ZWARTWITPENSBOKFONTEIN SOLAR FACILITY – AVIFAUNA SITE SENSITIVITY VERIFICATION

Koedoeskop, Limpopo Province, South Africa

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CLIENT

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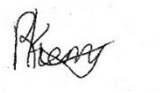
Report Name	**ZWARTWITPENSBOKFONTEIN SOLAR FACILITY – AVIFAUNA SITE SENSITIVITY VERIFICATION**
Submitted to	CONSERVA Environmental Management Services
Report Writer	**Ryno Kemp** 
	Ryno Kemp is Pr Sci Nat registered (117462/17) in Zoological Science and is finalising his PhD in Zoology from the University of Pretoria. Ryno is a qualified Avifauna specialist with just over a year's experience, three years of experience in conservation and more than eight years of scientific research experience across South Africa.
Report Writer	**Caroline Grace Hannweg** 
	Caroline Hannweg is currently enrolled as a PhD candidate at the University of Pretoria. Caroline has over three years of experience working in avifaunal conservation and nearly six years of avifaunal research experience.
Reviewer	**Andrew Husted** 
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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1 Introduction

The Biodiversity Company was appointed to undertake an Avifauna Site Sensitivity Verification (SSV) for the proposed Zwartwitpensbokfontein Solar Photovoltaic Facility. The town of Northam is located approximately 10km west of the proposed development in the Limpopo Province (Figure 1-1 and Figure 1-2).

The proposed solar facility will include a PV Panel Array, inverters, and supportive infrastructure will also be developed, including roads, fencing and buildings. This report assesses the PV area and its associated footprint.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation” (Reporting Criteria).

In accordance with GN 320 and GN 1150 (20 March 2020)[1] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool). Caroline Grace Hannweg, Ryno Kemp and Andrew Husted, as avifauna specialists, have been commissioned to verify the sensitivity of the project sites under these specialist protocols.

