DEVELOPMENT OF TWO PV SOLAR ENERGY FACILITIES (THEMEDA PV & ARISTIDA PV) AND ASSOCIATED INFRASTRUCTURE NEAR LICHTENBURG, NORTH WEST PROVINCE

Avifauna Scoping Report

February 2022

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EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Themeda PV (Pty) Ltd and Aristida PV (Pty) Ltd to compile an avifauna scoping report for the proposed construction of two photovoltaic (PV) solar energy facilities (known as the Themeda PV and Aristida PV facilities), each with a contracted capacity of up to 100 MW located on a site approximately 5 km north west of the town of Lichtenburg in the North West Province.

The objectives of the scoping 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, ranging from open mixed dolomite grassland with bush clump mosaics, mixed woodland on dolomite outcrops, moist dense grassland, and secondary grassland and pastures. Approximately 176 bird species are expected to occur on the study area, including 11 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 overhead reticulation)[1].

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 proposed PV facilities (according to reporting rates obtained from the atlas project - SABAP2). Although these species are highly prone to powerline collisions, the placement of the PV panels may result in the displacement of foraging individuals from the area. However, the risk of collision is considered more important when vultures feed on a carcass in close proximity to a powerline.

Collision risks associated with overhead powerlines (e.g. OHL and the grid corridor) will be dealt with in a separate Basic Assessment report, and such impacts will not form part of this screening report.

[1] It is important to note that impacts associated with the proposed powerline infrastructure will be assessed as part of a standalone Basic Assessment process and not as part of the facility EIAs. This report does however report on potential powerline associated impacts and collision prone species as the two (the facilities and the grid connection infrastructure) are co-dependant and should be viewed holistically.

In addition, a total of 39 collision-prone bird species have been recorded from the study area (*sensu* atlas data), of which seven species could potentially interact with the PV panels. The study sites are not located near any prominent wetland system or impoundment, and therefore the risk of waterbird collisions with the proposed infrastructure (PV panels) was considered to be low.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

DECLARATION OF INDEPENDENCE

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

- I act as the independent specialist in this application to Themeda PV (Pty) Ltd and Aristida (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)
28 February 2022

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 15 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 Themeda PV (Pty) Ltd and Aristida PV (Pty) Ltd to compile an avifauna scoping report for the proposed construction of two photovoltaic (PV) solar energy facilities (known as the Themeda PV and Aristida PV facilities), each with a contracted capacity of up to 100 MW located on a site approximately 5 km north west of the town of Lichtenburg in the North West Province (Figure 1). The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality. The sites are accessible via the R503, located south east of the development area.

The infrastructure of each proposed facility will consist 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);
- Auxiliary buildings (22kV or 33kV switch room, gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc);
- Temporary and permanent laydown area;
- Cabling between the panels, to be laid underground where practical; and
- An on-site facility substation stepping up from 22kV or 33kV to 132kV, with an extent of up to 1ha to facilitate the connection between the solar PV facility and the grid connection solution.

Both sites are located on Portion 7 of Farm Elandsfontein 34. The development area of the Themeda PV facility is approximately 197 ha, while the development area of the Aristida PV facility is approximately 232 ha.

Both the Themeda PV and Aristida PV facilities intends to connect to the National Grid via the Watershed Main Transmission Substation (MTS) (approximately 5 km east of the facility), however, the connection infrastructure associated with this grid solution is being assessed as part of a separate Environmental Application.

1.2 Terms of Reference

The main aim of this scoping exercise was to investigate the avifaunal attributes of the proposed PV facilities by means of a desktop analysis of GIS based information and third-party datasets and included a brief site visit which constituted the austral summer season sampling survey (January 2022).

Since the two proposed PV facilities are spatially autocorrelated (located within the same broad-scale habitat types, topography and climatic conditions), a combined scoping report was compiled which aims to provide an overview of the avifaunal attributes on the following properties ("herewith referred to as the "study site"):

- Portion 7 of the Farm Elandsfontein 34

However, a separate avifaunal impact report will be compiled for each facility (two reports) during the EIA phase of the project.

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;
- 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;
    - 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.

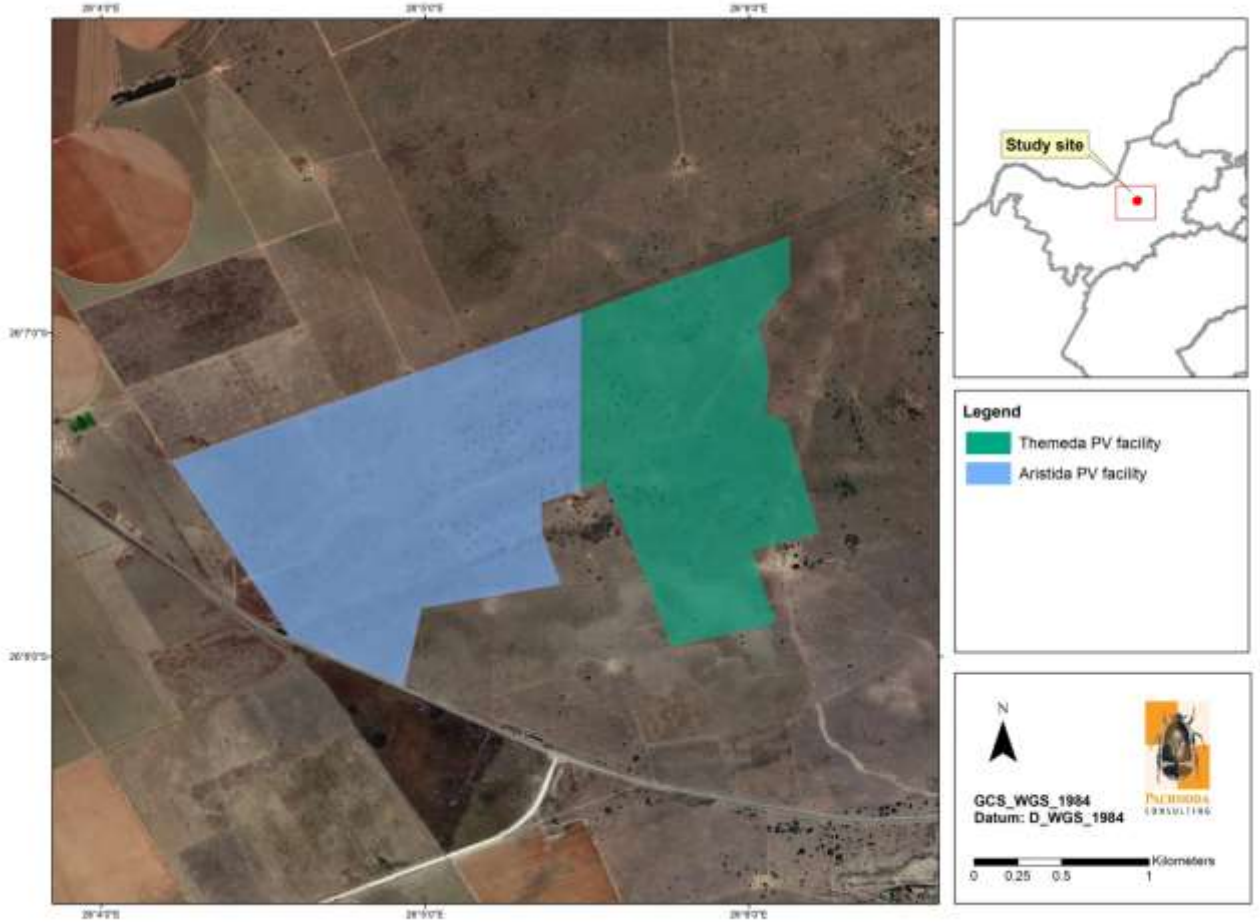

Figure 1: A satellite image illustrating the geographic position of the proposed PV facilities.

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 area, 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 SABAP2 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;
- observations made during a site visit (17 - 19 January 2022); and
- personal observations from similar habitat types in proximity to the study area, with emphasis on assessments conducted by Pachnoda Consulting (2018; 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 the quarter-degree grid cell (QDGC) 2626AA (Lichtenburg). 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 is 2605_2605 and 2605_2600 (although all eight pentad grids surrounding the central grid 2605_2605 were also scrutinised).
- **The expected bird list was inferred from personal observations obtained during previous surveys (2021 and 2018) in the study area (from neighbouring farm portions on the Farm Houthaalboomen 31).**
- 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).
- 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 interactions of birds with PV facilities was provided by the author's own personal observations.

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 a dry season and wet season survey will be conducted.

