AVIFAUNA IMPACT ASSESSMENT – GRIDLINE FOR PROPOSED HERCULES SOLAR PHOTOVOLTAIC (PV) CLUSTER PROJECT

Pixley Ka Seme District Municipality, Northern Cape Province, South Africa

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Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	**AVIFAUNA IMPACT ASSESSMENT – GRIDLINE FOR PROPOSED HERCULES SOLAR PHOTOVOLTAIC (PV) CLUSTER PROJECT**
Specialist Theme	Avifauna Theme
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Environmental Assessment Practitioner	
Fieldwork	André van Tonder, Ryno Kemp, Ernest Porter
Report Writer	Cameron Blair (SACNASP 170485 – pending)
Reviewer	Ryno Kemp (SACNASP 117462/17)
Reviewer	Andrew Husted (SACNASP 400213/11)
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, Amended. 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

1.1 Background

Mulilo Renewable Energy (Pty) Ltd is proposing the development of the proposed Hercules Solar Photovoltaic (PV) Cluster Project and associated 132 kV overhead powerline that will connect the PV cluster to the approved Kestrel Main Transmission Substation (MTS), approximately 10 km east of De Aar in the Emthanjeni Local Municipality, Pixley ka Seme District Municipality, Northern Cape Province.

The approach was informed by 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 320 (20 March 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).

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities at a scoping level, enabling informed decision making.

1.2 Project Description

The grid connection infrastructure for each project (which will be handed over to Eskom) may include:

- Onsite Switching Station (SS), adjacent to the IPP Substation.
- 132kV Overhead Power Line (OHPL) – 30m height from the switching station, with a length of <15km to a yet to be determined connection point.
    - Extension of the 132kV Busbar at the MTS;
    - 132kV Feeder Bay at the MTS;
    - Extension of the 400kV Busbar at the MTS; and
    - Installation of a new 400/132kV Transformer and bay at the MTS.

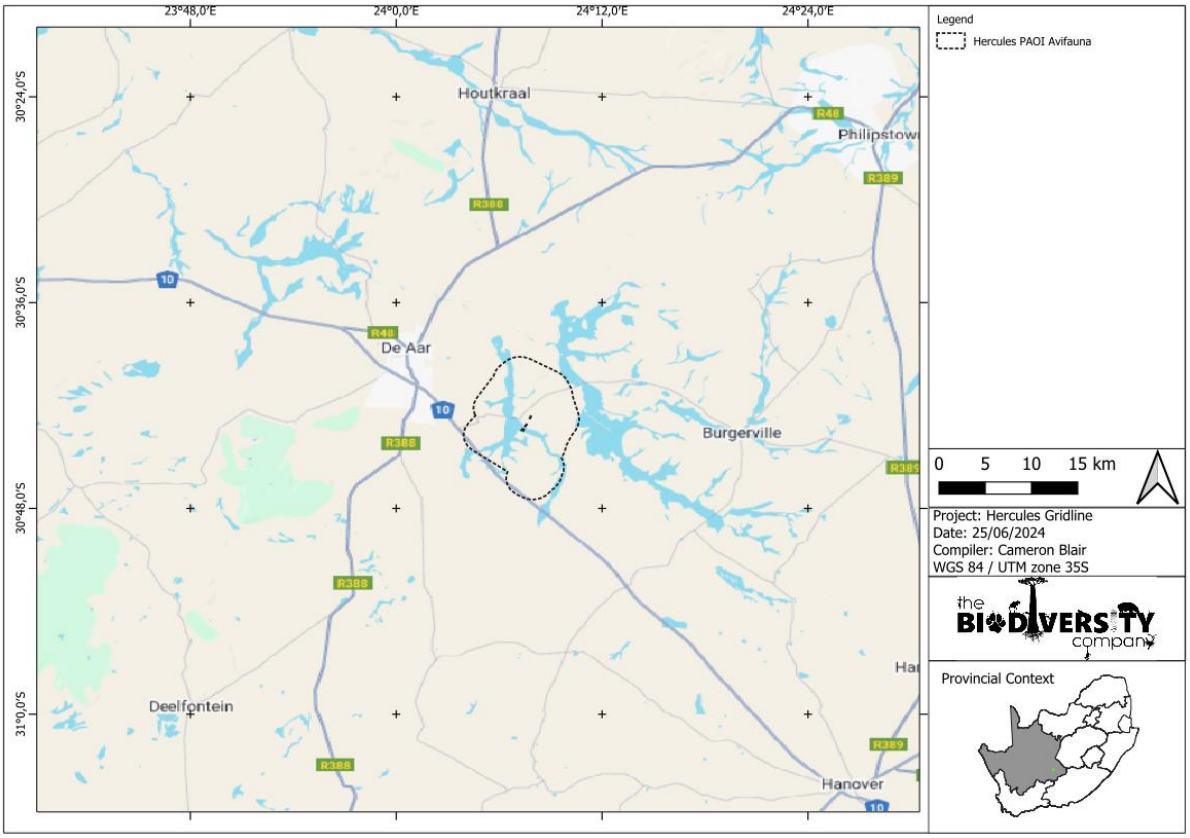


Figure 1-1 Proposed location of the project area in relation to the nearby towns

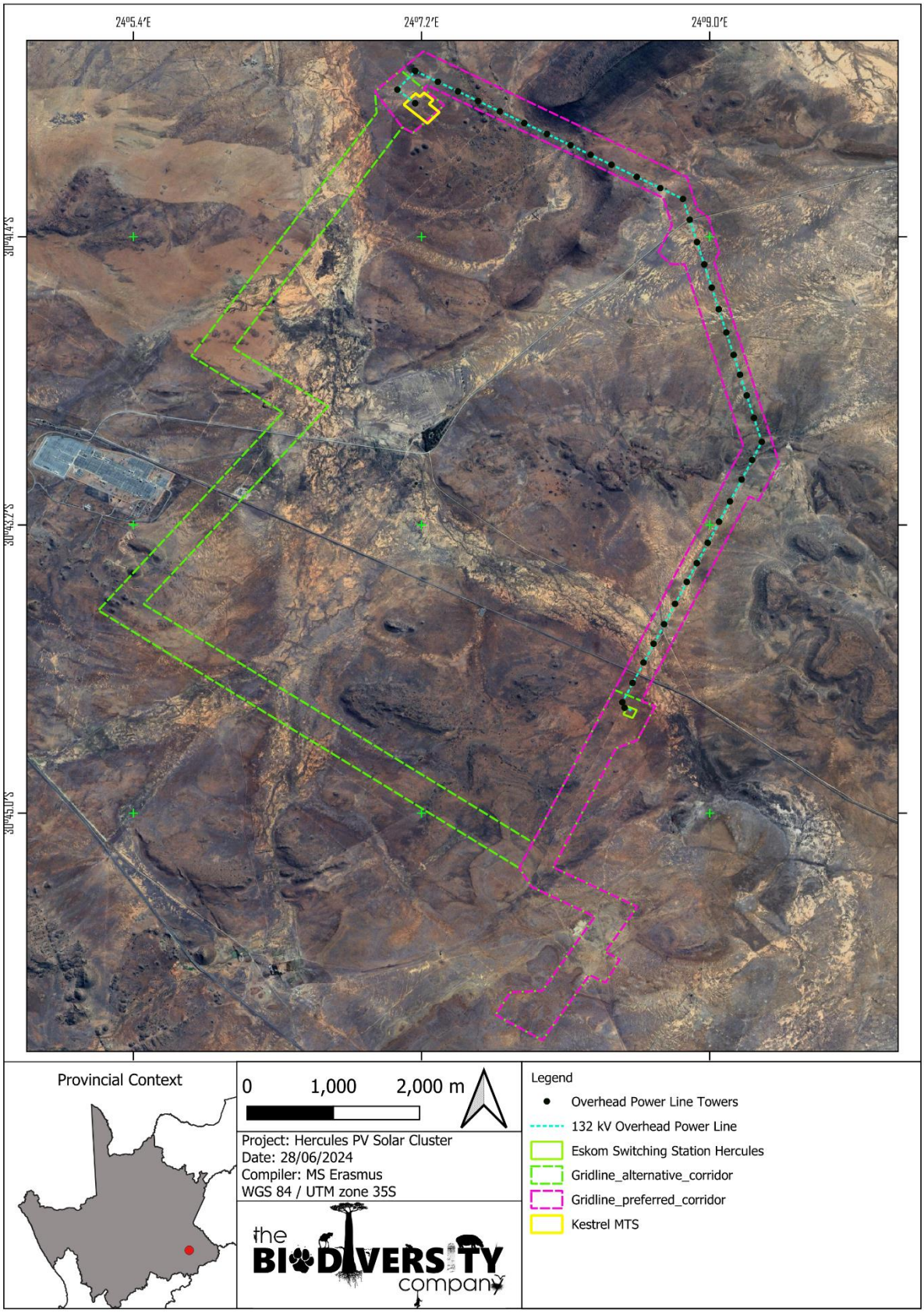


Figure 1-2 Project area of influence

1.3 Scope of Work

The assessment was achieved according to the above-mentioned legislation and the best-practice guidelines and principles for Avifaunal Impact Assessments within the context of PVs as outlined by BirdLife South Africa (2017).

- The scope of the Avifaunal Impact Assessment included the following:
- Desktop assessment to identify the relevant ecologically important geographical features within the Project Area of Influence (PAOI) and surrounding landscape
- Desktop assessment to compile an expected species list and possible avifauna Species of Conservation Concern (SCC) that potentially occur within the PAOI;
- Fieldwork to determine the density and composition of species in the PAOI;
- Description of the baseline avifauna species and Functional Feeding Guild (FFG) composition assemblage within the PAOI;
- Delineate site sensitivity or sensitivities i.e., the Site Ecological Importance (SEI) within the context of the avifauna species assemblage of the PAOI;
- Identify the manner in the proposed development impacts the avifauna community and evaluate the level of risk of these potential impacts; and
- Provide mitigation measures to prevent or reduce the possible impacts.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- The PAOI was based on the project footprint area as provided by the client. Any alterations to the area and/or missing GIS information pertaining to the assessment area would have affected the area surveyed and, hence the results of this assessment;
- The first avifaunal field survey was completed between 17-21 October 2022 for 5 days, the second survey was completed between 17-20 February 2023 for 4 days, and the third survey was completed between 18-21 May 2023 for 4 days. These assessments are deemed sufficient, and no additional field assessments are required;
- Whilst every effort was made to cover as much of the PAOI as possible, it is possible that some species that are present within the PAOI were not recorded during the field investigations due to their secretive behaviour; and
- The GPS used in the assessment has an accuracy of 5 m, and consequently, any spatial features delineated may be offset by up to 5 m.

1.5 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-1 are applicable to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-1 A list of key legislative requirements

Region	Legislation / Guideline	Comment
National	NEMA	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), Threatened or Protected Species Regulations	The protection of species and ecosystems that warrant protection
	Assessment Protocol (March 2020)	The minimum criteria for reporting.
	Assessment Protocol (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	NEMWA;	The regulation of waste management to protect the environment.
	NWA	The regulation of water uses.
	GN 1003 of GG 43726 of 18 Sept 2020	The regulation and management of alien invasive species.
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	To provide for control over the utilisation of the natural agricultural resources, including the vegetation and the combating of weeds and invader plants.
Provincial	Northern Cape Planning and Development Act no. 7 of 1998	To provide for the management and conservation of the province's biophysical environment and protected areas.
	Northern Cape Nature Conservation act no. 9 of 2009	To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management.
	Northern Cape Critical Biodiversity Areas Map (2017)	Designation of conservation areas and targets.

2 Fieldwork

2.1 Avifauna Field Assessment

The first avifaunal field survey was completed between 17-21 October 2022 for 5 days, the second survey was completed between 17-20 February 2023 for 4 days, and the third survey was completed between 18-21 May 2023 for 4 days. Sampling is deemed sufficient for a regime 3 assessment. Sampling consisted of standardised point counts as well as random diurnal incidental surveys. Standardised point counts (Buckland *et al,* 1993) were conducted to gather data on the composition of species and the relative abundance of species within the broad habitat types identified. The standardised point count technique was utilised as it was demonstrated to outperform line routes (Cumming & Henry, 2019). Each point count was run over a 10-minute 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. Diurnal incidental searches were conducted to supplement the species inventory with cryptic and illusive species that may not be detected during the rigid point count protocol. This involved the opportunistic sampling of species between point count periods, random meandering and road cruising. Effort was made to cover all the different habitat types within the limits of time and access.

3 Results & Discussion

3.1 Ecologically Important Landscape Features

The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features is summarised in Table 3-1.

Table 3-1 Summary of relevance of the proposed project to ecologically important landscape features

Desktop Information Considered	Relevant/Irrelevant	Section
Ecosystem Threat Status	Irrelevant – Only overlaps with "LC" Ecosystems (RLE, 2021).	-
Ecosystem Protection Level	Relevant – Overlaps with "Not Protected" and 'Poorly Protected' Ecosystems.	3.1.1
Provincial Conservation Plan	Relevant – Overlaps with CBAs and ESAs.	3.1.2
SAPAD & SACAD	Irrelevant – Does not overlap with any protected or conservation areas.	-
National Protected Areas Expansion Strategy	Irrelevant –Closest NPAES is ~ 10.4 km west of PAOI.	-
Important Bird and Biodiversity Areas	Relevant – Overlaps with Platberg-Karoo Conservancy IBA.	3.1.3
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Relevant – Overlap with CR wetlands.	3.1.4
National Freshwater Priority Area	Relevant – Overlaps with NFEPA wetlands or rivers.	3.1.5
Renewable Energy Development Zones	Irrelevant – Does not overlap with any REDZs	-
Renewable Energy Database	Relevant – REEA projects within the vicinity of the PAOI.	-
Strategic Transmission Corridors (EGI)	Relevant – Overlaps with the Central Corridor	-
Coordinated Water Bird Count	Irrelevant – Project area is ~ 6.4 km east of nearest CWAC location	3.1.6
Coordinated Avifaunal Road Count	Relevant - Project area overlaps with CAR routes	3.1.7

3.1.1 Ecosystem Protection Level

This is an 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. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. The proposed project overlaps with NP and PP ecosystems (Figure 3-1).

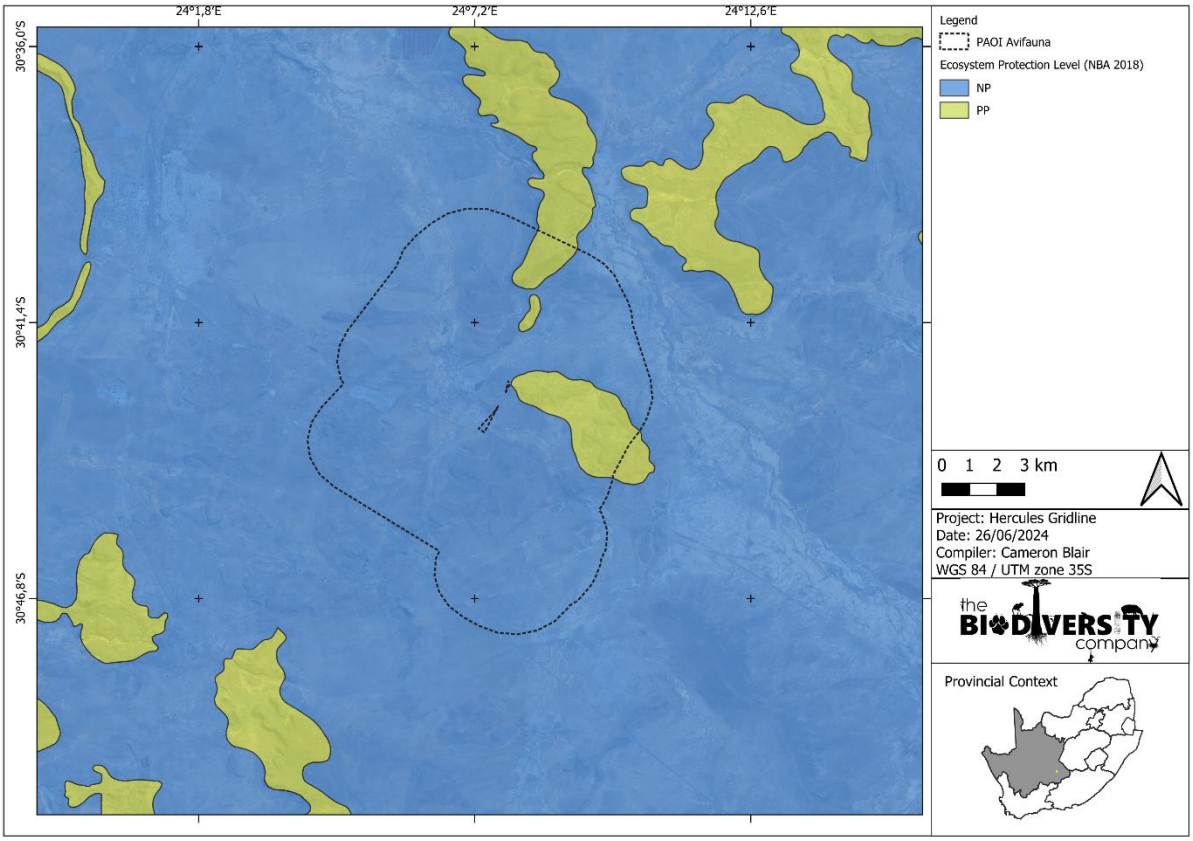


Figure 3-1 Map illustrating the ecosystem protection level associated with the PAOI

3.1.2 Critical Biodiversity Areas and Ecological Support Areas

The key output of this systematic biodiversity plan is a map of biodiversity priority areas (Northern Cape CBA Map, 2017). The Northern Cape CBA map delineates Critical Biodiversity Areas, Ecological Support Areas, Other Natural Areas and Protected Areas (Northern Cape CBA Map, 2017). The Northern Cape CBA Map (2017) uses the following terms to categorise the various land used types according to their biodiversity and environmental importance:

- Critical Biodiversity Area (CBA);
- Ecological Support Area (ESA);
- Other Natural Area (ONA); and
- Protected Area (PA).

According to the Northern Cape CBA Map the PAOI falls across an area classified as CBA and ESA (Figure 3-2).