[1] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

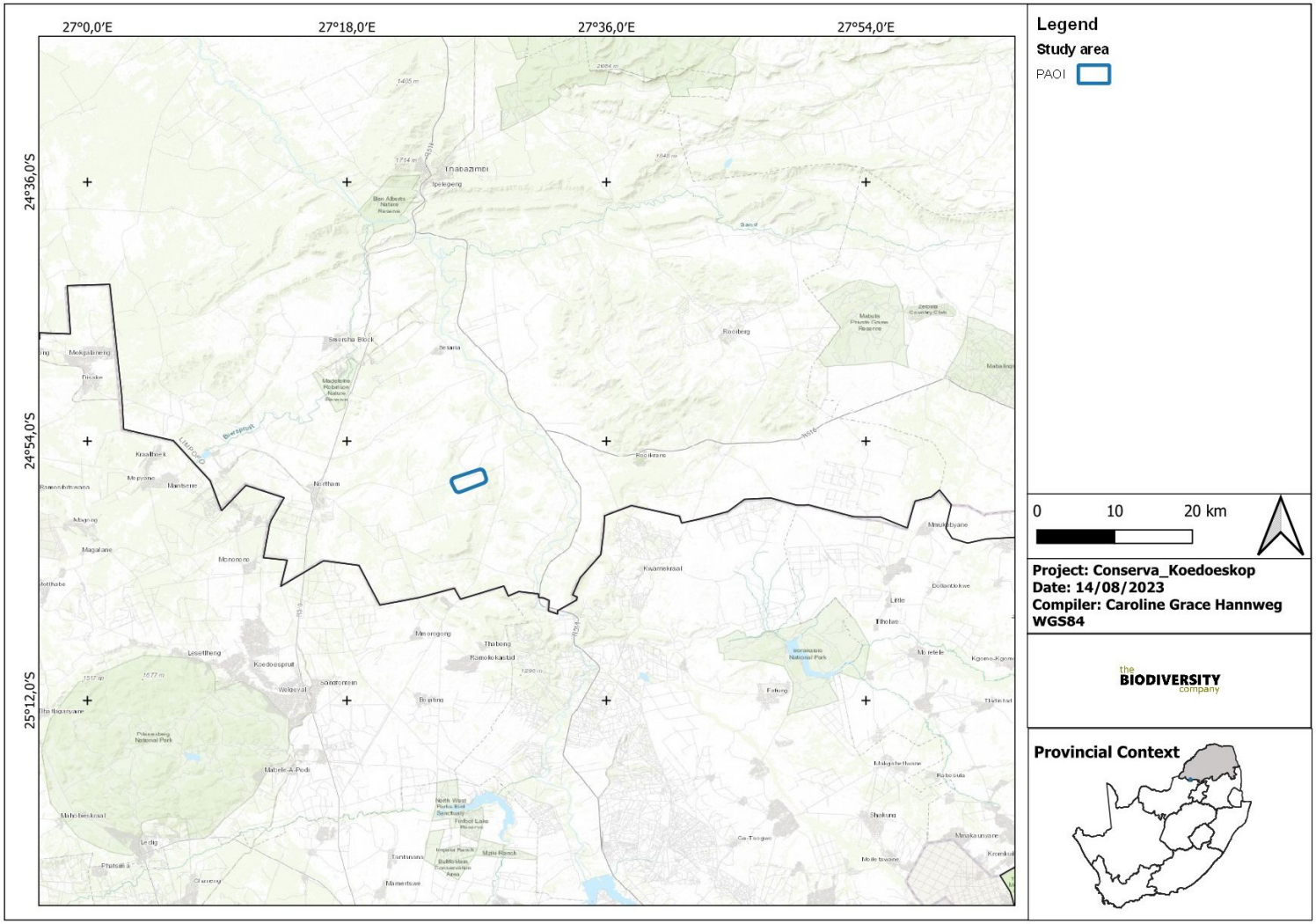

Figure 1-1 Map illustrating the location of the proposed Solar Power Plant (SPP) Project Area