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 facilities are located on Portion 7 of the Farm Elandsfontein 34, located approximately 5 km north west of the town of Lichtenburg in the North West Province (Figure 1).

3.2 Regional Vegetation Description

The proposed PV facilities correspond 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 2).

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.

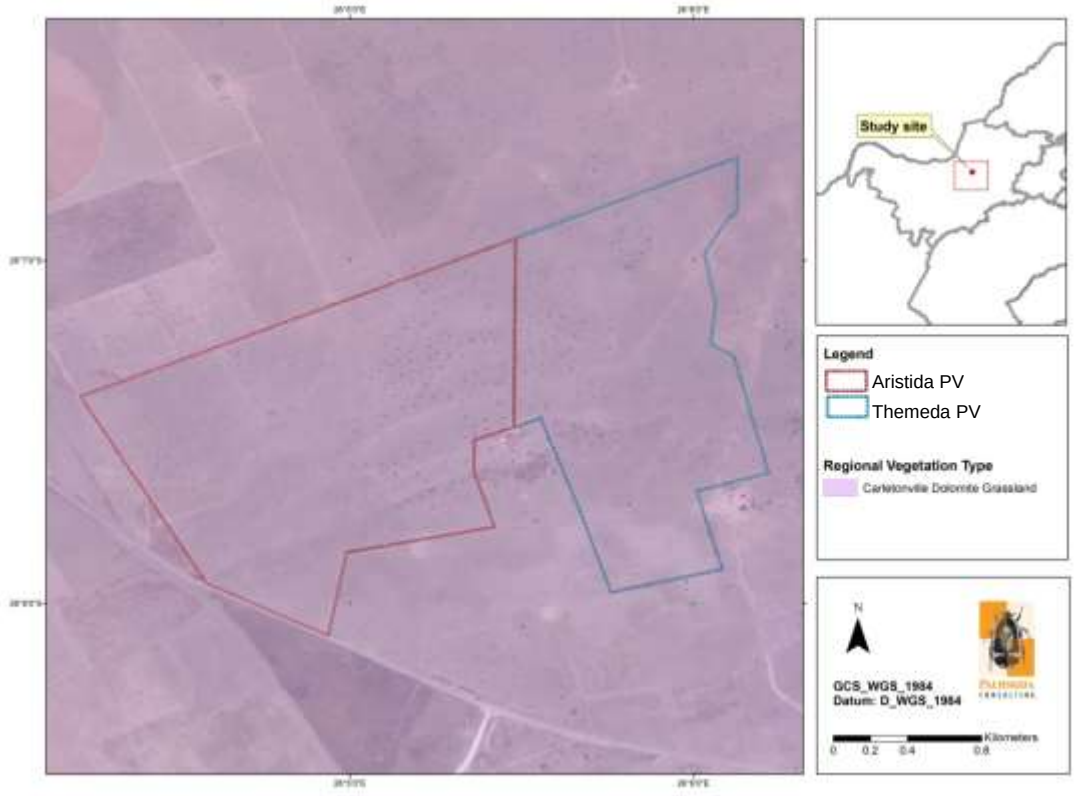

Figure 2: A satellite image illustrating the regional vegetation type corresponding to the study site. Vegetation type categories were defined by Mucina & Rutherford (2006).

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 3):

Natural areas:

- Grassland;
- Low shrubland;
- Woodland and open bush; and
- Wetlands

From the land cover dataset it is evident that most of the study site is covered by natural grassland, while some parts consist of low shrubland, especially on the western (mainly Themeda PV facility) and eastern section of the study site (mainly Aristida PV facility). The study site is primarily used for livestock production and livestock grazing. The north western part of the proposed Themeda PV facility is covered in secondary grassland that was historically part of a cultivated land, while the southern part of the proposed Aristida PV facility consists of derelict pastures. Figure 3 also shows a number of small wetland features on the western part of the Aristida PV site, but it is believed that these features were erroneously digitised during the production of the

national land cover dataset (these features were not observed during the recent site visit).

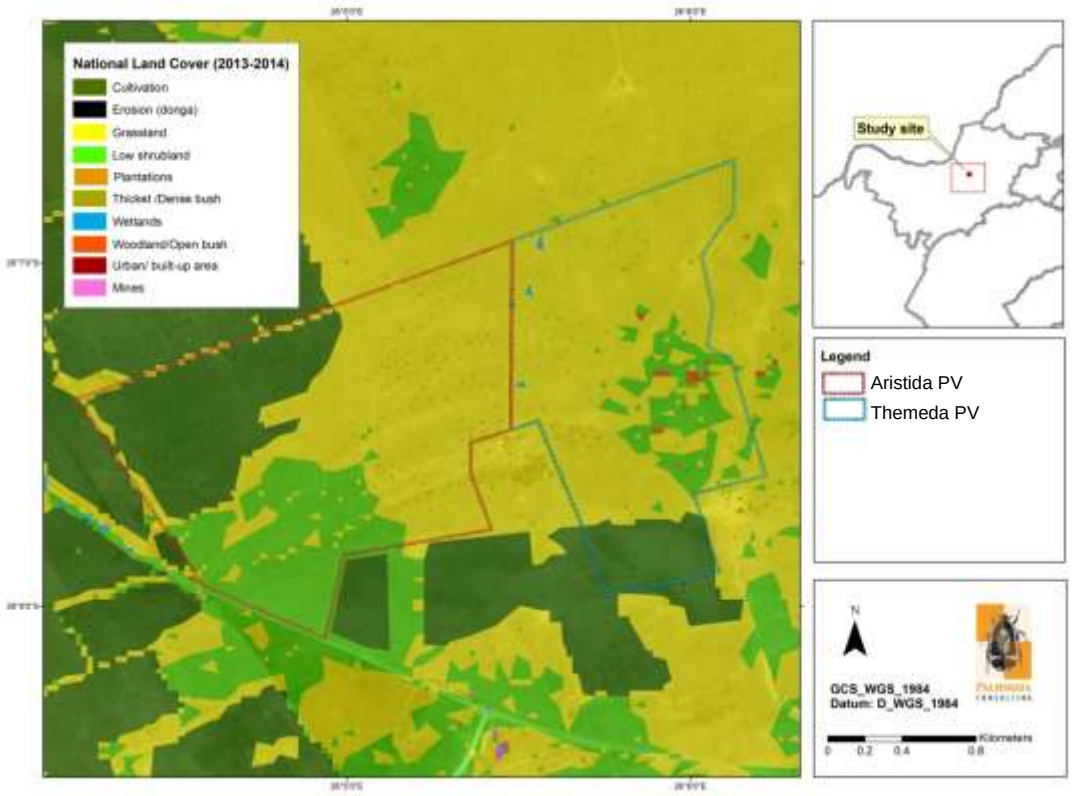

Figure 3: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed study site.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

The study site is located approximately 4.5 km west of the former Lichtenburg Game Breeding Centre (Figure 4). This conservation area contains a variety of game species, and the facility operates a vulture restaurant which attracts foraging vultures (c. three species) to the region. This area is currently under new 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.

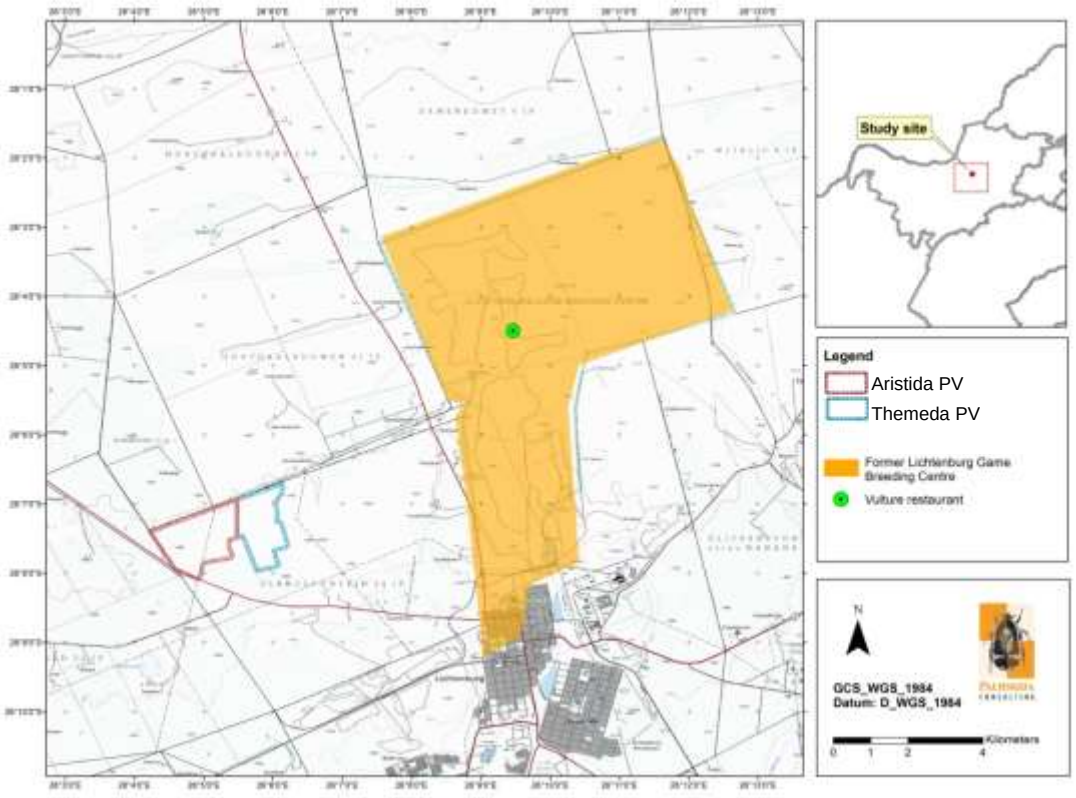

Figure 4: A map illustrating the locality of conservation areas in close proximity to the proposed study site.

