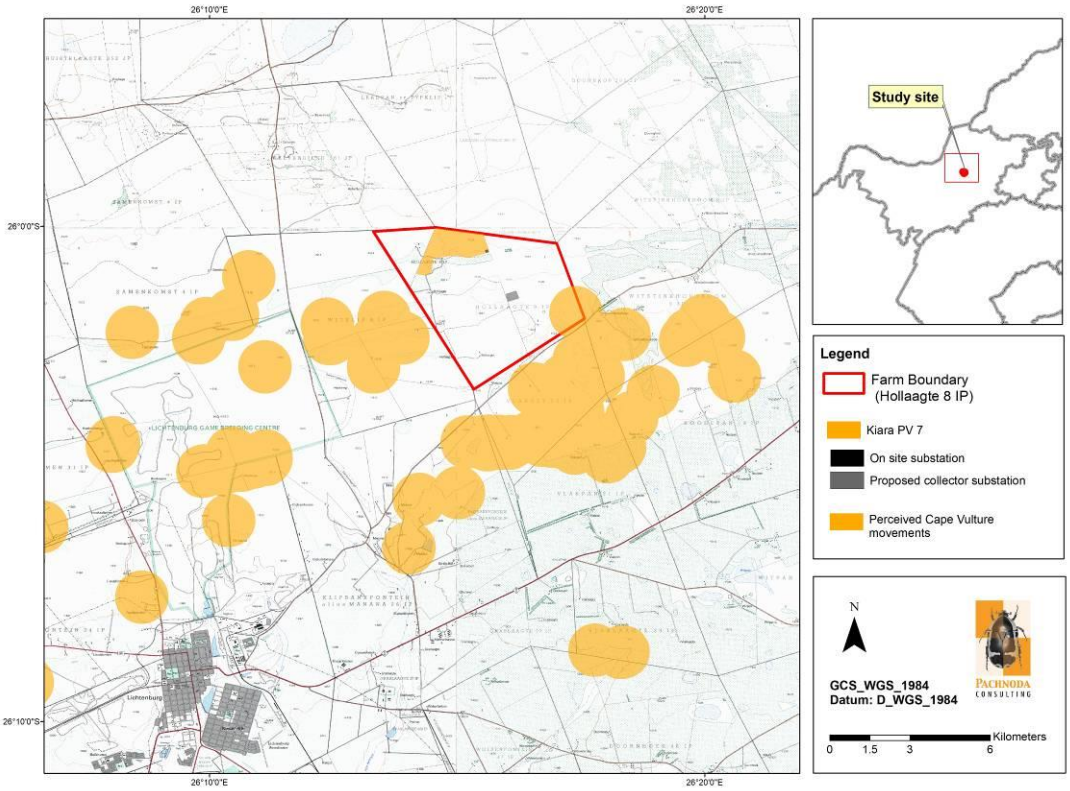

Figure 14: The occurrence of Cape Vultures (*Gyps coprotheres*) within the study region fitted with satellite trackers.