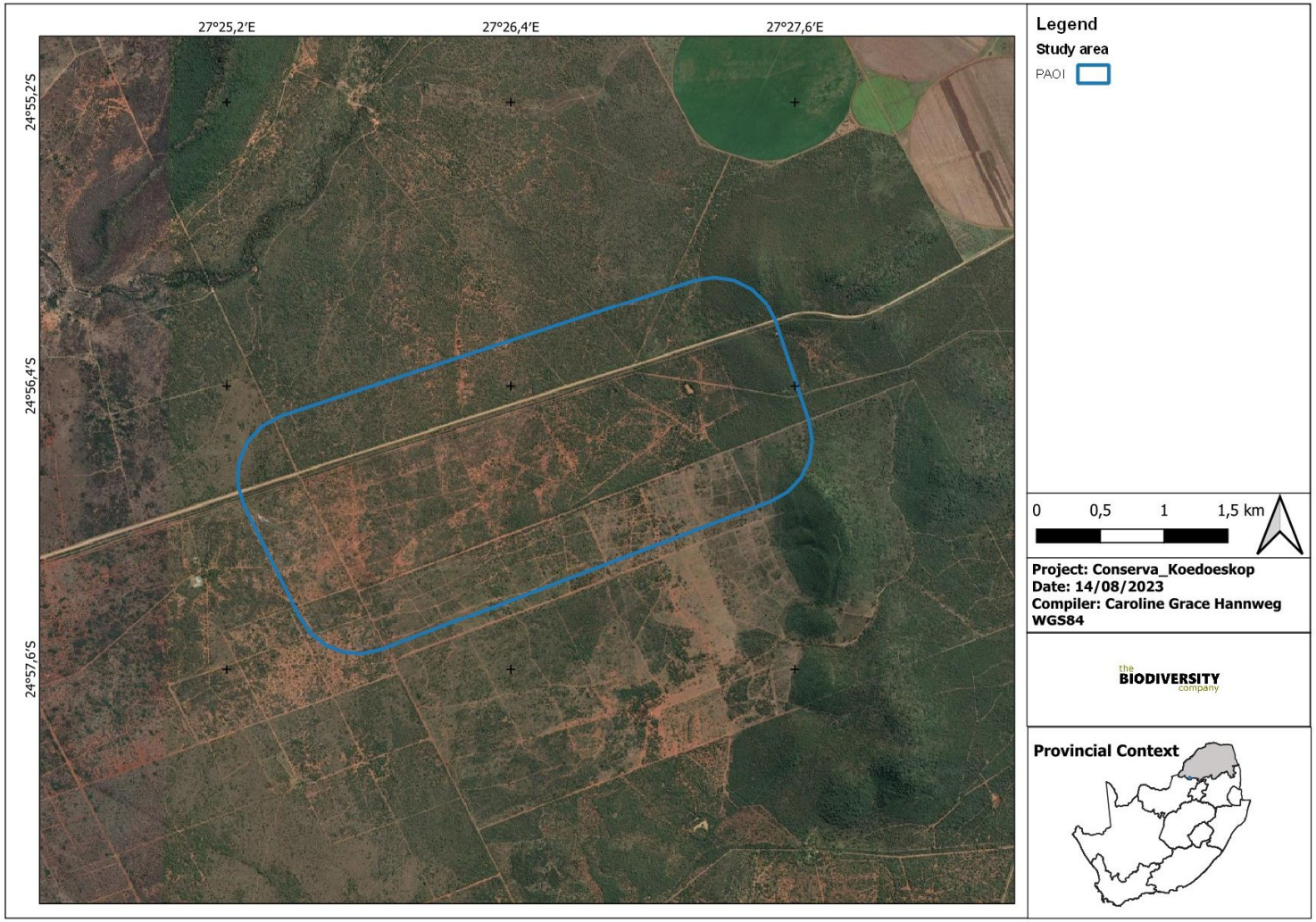

Figure 1-2 The proposed Solar Power Plant (SPP) broad layout

2 Methods

2.1 Desktop Assessment: Landscapes

The following information sources were consulted to compile this report:

- National Biodiversity Assessment 2018 (Skowno et al, 2019) - The purpose of the National Biodiversity Assessment (NBA) is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors. The NBA deals with all three components of biodiversity: genes, species and ecosystems; and assesses biodiversity and ecosystems across terrestrial, freshwater, estuarine and marine environments. The two headline indicators assessed in the NBA are:
    - Ecosystem Threat Status – indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition.
    - Ecosystem Protection Level – indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Not Protected, Poorly Protected or Moderately Protected ecosystem types are collectively referred to as under-protected ecosystems.

Protected areas:

- South Africa Protected Areas Database (SAPAD) and South Africa Conservation Areas Database (SACAD) (DEA, 2022) – The South African Protected Areas Database (SAPAD) and South Africa Conservation Areas Database (SACAD) contains spatial data for the conservation of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. The database is updated on a continuous basis and forms the basis for the Register of Protected Areas which is a legislative requirement under the National Environmental Management: Protected Areas Act, Act 57 of 2003.
- National Protected Areas Expansion Strategy (NPAES) (SANBI, 2018) – The National Protected Area Expansion Strategy (NPAES) provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and are therefore, of high importance for biodiversity, climate resilience and freshwater protection.
- The Limpopo Conservation Plan was completed in 2018 for the Limpopo Department of Economic Development, Environment & Tourism (LEDET) (Desmet *et al.,* 2018). The purpose of the LCPv2 was to develop the spatial component of a bioregional plan (i.e. map of Critical Biodiversity Areas and associated land-use guidelines). The previous Limpopo Conservation Plan (LCPv1) was completely revised and updated (Desmet et al., 2013). A Limpopo Conservation Plan map was produced as part of this plan and sites were assigned to the following CBA categories based on their biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes.

- Important Bird and Biodiversity Areas (BirdLife South Africa, 2015) – Important Bird and Biodiversity Areas (IBAs) constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria.

2.2 Desktop Assessment: Species

The avifaunal desktop assessment comprised of the following:

- Compiling an expected avifauna list from the Southern African Bird Atlas Project 2 (SABAP2) using 9 relevant pentads (2450_2720, 2450_2725, 2450_2730, 2450_2720, 2450_2725, 2450_2730, 2450_2720, 2450_2725, 2450_2730).
- Confirmation of nearby Coordinated Avifaunal Road Count (CAR) route.
- Confirmation of nearby Coordinated Waterbird Count (CWAC) site.

2.3 Field Assessment

One site visit was conducted for the proposed development. It was conducted in winter, over 2 days, from the 5 to 6 August 2023. Sampling consisted of standardised point counts and random diurnal incidental surveys. Standardised point counts (following Buckland et al. 1993) were conducted to gather data on the species composition and relative abundance of species within the broad habitat types identified. Each point count was run over a 10 min period. The horizontal detection limit was set at 150 m. At each point, the observer would document the date, start time, and end time, habitat, numbers of each species, detection method (seen or heard), behaviour (perched or flying) and general notes on habitat and nesting suitability for conservation important species. Incidental diurnal searches were conducted to supplement the species inventory with cryptic and elusive species that may not be detected during the rigid point count protocol. This involved opportunistic species sampling between point count periods, river scanning and road cruising.