3.5 Important avifaunal habitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the study site are a consequence of a combination of factors simulated by soil type, geology and grazing intensity (presence of livestock) which have culminated in a number of habitat types that deserve further discussion[2] (Figure 5 and Figure 6):

1. *Open mixed dolomite grassland with bush clump mosaics:* This unit is prominent on the study site and covers a significant extent in surface area of the proposed PV facilities. It is represented by two discrete floristic variations which also provide habitat for two discrete avifaunal associations (see Pachnoda Consulting, 2018; 2021). The first floristic variation consists of open untransformed to grazed mixed dolomite grassland and bush clumps with an eminent woody layer. The grassland variation is represented by untransformed to 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 is occupied by a typical grassland bird

[2] The habitat types are subject to change pending on the outcome of a detailed survey.

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*), Ant-eating Chat (*Myrmecocichla formicivora*) and Rufous-naped Lark (*Mirafra africana*). Prominent non-passerine species include Orange River Francolin (*Scleroptila gutturalis*), Swainson's Spurfowl (*Pternistis swainsonii*), Northern Black Korhaan (*Afrotis afraoides*), Crowned Lapwing (*Vanellus coronatus*) and Helmeted Guineafowl (*Numida meleagris*).

The bush clumps form a prominent mosaic characterised by the dominance of a woody layer of *Searsia lancea, S. pyroides, Ziziphus mucronata* and *Diospyros lycioides*. The eminent increase in vertical heterogeneity provided by the woody layer is colonised by 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*), Neddicky (*Cisticola fulvicapilla*) as well as granivores such as Yellow Canary (*Crithagra flaviventris*), Black-throated Canary (*Crithagra atrogularis*) and Southern Masked Weaver (*Ploceus velatus*). Non-passerine bird taxa are represented by Laughing Dove (*Spilopelia senegalensis*), Ring-necked Dove (*Streptopelia capicola*), Acacia Pied Barbet (*Tricholaema leucomelas*) and White-backed Mousebird (*Colius colius*).

2. *Mixed woodland on dolomite outcrops:* This unit is scattered on the study site where it occurs on both the Themeda and Aristida PV sites. It is represented by open to dense woodland dominated by *Searsia lancea, S. pyroides, Ziziphus mucronata* and *Diospyros lycioides* that are similar in floristic composition to the bush clump mosaics, although it occur on rocky soils. The vertical heterogeneity assists with the colonisation of a "Bushveld" bird association consisting of mainly insectivorous passerines. The latter composition is similar to the bird composition predicted for the bush clump mosaic habitat unit. Other noteworthy species include Spotted Flycatcher (*Muscicapa striata*), Crimson-breasted Shrike (*Laniarius atrococcineus*), Long-billed Crombec (*Sylvietta rufescens*) and Brown-crowned Tchagra (*Tchagra australis*).

3. *Moist dense grassland*: This habitat is located on the eastern part of the Aristida PV site which receives infiltration from run-off water during precipitation events. A small patch of *Imperata cylindrica* is also evident on the Themeda PV site. It is colonised by dense, coarse grass including dense *Hyparrhenia, Themeda triandra, Imperata cylindrica* and *Andropogon appendiculatum* which provide breeding and roosting habitat for Long-tailed Widowbird (*Euplectes progne*), Southern Red Bishop (*E. orix*) and Zitting Cisticola (*Cisticola juncidis*). It is also provides potential habitat for Marsh Owl (*Asio capensis*).

4. *Secondary grassland and pastures*: These are represented by secondary grassland and pastures that are dominated by tall coarse grass species such as *Hyparrhenia hirta* and *Chloris cf. gayana*. It is contains the same "grassland"

composition found within the open mixed dolomite grassland with bush clump mosaics although Cloud Cisticola (*Cisticola textrix*) and Long-tailed Widowbird (*Euplectes procne*) were prominent.

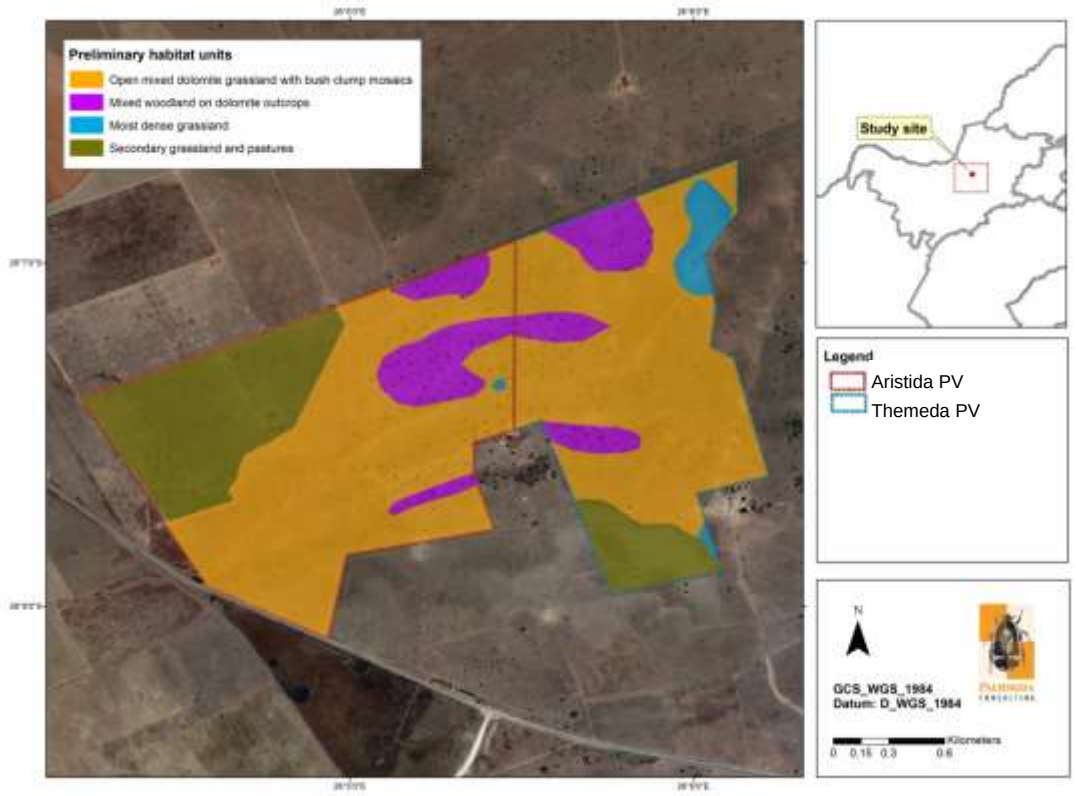

Figure 5: A preliminary habitat map illustrating the avifaunal habitat types on the study site (the habitat types are subject to change pending the outcome of detailed surveys).