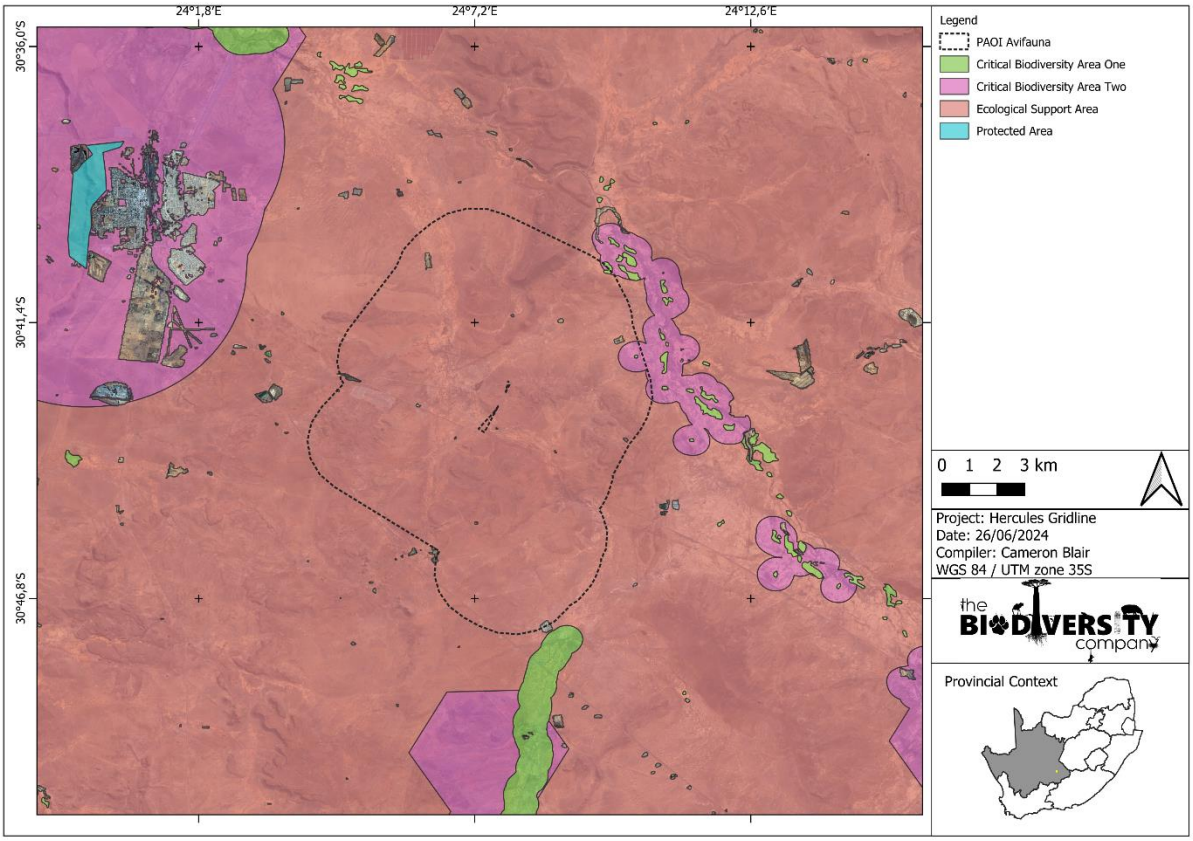


Figure 3-2 Map illustrating the biodiversity spatial plan in relation to the PAOI

3.1.3 Important Bird and Biodiversity Area

Important Bird & Biodiversity Areas (IBAs) are the sites of international significance for the conservation of the world's birds and other conservation significant species as identified by BirdLife International. These sites are also all Key Biodiversity Areas; sites that contribute significantly to the global persistence of biodiversity (Birdlife South Africa, 2017).

According to Birdlife South Africa (2017), the selection of IBAs is achieved through the application of quantitative ornithological criteria, grounded in up-to-date knowledge of the sizes and trends of bird populations. The criteria ensure that the sites selected as IBAs have true significance for the international conservation of bird populations and provide a common currency that all IBAs adhere to, thus creating consistency among, and enabling comparability between, sites at national, continental and global levels. Figure 3-3 shows that the PAOI overlaps with the Platberg-Karoo Conservancy IBA. This IBA is significant for the conservation of large terrestrial birds and raptors, including Blue Crane (*Anthropoides paradiseus*), Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*), Blue Korhaan (*Eupodotis caerulescens*), Black Stork (*Ciconia nigra*), Secretarybird (*Sagittarius serpentarius*), Martial Eagle (*Polemaetus bellicosus*), Verreaux's Eagle (*Aquila verreauxii*) and Tawny Eagle (*Aquila rapax*). Additionally, this IBA hosts close to 10% of the global population of Lesser Kestrels *Falco naumanni* during the austral summer.

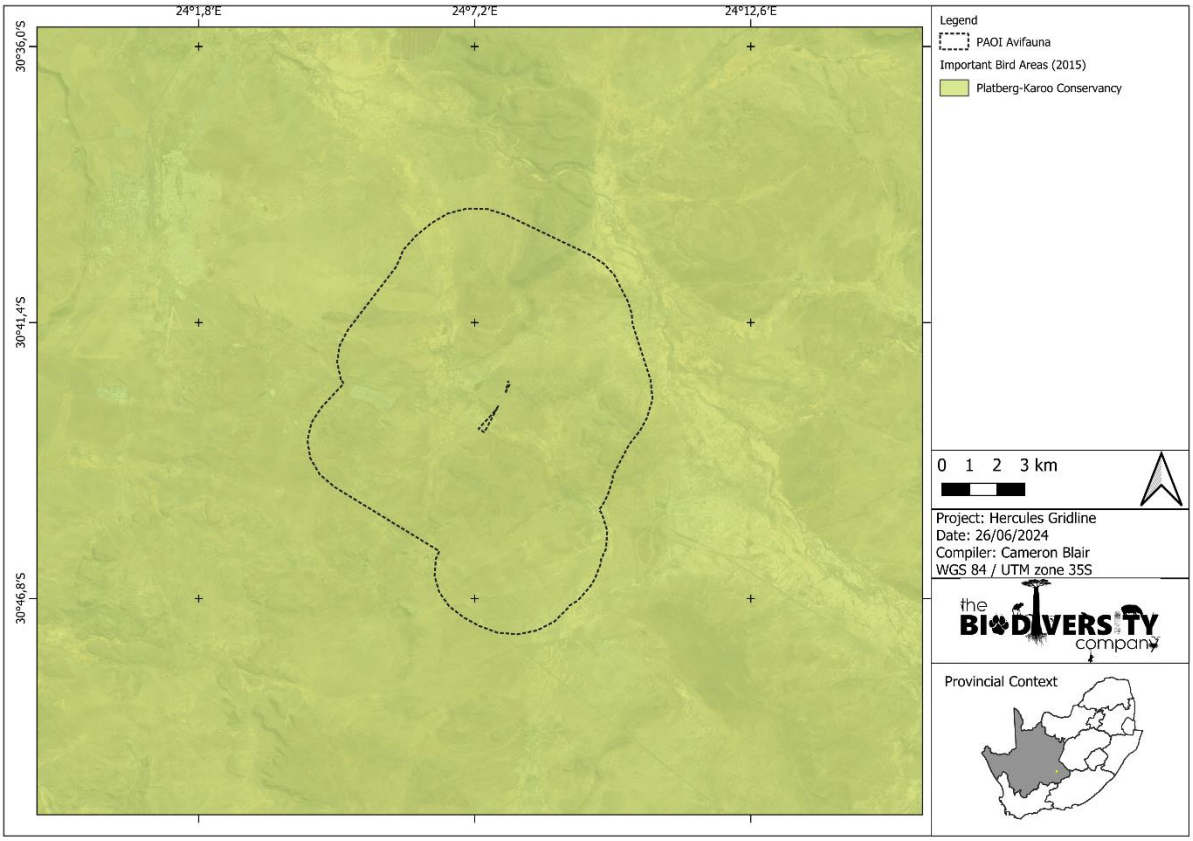


Figure 3-3 The PAOI in relation to the nearest IBAs

3.1.4 South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the NBA in 2018. Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT, with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al.,* 2019). The PAOI overlaps with EN wetlands (Figure 3-4).

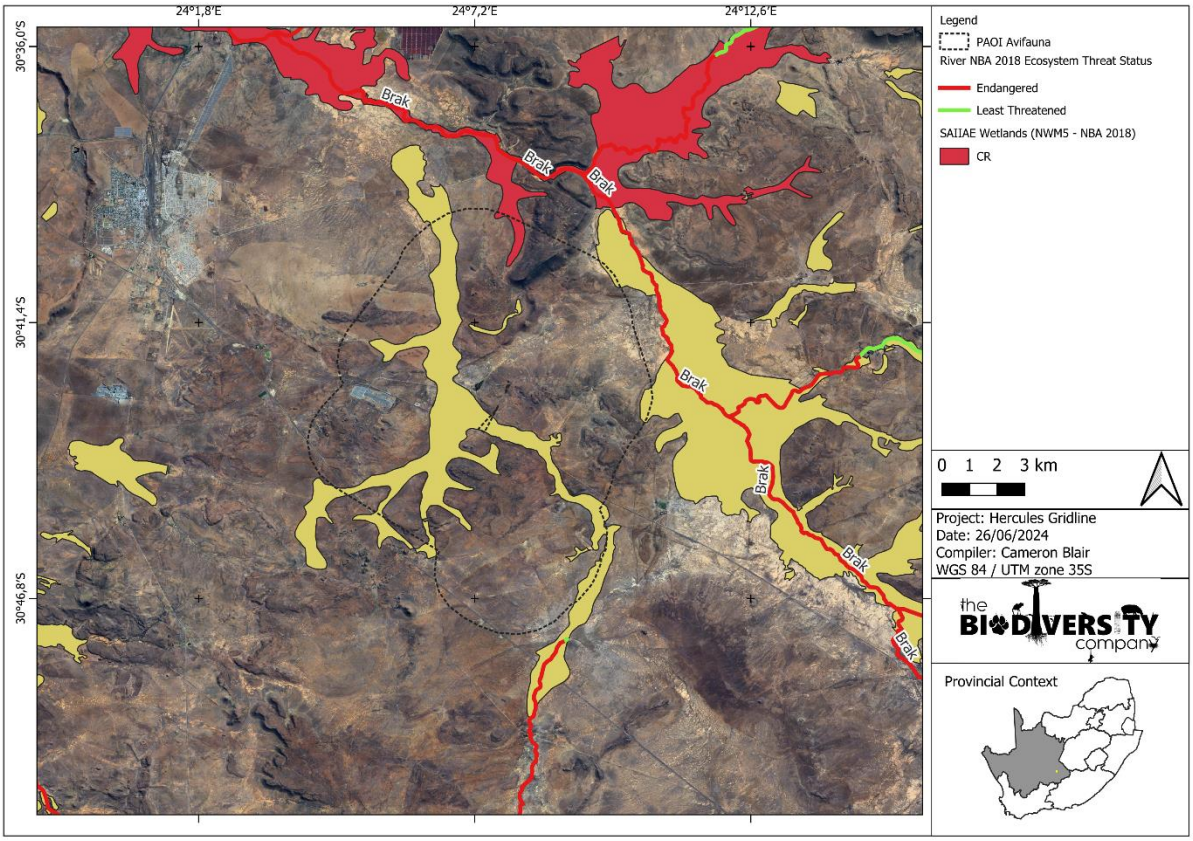


Figure 3-4 ***Map illustrating ecosystem threat status of rivers and wetland ecosystems in relation to the PAOI. Wetlands indicated in yellow do not have a specified threat status.***

3.1.5 National Freshwater Ecosystem Priority Area Status

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) biodiversity goals (Nel *et al.,* 2011).

Figure 3-5 shows that the PAOI overlaps with non-priority and priority wetlands and overlaps with a NFEPA river.

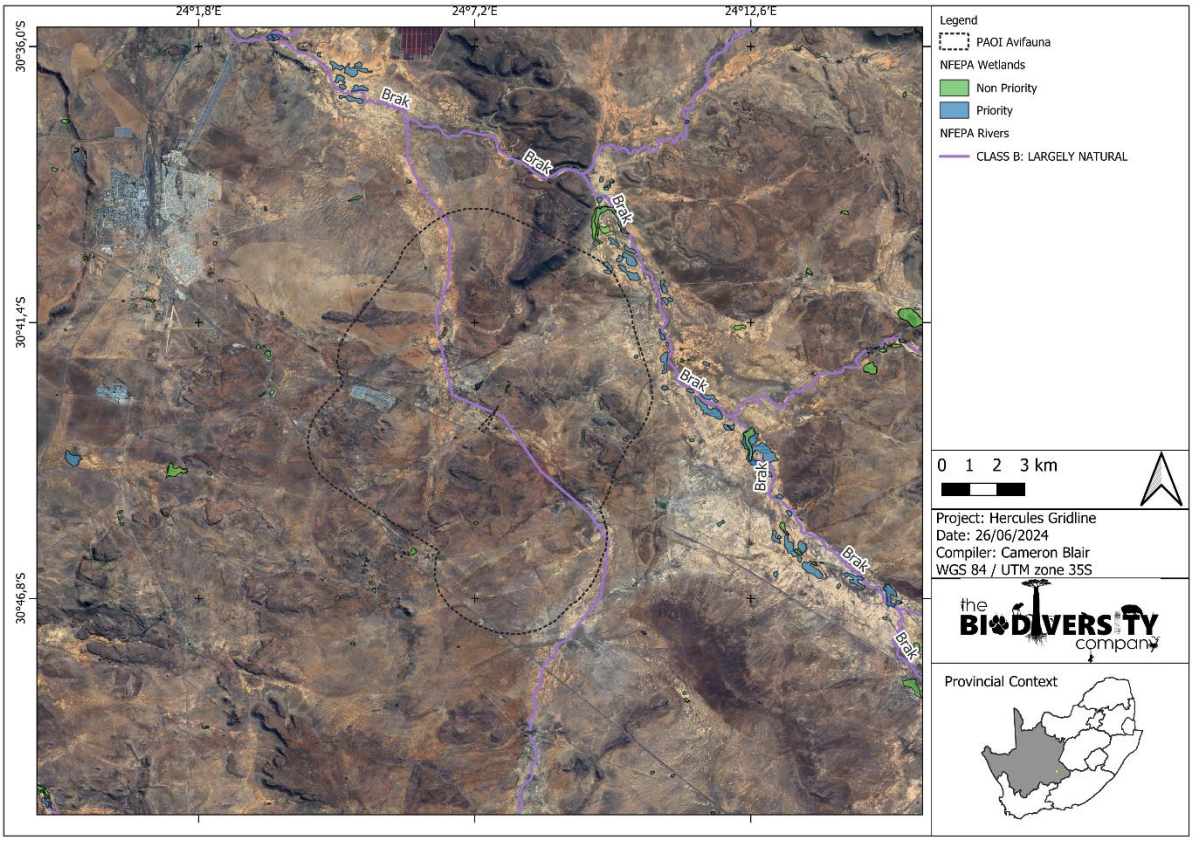


Figure 3-5 The PAOI in relation to the National Freshwater Ecosystem Priority Areas

3.1.6 Coordinated Waterbird Counts (CWAC)

The Animal Demography Unit launched the Coordinated Waterbird Counts (CWAC) project in 1992 as part of South Africa's commitment to International waterbird conservation. Regular mid-summer and mid-winter censuses are done to determine the various features of water birds including population size, how waterbirds utilise water sources and determining the health of wetlands. For a full description of CWAC please refer to http://cwac.birdmap.africa/about.php. Figure 3-6 shows the PAOI is 4.2 km west of the De Aar Sewage Works CWAC. Table 3-2 shows the species recorded as part of the De Aar Sewage Works CWAC counts.

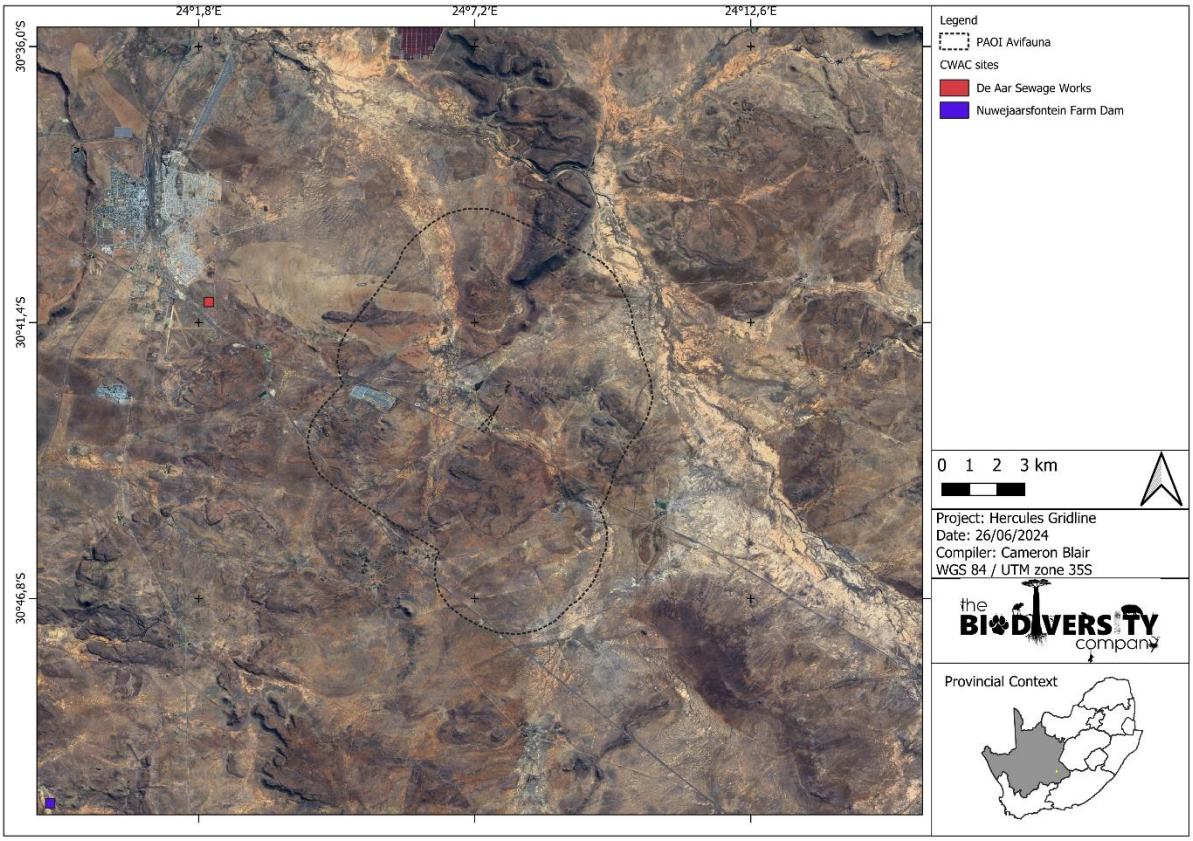


Figure 3-6 The PAOI in relation to the CWAC site

Table 3-2 Species recorded as part of the De Aar Sewage Works CWAC.

Common Name	Scientific Name
Ruff	Calidris pugnax
Red-knobbed Coot	Fulica cristata
Reed Cormorant	Microcarbo africanus
Yellow-billed Duck	Anas undulata
Greater Flamingo	Phoenicopterus roseus
Egyptian Goose	Alopochen aegyptiaca
Spur-winged Goose	Plectropterus gambensis
Little Grebe	Tachybaptus ruficollis
Common Greenshank	Tringa nebularia
Black-headed Heron	Ardea melanocephala
Grey Heron	Ardea cinerea
African Sacred Ibis	Threskiornis aethiopicus
Hadada Ibis	Bostrychia hagedash
Blacksmith Lapwing	Vanellus armatus
Brown-throated Martin	Riparia paludicola
Three-banded Plover	Charadrius tricollaris
Common Sandpiper	Actitis hypoleucos
Marsh Sandpiper	Tringa stagnatilis

Wood Sandpiper	Tringa glareola
South African Shelduck	Tadorna cana
Black-winged Stilt	Himantopus Himantopus
Little Stint	Calidris minuta
Cape Teal	Anas capensis
Cape Wagtail	Motacilla capensis

3.1.7 Coordinated Avifaunal Roadcount (CAR)

The ADU/Cape bird club pioneered avifaunal roadcount of larger birds in 1993 in South africa. Originally it was started to monitor the Blue Crane Anthropoides paradiseus and Denham's/Stanley's Bustard Neotis denhami. Today it has been expanded to the monitoring of 36 species of large terrestrial birds (cranes, bustards, korhaans, storks, Secretarybird and Southern Bald Ibis) along 350 fixed routes covering over 19 000 km. Twice a year, in midsummer (the last Saturday in January) and midwinter (the last Saturday in July), roadcounts are carried out using this standardised method. These counts are important for the conservation of these larger species that are under threat due to loss of habitat through changes in land use, increases in crop agriculture and human population densities, poisoning as well as man-made structures like power lines. With the prospect of wind and solar farms to increase the use of renewable energy sources monitoring of these species is most important (CAR, 2020). Figure 3-7 shows that the PAOI crosses Route NK041. Table 3-3 shows the avifauna species recorded on CAR route NK041.