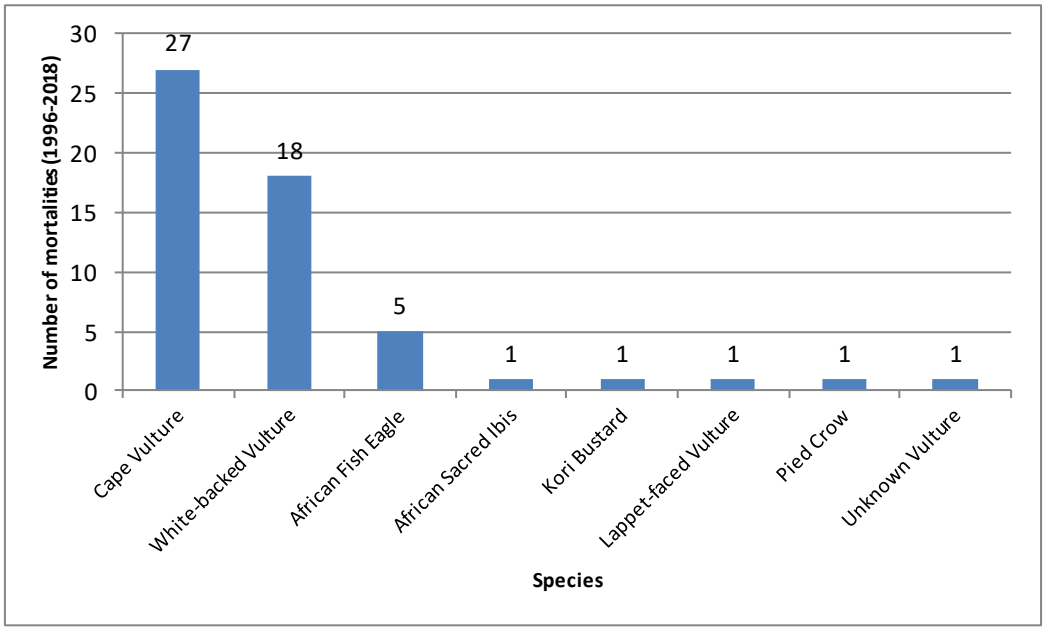

Figure 15: The number of mortalities (electrocutions and collisions) per bird species due to transmission and distribution lines in the study area (1996-2018).

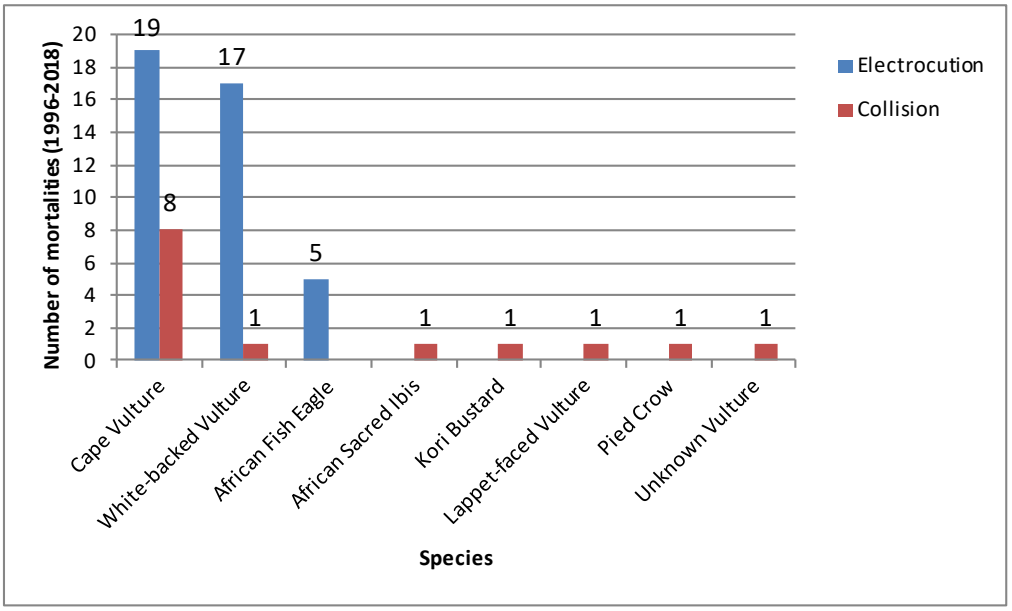

Figure 16: The number of mortalities per bird species caused by electrocutions (distribution lines) and collisions (transmission lines) (1996-2018).