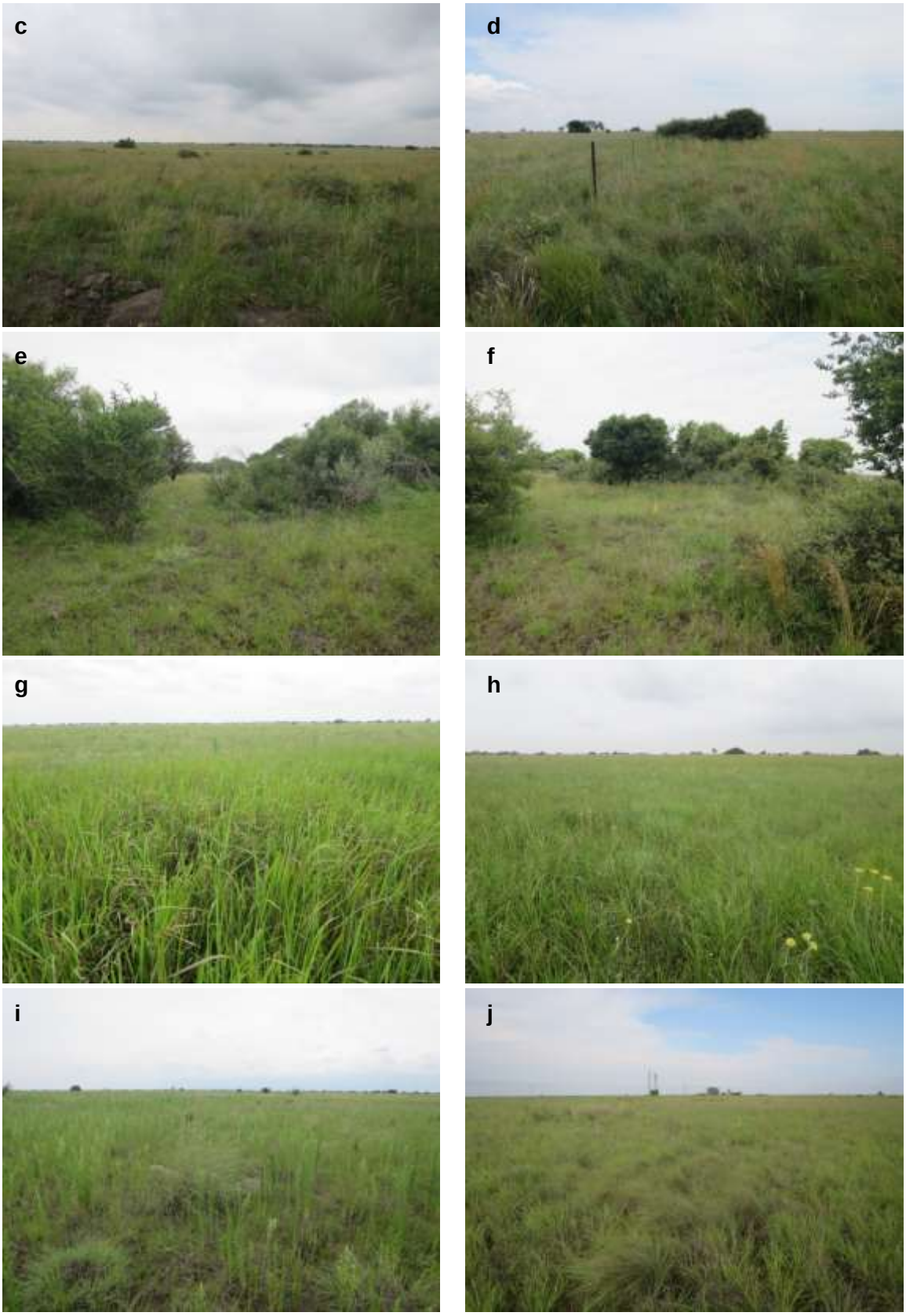

Figure 6: A collage of images illustrating examples of avifaunal habitat types on the study site observed during the austral summer season (January 2021): (a - d) open mixed dolomite grassland and bush clump mosaics, (e - f) mixed woodland on dolomite outcrops, (g - h). moist dense grassland and (i - j) secondary grassland and pastures.

3.6 Species Richness and Predicted summary statistics

Approximately ~176 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 (SABAP1 & SABAP2) (Harrison et al., 1997; www.sabap2.birdmap.africa), personal observations and the presence of suitable habitat in the study area. The expected richness is also strongly correlated with favourable environmental conditions (e.g. during good rains) and seasonality (e.g. when migratory species are present). This equates to 18 % of the approximate 986[3] species listed for the southern African subregion[4] (and approximately 21 % of the 858 species recorded within South Africa[5]). However, the average species richness obtained from the pentad grids 2605_2605 and 2605_2600 corresponding to the study site contained 132 species, with an average number of 45 species for each full protocol card submitted (for observations of two hours or more). According to personal observations, the average number of species observed on the study site range between 70-80 bird species (obtained during the austral summer season of January 2021).

According to Table 1, the study site is expected to be poorly represented by biome-restricted (see Table 2) and local endemic bird species. It is expected to support ca. 34 % of the near-endemic species present in the subregion. Of the 181 bird species expected to occur in the project area, 11 are threatened or near threatened species, 15 are southern African endemics and 21 are near-endemic species. In addition, two threatened species (White-backed Vulture *Gyps africanus* and Cape Vulture *G. coprotheres*) were observed on the study site (Table 3).

Table 1: A summary table of the total number of species, Red listed species (according to Taylor et al., 2015 and the IUCN, 2021), endemics and biome-restricted species (Marnewick et al., 2015) expected (*sensu* SABAP1 and SABAP2) to occur in the study site.

Description	Expected Richness Value***
Total number of species*	176 (21 %)
Number of Red Listed species*	11 (8 %)
Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes)*	4 (29 %)
Number of local endemics (BirdLife SA, 2018)*	2 (5 %)
Number of local near-endemics (BirdLife SA, 2018)*	7 (23 %)
Number of regional endemics (Hockey *et al.,* 2005)**	15 (14 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	21 (34 %)

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

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

3 *sensu* www.zestforbirds.co.za (Hardaker, 2020)

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

5 With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2018).

*** Percentage values in brackets refer to totals compared against the South African avifauna (*sensu* BirdLife SA, 2018).

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

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

3.7 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 11 species could occur on the study site which includes six globally threatened species, one globally near threatened species, two regionally threatened species and two regionally near-threatened species.

It is evident from Table 3 that the highest reporting rates (>5%) 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*) and globally near threatened Red-footed Falcon (*Falco vespertinus*) show reporting rates between 3% and 4 %. 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. However, during the brief scoping site visit it was noticed that extensive areas of suitable foraging habitat persists for some of these species (e.g. Secretarybird *Sagittarius serpentarius*) despite being ominously absent from the area. 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: SABAP1	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Anthropoides paradiseus (Blue Crane)	Vulnerable	Near threatened	47.18	-	Prefers open grasslands. Also forages in wetlands, pastures and agricultural land.	Potential vagrant or highly irregular foraging visitor. It has not been observed on the study area since 2007.
Aquila rapax (Tawny Eagle)	Endangered-	Endangered	2.11	-	Lowveld and Kalahari savannas, especially game farming areas and reserves	An irregular visitor or vagrant to the study site. It has not been observed on the study area since 2007.
Ciconia abdimii (Abdim's Stork)	-	Near threatened	7.75	3.70	Open stunted grassland, fallow land and agricultural fields.	An uncommon or occasional summer foraging visitor to areas consisting of secondary grassland or arable land.
Falco vespertinus (Red-footed Falcon)	Near threatened	Near threatened	2.11	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	2.82	4.00	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor to the study area.

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP1	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	17.16	10.67	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	16.18	13.33	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock carcasses).
Leptoptilos crumeniferus (Marabou Stork	-	Near threatened	0.70	1.56	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas	An irregular scavenging visitor to the area. It has not been observed on the study area since 2007.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	-	1.33	Varied, from open karroid shrub to lowland savanna.	An irregular foraging visitor.
Sagittarius serpentarius (Secretarybird)	Endangered	Vulnerable	2.45	2.67	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	Endangered	Endangered	5.63	5.33	Lowveld and Kalahari savanna;	A fairly regular foraging/scavenging visitor to the

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP1	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
(Lapped-faced Vulture)					mainly on game farms and reserves	study site pending the presence of food (e.g. livestock carcasses).

3.8 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 7):

Areas of high sensitivity

This habitat unit is represented by moist dense grassland which contains a distinct avifaunal composition that are primarily absent from the other habitat units. It is considered to be of high sensitivity since it represents a wetland unit (to be confirmed by a wetland scientist) with important ecological function (e.g. drainage, aquifer supply and local dispersal of facultative wetland-associated bird species) and has the potential to provide both roosting and foraging habitat (especially the areas dominated by *Imperata cylindrica* grass) for the regionally vulnerable African Grass-owl (*Tyto capensis*).

Areas of medium sensitivity

It includes the mixed woodland, secondary grasslands and pastures and the extensive open grassland and bush clump mosaics. The mixed woodland provides potential roosting platforms for vultures (observed during the dry season survey in August 2021 from an adjacent farm) and supported areas where a higher number of bird species are anticipated to occur

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.