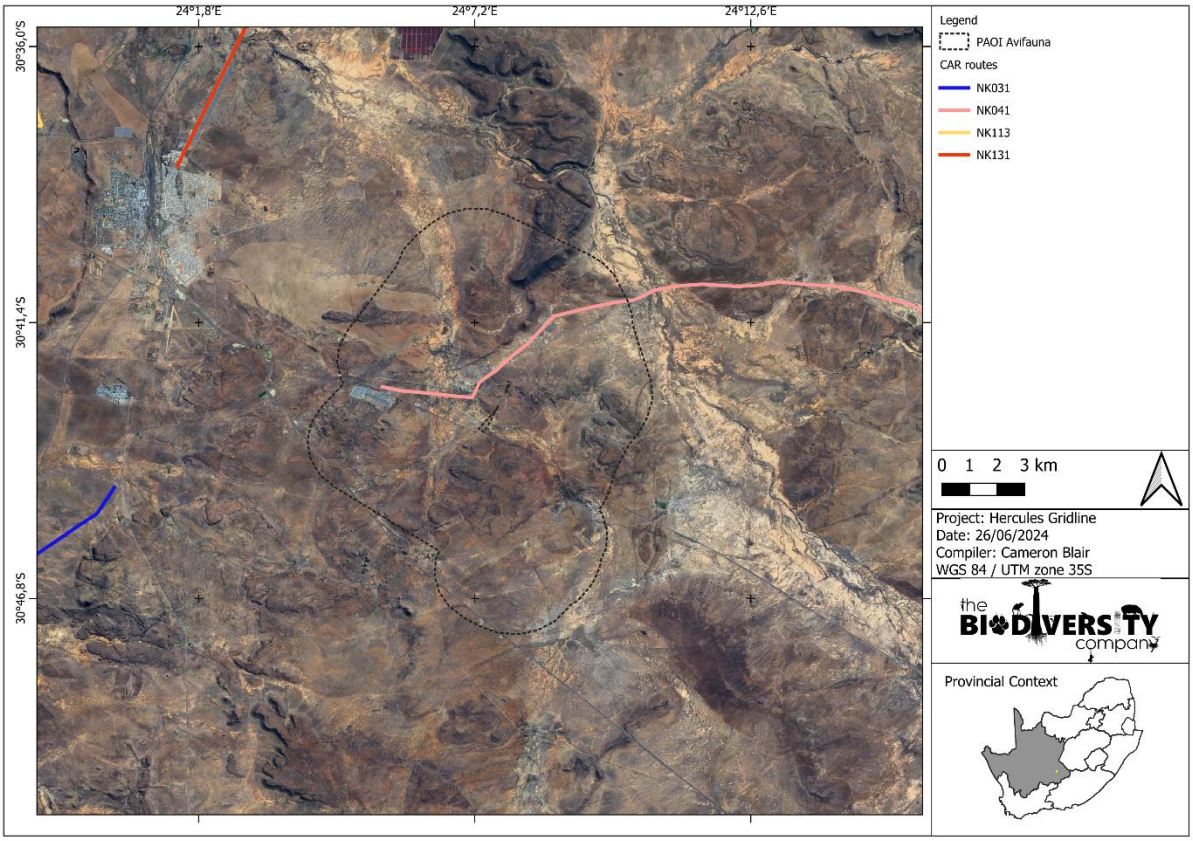


Figure 3-7 The CAR routes in relation to the PAOI

Table 3-3 Avifauna species recorded on CAR route NK041.

Common Name	Scientific Name

Kori Bustard	*Ardeotis kori*
Blue Crane	*Anthropoides paradiseus*
Spur-winged Goose	*Plectropterus gambensis*
Secretarybird	*Sagittarius serpentarius*
Black-headed Heron	*Ardea melanocephala*
Northern Black Korhaan	*Afrotis afraoides*
Ludwig's Bustard	*Neotis ludwigii*
Pied Crow	*Corvus albus*
Karoo Korhaan	*Eupodotis vigorsii*
White Stork	*Ciconia ciconia*
Jackal Buzzard	*Buteo rufofuscus*
Black-winged Kite	*Elanus caeruleus*
Blue Korhaan	*Eupodotis caerulescens*

3.2 Avifauna Expected Species

SABAP2 data indicate that 187 avifauna species are expected for the PAOI and surrounds. Of these, 14 are considered SCC (Table 3-4). The likelihood of occurrence within the POAI are included here.

Table 3-4 Threatened avifauna species that are expected to occur within the PAOI. EN = Endangered, LC = Least Concern, NT = Near Threatened and VU = Vulnerable

Common Name	Scientific Name	Regional*	Global+	Likelihood of occurrence
Secretarybird	*Sagittarius serpentarius*	VU	EN	Confirmed
Ludwig's Bustard	*Neotis ludwigii*	EN	EN	Confirmed
Blue Crane	*Anthropoides paradiseus*	NT	VU	Confirmed
Martial Eagle	*Polemaetus bellicosus*	EN	EN	Confirmed
Tawny Eagle	*Aquila rapax*	EN	VU	Confirmed
Verreaux's Eagle	*Aquila verreauxii*	NA	LC	Confirmed
Lanner Falcon	*Falco biarmicus*	VU	LC	High
Greater Flamingo	*Phoenicopterus roseus*	NT	LC	Confirmed
Blue Korhaan	*Eupodotis caerulescens*	LC	NT	High
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC	Confirmed
African Rock Pipit	*Anthus crenatus*	NT	LC	Confirmed
Curlew Sandpiper	*Calidris ferruginea*	LC	NT	Moderate
Black Stork	*Ciconia nigra*	VU	LC	High
Cape Vulture	*Gyps coprotheres*	EN	VU	High

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

Anthropoides paradiseus (Blue Crane) is listed as NT on a regional scale and as VU on a global scale. This species has declined, largely owing to direct poisoning, power-line collisions and loss of its grassland breeding habitat owing to afforestation, mining, agriculture and development (IUCN, 2017). This species breeds in natural grass- and sedge-dominated habitats, preferring secluded grasslands at high elevations where the vegetation is thick and short.

Anthus crenatus (African Rock Pipit) is endemic to South Africa and Lesotho (IUCN, 2017). They are classed as near threatened after undergoing a decline in habitat of 34% in the last 10 years (IUCN, 2017). The species is associated with rocky habitats that has abundant shrub and grassy areas.

Aquila rapax (Tawny Eagle) is listed as Endangered (EN) on a regional scale and occupies dry open habitats from sea level to 3000 m. It will occupy both woodland and wooded savannah (IUCN, 2017).

Aquila verreauxii (Verreaux's Eagle) is listed as VU on a regional scale and LC on a global scale. This species is locally persecuted in southern Africa where it coincides with livestock farms, but because the species does not take carrion, is little threatened by poisoned carcasses. Where hyraxes are hunted for food and skins, eagle populations have declined (IUCN, 2017). Based on the expected habitat, the close proximity of the Waterberg mountains and the availability of prey items.

Calidris ferruginea (Curlew Sandpiper) is migratory species which breeds on slightly elevated areas in the lowlands of the high Arctic, and may be seen in parts of South Africa during winter. During winter, the species occurs at the coast, but also inland on the muddy edges of marshes, large rivers and lakes (both saline and freshwater), irrigated land, flooded areas, dams and saltpans (IUCN, 2017).

Ciconia nigra (Black Stork) is native to South Africa, and nests on cliffsides in mountainous regions. They are known to forage in shallow streams, pools, marshes swampy patches, damp meadows, flood-plains, pools in dry riverbeds and occasionally grasslands, especially where there are stands of reeds or long grass (IUCN, 2017).

Eupodotis caerulescens (Blue Korhaan) is endemic to South Africa and Lesotho and occurs in grassveld usually over 1 500 m above sea level, preferring open, fairly short grassland and a mixture of grassland and karoo dwarf-shrubland within 1 km of water, with termite mounds and few or no trees (BirdLife International, 2017). The total global population is estimated to number between 12 000-15 000 individuals, equivalent to 8 000-10 000 mature individuals, with a decreasing population trend. The main threat is intensive agriculture, especially within the east of its range.

Eupodotis vigorsii (Karoo Korhaan) is listed as near threatened (NT) on a regional scale and as least concern (LC) on a global scale. This species has a very large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation).

Falco biarmicus (Lanner Falcon) is native to South Africa and inhabits a wide variety of habitats, from lowland deserts to forested mountains (IUCN, 2017). Global population estimates is more than 30000 breeding pairs, in South Africa it is estimated to be 1400 pairs. They may occur in groups up to 20 individuals, but have also been observed solitary. They are partial and facultative migrants, that breeds from May to early September. Nests are mostly found on cliff ledges, and they may alternate between more than one nest. Their diet is mainly composed of small birds such as pigeons and francolins. Anecdotal evidence suggest these species are susceptible to agrochemicals, another threat to their population is the clearing of grassland habitats (Roberts *et al.,* 2023).

Gyps coprotheres (Cape Vulture) is listed as Endangered (EN) on both a regional and global scale. Cape Vultures are long-lived carrion-feeders specialising on large carcasses, they fly long distances over open country, although they are usually found near steep terrain, where they breed and roost on cliffs (IUCN, 2017). Individuals may be seen foraging within the area but are unlikely to be resident. Likelihood of occurrence is rated as low.

Neotis ludwigii (Ludwig's Bustard) is listed as Endangered both locally and internationally. This species is found in the desert, grassland and shrubland specifically in rocky areas such as mountains and cliffs. The main reason for the decline in the numbers are ascribed to the collisions with power lines.

Phoenicopterus roseus (Greater Flamingo) is widely distributed throughout sub-Saharan Africa and inhabits shallow eutrophic waterbodies such as saline lagoons, saltpans and large saline or alkaline

lakes (BirdLife International, 2019b). Juveniles, and to a lesser extent adults undertake irregular nomadic or partially migratory movements throughout the species' range in response to water-level changes. In sub-Saharan Africa, the species may also join large flocks of non-breeding Phoeniconaias minor (Lesser Flamingo). The sub-Saharan African populations between 100 000 and 120 000 mature individuals. The species suffers from low reproductive success if exposed to disturbance at breeding colonies, or if water-levels surrounding nest-sites lower resulting in increased predation from ground predators. Further threats include effluents mining, pollution from sewage and heavy metal effluents from industries and collisions with powerlines (BirdLife International, 2019b).

Polemaetus bellicosus (Martial Eagle) is listed as EN on a regional scale and VU on a global scale. This species has an extensive range across much of sub-Saharan Africa, but populations are declining due to deliberate and incidental poisoning, habitat loss, reduction in available prey, pollution and collisions with power lines (IUCN, 2017). It inhabits open woodland, wooded savanna, bushy grassland, thorn-bush and, in southern Africa, more open country and even sub-desert (IUCN, 2017).

Sagittarius serpentarius (Secretarybird) is listed as EN on a global scale (BirdLife International, 2020). The species has a wide distribution across sub-Saharan Africa but surveyed densities suggest that the total population size does not exceed a five-figure number. Ad-hoc records, localised surveys and anecdotal observations indicate apparent declines in many parts of the species' range, especially in South Africa where reporting rates decreased by at least 60% of quarter degree grid cells used in Southern African Bird Atlas Projects. Threats include excessive burning of grasslands that may suppress populations of prey species, whilst the intensive grazing of livestock is also probably degrading otherwise suitable habitat. Disturbance by humans is likely to negatively affect breeding. The species is captured and traded; however, it is unknown how many deaths occur in captivity and transit. Direct hunting and nest-raiding for other uses and indiscriminate poisoning at waterholes are also further threats. A proposed conservation action is that landowners of suitable properties should join biodiversity stewardship initiatives and to manage their properties in a sustainable way for the species' populations.

3.3 Fieldwork Findings

3.3.1 Species List of First Field Survey

The first avifaunal field survey was completed between the 17-21 October 2022 for 5 days, the second survey was completed between the 17-20 February 2023 for 4 days, and the third survey was completed between the 18-21 May 2023 for 4 days. These three site visits constitute both dry and wet season surveys, to determine the presence of Species of Conservation Concern (SCC). Effort was made to cover all the different habitat types, within the limits of time and access.

Seven SCC were recorded during the first survey period (Table 3-5).

Table 3-5 SCC recorded in the first assessment.

Common Name	Scientific Name	Conservation Status	
		Regional	Global
Secretarybird	*Sagittarius serpentarius*	VU	EN
Ludwig's Bustard	*Neotis ludwigii*	EN	EN
Blue Crane	*Anthropoides paradiseus*	NT	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Tawny Eagle	*Aquila rapax*	EN	VU
Verreaux's Eagle	*Aquila verreauxii*	NA	LC
Greater Flamingo	*Phoenicopterus roseus*	NT	LC

3.3.1.1 Risk Species

As aforementioned, Priority Species are considered threatened, rare or prone to impacts from energy development (Ralston Paton *et al*, 2017). TBC has defined Risk Species as those species that are listed in Ralston Paton *et al* (2017) as Priority Species, as well as those listed in the Eskom poster of Birds and Power Lines (Eskom and EWT, no date), which together include all species, common or red-listed that may be at risk of collision, electrocution or habitat loss as a result of the proposed activity. Twenty-six (26) of the species observed within the PAOI are regarded as priority species (Table 3-6 and Figure 3-8).

Table 3-6 Summary of Priority Species recorded within and around the proposed development.

Common Name	Scientific Name	Collision	Electrocution	Disturbance/Habitat Loss
Black-winged Kite	*Elanus caeruleus*		x	
Black-winged Stilt	*Himantopus himantopus*	x		x
Blue Crane	*Grus paradisea*	x		x
Cape Teal	*Anas capensis*	x		x
Egyptian Goose	*Alopochen aegyptiaca*	x	x	
Greater Flamingo	*Phoenicopterus roseus*	x		x
Greater Kestrel	*Falco rupicoloides*	x	x	
Jackal Buzzard	*Buteo rufofuscus*	x	x	
Kittlitz's Plover	*Charadrius pecuarius*			x
Little Grebe	*Tachybaptus ruficollis*	x		x
Ludwig's Bustard	*Neotis ludwigii*	x		
Martial Eagle	*Polemaetus bellicosus*			

Northern Black Korhaan	*Afrotis afraoides*	x			
Pale Chanting Goshawk	*Melierax canorus*	x	x		
Pied Avocet	*Recurvirostra avosetta*	x			x
Pied Crow	*Corvus albus*	x	x		
Red-knobbed Coot	*Fulica cristata*	x			x
Rock Kestrel	*Falco rupicolus*	x	x		
Secretarybird	*Sagittarius serpentarius*	x	x		x
South African Shelduck	*Tadorna cana*	x			x
Spur-winged Goose	*Plectropterus gambensis*	x			x
Tawny Eagle	*Aquila rapax*	x	x		x
Three-banded Plover	*Charadrius tricollaris*				x
Verreaux's Eagle	*Aquila verreauxii*	x	x		x
White-necked Raven	*Corvus albicollis*	x	x		
Yellow-billed Duck	*Anas undulata*	x			x

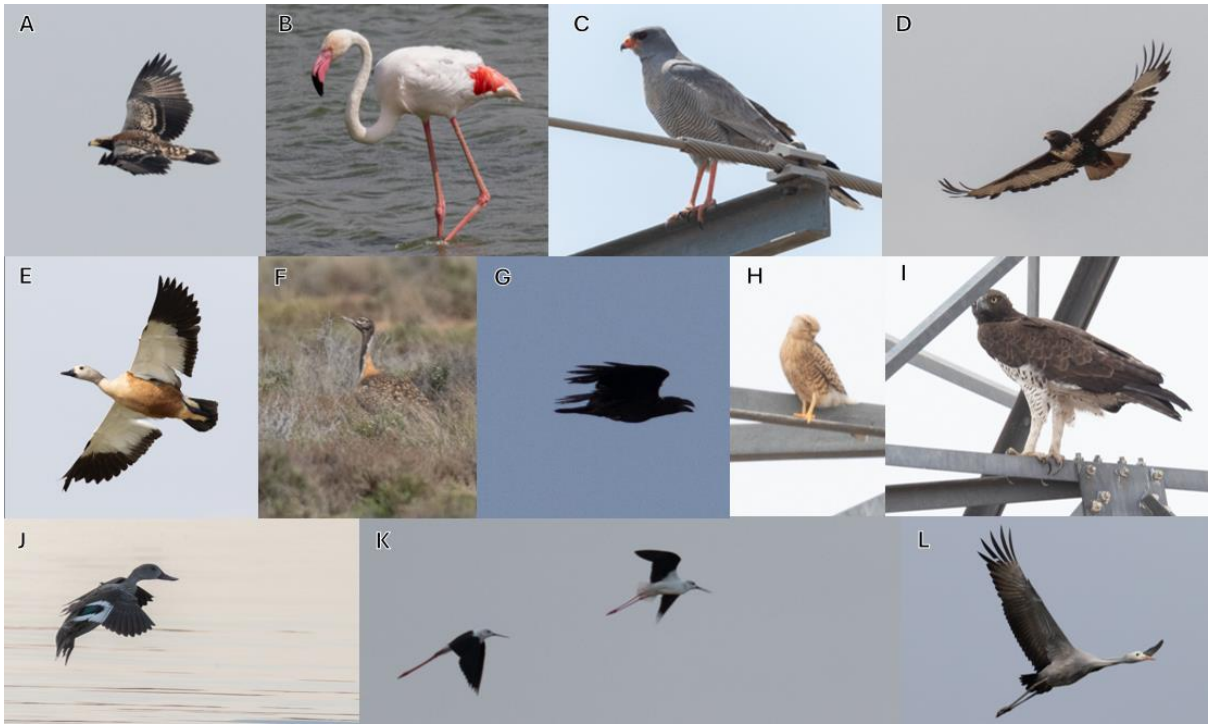


Figure 3-8 ***Photos illustrating some of the SCC and Priority Species observed on the 1st survey: A) Verreaux's Eagle (Aquila verreauxii), B) Greater Flamingo (Phoenicopterus roseus), C) Pale Chanting Goshawk (Melierax canorus), D) Jackal Buzzard (Buteo rufofuscus), E) South African Shelduck (Tadorna cana), F) Ludwig's Bustard (Neotis ludwigii), G) White-necked Raven (Corvus albicollis), H) Greater Kestrel (Falco rupicoloides), I) Martial Eagle (Polemaetus bellicosus), J) Cape Teal (Anas capensis), K) Black-winged Stilt (Himantopus Himantopus), L) Blue Crane (Anthropoides paradiseus).***

3.3.1.2 Dominant Species

Table 3-7 provides the relative abundance of the dominant species as well as the frequency with which each species appeared in the point count samples. The most abundant species was the Eastern

Clapper Lark (*Mirafra fasciolata*), with a relative abundance of 0.114 and a frequency of occurrence of 71.429% (Table 3-7).

Table 3-7 Relative abundance and frequency of occurrence of dominant avifauna species recorded during the standardised point counts within and around the proposed development during the field survey.