Nests, feathers, individuals and signs were photographed and GSP coordinates were taken.

Relevant field guides and texts consulted for identification purposes including the following:

- Roberts Bird Guide; A comprehensive field guide to over 950 bird species in southern Africa 1st Edition (Chittenden, 2007); and
- Roberts Birds of Southern Africa mobile app.

2.4 Site Ecological Importance

The different habitat types within the project area were delineated and identified based on observations during the field assessment, and available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts) as follows.

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows. The criteria for the CI and FI ratings are provided in Table 2-1 and

Table 2-2, respectively.

Table 2-1 Summary of Conservation Importance (CI) criteria

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Extremely Rare or CR species that have a global extent of occurrence (EOO) of < 10 km^2. Any area of natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.
Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very Low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

Table 2-2 Summary of Functional Integrity (FI) criteria

Functional Integrity	Fulfilling Criteria
Very High	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts, with no signs of major past disturbance.
High	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts, with no signs of major past disturbance and good rehabilitation potential.
Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
Very Low	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

BI can be derived from a simple matrix of CI and FI as provided in Table 2-3.

Table 2-3 Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

Biodiversity Importance (BI)		Conservation Importance (CI)				
		Very High	**High**	**Medium**	**Low**	**Very Low**
Functional Integrity (FI)	**Very High**	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor, as summarised in Table 2-4.

Table 2-4 Summary of Receptor Resilience (RR) criteria

Resilience	Fulfilling Criteria
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to: (i) remain at a site even when a disturbance or impact is occurring, or (ii) return to a site once the disturbance or impact has been removed.

Subsequent to the determination of the BI and RR, the SEI can be ascertained using the matrix as provided in Table 2-5.

Table 2-5 Matrix used to derive Site Ecological Importance from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance		Biodiversity Importance (BI)				
		Very high	High	Medium	Low	Very low
Receptor Resilience (RR)	Very Low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very High	Medium	Low	Very low	Very low	Very low

Interpretation of the SEI in the context of the proposed project is provided in Table 2-6.

Table 2-6 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities

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

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa. For the purposes of this assessment, only avifauna were considered.

3 Results

3.1 Species of Conservation Concern (SCC)

SABAP2 data indicate that 317 avifauna species are expected for the PAOI and surrounding habitats. Ten (10) of these are considered SCC and include those listed in Table 3-1. Seventy-six (76) of the 317 expected species were observed during the single site visit.

Table 3-1 Threatened avifauna species that are expected to occur within the project area CR = Critically Endangered, EN = Endangered, LC = Least Concern, NT = Near Threatened and VU = Vulnerable

Common Name	Scientific Name	Regional*	Global+
Lanner Falcon	*Falco biarmicus*	VU	LC
European Roller	*Coracias garrulus*	NT	LC
Secretarybird	*Sagittarius serpentarius*	VU	EN
Half-collared Kingfisher	*Alcedo semitorquata*	NT	LC
Abdim's Stork	*Ciconia abdimii*	NT	LC
Marabou Stork	*Leptoptilos crumenifer*	NT	LC
Cape Vulture	*Gyps coprotheres*	EN	VU
Lappet-faced Vulture	*Torgos tracheliotos*	EN	EN
White-backed Vulture	*Gyps africanus*	CR	CR
Yellow-throated Sandgrouse	*Pterocles gutturalis*	NT	LC

*(Taylor *et al*. 2015), + (IUCN 2021)

3.2 Habitats

Habitats identified during the site assessment can be found in Table 3-2

Table 3-2 Habitat types identifies during the initial site survey

Habitat	Description	SCC possibly occurring there	Photographs
Water Resource	Water system	*Alcedo semitorquata, Ciconia abdimii, Leptoptilos crumenifer, Pterocles gutturalis*	
Degraded Bushveld	Bushveld systems with some evidence of past agricultural activities.	*Falco biarmicus, Coracias garrulus, Saggitarius serpentarius, Leptoptilos crumenifer, Gyps coprotheres, Gyps africanus, Pterocles gutturalis*	
Modified	Homesteads and associated infrastructure as well as prominent roads, disturbed areas and current agricultural activities	*Falco biarmicus, Coracias garrulus*	