Although the secondary grassland and pastures are considered as transformed habitat units, they both provides ephemeral foraging habitat for large terrestrial bird species and should be treated with a medium avifaunal sensitivity.

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 7 pending the outcome of a detailed season surveys.

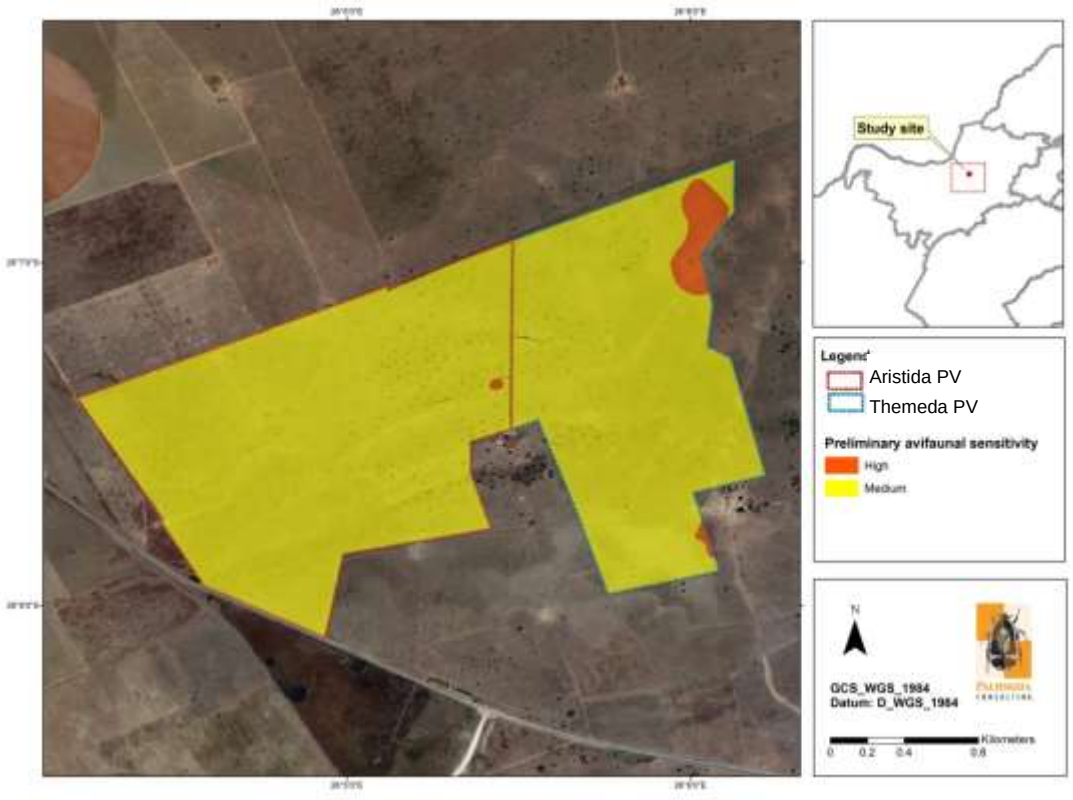

Figure 7: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

3.9 Overview of Avian Impacts at Solar Facilities

3.9.1 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.

3.9.2 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.

3.10 Potential Impacts associated with the Themeda PV and Aristida PV Solar Energy Facilities

3.10.1 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*);
- Ashy Tit (*Melaniparus cinerascens*);
- Kalahari Scrub Robin (*Cercotrichas paena*);
- Orange River Francolin (*Scleroptila gutturalis*) and potentially also small to medium birds of prey such as:
- Black-winged Kite (*Elanus caeruleus*);
- Amur Falcon (*Falco amurensis*);
- Lesser Kestrel (*Falco rupicolus*) and
- Black-chested Snake-eagle (*Circaetus pectoralis*).

3.10.2 Collision trauma caused by photovoltaic panels (the "lake-effect")

The study site is not located in close proximity to any major wetland system or water body. The nearest large wetland system that is inundated is approximately 5 km from the study site, which explain the low expected occurrence of waterbird taxa at the study site. The waterbirds could accidentally mistake the reflective panels for waterbodies, thereby resulting in bird collisions with the panel surfaces. At this stage the impact is considered to be low, depending on subsequent site visits (e.g. pre-construction monitoring).

However, desktop results and previous site observations show that the following species could potentially interact with the panel infrastructure:

- Yellow-billed Duck (*Anas undulata*);
- Spur-winged Goose (*Plectropterus gambiensis*);
- Egyptian Goose (*Alopochen aegyptiaca*);
- Black-headed Heron (*Ardea melanocephala*); and probably also
- Grey Heron (*Ardea cinerea*) and

Of these species, the Spur-winged Goose, Egyptian Goose and Black-headed Heron are regarded as the only regular visitor to the immediate surroundings.

3.10.3 Creation of "new" avian habitat and bird pollution

It is possible that the infrastructure (during operation) could attract bird species which may occupy the site or interact with the local bird assemblages in the wider region. These include alien and cosmopolitan species, as well as aggressive omnivorous passerines which could displace other bird species from the area:

- House Sparrow (*Passer domesticus*);
- Common Myna (*Acridotheres tristis*);
- Pied Crow (*Corvus albus*); and
- Speckled Pigeon (*Columba guinea*).

The infrastructure may attract large numbers of roosting columbid taxa, especially Speckled Pigeons (*Columba guinea*), which may result in avian "pollution" through excreta, thereby fouling the panel surfaces. The impact is manageable.

3.10.4 Interaction with overhead powerlines (grid connection)

An overhead powerline is proposed for the grid connection from the facility substation to the Watershed Main Transmission Substation. 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 8[6].

From Figure 8 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 8: Two bird-friendly tower designs to be used for the current project.

[6] 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. Table 4 provides a list of potential bird species that could collide with the overhead grid connection

- *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.

It is important to note that impacts associated with the proposed powerline infrastructure will be assessed as part of a standalone Basic Assessment process and not as part of the facility EIAs. This baseline report does however report on the potential impacts as the two (the facilities and the grid connection infrastructure) are co-dependant and should be viewed holistically.

3.11 Collision-prone bird species

A total of 39 collision-prone bird species have been recorded in the wider study area (*sensu* SABAP2), of which seven species could interact with the PV panels (Table 4). However, most f these species are more at risk of colliding with overhead powerlines (to be assessed during a separate Basic Assessment process).

Table 4: Collision-prone bird species and Red listed species (in red) expected to be present on the study site.

Common Name	Scientific Name	National conservation status (sensu Taylor et al., 2015)	SABAP2 Reporting Rate (Full Protocol)
Pale Chanting Goshawk	*Melierax canorus*		n/a
Rock Kestrel	*Falco rupicolus*		n/a
Speckled Pigeon	*Columba guinea*		69.33
Hadada Ibis	*Bostrychia hagedash*		62.67
Western Cattle Egret	*Bubulcus ibis*		49.33
Ant-eating Chat	*Myrmecocichla formicivora*		46.67
Pied Crow	*Corvus albus*		45.33
Helmeted Guineafowl	*Numida meleagris*		44.00
Swainson's Spurfowl	*Pternistis swainsonii*		40.00
Northern Black Korhaan	*Afrotis afraoides*		34.67
Yellow-billed Duck	*Anas undulata*		34.67
Black-winged Kite	*Elanus caeruleus*		32.00
Black-headed Heron	*Ardea melanocephala*		26.67
Amur Falcon	*Falco amurensis*		21.33
Egyptian Goose	*Alopochen aegyptiaca*		20.00
Orange River Francolin	*Scleroptila gutturalis*		20.00
Rock Dove	*Columba livia*		18.67
Lesser Kestrel	*Falco naumanni*		16.00
White-backed Vulture	*Gyps africanus*	CR	13.33
Yellow-billed Kite	*Milvus aegyptius*		12.00
African Sacred Ibis	*Threskiornis aethiopicus*		10.67
Cape Vulture	*Gyps coprotheres*	EN	10.67
Spur-winged Goose	*Plectropterus gambensis*		10.67
Coqui Francolin	*Peliperdix coqui*		6.67
Lappet-faced Vulture	*Torgos tracheliotos*	EN	5.33
Black-chested Snake Eagle	*Circaetus pectoralis*		4.00
Common (Steppe) Buzzard	*Buteo buteo vulpinus*		4.00
Greater Kestrel	*Falco rupicoloides*		4.00
Lanner Falcon	*Falco biarmicus*	VU	4.00
African Harrier-Hawk	*Polyboroides typus*		2.67
Arrow-marked Babbler	*Turdoides jardineii*		2.67
Red-footed Falcon	*Falco vespertinus*	NT	2.67
Secretarybird	*Sagittarius serpentarius*	VU	2.67
Spotted Eagle-Owl	*Bubo africanus*		2.67
Western Barn Owl	*Tyto alba*		2.67
Black Kite	*Milvus migrans*		1.33
Brown Snake Eagle	*Circaetus cinereus*		1.33
Martial Eagle	*Polemaetus bellicosus*	EN	1.33
Abdim's Stork	*Ciconia abdimii*	NT	0.00

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.