Common Name	Scientific Name	Family Name	Relative abundance	Frequency (%)
Eastern Clapper Lark	*Mirafra fasciolata*	Alaudidae	0,114	71,429
Red-billed Quelea	*Quelea quelea*	Ploceidae	0,105	3,571
Desert Cisticola	*Cisticola aridulus*	Cisticolidae	0,086	82,143
Pied Crow	*Corvus albus*	Corvidae	0,056	53,571
Spike-heeled Lark	*Chersomanes albofasciata*	Alaudidae	0,052	42,857
Southern Red Bishop	*Euplectes orix*	Ploceidae	0,051	1,7857
African Pipit	*Anthus cinnamomeus*	Motacillidae	0,037	46,429
Ant-eating Chat	*Myrmecocichla formicivora*	Muscicapidae	0,032	25,000
Northern Black Korhaan	*Afrotis afraoides*	Otididae	0,032	42,857
Lark-like Bunting	*Emberiza impetuani*	Emberizidae	0,027	21,429
Helmeted Guineafowl	*Numida meleagris*	Numididae	0,023	8,929
Large-billed Lark	*Galerida magnirostris*	Alaudidae	0,021	30,357
Rufous-eared Warbler	*Malcorus pectoralis*	Cisticolidae	0,021	26,786
Blue Crane	*Grus paradisea*	Gruidae	0,020	16,071
African Quail-finch	*Ortygospiza atricollis*	Estrildidae	0,017	10,714
Greater Flamingo	*Phoenicopterus roseus*	*Phoenicopteridae*	0,017	1,7857
Egyptian Goose	*Alopochen aegyptiaca*	Anatidae	0,016	12,500
Cloud Cisticola	*Cisticola textrix*	Cisticolidae	0,015	23,214
Cape Sparrow	*Passer melanurus*	Passeridae	0,013	5,357
Grey-backed Sparrow-lark	*Eremopterix verticalis*	Alaudidae	0,013	5,357
South African Shelduck	*Tadorna cana*	Anatidae	0,012	5,357
Southern Masked Weaver	*Ploceus velatus*	Ploceidae	0,012	8,929
Greater Striped Swallow	*Cecropis cucullata*	Hirundinidae	0,011	8,929
Wattled Starling	*Creatophora cinerea*	Sturnidae	0,011	3,571

3.3.1.3 Trophic Guilds

Trophic guilds are defined as a group of species that exploit the same class of environmental resources in a similar way (González-Salazar *et al,* 2014). The guild classification used in this assessment is as per González-Salazar *et al* (2014); they divided avifauna into 13 major groups based on their diet, habitat, and main area of activity. Although species to tend to exhibit varied diet with invertivores consuming fruit and frugivores consuming insects for example, the dominant composition of the diet was considered.

The analysis of the major avifaunal guilds reveals that the species composition during the survey was dominated by Insectivore Ground Diurnal (IGD) birds, followed by Omnivore Ground Diurnal (OGD) and Granivore Ground Diurnal (GGD) (Figure 3-9).

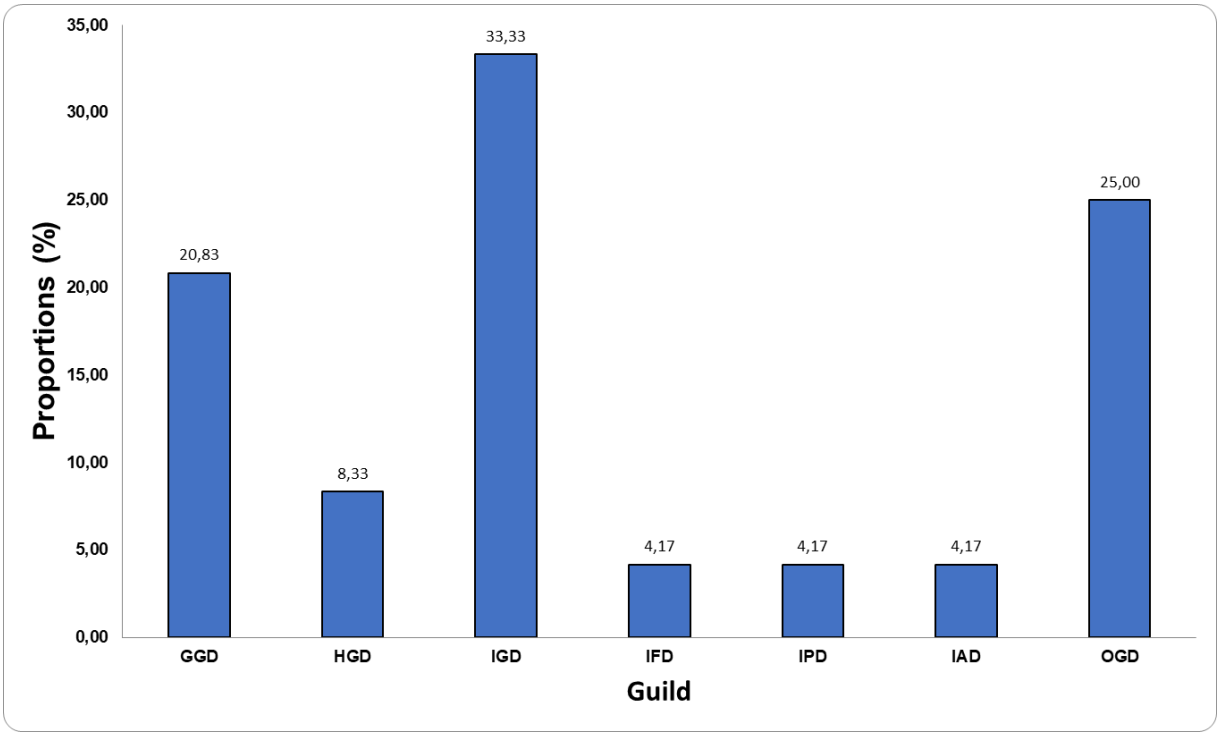


Figure 3-9 ***Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance. Avifaunal trophic guilds – GGD, Granivore Ground Diurnal; HGD, Herbivore Ground Diurnal; IGD, Insectivore Ground Diurnal; IFD, Invertivore Foliage Diurnal; IPD, Invertivore Perch Diurnal; IAD, Invertivore Air Diurnal; OGD, Omnivore Ground Diurnal.***

3.3.2 Species List of Second Field Survey

The first avifaunal field survey was completed between the 17-21 October 2022 for 5 days, the second survey was completed between the 17-20 February 2023 for 4 days, and the third survey was completed between the 18-21 May 2023 for 4 days. These three site visits constitute both dry and wet season surveys, to determine the presence of Species of Conservation Concern (SCC). Effort was made to cover all the different habitat types, within the limits of time and access.

Eight SCC were recorded during the second survey period (Table 3-8).

Table 3-8 ***SCC recorded in the second assessment***

Common Name	Scientific Name	Conservation Status	
		Regional	Global
Ludwig's Bustard	*Neotis ludwigii*	EN	EN
Tawny Eagle	*Aquila rapax*	EN	VU
Blue Crane	*Anthropoides paradiseus*	EN	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Verreaux's Eagle	*Aquila verreauxii*	EN	VU
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC
Secretarybird	*Sagittarius serpentarius*	VU	EN
African Rock Pipit	*Anthus crenatus*	NT	LC

3.3.2.1 Risk Species

As aforementioned, Priority Species are considered threatened, rare or prone to impacts from energy development (Ralston Paton *et al*, 2017). TBC has defined Risk Species as those species that are listed in Ralston Paton *et al* (2017) as Priority Species, as well as those listed in the Eskom poster of Birds and Power Lines (Eskom and EWT, no date), which together include all species, common or red-listed that may be at risk of collision, electrocution or habitat loss as a result of the proposed activity. Thirteen (13) of the species observed within the PAOI are regarded as priority species (Table 3-9).

Table 3-9 Summary of Priority Species recorded within and around the proposed development

Common Name	Scientific Name	Collision	Electrocution	Disturbance/Habitat Loss
Greater Kestrel	*Falco rupicoloides*	x	x	
Helmeted Guineafowl	*Numida meleagris*	x		
Pale Chanting Goshawk	*Melierax canorus*	x	x	
Pied Crow	*Corvus albus*	x	x	
Egyptian Goose	*Alopochen aegyptiaca*	x		x
Northern Black Korhaan	*Afrotis afraoides*	x		
Karoo Korhaan	*Eupodotis vigorsii*	x		
Ludwig's Bustard	*Neotis ludwigii*	x		
Tawny Eagle	*Aquila rapax*	x	x	
Verreaux's Eagle	*Aquila verreauxii*	x	x	
African Rock Pipit	*Anthus crenatus*			x

3.3.2.2 Dominant Species

Table 3-10 provides the relative abundance of the dominant species as well as the frequency with which each species appeared in the point count samples. The most abundant species was African Pipit (*Anthus cinnamomeus*) with a relative abundance of 0.110 and a frequency of occurrence of 16.33% (Table 3-10).

Table 3-10 Relative abundance and frequency of occurrence of dominant avifauna species recorded during the standardised point counts within and around the proposed development during the field survey.

Common Name	Scientific Name	Family Name	Relative abundance	Frequency (%)
African Pipit	Anthus cinnamomeus	Motacillidae	0,110	16,33
Spike-heeled Lark	Chersomanes albofasciata	Alaudidae	0,088	34,69
Red-billed Quelea	Quelea quelea	Ploceidae	0,071	2,04
Large-billed Lark	Galerida magnirostris	Alaudidae	0,058	16,33
Cape Sparrow	Passer melanurus	Passeridae	0,054	16,33
Pied Crow	Corvus albus	Corvidae	0,052	24,49
European Bee-eater	Merops apiaster	Meropidae	0,052	4,08
Rufous-eared Warbler	Malcorus pectoralis	Cisticolidae	0,046	28,57
Ant-eating Chat	Myrmecocichla formicivora	Muscicapidae	0,046	6,12
Grey-backed Sparrow-Lark	Eremopterix verticalis	Alaudidae	0,038	6,12
Lark-like Bunting	Emberiza impetuani	Emberizidae	0,029	16,33

Desert Cisticola	Cisticola aridulus	Cisticolidae	0,025	22,45
South African Cliff Swallow	Petrochelidon spilodera	Hirundinidae	0,023	2,04
Southern Fiscal	Lanius collaris	Laniidae	0,021	6,12
Southern Masked Weaver	Ploceus velatus	Ploceidae	0,019	6,12
Northern Black Korhaan	Afrotis afraoides	Otididae	0,019	14,29
Red-capped Lark	Calandrella cinerea	Alaudidae	0,017	8,16
Capped Wheatear	Oenanthe pileata	Muscicapidae	0,017	12,24
Bokmakierie	Telophorus zeylonus	Malaconotidae	0,013	12,24
Helmeted Guineafowl	Numida meleagris	Numididae	0,013	2,04
Egyptian Goose	Alopochen aegyptiaca	Anatidae	0,010	6,12
Black-winged Stilt	Himantopus himantopus	Recurvirostridae	0,010	4,08
Crowned Lapwing	Vanellus coronatus	Charadriidae	0,010	4,08
Greater Striped Swallow	Cecropis cucullata	Hirundinidae	0,010	4,08

3.3.2.3 Trophic Guilds

Trophic guilds are defined as a group of species that exploit the same class of environmental resources in a similar way (González-Salazar *et al*, 2014). The guild classification used in this assessment is as per González-Salazar *et al* (2014); they divided avifauna into 13 major groups based on their diet, habitat, and main area of activity. Although species to tend to exhibit varied diet with invertivores consuming fruit and frugivores consuming insects for example, the dominant composition of the diet was considered.

The analysis of the major avifaunal guilds reveals that the species composition during the survey was dominated by Invertivore Ground Diurnal (IGD) birds, followed by Omnivore Ground Diurnal (OGD) and Granivore Ground Diurnal (Figure 3-10).

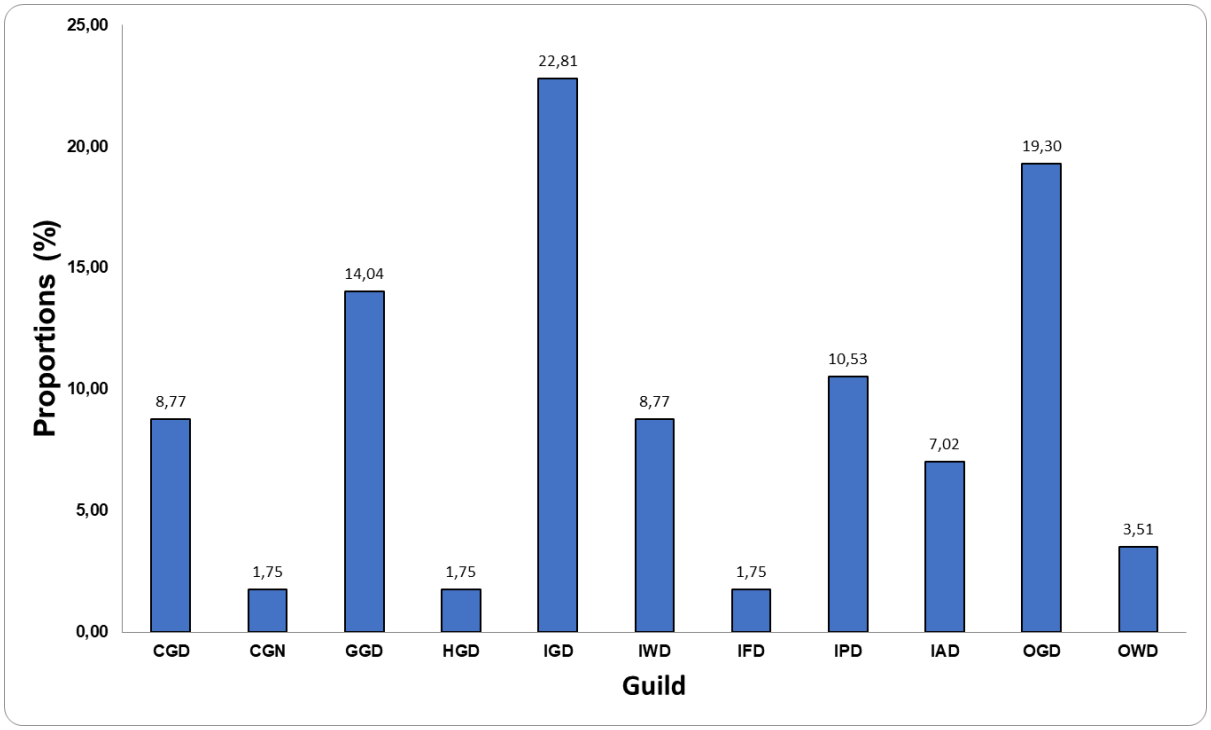


Figure 3-10 Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance. Avifaunal trophic guilds – CGD, Carnivore Ground Diurnal; CGN, Carnivore Ground Nocturnal; GGD, Granivore Ground Diurnal; HGD, Herbivore Ground Diurnal; IGD, Insectivore Ground Diurnal; IWD, Invertivore Water Diurnal; IFD, Invertivore Foliage Diurnal; IPD, Invertivore Perch Diurnal; IAD, Invertivore Air Diurnal; OGD, Omnivore Ground Diurnal; OWD, Omnivore Water Diurnal.

3.3.3 Species List of Third Field Survey

The first avifaunal field survey was completed between the 17-21 October 2022 for 5 days, the second survey was completed between the 17-20 February 2023 for 4 days, and the third survey was completed between the 18-21 May 2023 for 4 days. These three site visits constitute both dry and wet season surveys, to determine the presence of Species of Conservation Concern (SCC). Effort was made to cover all the different habitat types, within the limits of time and access.

Five SCC were recorded during the third survey period (Table 3-11).

Table 3-11 SCC recorded in the third assessment

Common Name	Scientific Name	Conservation Status	
		Regional	Global
Ludwig's Bustard	*Neotis ludwigii*	EN	EN
Tawny Eagle	*Aquila rapax*	EN	VU
Verreaux's Eagle	*Aquila verreauxii*	EN	VU
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC
African Rock Pipit	*Anthus crenatus*	NT	LC

3.3.3.1 Risk Species

As aforementioned, Priority Species are considered threatened, rare or prone to impacts from energy development (Ralston Paton *et al*, 2017). TBC has defined Risk Species as those species that are listed in Ralston Paton *et al* (2017) as Priority Species, as well as those listed in the Eskom poster of Birds and Power Lines (Eskom and EWT, no date), which together include all species, common or red-listed that may be at risk of collision, electrocution or habitat loss as a result of the proposed activity. Thirteen (13) of the species observed within the PAOI are regarded as priority species (Table 3-12).

Table 3-12 Summary of Priority Species recorded within and around the proposed development

Common Name	Scientific Name	Collision	Electrocution	Disturbance/Habitat Loss
Greater Kestrel	*Falco rupicoloides*	x	x	
Grey Heron	*Ardea cinerea*	x		
Helmeted Guineafowl	*Numida meleagris*	x		
Pale Chanting Goshawk	*Melierax canorus*	x	x	
Pied Crow	*Corvus albus*	x	x	
South African Shelduck	*Tadorna cana*	x		x
Spur-winged Goose	*Plectropterus gambensis*	x		x
Northern Black Korhaan	*Afrotis afraoides*	x		
Karoo Korhaan	*Eupodotis vigorsii*	x		
Ludwig's Bustard	*Neotis ludwigii*	x		
Tawny Eagle	*Aquila rapax*	x	x	

Verreaux's Eagle	*Aquila verreauxii*	x	x	
African Rock Pipit	*Anthus crenatus*			x

3.3.3.2 Dominant Species

Table 3-13 provides the relative abundance of the dominant species as well as the frequency with which each species appeared in the point count samples. The most abundant species was Lark-like Bunting (*Emberiza impetuani*) with a relative abundance of 0.232 and a frequency of occurrence of 28.00% (Table 3-13).

Table 3-13 Relative abundance and frequency of occurrence of dominant avifauna species recorded during the standardised point counts within and around the proposed development during the field survey.

Common Name	Scientific Name	Family Name	Relative abundance	Frequency (%)
Lark-like Bunting	*Emberiza impetuani*	Emberizidae	0,232	28,00
Spike-heeled Lark	*Chersomanes albofasciata*	Alaudidae	0,161	52,00
Pied Crow	*Corvus albus*	Corvidae	0,104	44,00
Namaqua Sandgrouse	*Pterocles namaqua*	Pteroclidae	0,095	12,00
Cape Sparrow	*Passer melanurus*	Passeridae	0,059	10,00
Ring-necked Dove	*Streptopelia capicola*	Columbidae	0,038	14,00
Karoo Korhaan	*Eupodotis vigorsii*	Otididae	0,031	12,00
Familiar Chat	*Oenanthe familiaris*	Muscicapidae	0,031	16,00
Bokmakierie	*Telophorus zeylonus*	Malaconotidae	0,024	12,00
Large-billed Lark	*Galerida magnirostris*	Alaudidae	0,024	14,00
Speckled Pigeon	*Columba guinea*	Columbidae	0,024	2,00
Spur-winged Goose	*Plectropterus gambensis*	Anatidae	0,024	2,00

3.3.3.3 Trophic Guilds

Trophic guilds are defined as a group of species that exploit the same class of environmental resources in a similar way (González-Salazar *et al*, 2014). The guild classification used in this assessment is as per González-Salazar *et al* (2014); they divided avifauna into 13 major groups based on their diet, habitat, and main area of activity. Although species to tend to exhibit varied diet with invertivores consuming fruit and frugivores consuming insects for example, the dominant composition of the diet was considered.

The analysis of the major avifaunal guilds reveals that the species composition during the survey was dominated by Invertivore Ground Diurnal (IGD) birds, followed by Omnivore Ground Diurnal (OMD) and Granivore Ground Diurnal (GGD) (Figure 3-11).