3.3 Screening Report

The following is deduced from the National Web-based Environmental Screening Tool Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended):

Terrestrial Biodiversity Theme sensitivity is 'Very High' for the project area due to the presence of a Critical Biodiversity Area 1 & 2, Ecological Support Area 1 and Koerooi Private Nature Reserve and Tortoiseshell Private Nature Reserve (Figure 3-1); and

- Animal Species Theme sensitivity is 'Medium' for the project area, with Avifauna Species of Conservation Concern (SCC) possibly present (Figure 3-2).
    - *Aquila rapax* (Tawny Eagle) – Medium

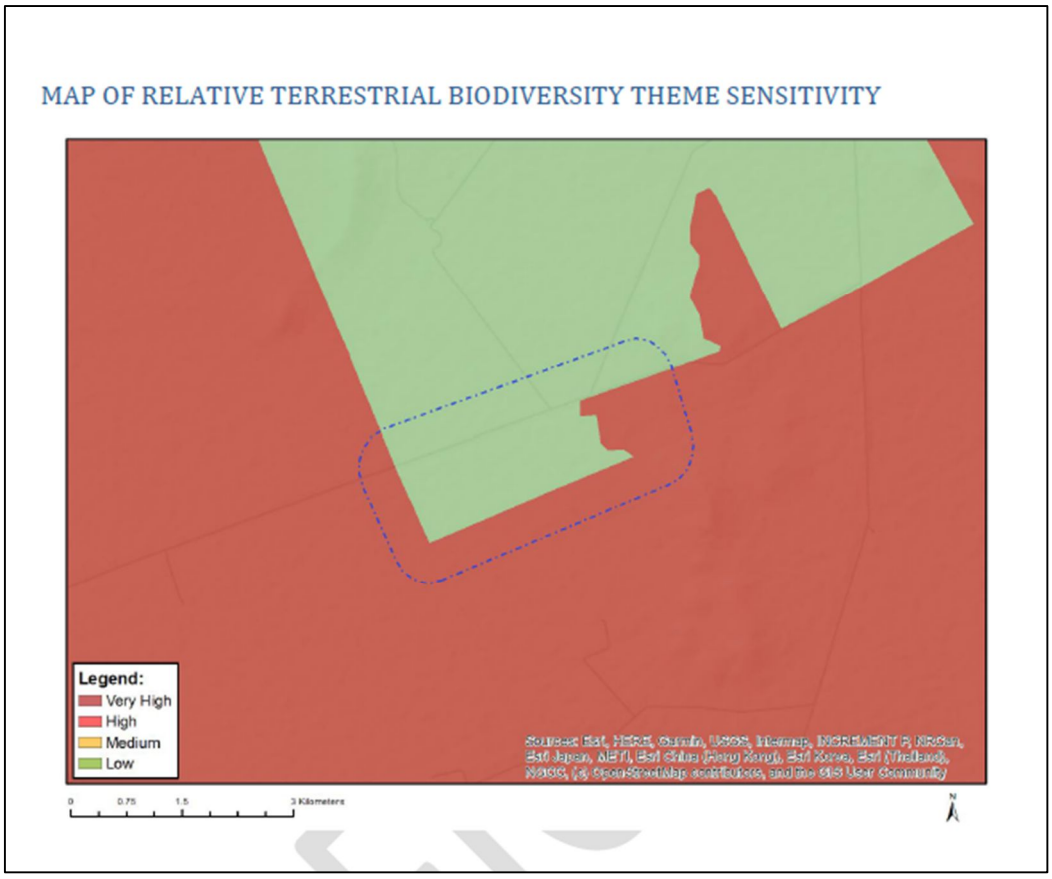

Figure 3-1 Map of Relative Terrestrial Biodiversity Theme Sensitivity for the proposed Solar Power Plant (SPP) Project Area generated by the Environmental Screening Tool