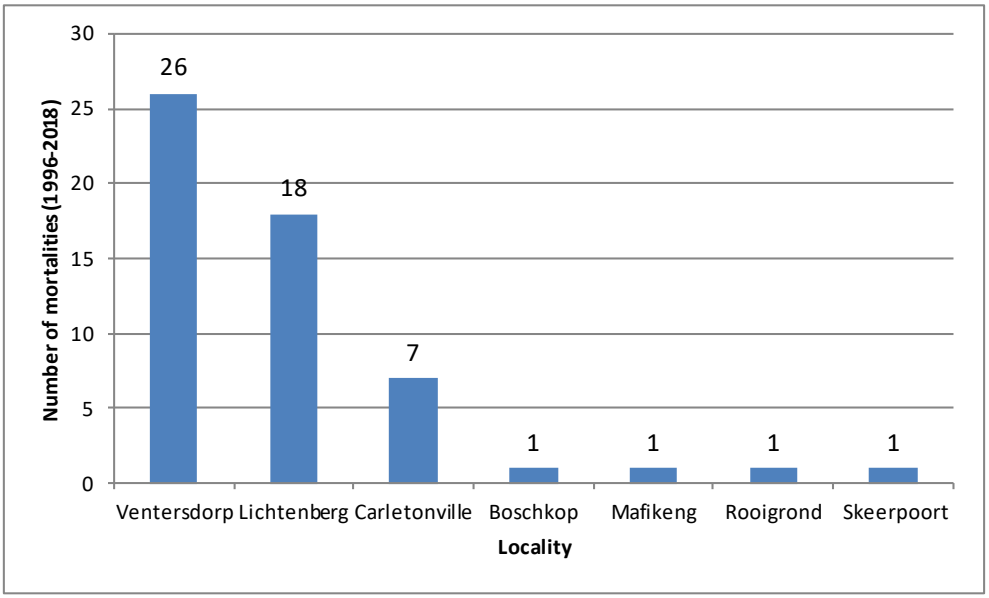

Figure 17: The number of bird mortalities caused by power lines per geographic locality (1996-2018), including the Lichtenburg area.

4. PLAN OF STUDY FOR THE EIA PHASE

Due to the limited level of detail that is normally implemented during a scoping assessment, it is imperative that detailed avifaunal investigations be conducted on the study area at an appropriate season.

4.1 Proposed approach and methods

The following methods are proposed during an austral summer season survey:

- Active searching and the compilation of a bird inventory while traversing much of the available habitat types;
- The determination of the occurrence of Red Data species and collision-prone bird species;
- The identification and mapping of suitable habitat for species of conservation concern while focussing on structural and topographical cues;
- A landscape analysis of important flyways or daily flight paths corresponding to important landscape features; and
- Density estimates will be collected by means of point counts to evaluate the dominant/typical species and their respective relative densities at each site. At each point the number of bird species seen will be recorded, as well as their respective abundances and distance from the observer (by means of a rangefinder). The data generated from the point counts will be analysed according to Clarke & Warwick (1994) based on the computed percentage contribution (%) of each species including the consistency (calculated as the similarity

coefficient/standard deviation) of its contribution to the each habitat type.

- Suitable bird repelling structures and bird diverters will be provided to avoid collision of birds with the PV facility and associated powerlines.

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Appendix 1: A shortlist of bird species expected to be present on the study area. The list provides an indication of the species occurrence according to SABAP2 reporting rates.