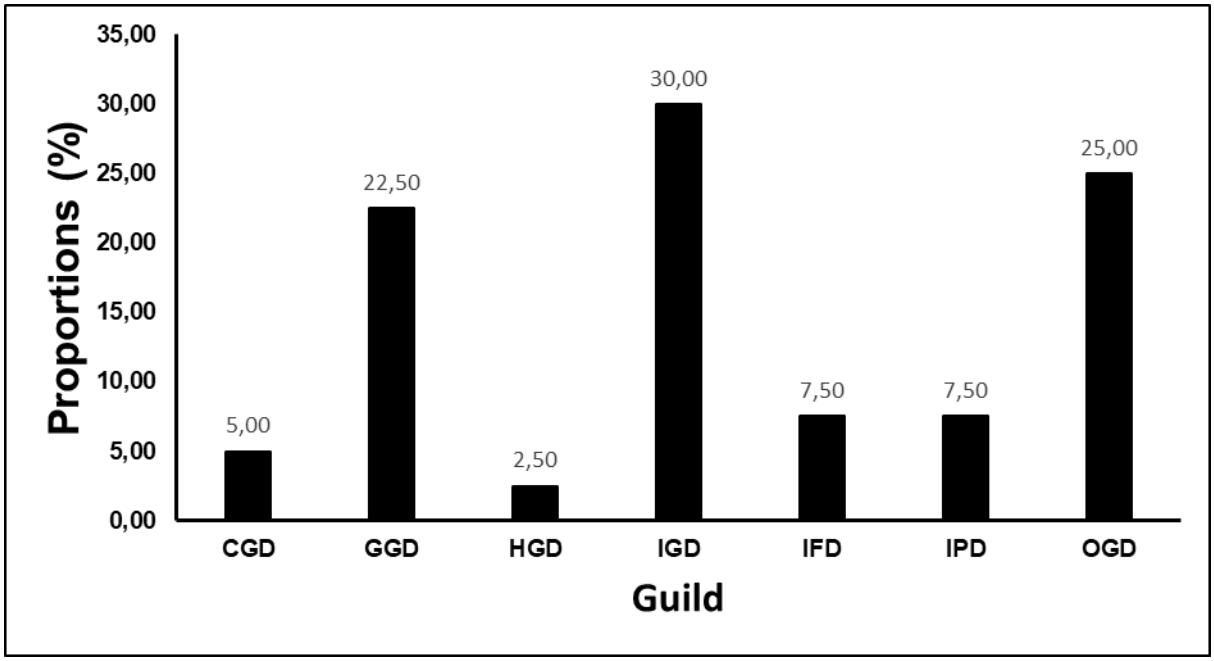


Figure 3-11 ***Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance. Avifaunal trophic guilds – CGD, Carnivore Ground Diurnal; GGD, Granivore Ground Diurnal; HGD, Herbivore Ground Diurnal; IGD, Insectivore Ground Diurnal; IFD, Invertivore Foliage Diurnal; IPD, Invertivore Perch Diurnal; OGD, Omnivore Ground Diurnal.***

3.3.4 Flight and Nest Analysis

Observing and monitoring flight paths and nesting sites of SCC and/or priority species are important in ascertaining habitat sensitivity and evaluating the impact risk significance of any proposed development. Flight analysis is also important for species that exhibit diel movement between roosting and foraging sites to prevent the risk of collision with infrastructure. A very condensed version of flight path analysis was done, the aim of this was to determine if there is a general direction of most birds on site. This section needs to be interpreted cautiously based on the limited time spent on this component.

No specific flight paths were noted.

Two active Verreaux's Eagle (*Aquila verreauxii*) nests were located near the project area. No development is allowed within 1 km of the nest sites. Additionally, no development may happen between April and September within 2 km of the nest sites. Three Greater Kestrel nests and one Jackal Buzzard nest were located near the site. Within 750 m of each of these nests, development is only allowed between March and June. Alternatively, if development within 750 m of these nests is to occur outside of these months, the nest site needs to be assessed by an avifaunal specialist to determine whether the nest is currently active. A significant proportion of the preferred corridor is located within 1 km of one Verreaux's Eagle nest, therefore the current layout of this route is fatally flawed (Figure 3-12).

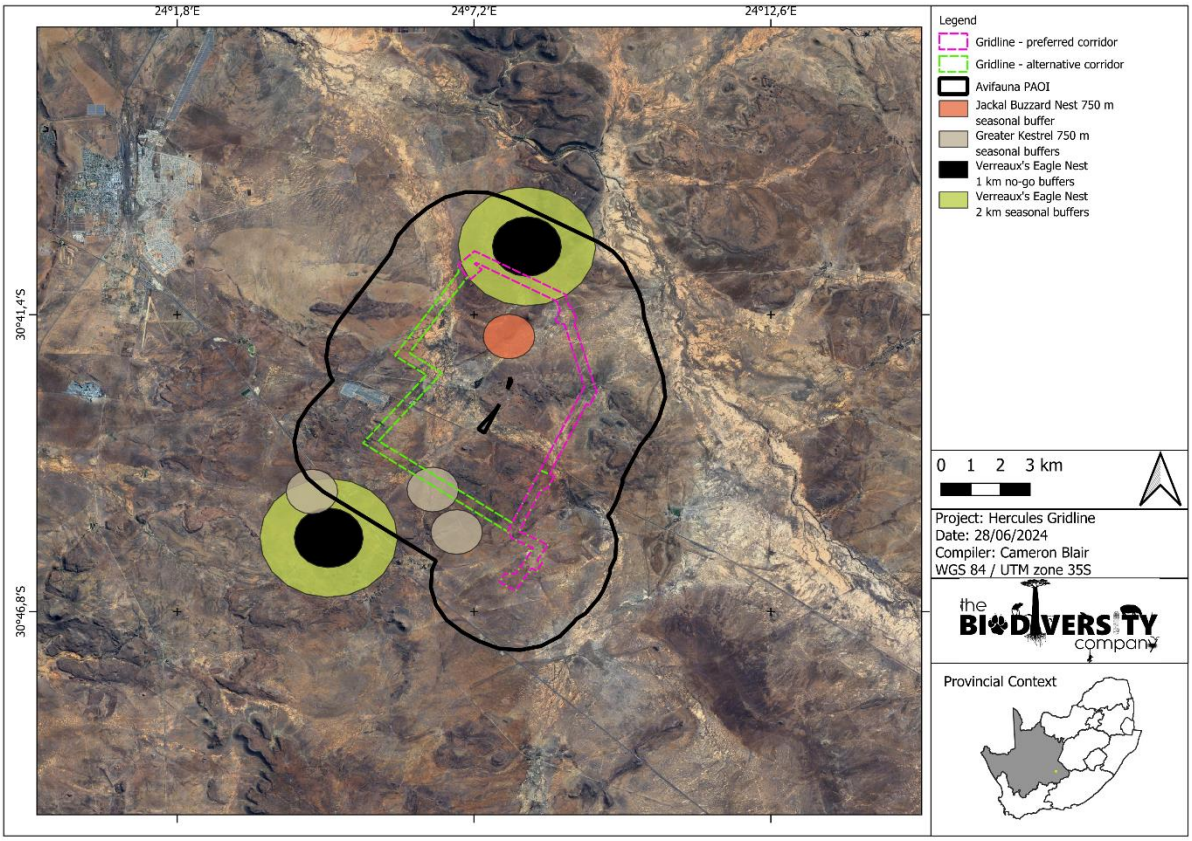


Figure 3-12 Nest buffers for each of the nests found near the proposed gridline corridors

3.4 Habitat Assessment

Fine-scale habitats within the landscape are important in supporting a diverse avifauna community as they provide differing nesting, foraging and reproductive opportunities.

The main habitat types identified across the PAOI were initially delineated largely based on aerial imagery, and these main habitat types were then refined based on the field coverage and data collected during the survey. Four (4) habitats were delineated in total (Figure 3-13), a full description of the habitats are provided below.

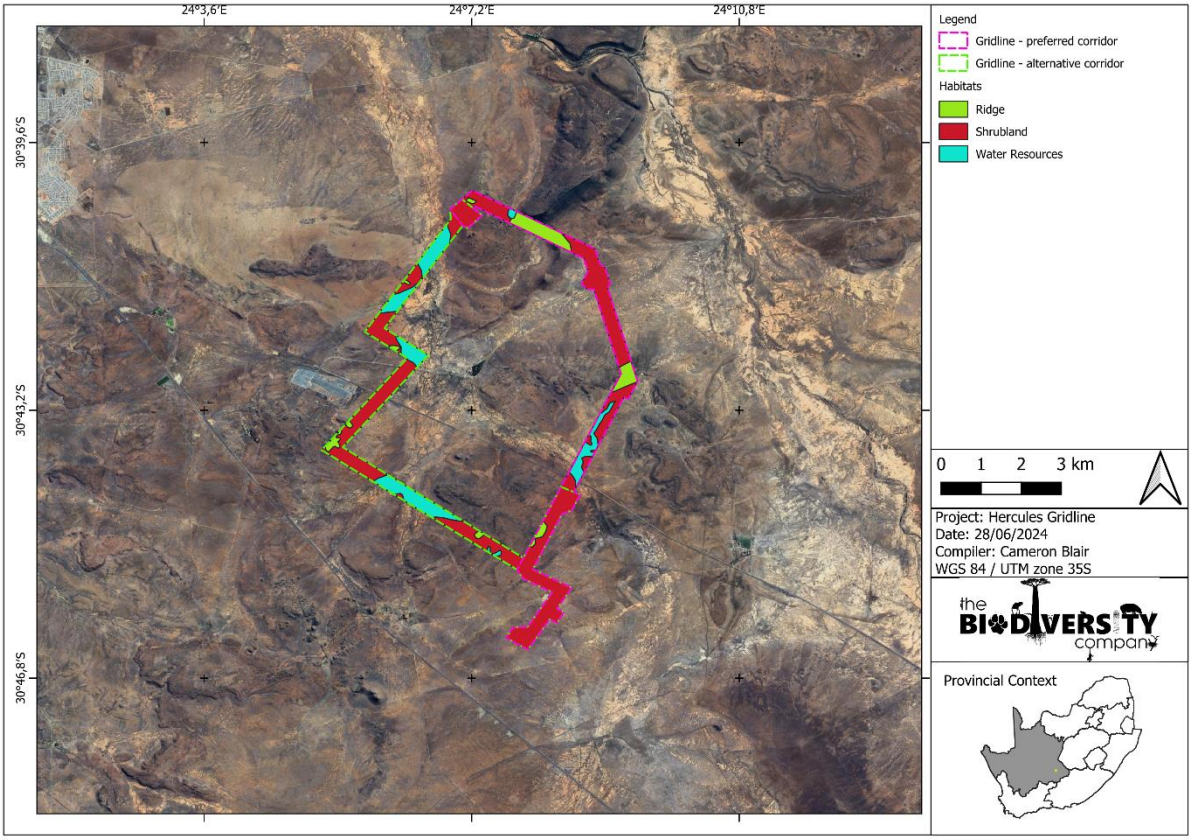


Figure 3-13 Habitats identified within the assessment area of each proposed corridor alternative.

3.4.1 Shrubland

This habitat is the remainder of the shrubland that has been disturbed by the historic and current grazing (Figure 3-14). This habitat type is regarded as semi-natural shrubland, but slightly disturbed due to the grazing by livestock, mismanagement and also human infringement. Numerous SCC were recorded in this habitat with more SCC expected to occur, utilising the habitat for both nesting and foraging.

SCC possible occupying this habitat: Secretarybird, Ludwig's Bustard, Blue Crane, Martial Eagle, Tawny Eagle, Lanner Falcon, Blue Korhaan, Karoo Korhaan, Cape Vulture

Figure 3-14 Shrubland habitat

3.4.2 Ridge

This habitat includes areas that are rocky outcrops, stony and rocky ridges/hills with varying slopes, bedrock protruding from the soil layer with the associated boulders and large rocks that occur within the shrubland habitat. This habitat supports sensitive avifauna SCC that use this habitat for both nesting and foraging (Figure 3-15).

SCC possible occupying this habitat: Verreaux's Eagle, Lanner Falcon, African Rock Pipit, Cape Vulture

Figure 3-15 Ridge habitat

3.4.3 Water Resources

This habitat is regarded as areas where intermittent rivers sporadically flow and exists as well as the drainage flats/floodplains connected to these areas. This habitat is shrubland that has been disturbed mainly by the historic and current grazing (Figure 3-16). This habitat type is regarded as semi-natural shrubland, but slightly disturbed due to the grazing by livestock the associated human infringement and use (dams). Current human infringement still occurs throughout, especially in areas close to roads. The drainage lines and within the project area can be regarded as non-perennial and possess surface flow only briefly during and following a period of rainfall (ephemeral), which is a feature of semi-arid/arid regions. This habitat likely supports various SCC, and after periods of rain may facilitate influxes of

nomadic species that require drinking water, and waterbirds, many which are particularly vulnerable to collisions.

SCC possible occupying this habitat: Blue Crane, Greater Flamingo, Curlew Sandpiper, Black Stork

Figure 3-16 Water Resources habitat

3.5 Site Ecological Importance

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.

Three habitat types were delineated within the Project Area, namely Shrubland, Ridge and Water Resources. Their respective SEI and the corresponding mitigation guidelines are summarised in Table 3-14.

Table 3-14 Summary of habitat types delineated within field assessment area

Habitat Type	Conservation Importance	Functional Integrity	Biodiversity Importance	Project component in relation to habitat type	Receptor Resilience	Site Ecological Importance Guidelines
Shrubland	High Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.	High Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type	High	Without mitigation	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.	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.
				With mitigation	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	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.
Ridge	High Confirmed or highly likely occurrence of CR, EN, VU species that	High Medium (> 5 ha but < 20 ha) semi-intact area for any	High	Without mitigation	Low Habitat that is unlikely to be able to recover fully after a relatively long	Very High Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not

	have a global EOO of > 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.	conservation status of ecosystem type			period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality.	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.
				With mitigation	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.	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.
Water Resources	High Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.	High Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type	High	Without mitigation	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.	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.
				With mitigation	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	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.

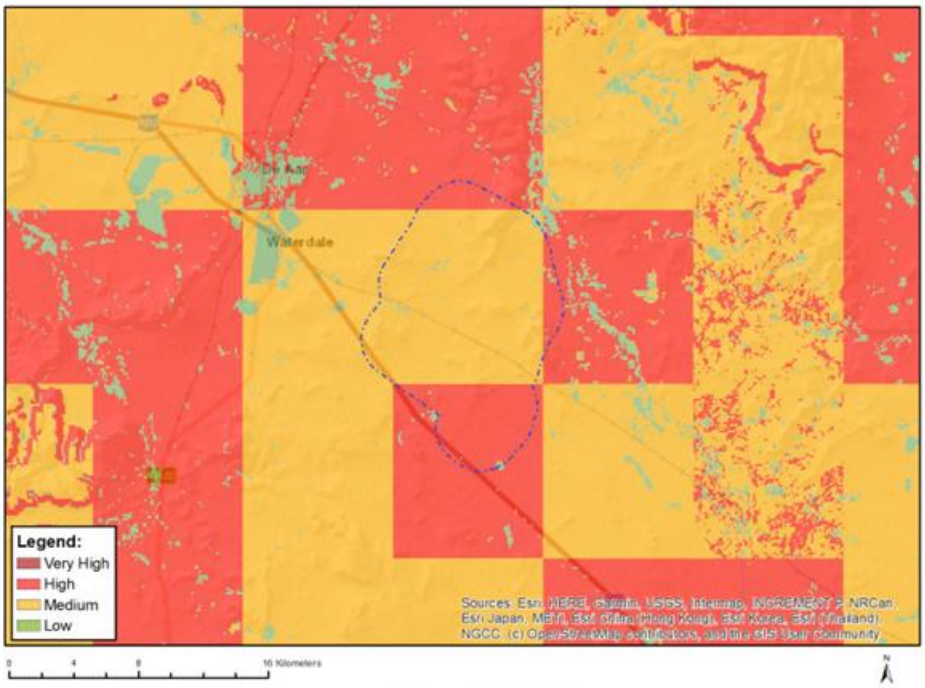
	disturbance or impact has been removed	
Verreaux's Eagle nest 1 km no go buffer		No-Go development
Verreaux's Eagle nest 2 km seasonal buffer (no development permitted during April – September)		High Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities. **No development permitted during the breeding season (April – September).**
Greater Kestrel nest 750 m no go buffer		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. **No development permitted during the breeding season (June to February).**

3.5.1 Desktop Ecological Senstivity

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):

- Animal Species Theme sensitivity is 'High' for the PAOI, with the possibility of Avifauna Species of Conservation Concern (SCC) being present (Figure 3-17).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Neotis ludwigii
High	Aves-Falco biarmicus
Low	Subject to confirmation
Medium	Aves-Neotis ludwigii
Medium	Aves-Aquila rapax
Medium	Aves-Aquila verreauxii

Figure 3-17 Animal Species Theme Sensitivity

3.5.2 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas in Table 3-15 below. A summative explanation for each result is provided as relevant. 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 or protected species. The sensitivities delineated for the project area is illustrated in Figure 3-18.

Table 3-15 Summary of the screening tool vs specialist assigned sensitivities

Screening Tool Theme	Screening Tool	Habitat	Specialist	Tool Validated or Disputed by Specialist - Reasoning

Animal Theme	**High**	**Shrubland**	**High**	Validated - Habitat holds the potential to support various important SCCs
		Ridge	**Very High**	Disputed – Very important habitat for SCCs, especially for nesting.
		Water Resources	**High**	Validated - Habitat holds the potential to support various important SCCs

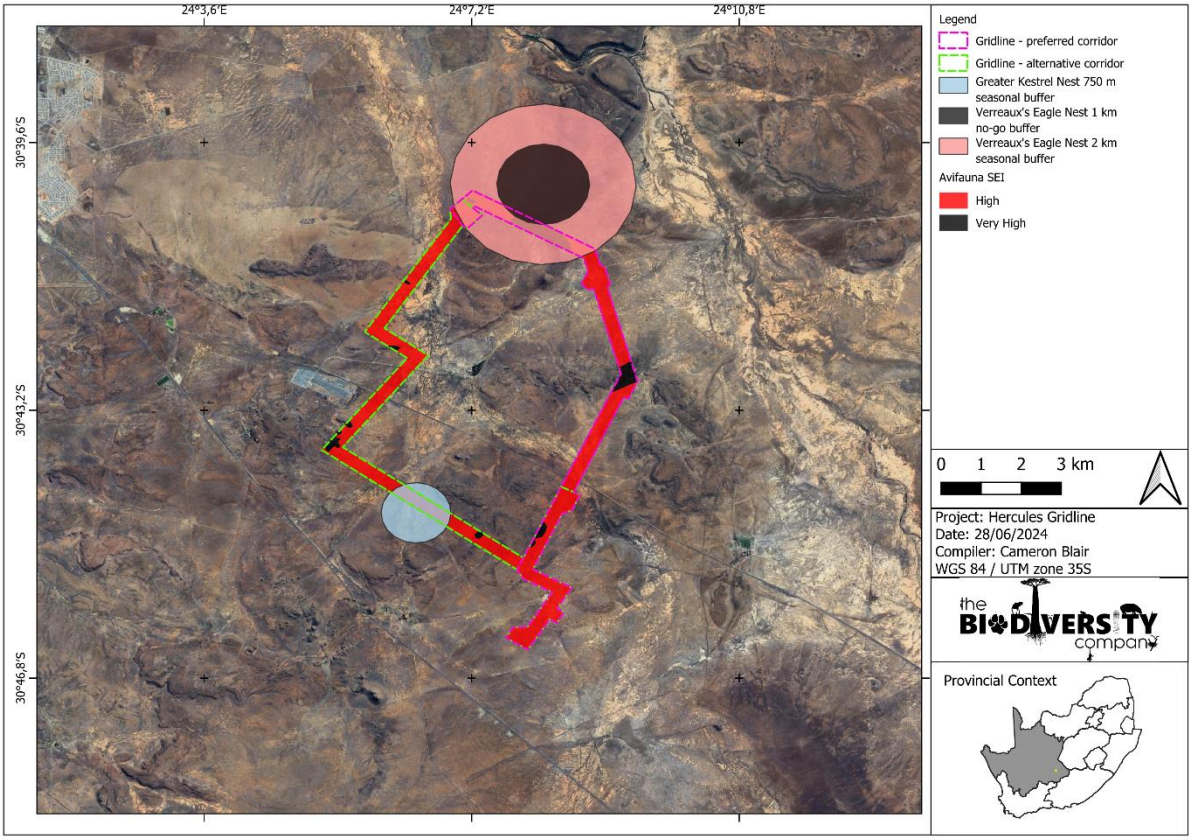


Figure 3-18 Site ecological importance, with mitigation measures applied, along with no-go and seasonal buffers, for each proposed corridor.

4 Impact Assessment

4.1 Current Impacts to Biodiversity

In consideration that there are anthropogenic activities and influences present within the landscape, there are currently several negative impacts to biodiversity, including avifauna. These include:

- Historic land modification to accommodate roads, railways, powerline infrastructure, and the associated land clearing;
- Livestock; and
- Fences and the associated infrastructure (Figure 4-1).