3.11.1 Vultures

Three species of vulture occur in the study area, which are prone towards electrocution and collision with powerlines[7]. 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 9).

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 10). 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 11). 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. Most of the powerline interactions also occurred in the Ventersdorp and Lichtenburg area (Figure 12), 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 an overhead 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**.

[7] It is important to note that impacts associated with the proposed powerline infrastructure will be assessed as part of a standalone Basic Assessment process and not as part of the facility EIAs. This report does however report on powerline collision prone species as the two (the facilities and the grid connection infrastructure) are co-dependant and should be viewed holistically.

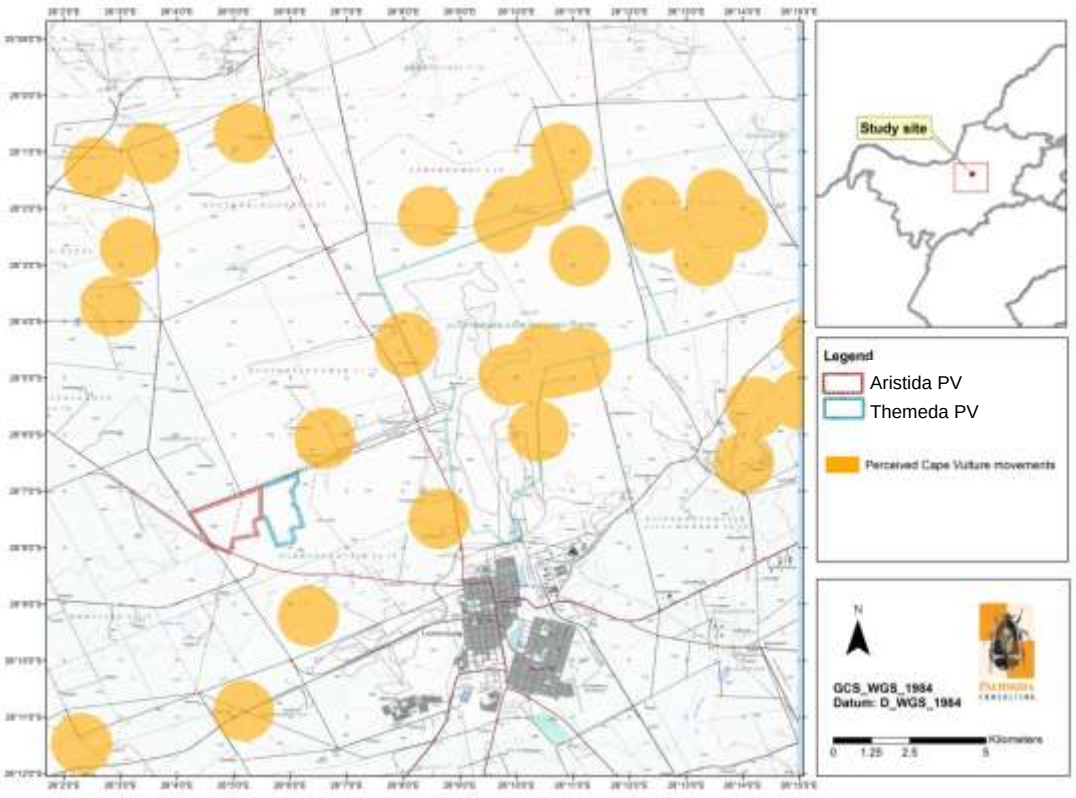

Figure 9: The occurrence of Cape Vultures (*Gyps coprotheres*) within the study region that were fitted with satellite trackers.

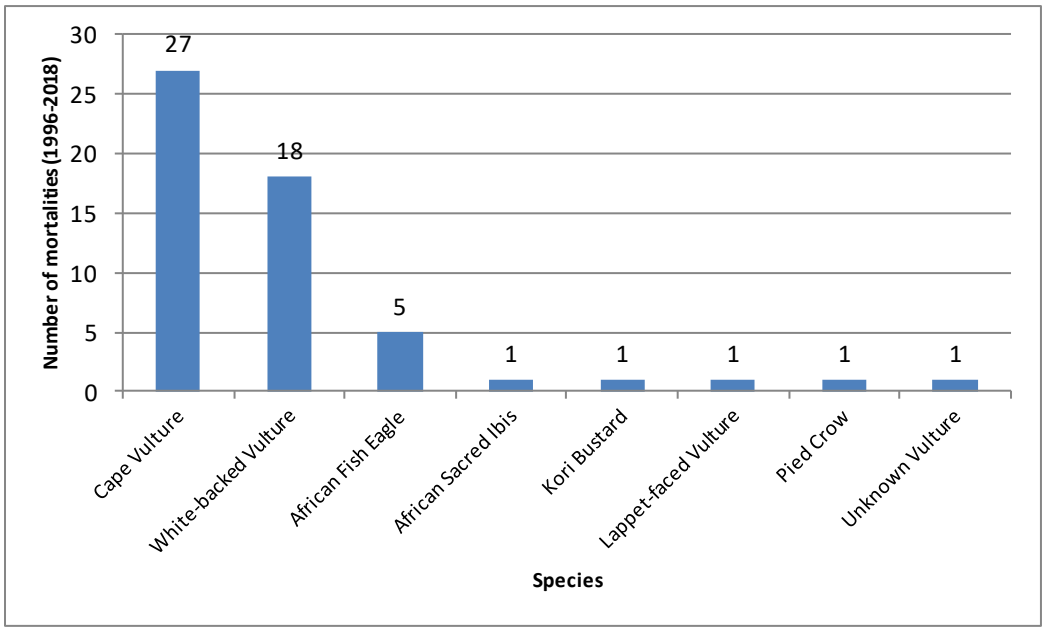

Figure 10: The number of mortalities (electrocutions and collisions) per bird species due to transmission and distribution lines in the study area (1996-2018).

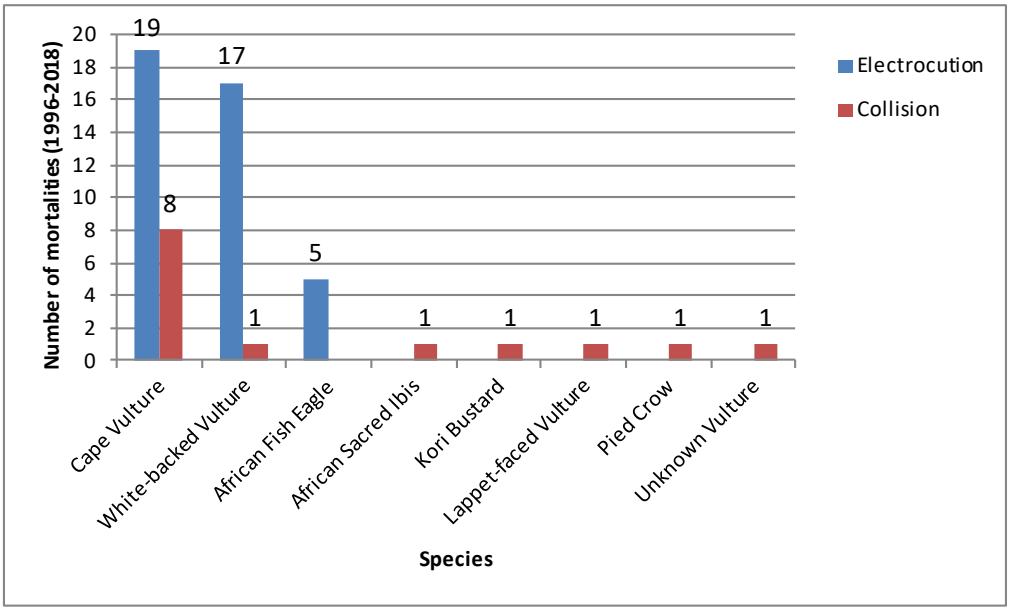

Figure 11: The number of mortalities per bird species caused by electrocutions (distribution lines) and collisions (transmission lines) (1996-2018).