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
432	Acacia Pied Barbet	*Tricholaema leucomelas*	44.00	33	7.69	1
171	African Harrier-Hawk	*Polyboroides typus*	2.67	2	0.00	0
418	African Hoopoe	*Upupa africana*	40.00	30	7.69	1
387	African Palm Swift	*Cypsiurus parvus*	38.67	29	0.00	0
682	African Paradise Flycatcher	*Terpsiphone viridis*	8.00	6	0.00	0
692	African Pipit	*Anthus cinnamomeus*	40.00	30	7.69	1
544	African Red-eyed Bulbul	*Pycnonotus nigricans*	42.67	32	0.00	0
81	African Sacred Ibis	*Threskiornis aethiopicus*	10.67	8	0.00	0
576	African Stonechat	*Saxicola torquatus*	44.00	33	0.00	0
772	Amethyst Sunbird	*Chalcomitra amethystina*	5.33	4	0.00	0
119	Amur Falcon	*Falco amurensis*	17.33	13	7.69	1
575	Ant-eating Chat	*Myrmecocichla formicivora*	49.33	37	23.08	3
533	Arrow-marked Babbler	*Turdoides jardineii*	5.33	4	0.00	0
514	Ashy Tit	*Melaniparus cinerascens*	4.00	3	7.69	1
510	Banded Martin	*Riparia cincta*	18.67	14	0.00	0
493	Barn Swallow	*Hirundo rustica*	37.33	28	7.69	1
513	Black Cuckooshrike	*Campephaga flava*	1.33	1	0.00	0
128	Black Kite	*Milvus migrans*	1.33	1	0.00	0
159	Black Sparrowhawk	*Accipiter melanoleucus*	2.67	2	0.00	0
650	Black-chested Prinia	*Prinia flavicans*	69.33	52	7.69	1
146	Black-chested Snake Eagle	*Circaetus pectoralis*	4.00	3	0.00	0
431	Black-collared Barbet	*Lybius torquatus*	33.33	25	15.38	2
715	Black-crowned Tchagra	*Tchagra senegalus*	5.33	4	0.00	0
55	Black-headed Heron	*Ardea melanocephala*	22.67	17	7.69	1
521	Black-headed Oriole	*Oriolus larvatus*	4.00	3	0.00	0
245	Blacksmith Lapwing	*Vanellus armatus*	70.67	53	7.69	1
860	Black-throated Canary	*Crithagra atrogularis*	48.00	36	15.38	2
130	Black-winged Kite	*Elanus caeruleus*	32.00	24	15.38	2
282	Black-winged Pratincole	*Glareola nordmanni*	2.67	2	0.00	0
839	Blue Waxbill	*Uraeginthus angolensis*	20.00	15	15.38	2
405	Blue-cheeked Bee-eater	*Merops persicus*	10.67	8	0.00	0
722	Bokmakierie	*Telophorus zeylonus*	48.00	36	7.69	1
145	Brown Snake Eagle	*Circaetus cinereus*	1.33	1	0.00	0
714	Brown-crowned Tchagra	*Tchagra australis*	14.67	11	15.38	2
509	Brown-throated Martin	*Riparia paludicola*	10.67	8	7.69	1
731	Brubru	*Nilaus afer*	2.67	2	7.69	1
695	Buffy Pipit	*Anthus vaalensis*	1.33	1	7.69	1
4131	Burchell's Coucal	*Centropus burchellii*	17.33	13	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
703	Cape Longclaw	*Macronyx capensis*	32.00	24	7.69	1
531	Cape Penduline Tit	*Anthoscopus minutus*	4.00	3	0.00	0
581	Cape Robin-Chat	*Cossypha caffra*	20.00	15	0.00	0
786	Cape Sparrow	*Passer melanurus*	74.67	56	15.38	2
737	Cape Starling	*Lamprotornis nitens*	32.00	24	7.69	1
316	Ring-necked Dove	*Streptopelia capicola*	28.00	21	15.38	2
106	Cape Vulture	*Gyps coprotheres*	12.00	9	0.00	0
686	Cape Wagtail	*Motacilla capensis*	56.00	42	0.00	0
799	Cape Weaver	*Ploceus capensis*	5.33	4	0.00	0
1172	Cape White-eye	*Zosterops virens*	30.67	23	0.00	0
568	Capped Wheatear	*Oenanthe pileata*	8.00	6	0.00	0
484	Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*	6.67	5	0.00	0
658	Chestnut-vented Warbler	*Curruca subcoerulea*	44.00	33	7.69	1
673	Chinspot Batis	*Batis molitor*	6.67	5	7.69	1
872	Cinnamon-breasted Bunting	*Emberiza tahapisi*	10.67	8	15.38	2
631	Cloud Cisticola	*Cisticola textrix*	22.67	17	7.69	1
154	Common (=Steppe) Buzzard	*Buteo buteo vulpinus*	2.67	2	0.00	0
507	Common House Martin	*Delichon urbicum*	1.33	1	0.00	0
734	Common Myna	*Acridotheres tristis*	68.00	51	7.69	1
421	Common Scimitarbill	*Rhinopomastus cyanomelas*	16.00	12	7.69	1