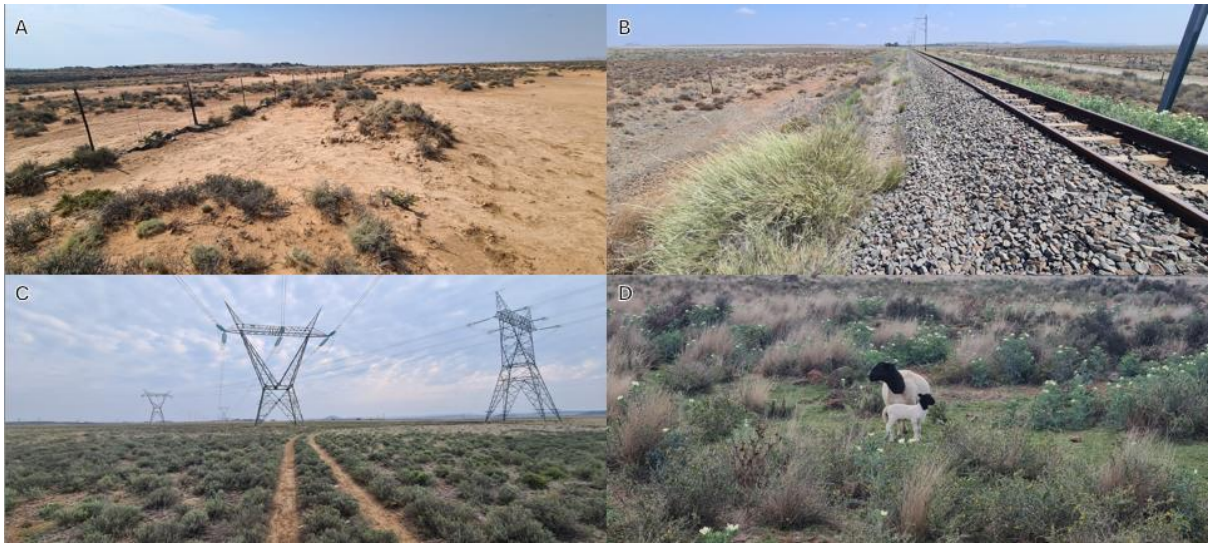


Figure 4-1 Photograph illustrating current negative impacts associated with the PAOI: A) Fences, B) Railway, C) Existing powerlines and D) Livestock

4.2 Alternatives Considered

Two line alternatives were provided, one preferred and an alternative (refer to Figure 1-2 for the layout of the options). A significant proportion of the preferred corridor is located within 1 km of one Verreaux's Eagle nest, therefore the current layout of this route is fatally flawed. From an avifauna perspective, the alternative option is the only option that is not fatally flawed. The alternative line is also better positioned to reduce collisions by other bird species, since it will run parallel to existing lines, rather than perpendicular, reducing the number of collisions.

4.3 Loss of Irreplaceable Resources

The proposed development will lead to the loss of the following irreplaceable resources:

- Habitat and possible nesting sites for numerous expected avifauna SCC; and
- ESA habitat (High SEI).

4.4 Quantitative Impact Assessment

Potential impacts were evaluated against the data captured during the fieldwork and from a desktop perspective to identify relevance to the project area of interest, specifically the proposed development footprint area. Bennun *et al* (2021) describes three broad types of impacts:

- Direct impacts – Impacts that result from project activities or operational decisions that can be predicted based on planned activities and knowledge of local biodiversity, such as habitat loss under the project footprint, habitat fragmentation as a result of project infrastructure and species disturbance or mortality as a result of project operations;
- Indirect impacts – Impacts induced by, or 'by-products' of, project activities within a project's area of influence; and
- Cumulative impacts – Impacts that result from the successive, incremental and/or combined effects of existing, planned and/or reasonably anticipated future human activities in combination with project development impacts.

The assessment of impact significance considers pre-mitigation as well as implemented post-mitigation scenarios. Three phases were considered for the impact assessment:

- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

4.4.1 Construction Phase

The following impacts were considered during the construction phase:

- Habitat destruction of the preferred gridline;
- Habitat destruction of the alternative gridline;
- Destruction, degradation and fragmentation of surrounding habitats due to noise pollution;
- Displacement/emigration of avifauna community (including SCC);
- Direct mortality from persecution or poaching of avifauna species and collection of eggs; and
- Direct mortality from increased vehicle and heavy machinery traffic.

The pre-mitigation and post-mitigation impact ratings for the construction phase are shown in Table 4-1.

Table 4-1 Impacts associated with the Construction Phase.

Nature of the Impact	Extent	Duration	Probability	Significance (without mitigation)	Significance (with mitigation)	Reversibility	Can impact be mitigated?	Loss of Resources	Can impact be avoided?	Can impact be managed?	Cumulative Impact
Collisions with preferred gridline	Local	Long term	Definite	Very high	High	Irreversible	Yes	Significant	Unavoidable	Low	High
Habitat destruction of the preferred gridline	Local	Medium term	Probable	Low	Low	Completely	Yes	Marginal	Low	High	Medium
Habitat destruction of the alternative gridline	Local	Medium term	Probable	Low	Low	Completely	Yes	Marginal	Low	High	Medium
Destruction, degradation and fragmentation of surrounding habitats due to noise pollution	Local	Medium term	Highly probable	Medium	Low	Partly	Yes	Marginal	Low	High	Medium
Displacement/ emigration of avifauna community (including SCC)	Local	Medium term	Highly probable	Medium	Low	Partly	Yes	Marginal	Low	High	Medium

Direct mortality from persecution or poaching of avifauna species and collection of eggs	Local	Medium term	Probable	Low	Low	Partly	Yes	Marginal	High	High	Medium
Direct mortality from increased vehicle and heavy machinery traffic	Local	Medium term	Highly probable	Medium	Low	Barely	Yes	Marginal	High	High	Medium

4.4.2 Operation Phase

The following impacts were considered during the operational phase:

- Collisions with preferred gridline;
- Collisions with alternative gridline;
- Electrocution; and
- Direct mortality from roadkills, persecution or poaching of avifauna species and collection of eggs.

The pre-mitigation and post-mitigation impact ratings for the construction phase are shown in Table 4-2. The collision risk of the alternative gridline is lower than the preferred gridline since the alternative gridline runs parallel to another line.

Table 4-2 Impacts associated with the Operational phase

Nature of the Impact	Extent	Duration	Probability	Significance (without mitigation)	Significance (with mitigation)	Reversibility	Can impact be mitigated?	Loss of Resources	Can impact be avoided?	Can impact be managed?	Cumulative Impact
Collisions with preferred gridline	Local	Long term	Definite	Very high	High	Irreversible	Yes	Significant	Unavoidable	Low	High
Collisions with alternative gridline	Local	Long term	Highly probable	High	Medium	Irreversible	Yes	Significant	Medium	Medium	Medium
Electrocution	Local	Long term	Highly probable	High	Medium	Barely	Yes	Significant	Medium	Medium	Medium
Direct mortality from roadkill, persecution or poaching of avifauna species and collection of eggs	Local	Long term	Highly probable	Medium	Low	Barely	Yes	Marginal	High	High	Medium

4.4.3 Decomissioning Phase

The following impacts were considered during the decommissioning phase:

- Direct mortality due to earthworks, vehicle collisions and persecution;
- Collision
- Continued habitat degradation due to invasive alien plant encroachment and erosion.

The pre-mitigation and post-mitigation impact ratings for the construction phase are shown in Table 4-3.

Table 4-3 Impacts associated with the Decommissioning Phase.

Nature of the Impact	Extent	Duration	Probability	Significance (without mitigation)	Significance (with mitigation)	Reversibility	Can impact be mitigated?	Loss of Resources	Can impact be avoided?	Can impact be managed?	Cumulative Impact
Direct mortality due to earthworks, vehicle collisions and persecution	Local	Medium term	Highly probable	Medium	Low	Barely	Yes	Marginal	High	High	Medium
Collisions	Local	Long term	Highly probable	High	Medium	Irreversible	Yes	Significant	Medium	Medium	Medium
Continued habitat degradation due to invasive alien plant encroachment and erosion	Local	Long term	Highly probable	Medium	Low	Barely	Yes	Significant	Medium	Medium	Medium

5 Avifauna Impact Management Actions

The purpose of the Biodiversity Impact Management Actions of is to present the mitigations in such a way that they can be incorporated into the Environmental Management Programme (EMPr), allowing for more successful implementation and auditing of the mitigations and monitoring guidelines. This mitigation table must be read in conjunction with the Generic Environmental Management Programme (EMPR) for the development and expansion of substation infrastructure for the transmission and distribution of electricity as per No. 42323 GOVERNMENT GAZETTE, 22 MARCH 2019.

Table 5-1 presents the recommended mitigation measures and the respective timeframes, targets, and performance indicators pertaining to the avifaunal component.

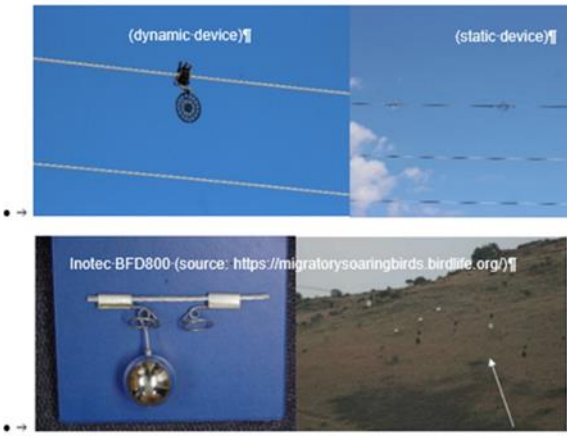
Table 5-1 Summary of management outcomes pertaining to impacts to avifauna and their habitats

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Management outcome: Habitats				
A nest walkdown must be performed prior to clearance of the site by an avifauna specialist. If nests are found a suitably qualified specialist must be contacted to advise on the way forward.	Construction Phase	Environmental Officer	Development footprint	During Phase
The areas to be developed must be specifically demarcated to prevent movement into surrounding environments.	Life of operation	Project Manager Environmental Officer	Development footprint	Ongoing
Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, must under no circumstances be fragmented or disturbed further.	Life of operation	Project Manager Environmental Officer	Areas of indigenous vegetation	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion. This will also reduce the likelihood of encroachment by alien invasive plant species. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are indigenous to this vegetation type.	Decommissioning /Rehabilitation	Project Manager	Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion. This will also reduce the likelihood of encroachment by alien invasive plant species. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are indigenous to this vegetation type.	Decommissioning /Rehabilitation
A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall	Life of operation	Environmental	Spill events, Vehicles dripping.	Ongoing

be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. No servicing of equipment on site unless necessary. All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons oils, diesel etc.) in such a way as to prevent them leaking and entering the environment.		Officer Contractor		
The cement must be mixed in a designated area on a liner away from water sources and buffers, so that successful rehabilitation of the construction areas can take place.	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Water pollution and restricted rehabilitation	During phase
Leaking equipment and vehicles must be repaired immediately or be removed from PAOI to facilitate repair.	Life of operation	Environmental Officer Contractor	Leaks and spills	Ongoing
A fire management plan needs to be complied to restrict the impact of fire.	Life of operation	Environmental Officer Contractor	Fire Management	During Phase
Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all areas of construction. This includes wetting of exposed soft soil surfaces. No non-environmentally friendly suppressants may be used as this could result in the pollution of water sources.	Life of operation	Project Manager Contractor	Dustfall	As per dust monitoring program.

Management outcome: Avifauna

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting, or hunting terrestrial species, and owls, which are often persecuted out of superstition. Signs must be put up to enforce this.	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
The duration of the construction must be kept to a minimum to avoid disturbing avifauna.	Construction/Operational Phase	Project Manager Environmental Officer	Construction/Closure Phase	Ongoing
Outside lighting must be designed and limited to minimize impacts on avifauna. All outside lighting should be directed away from highly sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (red/green) lights should be used.	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Light pollution and period of light.	Ongoing
Bird diverters must be placed along the whole route, this must be done at 5 m intervals. Alternatively, a detailed hotspot analysis can be conducted by a SACNASP registered avifaunal specialist to identify hotspot areas that require bird diverters.	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Bird Collisions	Ongoing
Overhead cables/lines must be fitted with industry standard bird flight diverters in order to make the lines as visible as possible to collision-susceptible species. Shaw *et al* (2021) demonstrated that large avifauna species mortality was reduced by 51% (95% CI: 23–68%). Recommended bird diverters such	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Bird Collisions	Ongoing

as flapping devices (dynamic device) and thickened wire spirals (static device) that increase the visibility of the lines should be fitted 5 m apart. The Inotec BFD88 bird diverter is highly recommended due to its visibility under low light conditions when most species move from roosting to feeding sites. 				
Any OHLs must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' monopole structures, with clearances between live components of 5 m or greater.	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Bird Electrocutions	Ongoing
Ensure that the phase cables are spaced far enough apart to reduce the risk of large birds touching both simultaneously (2 m for large raptors) (Prinsen *et al.,* 2012). If such separation (isolation) cannot be provided, exposed parts must be covered (insulated) to reduce electrocution risk.	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Bird Electrocutions	Ongoing
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limit (40 km/h), to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited.	Life of Operation	Health and Safety Officer	Compliance to the training.	Ongoing
All project activities must be undertaken with appropriate noise mitigation measures to avoid disturbance to avifauna population in the region	Construction/Operational Phase	Project Manager Environmental Officer	Noise	Ongoing
All areas to be developed must be walked through prior to any activity to ensure no nests or avifauna species are found in the area. Should any Species of Conservation Concern be found and not move out of the area, or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.	Construction	Environmental Officer	Presence of avifauna species and nests	During Phase
The design of the proposed transmission line must be of a type or similar structure as endorsed by the Eskom-EWT Strategic Partnership on Birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins *et al.,* 2017).	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Presence of electrocuted birds or bird strikes	During Phase
Infrastructure must be consolidated where possible in order to minimise the amount of ground and air space used.	Planning and Construction	Project Manager Environmental	Presence of bird collisions	During phase

		Officer Contractor Engineer		
All the parts of the infrastructure must be nest proofed and anti-perch devices placed on areas that can lead to electrocution	Planning and Construction	Environmental Officer Contractor Engineer	Presence of electrocuted birds	During phase
Use environmentally friendly cleaning and dust suppressant products	Construction and Operation	Environmental Officer Contractor Engineer	Chemicals used	During phase
Fencing mitigations: • Top 2 strands must be smooth wire; • Routinely retention loose wires; • Minimum 300 mm between wires; • Place markers on fences; and • Fences must be fitted with bird diverters	Life of Operation	Project Manager Environmental Officer Contractor Design Engineer	Presence of birds stuck /dead in fences Monitor fences for slack wires	During phase
As far as possible power cables within the PAOI should be thoroughly insulated and preferably buried.	Construction and Operation	Project Manager Environmental Officer Design Engineer	Exposed cables	During phase
All infrastructure, must be removed if the facility is decommissioned.	Closure/Rehabilitation	Project Manager Environmental Officer	Infrastructure removal	During Process

6 Monitoring

Post-construction monitoring should follow the BirdLife South Africa best practice guidelines for solar energy facilities (BirdLife South Africa, 2017). If monitoring results indicate excessive bird fatalities, then adaptive mitigations should be implemented. Before implementation, these should be discussed with the avifaunal specialist and ECO and could include the retrofitting/incorporation of additional visual cues/diverters to existing PV panels/infrastructure. Post construction monitoring must be performed for two years following the construction phase.

7 Conclusion

Based on the SABAP2 data 187 avifauna species are expected for the PAOI and surrounds. Of these, 14 are considered SCC. A regime 3 assessment was performed, the first avifaunal field survey was completed between the 17-21 October 2022 for 5 days, the second survey was completed between the 17-20 February 2023 for 4 days, and the third survey was completed between the 18-21 May 2023 for 4 day. During the assessments nine SCC were recorded: Secretarybird (*Sagittarius serpentarius*), Ludwig's Bustard (*Neotis ludwigii*), Blue Crane (*Anthropoides paradiseus*), Martial Eagle (*Polemaetus bellicosus*), Tawny Eagle (*Aquila rapax*), Verreaux's Eagle (*Aquila verreauxii*), Greater Flamingo (*Phoenicopterus roseus*), Karoo Korhaan (*Eupodotis vigorsii*) and African Rock Pipit (*Anthus crenatus*). A further twenty-one (21) risk species were also recorded. These risk species are susceptible to collisions, electrocutions and habitat loss.

Three habitats were delineated, namely Shrubland, Ridge, and Water Resources. Majority of the project area was found to be either High or Very High sensitivity validating and disputing the screening tool High sensitivity. The collision risk, electrocution risk and loss of habitat are the main impacts should these be successfully mitigated the overall impact rating can be reduced.

The alternative gridline is the only route alternative that is not fatally flawed from an avifauna perspective, since the preferred gridline corridor runs within 1 km of an active Verreaux's Eagle (*Aquila verreauxii*) nest. Additionally, the alternative gridline corridor runs parallel to existing lines, rather than perpendicular, leading to reduced collisions. The presence of a Greater Kestrel (*Falco rupicoloides*) nest within 750 m of the alternative gridline corridor means that construction cannot occur within the months of July – February without an avifaunal specialist confirming the nest is inactive at the time of construction.

7.1 Impact Statement

The main expected impacts of the proposed PV and infrastructure will include the following:

- Habitat loss and fragmentation;
- Electrocutions; and
- Collisions resulting in mortalities of amongst other SCCs.

Mitigation measures as described in this report can be implemented to reduce the significance of the risk but there is still a likelihood of impacts. Considering that this area that has been identified as being of significance for biodiversity maintenance and ecological processes (High and Very High sensitivity), development may proceed only on the alternative gridline corridor route but with caution and only with the implementation of mitigation measures.

7.2 Specialist Opinion

It is the opinion of the specialist that the development can be favourably considered for the alternative gridline, should the mitigation measures and management actions be implemented. The current layout of the preferred gridline is fatally flawed. Very High sensitivity areas must be avoided. However, based on the information at hand, after assessing the offset guidelines, the Northern Upper Karoo vegetation type does not require an offset.

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9 Appendix Items

9.1 Appendix A: Methodology

9.1.1 Desktop Dataset Assessment

The desktop assessment was principally undertaken using a Geographic Information System (GIS) to access the latest available spatial datasets to develop digital cartographs and species lists. These datasets and their date of publishing are provided below.

9.1.1.1 Expected Species

The avifaunal desktop assessment comprised of the following, compiling an expected species list:

- Avifauna list, generated from the SABAP2 dataset by looking at pentads 3030_2400; 3030_2405; 3030_2410; 3035_2355; 3035_2400; 3035_2405; 3035_2410; 3035_2415; 3040_2355; 3040_2400; 3040_2405; 3040_2410; 3040_2415; 3045_2355; 3045_2340; 3045_2405; 3045_2410_3045_2415; 3050_2400; 3050_2405; 3050_2410; and

- Compilation of a Coordinated Water Bird Count (CWAC) species list if the PAOI was found to be in the vicinity of a CWAC site.

- Compilation of a Coordinated Avifaunal Roadcount (CAR) species list if the PAOI was found to be in the vicinity of a CAR route.