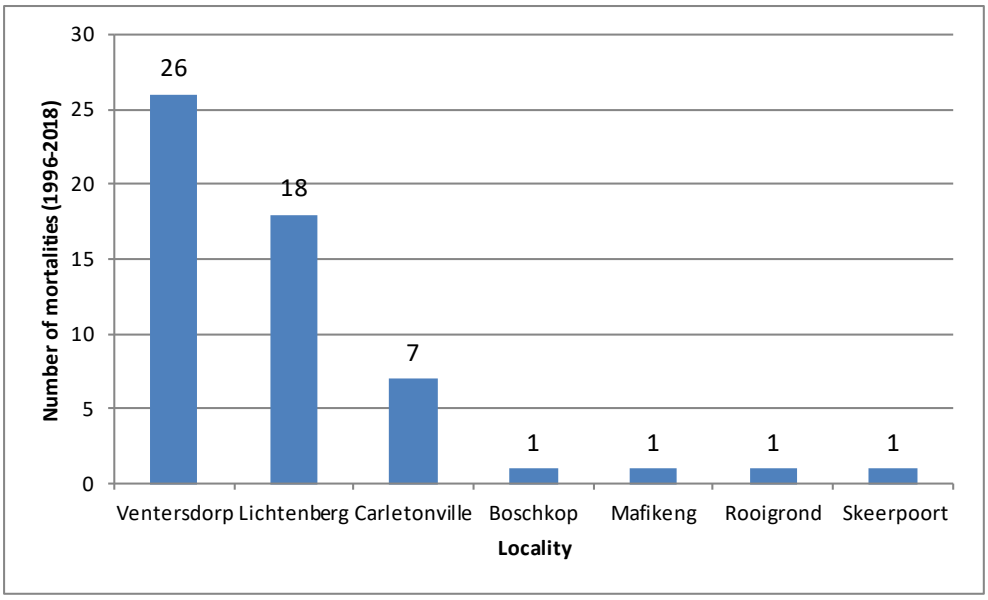

Figure 12: The number of bird mortalities caused by power lines per geographic locality (1996-2018), including the Lichtenburg area.

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 which includes seasonal coverage.

4.1 Proposed approach and methods

The following methods are proposed during the respective surveys:

- 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.

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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. The list was derived (and modified) from species observed in pentad grid 2605_2605 and the eight surrounding grids.

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
78	Abdim's Stork	*Ciconia abdimii*	0.00	0	3.70	1
432	Acacia Pied Barbet	*Tricholaema leucomelas*	37.33	28	3.70	1
171	African Harrier-Hawk	*Polyboroides typus*	2.67	2	0.00	0
418	African Hoopoe	*Upupa africana*	44.00	33	0.00	0
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*	37.33	28	3.70	1
544	African Red-eyed Bulbul	*Pycnonotus nigricans*	42.67	32	0.00	0
606	African Reed Warbler	*Acrocephalus baeticatus*	20.00	15	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
247	African Wattled Lapwing	*Vanellus senegallus*	1.33	1	0.00	0
772	Amethyst Sunbird	*Chalcomitra amethystina*	5.33	4	0.00	0
119	Amur Falcon	*Falco amurensis*	21.33	16	3.70	1
575	Ant-eating Chat	*Myrmecocichla formicivora*	46.67	35	7.41	2
533	Arrow-marked Babbler	*Turdoides jardineii*	2.67	2	0.00	0
514	Ashy Tit	*Melaniparus cinerascens*	4.00	3	0.00	0
510	Banded Martin	*Riparia cincta*	13.33	10	3.70	1
493	Barn Swallow	*Hirundo rustica*	36.00	27	7.41	2
622	Bar-throated Apalis	*Apalis thoracica*	1.33	1	0.00	0
128	Black Kite	*Milvus migrans*	1.33	1	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
712	Black-backed Puffback	*Dryoscopus cubla*	1.33	1	0.00	0
650	Black-chested Prinia	*Prinia flavicans*	68.00	51	7.41	2
146	Black-chested Snake Eagle	*Circaetus pectoralis*	4.00	3	0.00	0
431	Black-collared Barbet	*Lybius torquatus*	34.67	26	3.70	1
715	Black-crowned Tchagra	*Tchagra senegalus*	2.67	2	0.00	0
55	Black-headed Heron	*Ardea melanocephala*	26.67	20	3.70	1
521	Black-headed Oriole	*Oriolus larvatus*	2.67	2	0.00	0
245	Blacksmith Lapwing	*Vanellus armatus*	70.67	53	3.70	1
860	Black-throated Canary	*Crithagra atrogularis*	42.67	32	0.00	0
130	Black-winged Kite	*Elanus caeruleus*	32.00	24	25.93	7
839	Blue Waxbill	*Uraeginthus angolensis*	25.33	19	3.70	1
722	Bokmakierie	*Telophorus zeylonus*	44.00	33	3.70	1
145	Brown Snake Eagle	*Circaetus cinereus*	1.33	1	0.00	0
714	Brown-crowned Tchagra	*Tchagra australis*	13.33	10	7.41	2
402	Brown-hooded Kingfisher	*Halcyon albiventris*	1.33	1	0.00	0
731	Brubru	*Nilaus afer*	4.00	3	3.70	1
695	Buffy Pipit	*Anthus vaalensis*	1.33	1	0.00	0
4131	Burchell's Coucal	*Centropus burchellii*	17.33	13	0.00	0
703	Cape Longclaw	*Macronyx capensis*	30.67	23	3.70	1
531	Cape Penduline Tit	*Anthoscopus minutus*	2.67	2	0.00	0
581	Cape Robin-Chat	*Cossypha caffra*	21.33	16	0.00	0
786	Cape Sparrow	*Passer melanurus*	74.67	56	14.81	4
737	Cape Starling	*Lamprotornis nitens*	29.33	22	7.41	2
316	Ring-necked Dove	*Streptopelia capicola*	24.00	18	14.81	4
106	Cape Vulture	*Gyps coprotheres*	10.67	8	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
686	Cape Wagtail	*Motacilla capensis*	57.33	43	0.00	0
799	Cape Weaver	*Ploceus capensis*	5.33	4	0.00	0
1172	Cape White-eye	*Zosterops virens*	28.00	21	0.00	0
568	Capped Wheatear	*Oenanthe pileata*	9.33	7	0.00	0
484	Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*	10.67	8	11.11	3
658	Chestnut-vented Warbler	*Curruca subcoerulea*	38.67	29	7.41	2
673	Chinspot Batis	*Batis molitor*	6.67	5	0.00	0
872	Cinnamon-breasted Bunting	*Emberiza tahapisi*	9.33	7	3.70	1
631	Cloud Cisticola	*Cisticola textrix*	17.33	13	3.70	1
154	Common (Steppe) Buzzard	*Buteo buteo vulpinus*	4.00	3	7.41	2
734	Common Myna	*Acridotheres tristis*	69.33	52	7.41	2
189	Common Quail	*Coturnix coturnix*	n/a			
421	Common Scimitarbill	*Rhinopomastus cyanomelas*	16.00	12	0.00	0
843	Common Waxbill	*Estrilda astrild*	18.67	14	0.00	0
594	Common Whitethroat	*Curruca communis*	1.33	1	0.00	0
173	Coqui Francolin	*Peliperdix coqui*	6.67	5	0.00	0
439	Crested Barbet	*Trachyphonus vaillantii*	65.33	49	0.00	0
711	Crimson-breasted Shrike	*Laniarius atrococcineus*	17.33	13	0.00	0
242	Crowned Lapwing	*Vanellus coronatus*	70.67	53	7.41	2
545	Dark-capped Bulbul	*Pycnonotus tricolor*	32.00	24	0.00	0
630	Desert Cisticola	*Cisticola aridulus*	20.00	15	7.41	2
352	Diederik Cuckoo	*Chrysococcyx caprius*	32.00	24	3.70	1
1183	Eastern Clapper Lark	*Mirafra fasciolata*	18.67	14	0.00	0
89	Egyptian Goose	*Alopochen aegyptiaca*	20.00	15	0.00	0
404	European Bee-eater	*Merops apiaster*	28.00	21	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
678	Fairy Flycatcher	*Stenostira scita*	n/a			
570	Familiar Chat	*Oenanthe familiaris*	4.00	3	0.00	0
665	Fiscal Flycatcher	*Melaenornis silens*	42.67	32	7.41	2
517	Fork-tailed Drongo	*Dicrurus adsimilis*	1.33	1	3.70	1
874	Golden-breasted Bunting	*Emberiza flaviventris*	2.67	2	3.70	1
447	Golden-tailed Woodpecker	*Campethera abingoni*	2.67	2	0.00	0
785	Great Sparrow	*Passer motitensis*	2.67	2	0.00	0
440	Greater Honeyguide	*Indicator indicator*	4.00	3	0.00	0
122	Greater Kestrel	*Falco rupicoloides*	4.00	3	3.70	1
502	Greater Striped Swallow	*Cecropis cucullata*	48.00	36	0.00	0
419	Green Wood Hoopoe	*Phoeniculus purpureus*	9.33	7	0.00	0
830	Green-winged Pytilia	*Pytilia melba*	10.67	8	3.70	1
339	Grey Go-away-bird	*Crinifer concolor*	20.00	15	0.00	0
557	Groundscraper Thrush	*Turdus litsitsirupa*	6.67	5	0.00	0
84	Hadada Ibis	*Bostrychia hagedash*	62.67	47	0.00	0
192	Helmeted Guineafowl	*Numida meleagris*	44.00	33	11.11	3
784	House Sparrow	*Passer domesticus*	54.67	41	11.11	3
835	Jameson's Firefinch	*Lagonosticta rhodopareia*	2.67	2	0.00	0
586	Kalahari Scrub Robin	*Cercotrichas paena*	34.67	26	7.41	2
1104	Karoo Thrush	*Turdus smithi*	54.67	41	0.00	0
552	Kurrichane Thrush	*Turdus libonyana*	n/a			
114	Lanner Falcon	*Falco biarmicus*	4.00	3	0.00	0
108	Lappet-faced Vulture	*Torgos tracheliotos*	5.33	4	0.00	0
317	Laughing Dove	*Spilopelia senegalensis*	90.67	68	25.93	7
706	Lesser Grey Shrike	*Lanius minor*	14.67	11	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
442	Lesser Honeyguide	*Indicator minor*	4.00	3	0.00	0
125	Lesser Kestrel	*Falco naumanni*	16.00	12	3.70	1
413	Lilac-breasted Roller	*Coracias caudatus*	1.33	1	0.00	0
410	Little Bee-eater	*Merops pusillus*	8.00	6	3.70	1
385	Little Swift	*Apus affinis*	34.67	26	3.70	1
621	Long-billed Crombec	*Sylvietta rufescens*	9.33	7	0.00	0
852	Long-tailed Paradise Whydah	*Vidua paradisaea*	5.33	4	0.00	0
818	Long-tailed Widowbird	*Euplectes progne*	41.33	31	14.81	4
661	Marico Flycatcher	*Melaenornis mariquensis*	5.33	4	0.00	0
607	Marsh Warbler	*Acrocephalus palustris*	5.33	4	3.70	1
142	Martial Eagle	*Polemaetus bellicosus*	1.33	1	0.00	0
456	Melodious Lark	*Mirafra cheniana*	n/a			
564	Mountain Wheatear	*Myrmecocichla monticola*	2.67	2	0.00	0
318	Namaqua Dove	*Oena capensis*	16.00	12	0.00	0
637	Neddicky	*Cisticola fulvicapilla*	18.67	14	3.70	1
1035	Northern Black Korhaan	*Afrotis afraoides*	34.67	26	3.70	1
179	Orange River Francolin	*Scleroptila gutturalis*	20.00	15	3.70	1
838	Orange-breasted Waxbill	*Amandava subflava*	4.00	3	0.00	0
165	Pale Chanting Goshawk	*Melierax canorus*	n/a			
522	Pied Crow	*Corvus albus*	45.33	34	7.41	2
746	Pied Starling	*Lamprotornis bicolor*	6.67	5	7.41	2
846	Pin-tailed Whydah	*Vidua macroura*	26.67	20	0.00	0
694	Plain-backed Pipit	*Anthus leucophrys*	4.00	3	0.00	0
844	Quailfinch	*Ortygospiza atricollis*	18.67	14	3.70	1
642	Rattling Cisticola	*Cisticola chiniana*	10.67	8	0.00	0