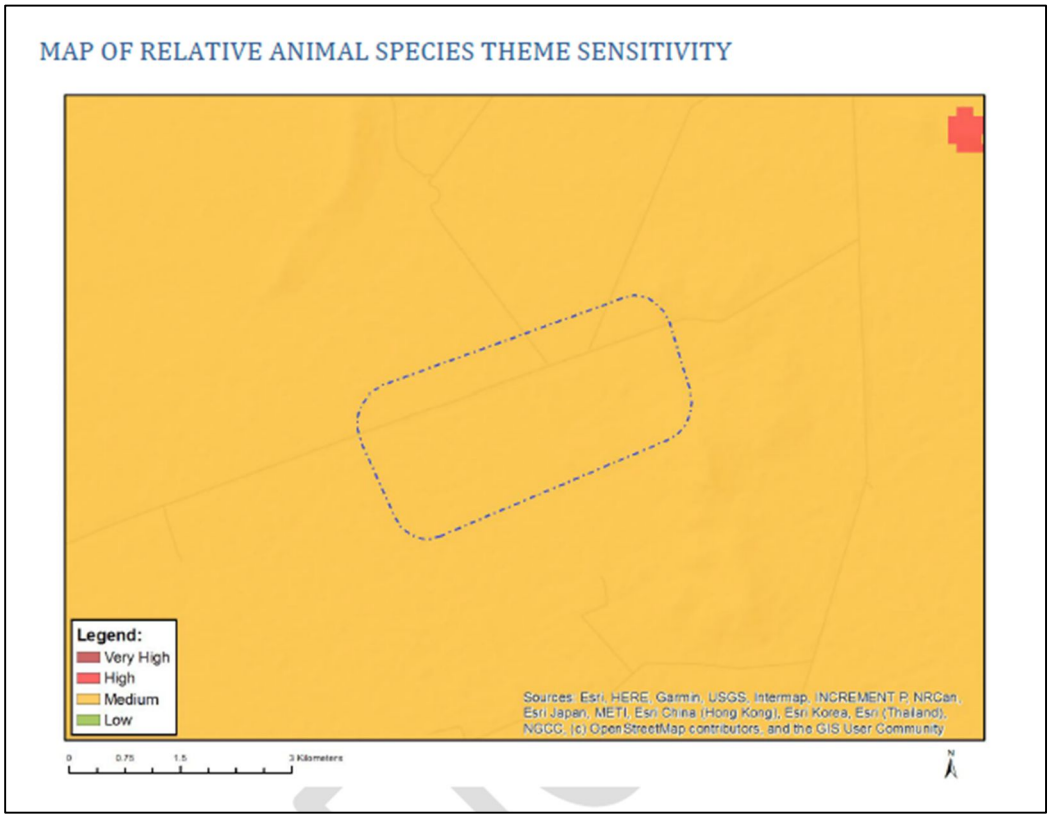

Figure 3-2 ***Map of Relative Animal Biodiversity Theme Sensitivity for the proposed Solar Power Plant (SPP) Project Area generated by the Environmental Screening Tool***

3.4 Site Ecological Importance (SEI)

The different habitat types within the PAOI were delineated and identified based on observations during the field assessment and available satellite imagery. These habitat types were assigned Site Ecological Importance (SEI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern.

The habitat types were delineated within the Project Area, namely Degraded Bushveld and Modified habitat. Their respective SEI and the corresponding mitigation guidelines are summarised in Table 3-3 and visually illustrated in Figure 3-3.

Table 3-3 Summary of Avifauna Site Ecological Importance (SEI) for the Zwartwitpensbokfontein Solar Power Plant (SPP) Project Area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance	Site Ecological Importance (SEI) Guidelines for interpreting SEI in the context of the proposed development activities
Water Resources	Medium Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals.	Medium Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.	**Medium**	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.	**Medium**	**Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities**
Degraded Bushveld	High Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches.	**Medium**	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.	**Medium**	**Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities**
Modified Habitat	High Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO	Low Almost no habitat connectivity but migrations still possible across some modified or degraded	**Medium**	Very High Habitat that can recover rapidly	**Very Low**	**Minimisation mitigation – development activities of medium to high**

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance	Site Ecological Importance (SEI) Guidelines for interpreting SEI in the context of the proposed development activities
	of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.	natural habitat and a very busy used road network surrounds the area.				**impact acceptable and restoration activities may not be required.**