9.1.1.2 Ecologically Important Landscape Features

Existing ecologically relevant data layers were incorporated into a GIS to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- Ecosystem Threat Status (ETS) – 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. The revised red list of threatened ecosystems was developed between 2016 and 2021 incorporating the best available information on terrestrial ecosystem extent and condition, pressures and drivers of change. The revised list (known as the Red List of Ecosystems (RLE) 2022) is based on assessments that followed the International Union for Conservation of Nature (IUCN) Red List of Ecosystems Framework (version 1.1) and covers all 456 terrestrial ecosystem types described in South Africa (Mucina and Rutherford 2006; with updates described in Dayaram *et al.,* 2019). The revised list identifies 120 threatened terrestrial ecosystem types (55 Critically Endangered, 51 Endangered and 14 Vulnerable types). The revised list was published in the Government Gazette (Gazette Number 47526, Notice Number 2747) and came into effect on 18 November 2022;

- Ecosystem Protection level (EPL) informs on whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Not Protected (NP), Poorly Protected (PP), Moderately Protected (MP) or Well Protected (WP), based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno *et al.,* 2019). NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems.

- Protected areas - South Africa Protected Areas Database (SAPAD) (DEA, 2023) – The SAPAD Database contains spatial data pertinent to the conservation of South African biodiversity. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. SAPAD 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 NPAES provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and therefore, of high importance for biodiversity, climate resilience and freshwater protection.

- The Northern Cape Critical Biodiversity Areas (CBA) map specifies two different CBA areas, Irreplaceable CBA's and Optimal CBA's. Irreplaceable CBA's include: (1) areas required to meet targets and with irreplaceability biodiversity values of more than 80%; (2) critical linkages or pinch-points in the landscape that must remain natural; or (3) critically Endangered ecosystems (Northern Cape CBA Map, 2016).

- ESAs are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic (SANBI-BGIS, 2017).

- ONAs consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs. A biodiversity sector plan or bioregional plan must not specify the desired state/management objectives for ONAs or provide land-use guidelines for ONAs (SANBI-BGIS, 2017).

- Important Bird and Biodiversity Areas (IBAs) (BirdLife South Africa, 2017) – 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; and

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al.,* 2018) – A SAIIAE was established during the NBA of 2018. It is a collection of data layers that represent the extent of river and inland wetland ecosystem types and pressures on these systems.

9.1.2 Avifauna Survey

Sampling consisted of standardized point counts as well as random diurnal incidental surveys. Standardised point counts (Buckland *et al,* 1993) were conducted to gather data on the species composition and relative abundance of species within the broad habitat types identified. The standardized point count technique was utilised as it was demonstrated to outperform line routes (Cumming & Henry, 2019). 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. To supplement the species inventory with cryptic and illusive species that may not be detected during the rigid point count protocol, diurnal and nocturnal incidental searches were conducted. This involved the opportunistic sampling of species between point count periods, random meandering and road cruising. Effort was made to cover all the different habitat types within the limits of time and access.

9.1.2.1 Data Analysis

The analyses described below only used the data collected from the standardised point counts. See Appendix B and D for the point count raw data.

The analyses described below only used the data collected from the Standardised Point Counts. Raw count data was converted to relative abundance values and used to establish dominant species and calculate the diversity of each habitat. Present, and potentially occurring species were assigned to 13 major trophic guilds loosely based on the classification system developed by González-Salazar *et al*. (2014). Species were first classified by their dominant diet (carnivore, herbivore, granivore, frugivore, nectarivore, omnivore), then by the medium upon / within which they most frequently forage (ground, water, foliage, air) and lastly by their activity period (nocturnal or diurnal).

9.2 Appendix B: Site Ecological Importance

The different habitat types within the study 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 SCC and their ecosystem processes.

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 Table 9-1 and , respectively.

Table 9-1 Summary of Conservation Importance (CI) criteria

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of CR, EN, 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 9-2 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 9-3.

Table 9-3 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 9-4.

Table 9-4 Summary of Resource 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 remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of 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 remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of 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 remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of 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 remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of 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 remain at a site even when a disturbance or impact is occurring, or species that are unlikely to 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 9-5.

Table 9-5 Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance (SEI)		**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 development activities is provided in Table 9-6.

Table 9-6 Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities

Site Ecological Importance (SEI)	**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.

9.3 Appendix C: Impact / Risk Assessment

Impact assessment must take account of the nature, scale, and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the criteria provided by Sharples Ecological Services was used.

9.4 Appendix D: Avifauna Expected Species

Scientific Name	Common Name	Family Name	Regional	Global (IUCN)	Endemism in South Africa (E)
Telophorus zeylonus	Bokmakierie	Malaconotidae	Unlisted	Unlisted	
Scopus umbretta	Hamerkop	Scopidae	Unlisted	Unlisted	
Cisticola fulvicapilla	Neddicky	Cisticolidae	Unlisted	Unlisted	
Ortygospiza atricollis	Quailfinch	Estrildidae	Unlisted	Unlisted	
Calidris pugnax	Ruff	Scolopacidae	Unlisted	Unlisted	
Sagittarius serpentarius	Secretarybird	Sagittariidae	VU	EN	
Recurvirostra avosetta	Pied Avocet	Recurvirostridae	Unlisted	Unlisted	
Tricholaema leucomelas	Acacia Pied Barbet	Lybiidae	Unlisted	Unlisted	
Trachyphonus vaillantii	Crested Barbet	Lybiidae	Unlisted	Unlisted	
Batis pririt	Pririt Batis	Platysteiridae	Unlisted	Unlisted	
Merops apiaster	European Bee-eater	Meropidae	Unlisted	Unlisted	
Euplectes orix	Southern Red Bishop	Ploceidae	Unlisted	Unlisted	
Laniarius ferrugineus	Southern Boubou	Malaconotidae	Unlisted	Unlisted	
Pycnonotus nigricans	African Red-eyed Bulbul	Pycnonotidae	Unlisted	Unlisted	
Emberiza capensis	Cape Bunting	Emberizidae	Unlisted	Unlisted	
Emberiza impetuani	Lark-like Bunting	Emberizidae	Unlisted	Unlisted	
Neotis ludwigii	Ludwig's Bustard	Otididae	EN	EN	

Buteo buteo	Common Buzzard	Accipitridae	Unlisted	Unlisted	
Buteo rufofuscus	Jackal Buzzard	Accipitridae	Unlisted	Unlisted	NE
Serinus alario	Black-headed Canary	Fringillidae	Unlisted	Unlisted	NE
Crithagra atrogularis	Black-throated Canary	Fringillidae	Unlisted	Unlisted	
Crithagra albogularis	White-throated Canary	Fringillidae	Unlisted	Unlisted	
Crithagra flaviventris	Yellow Canary	Fringillidae	Unlisted	Unlisted	
Myrmecocichla formicivora	Ant-eating Chat	Muscicapidae	Unlisted	Unlisted	
Oenanthe familiaris	Familiar Chat	Muscicapidae	Unlisted	Unlisted	
Emarginata schlegelii	Karoo Chat	Muscicapidae	Unlisted	Unlisted	
Emarginata sinuata	Sickle-winged Chat	Muscicapidae	Unlisted	Unlisted	NE
Cisticola textrix	Cloud Cisticola	Cisticolidae	Unlisted	Unlisted	NE
Cisticola aridulus	Desert Cisticola	Cisticolidae	Unlisted	Unlisted	
Cisticola subruficapilla	Grey-backed Cisticola	Cisticolidae	Unlisted	Unlisted	
Cisticola tinniens	Levaillant's Cisticola	Cisticolidae	Unlisted	Unlisted	
Cisticola juncidis	Zitting Cisticola	Cisticolidae	Unlisted	Unlisted	
Fulica cristata	Red-knobbed Coot	Rallidae	Unlisted	Unlisted	
Phalacrocorax lucidus	White-breasted Cormorant	Phalacrocoracidae	Unlisted	Unlisted	
Rhinoptilus africanus	Double-banded Courser	Glareolidae	Unlisted	Unlisted	
Zapornia flavirostra	Black Crake	Rallidae	Unlisted	Unlisted	
Anthropoides paradiseus	Blue Crane	Gruidae	NT	VU	
Sylvietta rufescens	Long-billed Crombec	Macrosphenidae	Unlisted	Unlisted	
Corvus capensis	Cape Crow	Corvidae	Unlisted	Unlisted	
Corvus albus	Pied Crow	Corvidae	Unlisted	Unlisted	
Chrysococcyx caprius	Diederik Cuckoo	Cuculidae	Unlisted	Unlisted	
Streptopelia capicola	Ring-necked Dove	Columbidae	Unlisted	Unlisted	
Spilopelia senegalensis	Laughing Dove	Columbidae	Unlisted	Unlisted	
Oena capensis	Namaqua Dove	Columbidae	Unlisted	Unlisted	
Streptopelia semitorquata	Red-eyed Dove	Columbidae	Unlisted	Unlisted	
Columba livia	Rock Dove	Columbidae	Unlisted	Unlisted	
Anas sparsa	African Black Duck	Anatidae	Unlisted	Unlisted	
Dendrocygna viduata	White-faced Whistling Duck	Anatidae	Unlisted	Unlisted	
Anas undulata	Yellow-billed Duck	Anatidae	Unlisted	Unlisted	
Circaetus pectoralis	Black-chested Snake Eagle	Accipitridae	Unlisted	Unlisted	
Hieraaetus pennatus	Booted Eagle	Accipitridae	Unlisted	Unlisted	
Polemaetus bellicosus	Martial Eagle	Accipitridae	EN	EN	
Aquila rapax	Tawny Eagle	Accipitridae	EN	VU	
Aquila verreauxii	Verreaux's Eagle	Accipitridae	NA	LC	
Bubo africanus	Spotted Eagle-Owl	Strigidae	Unlisted	Unlisted	
Egretta garzetta	Little Egret	Ardeidae	Unlisted	Unlisted	

Bubulcus ibis	Western Cattle Egret	Ardeidae	Unlisted	Unlisted	
Eremomela gregalis	Karoo Eremomela	Cisticolidae	Unlisted	Unlisted	NE
Eremomela icteropygialis	Yellow-bellied Eremomela	Cisticolidae	Unlisted	Unlisted	
Falco amurensis	Amur Falcon	Falconidae	Unlisted	Unlisted	
Falco biarmicus	Lanner Falcon	Falconidae	VU	LC	
Amadina erythrocephala	Red-headed Finch	Estriididae	Unlisted	Unlisted	
Lanius collaris	Southern Fiscal	Laniidae	Unlisted	Unlisted	
Phoenicopterus roseus	Greater Flamingo	Phoenicopteridae	NT	LC	
Melaenornis infuscatus	Chat Flycatcher	Muscicapidae	Unlisted	Unlisted	
Stenostira scita	Fairy Flycatcher	Muscicapidae	Unlisted	Unlisted	NE
Melaenornis silens	Fiscal Flycatcher	Muscicapidae	Unlisted	Unlisted	NE
Muscicapa striata	Spotted Flycatcher	Muscicapidae	Unlisted	Unlisted	
Scleroptila afra	Grey-winged Francolin	Phasianidae	Unlisted	Unlisted	SLS
Scleroptila gutturalis	Orange River Francolin	Phasianidae	Unlisted	Unlisted	
Alopochen aegyptiaca	Egyptian Goose	Anatidae	Unlisted	Unlisted	
Plectropterus gambensis	Spur-winged Goose	Anatidae	Unlisted	Unlisted	
Micronisus gabar	Gabar Goshawk	Accipitridae	Unlisted	Unlisted	
Melierax canorus	Pale Chanting Goshawk	Accipitridae	Unlisted	Unlisted	
Tachybaptus ruficollis	Little Grebe	Podicipedidae	Unlisted	Unlisted	
Tringa nebularia	Common Greenshank	Pycnonotidae	Unlisted	Unlisted	
Numida meleagris	Helmeted Guineafowl	Numididae	Unlisted	Unlisted	
Chroicocephalus cirrocephalus	Grey-headed Gull	Laridae	Unlisted	Unlisted	
Polyboroides typus	African Harrier-Hawk	Accipitridae	Unlisted	Unlisted	
Ardea melanocephala	Black-headed Heron	Ardeidae	Unlisted	Unlisted	
Ardea cinerea	Grey Heron	Ardeidae	Unlisted	Unlisted	
Upupa africana	African Hoopoe	Upupidae	Unlisted	Unlisted	
Threskiornis aethiopicus	African Sacred Ibis	Threskiornithidae	Unlisted	Unlisted	
Plegadis falcinellus	Glossy Ibis	Threskiornithidae	Unlisted	Unlisted	
Bostrychia hagedash	Hadada Ibis	Threskiornithidae	Unlisted	Unlisted	
Falco rupicoloides	Greater Kestrel	Falconidae	Unlisted	Unlisted	
Falco naumanni	Lesser Kestrel	Falconidae	Unlisted	Unlisted	
Falco rupicolus	Rock Kestrel	Falconidae	Unlisted	Unlisted	
Corythornis cristatus	Malachite Kingfisher	Alcedinidae	Unlisted	Unlisted	
Elanus caeruleus	Black-winged Kite	Accipitridae	Unlisted	Unlisted	
Milvus aegyptius	Yellow-billed Kite	Accipitridae	Unlisted	Unlisted	
Eupodotis caerulescens	Blue Korhaan	Otididae	LC	NT	SLS
Eupodotis vigorsii	Karoo Korhaan	Otididae	NT	LC	
Afrotis afraoides	Northern Black Korhaan	Otididae	Unlisted	Unlisted	
Vanellus armatus	Blacksmith Lapwing	Charadriidae	Unlisted	Unlisted	

Vanellus coronatus	Crowned Lapwing	Charadriidae	Unlisted	Unlisted	
Mirafra fasciolata	Eastern Clapper Lark	Alaudidae	Unlisted	Unlisted	
Calendulauda albescens	Karoo Lark	Alaudidae	Unlisted	Unlisted	NE
Certhilauda subcoronata	Karoo Long-billed Lark	Alaudidae	Unlisted	Unlisted	
Galerida magnirostris	Large-billed Lark	Alaudidae	Unlisted	Unlisted	NE
Mirafra cheniana	Melodious Lark	Alaudidae	Unlisted	Unlisted	NE
Spizocorys conirostris	Pink-billed Lark	Alaudidae	Unlisted	Unlisted	
Calandrella cinerea	Red-capped Lark	Alaudidae	Unlisted	Unlisted	
Calendulauda sabota	Sabota Lark	Alaudidae	Unlisted	Unlisted	
Chersomanes albofasciata	Spike-heeled Lark	Alaudidae	Unlisted	Unlisted	
Spizocorys starki	Stark's Lark	Alaudidae	Unlisted	Unlisted	
Riparia paludicola	Brown-throated Martin	Hirundinidae	Unlisted	Unlisted	
Ptyonoprogne fuligula	Rock Martin	Hirundinidae	Unlisted	Unlisted	
Gallinula chloropus	Common Moorhen	Rallidae	Unlisted	Unlisted	
Urocolius indicus	Red-faced Mousebird	Coliidae	Unlisted	Unlisted	
Colius colius	White-backed Mousebird	Coliidae	Unlisted	Unlisted	
Caprimulgus rufigena	Rufous-cheeked Nightjar	Caprimulgidae	Unlisted	Unlisted	
Struthio camelus	Common Ostrich	Struthionidae	Unlisted	Unlisted	
Columba guinea	Speckled Pigeon	Columbidae	Unlisted	Unlisted	
Anthus cinnamomeus	African Pipit	Motacillidae	Unlisted	Unlisted	
Anthus crenatus	African Rock Pipit	Motacillidae	NT	LC	SLS
Anthus vaalensis	Buffy Pipit	Motacillidae	Unlisted	Unlisted	
Anthus nicholsoni	Nicholson's Pipit	Motacillidae	Unlisted	Unlisted	
Anthus leucophrys	Plain-backed Pipit	Motacillidae	Unlisted	Unlisted	
Charadrius pecuarius	Kittlitz's Plover	Charadriidae	Unlisted	Unlisted	
Charadrius tricollaris	Three-banded Plover	Charadriidae	Unlisted	Unlisted	
Prinia flavicans	Black-chested Prinia	Cisticolidae	Unlisted	Unlisted	
Prinia maculosa	Karoo Prinia	Cisticolidae	Unlisted	Unlisted	NE
Coturnix coturnix	Common Quail	Phasianidae	Unlisted	Unlisted	
Quelea quelea	Red-billed Quelea	Ploceidae	Unlisted	Unlisted	
Corvus albicollis	White-necked Raven	Corvidae	Unlisted	Unlisted	
Cossypha caffra	Cape Robin-Chat	Muscicapidae	Unlisted	Unlisted	
Pterocles namaqua	Namaqua Sandgrouse	Pteroclidae	Unlisted	Unlisted	
Calidris ferruginea	Curlew Sandpiper	Scolopacidae	LC	NT	
Tringa glareola	Wood Sandpiper	Scolopacidae	Unlisted	Unlisted	
Cercotrichas paena	Kalahari Scrub Robin	Muscicapidae	Unlisted	Unlisted	
Cercotrichas coryphoeus	Karoo Scrub Robin	Muscicapidae	Unlisted	Unlisted	
Tadorna cana	South African Shelduck	Anatidae	Unlisted	Unlisted	
Spatula smithii	Cape Shoveler	Anatidae	Unlisted	Unlisted	

Gallinago nigripennis	African Snipe	Scolopacidae	Unlisted	Unlisted	
Passer melanurus	Cape Sparrow	Passeridae	Unlisted	Unlisted	
Passer domesticus	House Sparrow	Passeridae	Unlisted	Unlisted	
Passer diffusus	Southern Grey-headed Sparrow	Passeridae	Unlisted	Unlisted	
Eremopterix australis	Black-eared Sparrow-Lark	Alaudidae	Unlisted	Unlisted	NE
Eremopterix verticalis	Grey-backed Sparrow-Lark	Alaudidae	Unlisted	Unlisted	
Plocepasser mahali	White-browed Sparrow-Weaver	Ploceidae	Unlisted	Unlisted	
Accipiter rufiventris	Rufous-breasted Sparrowhawk	Accipitridae	Unlisted	Unlisted	
Platalea alba	African Spoonbill	Threskiornithidae	Unlisted	Unlisted	
Lamprotornis nitens	Cape Starling	Sturnidae	Unlisted	Unlisted	
Sturnus vulgaris	Common Starling	Sturnidae	Unlisted	Unlisted	
Onychognathus nabouroup	Pale-winged Starling	Sturnidae	Unlisted	Unlisted	
Lamprotornis bicolor	Pied Starling	Sturnidae	Unlisted	Unlisted	SLS
Onychognathus morio	Red-winged Starling	Sturnidae	Unlisted	Unlisted	
Creatophora cinerea	Wattled Starling	Sturnidae	Unlisted	Unlisted	
Himantopus himantopus	Black-winged Stilt	Recurvirostridae	Unlisted	Unlisted	
Calidris minuta	Little Stint	Scolopacidae	Unlisted	Unlisted	
Saxicola torquatus	African Stonechat	Muscicapidae	Unlisted	Unlisted	
Ciconia nigra	Black Stork	Ciconiidae	VU	LC	
Ciconia ciconia	White Stork	Ciconiidae	Unlisted	Unlisted	
Cinnyris fuscus	Dusky Sunbird	Nectariniidae	Unlisted	Unlisted	
Hirundo rustica	Barn Swallow	Hirundinidae	Unlisted	Unlisted	
Cecropis cucullata	Greater Striped Swallow	Hirundinidae	Unlisted	Unlisted	
Petrochelidon spilodera	South African Cliff Swallow	Hirundinidae	Unlisted	Unlisted	BNE
Hirundo albigularis	White-throated Swallow	Hirundinidae	Unlisted	Unlisted	
Apus barbatus	African Black Swift	Apodidae	Unlisted	Unlisted	
Tachymarptis melba	Alpine Swift	Apodidae	Unlisted	Unlisted	
Apus bradfieldi	Bradfield's Swift	Apodidae	Unlisted	Unlisted	
Apus apus	Common Swift	Apodidae	Unlisted	Unlisted	
Apus affinis	Little Swift	Apodidae	Unlisted	Unlisted	
Apus caffer	White-rumped Swift	Apodidae	Unlisted	Unlisted	
Anas capensis	Cape Teal	Anatidae	Unlisted	Unlisted	
Anas erythrorhyncha	Red-billed Teal	Anatidae	Unlisted	Unlisted	
Burhinus capensis	Spotted Thick-knee	Burhinidae	Unlisted	Unlisted	
Turdus smithi	Karoo Thrush	Turdidae	Unlisted	Unlisted	NE
Monticola brevipes	Short-toed Rock Thrush	Muscicapidae	Unlisted	Unlisted	
Anthoscopus minutus	Cape Penduline Tit	Remizidae	Unlisted	Unlisted	
Melaniparus afer	Grey Tit	Paridae	Unlisted	Unlisted	NE