843	Common Waxbill	*Estrilda astrild*	20.00	15	0.00	0
594	Common Whitethroat	*Curruca communis*	2.67	2	0.00	0
173	Coqui Francolin	*Peliperdix coqui*	10.67	8	0.00	0
439	Crested Barbet	*Trachyphonus vaillantii*	68.00	51	7.69	1
174	Crested Francolin	*Dendroperdix sephaena*	2.67	2	0.00	0
711	Crimson-breasted Shrike	*Laniarius atrococcineus*	22.67	17	7.69	1
242	Crowned Lapwing	*Vanellus coronatus*	70.67	53	7.69	1
545	Dark-capped Bulbul	*Pycnonotus tricolor*	42.67	32	7.69	1
630	Desert Cisticola	*Cisticola aridulus*	25.33	19	7.69	1
352	Diederik Cuckoo	*Chrysococcyx caprius*	32.00	24	0.00	0
1183	Eastern Clapper Lark	*Mirafra fasciolata*	25.33	19	0.00	0
89	Egyptian Goose	*Alopochen aegyptiaca*	21.33	16	7.69	1
404	European Bee-eater	*Merops apiaster*	28.00	21	0.00	0
570	Familiar Chat	*Oenanthe familiaris*	4.00	3	0.00	0
665	Fiscal Flycatcher	*Melaenornis silens*	44.00	33	0.00	0
517	Fork-tailed Drongo	*Dicrurus adsimilis*	1.33	1	7.69	1
874	Golden-breasted Bunting	*Emberiza flaviventris*	1.33	1	7.69	1
447	Golden-tailed Woodpecker	*Campethera abingoni*	1.33	1	0.00	0
785	Great Sparrow	*Passer motitensis*	1.33	1	0.00	0
440	Greater Honeyguide	*Indicator indicator*	4.00	3	0.00	0
122	Greater Kestrel	*Falco rupicoloides*	5.33	4	15.38	2
502	Greater Striped Swallow	*Cecropis cucullata*	50.67	38	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
419	Green Wood Hoopoe	*Phoeniculus purpureus*	10.67	8	0.00	0
830	Green-winged Pytilia	*Pytilia melba*	13.33	10	7.69	1
339	Grey Go-away-bird	*Crinifer concolor*	22.67	17	7.69	1
557	Groundscraper Thrush	*Turdus litsitsirupa*	6.67	5	0.00	0
84	Hadada Ibis	*Bostrychia hagedash*	65.33	49	0.00	0
72	Hamerkop	*Scopus umbretta*	4.00	3	0.00	0
192	Helmeted Guineafowl	*Numida meleagris*	49.33	37	7.69	1
784	House Sparrow	*Passer domesticus*	52.00	39	7.69	1
835	Jameson's Firefinch	*Lagonosticta rhodopareia*	2.67	2	0.00	0
586	Kalahari Scrub Robin	*Cercotrichas paena*	37.33	28	7.69	1
1104	Karoo Thrush	*Turdus smithi*	52.00	39	0.00	0
114	Lanner Falcon	*Falco biarmicus*	4.00	3	0.00	0
108	Lappet-faced Vulture	*Torgos tracheliotos*	5.33	4	7.69	1
317	Laughing Dove	*Spilopelia senegalensis*	92.00	69	23.08	3
706	Lesser Grey Shrike	*Lanius minor*	13.33	10	0.00	0
442	Lesser Honeyguide	*Indicator minor*	5.33	4	0.00	0
125	Lesser Kestrel	*Falco naumanni*	16.00	12	0.00	0
646	Levaillant's Cisticola	*Cisticola tinniens*	40.00	30	0.00	0
413	Lilac-breasted Roller	*Coracias caudatus*	1.33	1	0.00	0
410	Little Bee-eater	*Merops pusillus*	8.00	6	7.69	1
385	Little Swift	*Apus affinis*	33.33	25	0.00	0
621	Long-billed Crombec	*Sylvietta rufescens*	8.00	6	0.00	0
852	Long-tailed Paradise Whydah	*Vidua paradisaea*	4.00	3	0.00	0
818	Long-tailed Widowbird	*Euplectes progne*	45.33	34	0.00	0
73	Marabou Stork	*Leptoptilos crumenifer*	1.33	1	0.00	0
661	Marico Flycatcher	*Melaenornis mariquensis*	5.33	4	0.00	0
755	Marico Sunbird	*Cinnyris mariquensis*	1.33	1	0.00	0
142	Martial Eagle	*Polemaetus bellicosus*	1.33	1	0.00	0
318	Namaqua Dove	*Oena capensis*	16.00	12	7.69	1
183	Natal Spurfowl	*Pternistis natalensis*	2.67	2	0.00	0
637	Neddicky	*Cisticola fulvicapilla*	22.67	17	7.69	1
1035	Northern Black Korhaan	*Afrotis afraoides*	42.67	32	7.69	1
179	Orange River Francolin	*Scleroptila gutturalis*	25.33	19	15.38	2
838	Orange-breasted Waxbill	*Amandava subflava*	2.67	2	0.00	0
522	Pied Crow	*Corvus albus*	52.00	39	23.08	3
746	Pied Starling	*Lamprotornis bicolor*	8.00	6	7.69	1
846	Pin-tailed Whydah	*Vidua macroura*	26.67	20	0.00	0
694	Plain-backed Pipit	*Anthus leucophrys*	5.33	4	0.00	0