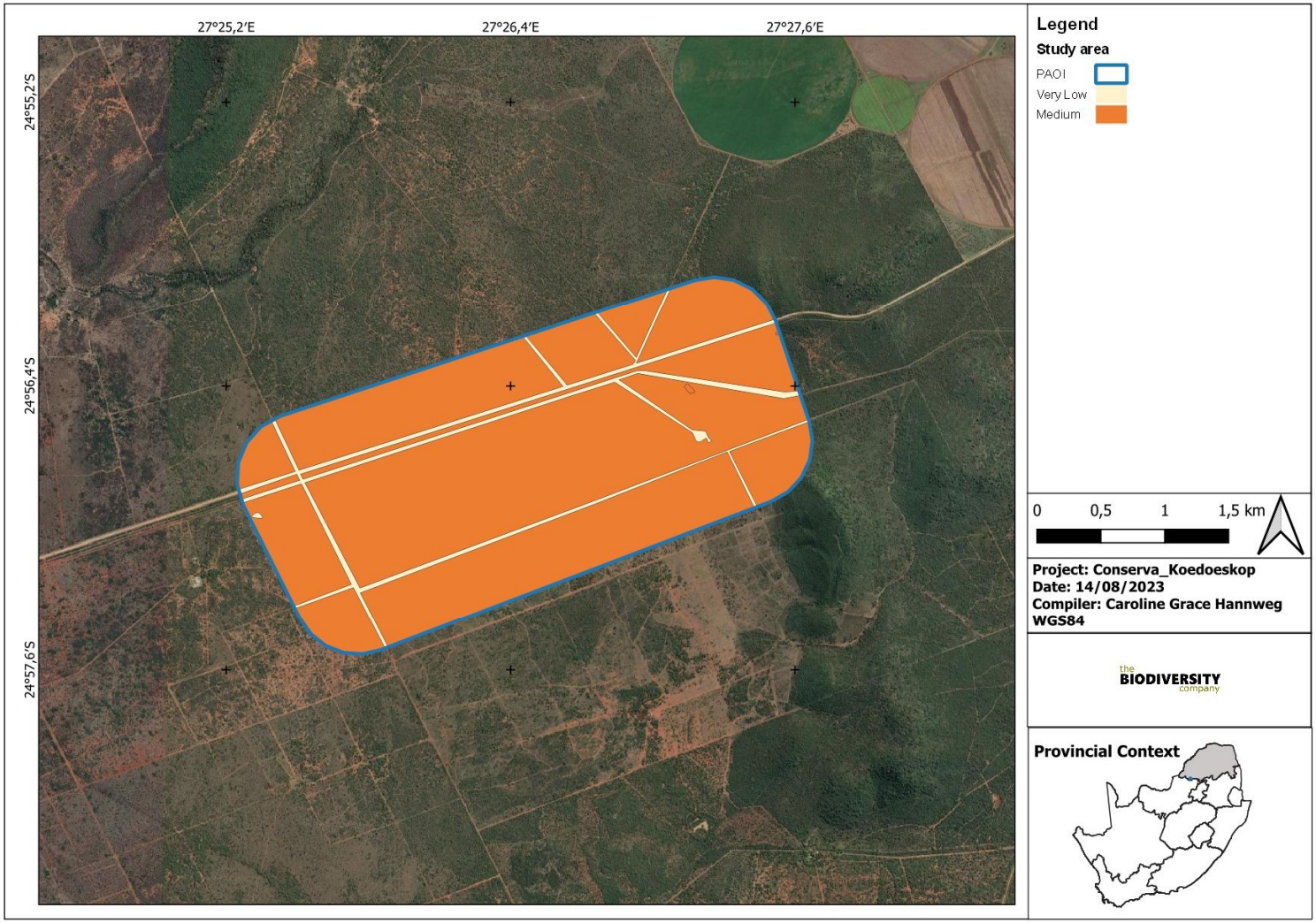

Figure 3-3 Map illustrating the Avifauna Site Ecological Importance (SEI) for the proposed Solar Power Plant (SPP) Project Area

3.5 Screening Tool Comparison

Table 3-4 provides a comparison between the Environmental Screening Tool and the specialist determined the Site Ecological Importance (SEI). The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC. Due to the different distinctive habitats present within the Project Area, these were compared separately.