Gyps coprotheres	Cape Vulture	Accipitridae	EN	VU	
Motacilla capensis	Cape Wagtail	Motacillidae	Unlisted	Unlisted	
Acrocephalus baeticatus	Common Reed Warbler	Acrocephalidae	Unlisted	Unlisted	
Curruca subcoerulea	Chestnut-vented Warbler	Sylviidae	Unlisted	Unlisted	
Euryptila subcinnamomea	Cinnamon-breasted Warbler	Cisticolidae	Unlisted	Unlisted	NE
Curruca layardi	Layard's Warbler	Sylviidae	Unlisted	Unlisted	NE
Acrocephalus gracilirostris	Lesser Swamp Warbler	Acrocephalidae	Unlisted	Unlisted	
Malcorus pectoralis	Rufous-eared Warbler	Cisticolidae	Unlisted	Unlisted	
Estrilda astrild	Common Waxbill	Estrildidae	Unlisted	Unlisted	
Ploceus capensis	Cape Weaver	Ploceidae	Unlisted	Unlisted	NE
Ploceus velatus	Southern Masked Weaver	Ploceidae	Unlisted	Unlisted	
Oenanthe pileata	Capped Wheatear	Muscicapidae	Unlisted	Unlisted	

9.5 Appendix E: Point Count Data

Survey 1

Common Name	Scientific Name	Relative abundance	Frequency (%)
Eastern Clapper Lark	*Mirafra fasciolata*	0,114	71,429
Red-billed Quelea	*Quelea quelea*	0,105	3,571
Desert Cisticola	*Cisticola aridulus*	0,086	82,143
Pied Crow	*Corvus albus*	0,056	53,571
Spike-heeled Lark	*Chersomanes albofasciata*	0,052	42,857
Southern Red Bishop	*Euplectes orix*	0,051	1,786
African Pipit	*Anthus cinnamomeus*	0,037	46,429
Ant-eating Chat	*Myrmecocichla formicivora*	0,032	25,000
Northern Black Korhaan	*Afrotis afraoides*	0,032	42,857
Lark-like Bunting	*Emberiza impetuani*	0,027	21,429
Helmeted Guineafowl	*Numida meleagris*	0,023	8,929
Large-billed Lark	*Galerida magnirostris*	0,021	30,357
Rufous-eared Warbler	*Malcorus pectoralis*	0,021	26,786
Blue Crane	*Grus paradisea*	0,020	16,071
African Quail-finch	*Ortygospiza atricollis*	0,017	10,714
Greater Flamingo	*Phoenicopterus roseus*	0,017	1,786
Egyptian Goose	*Alopochen aegyptiaca*	0,016	12,500
Cloud Cisticola	*Cisticola textrix*	0,015	23,214
Cape Sparrow	*Passer melanurus*	0,013	5,357
Grey-backed Sparrow-lark	*Eremopterix verticalis*	0,013	5,357
South African Shelduck	*Tadorna cana*	0,012	5,357
Southern Masked Weaver	*Ploceus velatus*	0,012	8,929
Greater Striped Swallow	*Cecropis cucullata*	0,011	8,929

Wattled Starling	*Creatophora cinerea*	0,011	3,571
Black-winged Stilt	*Himantopus himantopus*	0,010	5,357
Red-knobbed Coot	*Fulica cristata*	0,010	1,786
Cape Teal	*Anas capensis*	0,009	3,571
Pale-winged Starling	*Onychognathus nabouroup*	0,008	3,571
Three-banded Plover	*Charadrius tricollaris*	0,008	5,357
Blacksmith Lapwing	*Vanellus armatus*	0,007	7,143
Greater Kestrel	*Falco rupicoloides*	0,007	8,929
Ludwig's Bustard	*Neotis ludwigii*	0,007	8,929
Grey-backed Cisticola	*Cisticola subruficapilla*	0,006	8,929
Speckled Pigeon	*Columba guinea*	0,006	5,357
Cape Turtle (Ring-necked) Dove	*Streptopelia capicola*	0,005	3,571
Hadeda (Hadada) Ibis	*Bostrychia hagedash*	0,005	5,357
Cape Glossy (Cape) Starling	*Lamprotornis nitens*	0,004	5,357
Pied Starling	*Lamprotornis bicolor*	0,004	1,786
Verreaux's Eagle	*Aquila verreauxii*	0,004	3,571
Cape Wagtail	*Motacilla capensis*	0,003	3,571
Jackal Buzzard	*Buteo rufofuscus*	0,003	3,571
Karoo Long-billed Lark	*Certhilauda subcoronata*	0,003	3,571
Karoo Scrub Robin	*Cercotrichas coryphoeus*	0,003	5,357
Layard's Tit-Babbler (Warbler)	*Curruca layardi*	0,003	3,571
Melodious Lark	*Mirafra cheniana*	0,003	5,357
Pale Chanting Goshawk	*Melierax canorus*	0,003	5,357
Southern (Common) Fiscal	*Lanius collaris*	0,003	3,571
White-necked Raven	*Corvus albicollis*	0,003	3,571
Yellow-billed Duck	*Anas undulata*	0,003	1,786
African Stonechat	*Saxicola torquatus*	0,002	1,786
Black-chested Prinia	*Prinia flavicans*	0,002	3,571
Capped Wheatear	*Oenanthe pileata*	0,002	1,786
European Bee-eater	*Merops apiaster*	0,002	1,786
Little Swift	*Apus affinis*	0,002	1,786
Mountain Wheatear	*Myrmecocichla monticola*	0,002	1,786
Namaqua Dove	*Oena capensis*	0,002	3,571
Red-capped Lark	*Calandrella cinerea*	0,002	3,571
Red-headed Finch	*Amadina erythrocephala*	0,002	1,786
Sabota Lark	*Calendulauda sabota*	0,002	3,571
Secretarybird	*Sagittarius serpentarius*	0,002	1,786
Sickle-winged Chat	*Emarginata sinuata*	0,002	1,786
Spur-winged Goose	*Plectropterus gambensis*	0,002	3,571

White-throated Swallow	*Hirundo albigularis*	0,002	3,571
Yellow Canary	*Crithagra flaviventris*	0,002	3,571
Acacia Pied Barbet	*Tricholaema leucomelas*	0,001	1,786
Black-winged Kite	*Elanus caeruleus*	0,001	1,786
Cape Robin-Chat	*Cossypha caffra*	0,001	1,786
Chat Flycatcher	*Melaenornis infuscatus*	0,001	1,786
Fiscal Flycatcher	*Melaenornis silens*	0,001	1,786
Kalahari Scrub Robin	*Cercotrichas paena*	0,001	1,786
Karoo Chat	*Emarginata schlegelii*	0,001	1,786
Kittlitz's Plover	*Charadrius pecuarius*	0,001	1,786
Laughing Dove	*Spilopelia senegalensis*	0,001	1,786
Little Grebe	*Tachybaptus ruficollis*	0,001	1,786
Martial Eagle	*Polemaetus bellicosus*	0,001	1,786
Neddicky	*Cisticola fulvicapilla*	0,001	1,786
Orange River White-eye	*Zosterops pallidus*	0,001	1,786
Pearl-breasted Swallow	*Hirundo dimidiata*	0,001	1,786
Pied Avocet	*Recurvirostra avosetta*	0,001	1,786
Pink-billed Lark	*Spizocorys conirostris*	0,001	1,786
Tawny Eagle	*Aquila rapax*	0,001	1,786
Yellow-bellied Eremomela	*Eremomela icteropygialis*	0,001	1,786

Survey 2

Common Name	**Scientific Name**	**Relative abundance**	**Frequency (%)**
African Pipit	*Anthus cinnamomeus*	0,110	16,327
Spike-heeled Lark	*Chersomanes albofasciata*	0,088	34,694
Red-billed Quelea	*Quelea quelea*	0,071	2,041
Large-billed Lark	*Galerida magnirostris*	0,058	16,327
Cape Sparrow	*Passer melanurus*	0,054	16,327
Pied Crow	*Corvus albus*	0,052	24,490
European Bee-eater	*Merops apiaster*	0,052	4,082
Rufous-eared Warbler	*Malcorus pectoralis*	0,046	28,571
Ant-eating Chat	*Myrmecocichla formicivora*	0,046	6,122
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	0,038	6,122
Lark-like Bunting	*Emberiza impetuani*	0,029	16,327
Desert Cisticola	*Cisticola aridulus*	0,025	22,449
South African Cliff Swallow	*Petrochelidon spilodera*	0,023	2,041
Southern Fiscal	*Lanius collaris*	0,021	6,122
Southern Masked Weaver	*Ploceus velatus*	0,019	6,122

Northern Black Korhaan	*Afrotis afraoides*	0,019	14,286
Red-capped Lark	*Calandrella cinerea*	0,017	8,163
Capped Wheatear	*Oenanthe pileata*	0,017	12,245
Bokmakierie	*Telophorus zeylonus*	0,013	12,245
Helmeted Guineafowl	*Numida meleagris*	0,013	2,041
Egyptian Goose	*Alopochen aegyptiaca*	0,010	6,122
Black-winged Stilt	*Himantopus himantopus*	0,010	4,082
Crowned Lapwing	*Vanellus coronatus*	0,010	4,082
Greater Striped Swallow	*Cecropis cucullata*	0,010	4,082
Red-backed Shrike	*Lanius collurio*	0,008	4,082
Spotted Eagle-Owl	*Bubo africanus*	0,008	2,041
Blue Crane	*Anthropoides paradiseus*	0,008	4,082
Tawny Eagle	*Aquila rapax*	0,006	4,082
Little Stint	*Calidris minuta*	0,006	4,082
Scaly-feathered Weaver	*Sporopipes squamifrons*	0,006	2,041
Karoo Korhaan	*Eupodotis vigorsii*	0,006	4,082
Ludwig's Bustard	*Neotis ludwigii*	0,006	4,082
Lesser Kestrel	*Falco naumanni*	0,006	6,122
Cape Wagtail	*Motacilla capensis*	0,006	4,082
Blacksmith Lapwing	*Vanellus armatus*	0,006	4,082
Amur Falcon	*Falco amurensis*	0,006	2,041
Black-winged Kite	*Elanus caeruleus*	0,006	2,041
Karoo Prinia	*Prinia maculosa*	0,004	4,082
Three-banded Plover	*Charadrius tricollaris*	0,004	2,041
Ring-necked Dove	*Streptopelia capicola*	0,004	2,041
Greater Kestrel	*Falco rupicoloides*	0,004	4,082
Kittlitz's Plover	*Charadrius pecuarius*	0,004	4,082
African Black Duck	*Anas sparsa*	0,004	2,041
Familiar Chat	*Oenanthe familiaris*	0,004	4,082
Speckled Pigeon	*Columba guinea*	0,004	2,041
Rock Martin	*Ptyonoprogne fuligula*	0,004	2,041
White-throated Canary	*Crithagra albogularis*	0,004	2,041
Karoo Lark	*Calendulauda albescens*	0,002	2,041
Pale Chanting Goshawk	*Melierax canorus*	0,002	2,041
Sabota Lark	*Calendulauda sabota*	0,002	2,041
Martial Eagle	*Polemaetus bellicosus*	0,002	2,041
Cloud Cisticola	*Cisticola textrix*	0,002	2,041
Nicholson's Pipit	*Anthus nicholsoni*	0,002	2,041
Cape Teal	*Anas capensis*	0,002	2,041

Rock Kestrel	*Falco rupicolus*	0,002	2,041
Grey-backed Cisticola	*Cisticola subruficapilla*	0,002	2,041
Common Buzzard	*Buteo buteo*	0,002	2,041

Survey 3

Common Name	Scientific Name	Relative abundance	Frequency (%)
Cape Robin-Chat	*Cossypha caffra*	0,002	2,000
Ludwig's Bustard	*Neotis ludwigii*	0,014	6,000
Rufous-eared Warbler	*Malcorus pectoralis*	0,021	16,000
Zitting Cisticola	*Cisticola juncidis*	0,002	2,000
Capped Wheatear	*Oenanthe pileata*	0,005	4,000
White-throated Canary	*Crithagra albogularis*	0,002	2,000
Cape Sparrow	*Passer melanurus*	0,059	10,000
Red-headed Finch	*Amadina erythrocephala*	0,005	2,000
Karoo Long-billed Lark	*Certhilauda subcoronata*	0,002	2,000
Pink-billed Lark	*Spizocorys conirostris*	0,009	4,000
African Stonechat	*Saxicola torquatus*	0,002	2,000
Karoo Thrush	*Turdus smithi*	0,002	2,000
Eastern Clapper Lark	*Mirafra fasciolata*	0,009	6,000
Northern Black Korhaan	*Afrotis afraoides*	0,007	6,000
Karoo Chat	*Emarginata schlegelii*	0,005	4,000
Stark's Lark	*Spizocorys starki*	0,005	2,000
Ant-eating Chat	*Myrmecocichla formicivora*	0,002	2,000
Pied Crow	*Corvus albus*	0,104	44,000
Large-billed Lark	*Galerida magnirostris*	0,024	14,000
Southern Fiscal	*Lanius collaris*	0,002	2,000
Yellow-bellied Eremomela	*Eremomela icteropygialis*	0,002	2,000
Cape Longclaw	*Macronyx capensis*	0,002	2,000
Tawny Eagle	*Aquila rapax*	0,002	2,000
Spike-heeled Lark	*Chersomanes albofasciata*	0,161	52,000
Karoo Korhaan	*Eupodotis vigorsii*	0,031	12,000
Familiar Chat	*Oenanthe familiaris*	0,031	16,000
Pied Starling	*Lamprotornis bicolor*	0,002	2,000
Bokmakierie	*Telophorus zeylonus*	0,024	12,000
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	0,017	4,000
Fiscal Flycatcher	*Melaenornis silens*	0,002	2,000
Lark-like Bunting	*Emberiza impetuani*	0,232	28,000
Namaqua Sandgrouse	*Pterocles namaqua*	0,095	12,000

Ring-necked Dove	*Streptopelia capicola*	0,038	14,000
Speckled Pigeon	*Columba guinea*	0,024	2,000
Spur-winged Goose	*Plectropterus gambensis*	0,024	2,000
Karoo Prinia	*Prinia maculosa*	0,019	10,000
Red-eyed Dove	*Streptopelia semitorquata*	0,002	2,000

9.6 Appendix F: Incidental Records

Common Name	Scientific Name
Acacia Pied Barbet	*Tricholaema leucomelas*
African Pipit	*Anthus cinnamomeus*
African Red-eyed Bulbul	*Pycnonotus nigricans*
African Rock Pipit	*Anthus crenatus*
African Stonechat	*Saxicola torquatus*
Ant-eating Chat	*Myrmecocichla formicivora*
Blacksmith Lapwing	*Vanellus armatus*
Black-winged Stilt	*Himantopus himantopus*
Blue Crane	*Anthropoides paradiseus*
Bokmakierie	*Telophorus zeylonus*
Cape Bunting	*Emberiza capensis*
Cape Sparrow	*Passer melanurus*
Cape Starling	*Lamprotornis nitens*
Capped Wheatear	*Oenanthe pileata*
Common Quail	*Coturnix coturnix*
Eastern Clapper Lark	*Mirafra fasciolata*
Egyptian Goose	*Alopochen aegyptiaca*
European Bee-eater	*Merops apiaster*
Familiar Chat	*Oenanthe familiaris*
Stark's Lark	*Spizocorys starki*
Greater Kestrel	*Falco rupicoloides*
Greater Kestrel	*Falco rupicoloides*
Grey Heron	*Ardea cinerea*
Grey Tit	*Melaniparus afer*
Helmeted Guineafowl	*Numida meleagris*
House Sparrow	*Passer domesticus*
Karoo Chat	*Emarginata schlegelii*

Karoo Korhaan	*Eupodotis vigorsii*
Karoo Thrush	*Turdus smithi*
Lark-like Bunting	*Emberiza impetuani*
Little Swift	*Apus affinis*
Ludwig's Bustard	*Neotis ludwigii*
Melodious Lark	*Mirafra cheniana*
Mountain Wheatear	*Myrmecocichla monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Northern Black Korhaan	*Afrotis afraoides*
Pale Chanting Goshawk	*Melierax canorus*
Pink-billed Lark	*Spizocorys conirostris*
Pin-tailed Whydah	*Vidua macroura*
Red-headed Finch	*Amadina erythrocephala*
Ring-necked Dove	*Streptopelia capicola*
South African Shelduck	*Tadorna cana*
Southern Grey-headed Sparrow	*Passer diffusus*
Southern Red Bishop	*Euplectes orix*
Speckled Pigeon	*Columba guinea*
Spur-winged Goose	*Plectropterus gambensis*
Stark's Lark	*Spizocorys starki*
Verreaux's Eagle	*Aquila verreauxii*
White-browed Sparrow-Weaver	*Plocepasser mahali*
White-throated Canary	*Crithagra albogularis*
Yellow-bellied Eremomela	*Eremomela icteropygialis*

9.7 Appendix G: Specialist Declaration of Independence

I, Andrew Husted, declare that:

- I act as the independent specialist in this application;
- 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 expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- 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;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Andrew Husted

Ecologist

The Biodiversity Company

January 2024

9.8 Appendix F – Specialist CVs

Andrew Husted

M.Sc Aquatic Health (*Pr Sci Nat*)

Cell: +27 81 319 1225
Email: andrew@thebiodiversitycompany.com
Identity Number: 7904195054081
Date of birth: 19 April 1979

Profile Summary

Working experience throughout South Africa, West and Central Africa and also Armenia & Serbia.

Specialist experience in exploration, mining, engineering, hydropower, private sector and renewable energy.

Experience with project management for national and international multi-disciplinary projects.

Specialist guidance, support and facilitation for the compliance with legislative processes, for in-country requirements, and international lenders.

Specialist expertise include Instream Flow and Ecological Water Requirements, Freshwater Ecology, Terrestrial Ecology and also Ecosystem Services.

Areas of Interest

Sustainability and Conservation.

Instream Flow and Ecological Water Requirements.

Publication of scientific journals and articles.

Key Experience

- Familiar with World Bank, Equator Principles and the International Finance Corporation requirements
- Environmental, Social and Health Impact Assessments (ESHIA)
- Environmental Management Programmes (EMP)
- Ecological Water Requirement determination experience
- Wetland delineations and ecological assessments
- Rehabilitation Plans and Monitoring
- Fish population structure assessments
- The use of macroinvertebrates to determine water quality
- Aquatic Ecological Assessments
- Aquaculture

Country Experience

Botswana, Cameroon

Democratic Republic of Congo

Ghana, Ivory Coast, Lesotho

Liberia, Mali, Mozambique

Nigeria, Republic of Armenia,

Senegal, Serbia, Sierra Leone, South Africa

Tanzania

Nationality

South African

Languages

English – Proficient

Afrikaans – Conversational

German - Basic

Qualifications

- MSc (University of Johannesburg) – Aquatic Health.
- BSc Honours (Rand Afrikaans University) – Aquatic Health
- BSc Natural Science
- Pr Sci Nat (400213/11)
- Certificate of Competence: Mondi Wetland Assessments
- Certificate of Competence: Wetland WET-Management
- SASS 5 (Expired) – Department of Water Affairs and Forestry for the River Health Programme
- EcoStatus application for rivers and streams