844	Quailfinch	*Ortygospiza atricollis*	20.00	15	7.69	1
642	Rattling Cisticola	*Cisticola chiniana*	9.33	7	0.00	0
708	Red-backed Shrike	*Lanius collurio*	26.67	20	0.00	0
837	Red-billed Firefinch	*Lagonosticta senegala*	14.67	11	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
805	Red-billed Quelea	*Quelea quelea*	46.67	35	7.69	1
501	Red-breasted Swallow	*Cecropis semirufa*	2.67	2	7.69	1
488	Red-capped Lark	*Calandrella cinerea*	9.33	7	0.00	0
813	Red-collared Widowbird	*Euplectes ardens*	2.67	2	0.00	0
314	Red-eyed Dove	*Streptopelia semitorquata*	74.67	56	23.08	3
392	Red-faced Mousebird	*Urocolius indicus*	52.00	39	15.38	2
120	Red-footed Falcon	*Falco vespertinus*	2.67	2	0.00	0
820	Red-headed Finch	*Amadina erythrocephala*	29.33	22	0.00	0
940	Rock Dove	*Columba livia*	17.33	13	0.00	0
506	Rock Martin	*Ptyonoprogne fuligula*	5.33	4	7.69	1
458	Rufous-naped Lark	*Mirafra africana*	36.00	27	15.38	2
460	Sabota Lark	*Calendulauda sabota*	5.33	4	7.69	1
789	Scaly-feathered Weaver	*Sporopipes squamifrons*	29.33	22	0.00	0
105	Secretarybird	*Sagittarius serpentarius*	1.33	1	0.00	0
847	Shaft-tailed Whydah	*Vidua regia*	1.33	1	7.69	1
504	South African Cliff Swallow	*Petrochelidon spilodera*	29.33	22	0.00	0
707	Southern Fiscal	*Lanius collaris*	74.67	56	23.08	3
709	Southern Boubou	*Laniarius ferrugineus*	2.67	2	0.00	0
4142	Southern Grey-headed Sparrow	*Passer diffusus*	24.00	18	7.69	1
803	Southern Masked Weaver	*Ploceus velatus*	80.00	60	15.38	2
808	Southern Red Bishop	*Euplectes orix*	61.33	46	7.69	1
390	Speckled Mousebird	*Colius striatus*	14.67	11	7.69	1
311	Speckled Pigeon	*Columba guinea*	69.33	52	23.08	3
474	Spike-heeled Lark	*Chersomanes albofasciata*	29.33	22	0.00	0
368	Spotted Eagle-Owl	*Bubo africanus*	2.67	2	0.00	0
654	Spotted Flycatcher	*Muscicapa striata*	20.00	15	0.00	0
275	Spotted Thick-knee	*Burhinus capensis*	6.67	5	0.00	0
88	Spur-winged Goose	*Plectropterus gambensis*	12.00	9	0.00	0
867	Streaky-headed Seedeater	*Crithagra gularis*	4.00	3	0.00	0
185	Swainson's Spurfowl	*Pternistis swainsonii*	49.33	37	0.00	0
649	Tawny-flanked Prinia	*Prinia subflava*	6.67	5	0.00	0
238	Three-banded Plover	*Charadrius tricollaris*	30.67	23	0.00	0
840	Violet-eared Waxbill	*Granatina granatina*	4.00	3	0.00	0
735	Wattled Starling	*Creatophora cinerea*	42.67	32	0.00	0
359	Western Barn Owl	*Tyto alba*	4.00	3	0.00	0
61	Western Cattle Egret	*Bubulcus ibis*	49.33	37	0.00	0
391	White-backed Mousebird	*Colius colius*	54.67	41	7.69	1
107	White-backed Vulture	*Gyps africanus*	13.33	10	0.00	0
763	White-bellied Sunbird	*Cinnyris talatala*	12.00	9	0.00	0
780	White-browed Sparrow-Weaver	*Plocepasser mahali*	70.67	53	7.69	1
409	White-fronted Bee-eater	*Merops bullockoides*	12.00	9	0.00	0
383	White-rumped Swift	*Apus caffer*	29.33	22	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of Cards	Ad hoc Protocol (%)	Number of Cards
582	White-throated Robin-Chat	*Cossypha humeralis*	1.33	1	0.00	0
495	White-throated Swallow	*Hirundo albigularis*	29.33	22	0.00	0
814	White-winged Widowbird	*Euplectes albonotatus*	20.00	15	0.00	0
599	Willow Warbler	*Phylloscopus trochilus*	12.00	9	7.69	1
866	Yellow Canary	*Crithagra flaviventris*	66.67	50	7.69	1
129	Yellow-billed Kite	*Milvus aegyptius*	12.00	9	0.00	0
812	Yellow-crowned Bishop	*Euplectes afer*	8.00	6	0.00	0
859	Yellow-fronted Canary	*Crithagra mozambica*	1.33	1	0.00	0
437	Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	2.67	2	0.00	0
629	Zitting Cisticola	*Cisticola juncidis*	38.67	29	0.00	0