Table 3-4 Summary of the Screening Tool Sensitivity versus the Specialist assigned Site Ecological Importance (SEI) for the proposed Solar Power Plant (SPP) Project Area

Screening Tool Theme	Screening Tool	Habitat	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	Medium	Water Resources	Medium	Validated - Habitat has been altered with potential to support NT SCC..
		Degraded Bushveld	Medium	Validated - Habitat has been altered with potential to support CR, EN and VU SCC.
		Modified Habitat	Very low	Disputed - Habitat is generally intact, possesses Very High resilience to impacts and only two SCC expected to forage within this habitat

4 Impact Assessment

4.1 Potential Impacts

This section describes the potential impacts on avifauna associated with the construction, operational and decommissioning phases of the proposed development. During the construction phase vegetation clearing and brush cutting of vegetation for the associated infrastructure will lead to direct habitat loss. Vegetation clearing will create a disturbance and will therefore potentially lead to the displacement of avifaunal species. The operation of construction machinery on site will generate noise and cause dust pollution. Should non-environmentally friendly dust suppressants be used, chemical pollution can take place. Increased human presence can lead to poaching and the increase in vehicle traffic will potentially lead to roadkill.

The principal impacts of the operational phase fencing, chemical pollution due to chemical for the cleaning of the PV panels and habitat loss. Solar panels have been implicated as a potential risk for bird collisions. Collisions are thought to arise when birds (particularly waterbirds) mistake the panels for waterbodies, known as the “lake effect” (Lovich & Ennen, 2011), or when migrating or dispersing birds become disorientated by the polarised light reflected by the panels. This “lake-effect” hypothesis has not been substantiated or refuted to date (Visser *et al.,* 2019). It can however be said that the combination of powerlines, fencing and large infrastructure will influence avifauna species. Visser *et al.* (2019) performed a study at a utility-scale PV SEF in the Northern Cape and found that most of the species affected by the facility were passerine species. Larger species were said to be more influenced by the facilities when they were found foraging close by and were disturbed by predators which resulted in collisions.

Fencing of the PV site can influence birds in six ways (Birdlife SA, 2015):

- Snagging – Occurs when a body part is impaled on one or more barbs or razor points of a fence;
- Snaring – When a bird’s foot/leg becomes trapped between two overlapping wires;
- Impact injuries – birds flying into a fence, the impact may kill or injure the bird;

- Snarling – When birds try and push through a mesh or wire stands, ultimately becoming trapped (uncommon);
- Electrocution – Electrified fence can kill or severely injure birds; and
- Barrier effect – Fences may limit flightless birds (e.g., moulting waterfowl) from resources.

Chemical pollution from PV cleaning, if not environmentally friendly, will result in either long-term or short-term poisoning. Should this chemical run into the water sources, it would also impact the whole bird population, not just species found in and around the PV footprint.

PV sites lead to a significant loss of vegetation to minimise the risk of fire (Birdlife, 2017), which will displace various avifauna species.

4.2 Management & Mitigation Measures

This section provides the management and mitigation measures deemed applicable for the proposed development. Note that this is not a complete list of mitigation measures for the proposed development but those considered pertinent. Further mitigation measures may be provided within the Impact Assessment report upon identification of further impacts. Appropriate mitigation measures include:

- Indigenous herbaceous and graminoid vegetation should be maintained under solar panels to ensure biodiversity and prevent soil erosion—Environmental Officer (EO) to supervise and oversee vegetation clearing activities.
- Once confirmed, avoid 'High' SEI, including appropriate buffers.
- Compile and implement a Rehabilitation Plan from the onset of the project.
- Consult a fire expert and compile and implement a Fire Management Plan to minimise the risk of veld fires around the project site.
- A Solid Waste Management Plan must be developed and implemented to avoid impacts on surrounding habitats.
- Applying covers on phases or grounds where adequate separation is not feasible. Examples of covers include insulator/conductor covers, bushing covers, arrester covers, cutout covers, and jumper wire covers.
- Fencing mitigations:
    - Top 2 strands must be smooth wire.
    - Routinely retention loose wires.
    - Minimum 30 cm between wires.
    - Environmental Awareness Training for all staff and contractors. Hunting of species must be made a punishable offence. This is especially pertinent to avifauna SCC.

5 Conclusion

The avifauna SEI for the proposed Zwartwitpensbokfontein SPP was determined to be 'Medium' or 'Very Low' depending on the habitat. Accordingly, the following guidelines are considered relevant to the proposed development activity:

Minimisation and restoration mitigation (Medium SEI Areas) – Any development activities of medium impact acceptable, followed by appropriate restoration be activities.

Minimisation mitigation (Very Low SEI Habitats) – medium to high impact development activities are acceptable and restoration activities may not be required.