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
708	Red-backed Shrike	*Lanius collurio*	22.67	17	0.00	0
837	Red-billed Firefinch	*Lagonosticta senegala*	14.67	11	0.00	0
805	Red-billed Quelea	*Quelea quelea*	40.00	30	7.41	2
488	Red-capped Lark	*Calandrella cinerea*	9.33	7	3.70	1
813	Red-collared Widowbird	*Euplectes ardens*	5.33	4	0.00	0
314	Red-eyed Dove	*Streptopelia semitorquata*	78.67	59	11.11	3
392	Red-faced Mousebird	*Urocolius indicus*	52.00	39	7.41	2
120	Red-footed Falcon	*Falco vespertinus*	2.67	2	0.00	0
820	Red-headed Finch	*Amadina erythrocephala*	30.67	23	0.00	0
940	Rock Dove	*Columba livia*	18.67	14	0.00	0
123	Rock Kestrel	*Falco rupicolus*	n/a			
506	Rock Martin	*Ptyonoprogne fuligula*	6.67	5	3.70	1
458	Rufous-naped Lark	*Mirafra africana*	36.00	27	3.70	1
460	Sabota Lark	*Calendulauda sabota*	8.00	6	3.70	1
789	Scaly-feathered Weaver	*Sporopipes squamifrons*	28.00	21	0.00	0
105	Secretarybird	*Sagittarius serpentarius*	2.67	2	0.00	0
847	Shaft-tailed Whydah	*Vidua regia*	1.33	1	3.70	1
504	South African Cliff Swallow	*Petrochelidon spilodera*	30.67	23	0.00	0
707	Southern Fiscal	*Lanius collaris*	72.00	54	14.81	4
709	Southern Boubou	*Laniarius ferrugineus*	1.33	1	0.00	0
4142	Southern Grey-headed Sparrow	*Passer diffusus*	26.67	20	3.70	1
803	Southern Masked Weaver	*Ploceus velatus*	78.67	59	3.70	1
808	Southern Red Bishop	*Euplectes orix*	64.00	48	3.70	1
390	Speckled Mousebird	*Colius striatus*	16.00	12	3.70	1
311	Speckled Pigeon	*Columba guinea*	69.33	52	11.11	3

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
474	Spike-heeled Lark	*Chersomanes albofasciata*	28.00	21	0.00	0
368	Spotted Eagle-Owl	*Bubo africanus*	2.67	2	0.00	0
654	Spotted Flycatcher	*Muscicapa striata*	17.33	13	0.00	0
275	Spotted Thick-knee	*Burhinus capensis*	6.67	5	0.00	0
88	Spur-winged Goose	*Plectropterus gambensis*	10.67	8	0.00	0
867	Streaky-headed Seedeater	*Crithagra gularis*	4.00	3	0.00	0
185	Swainson's Spurfowl	*Pternistis swainsonii*	40.00	30	0.00	0
649	Tawny-flanked Prinia	*Prinia subflava*	6.67	5	0.00	0
277	Temminck's Courser	*Cursorius temminckii*	n/a			
736	Violet-backed Starling	*Cinnyricinclus leucogaster*	1.33	1	0.00	0
840	Violet-eared Waxbill	*Granatina granatina*	5.33	4	0.00	0
735	Wattled Starling	*Creatophora cinerea*	49.33	37	0.00	0
359	Western Barn Owl	*Tyto alba*	2.67	2	0.00	0
61	Western Cattle Egret	*Bubulcus ibis*	49.33	37	3.70	1
391	White-backed Mousebird	*Colius colius*	46.67	35	3.70	1
107	White-backed Vulture	*Gyps africanus*	13.33	10	0.00	0
763	White-bellied Sunbird	*Cinnyris talatala*	13.33	10	0.00	0
780	White-browed Sparrow-Weaver	*Plocepasser mahali*	69.33	52	18.52	5
588	White-browed Scrub Robin	*Cercotrichas leucophrys*	1.33	1	0.00	0
409	White-fronted Bee-eater	*Merops bullockoides*	10.67	8	0.00	0
383	White-rumped Swift	*Apus caffer*	26.67	20	0.00	0
582	White-throated Robin-Chat	*Cossypha humeralis*	n/a			
814	White-winged Widowbird	*Euplectes albonotatus*	20.00	15	3.70	1
599	Willow Warbler	*Phylloscopus trochilus*	10.67	8	3.70	1
866	Yellow Canary	*Crithagra flaviventris*	66.67	50	7.41	2

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
96	Yellow-billed Duck	*Anas undulata*	34.67	26	0.00	0
129	Yellow-billed Kite	*Milvus aegyptius*	12.00	9	7.41	2
812	Yellow-crowned Bishop	*Euplectes afer*	9.33	7	0.00	0
859	Yellow-fronted Canary	*Crithagra mozambica*	2.67	2	0.00	0
629	Zitting Cisticola	*Cisticola juncidis*	33.33	25	0.00	0